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.

**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 17). 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 RVUs published by 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.

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.

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

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.

See abbreviations on page 2

### 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] |
| □ Significant trauma (ED setting) (IF ALL) |
| □ Significant trauma |
| □ Negative CT |
| □ High suspicion of ligament injury |
| □ Persistent neurologic deficit |
| □ Mild/moderate trauma (all settings) (IF ALL) |
| □ Suspected cervical fracture |
| □ Questionable findings or inadequate anatomical coverage on cervical spine radiograph OR |
| □ High clinical suspicion with negative radiograph OR |
| □ High clinical suspicion in high risk patient (known spondyloarthropathy, e.g. AS or DISH) AND |
| □ Persistent neurologic deficit AND/OR |
| □ Negative CT cervical spine AND |
| □ High suspicion of ligament injury |

Tables included on pages 18 through 21 indicate if the test is a primary recommendation or alternative recommendation.
PROVEN IMAGING FOR Neck Pain (NP)

DETECTION 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

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)

no → Imaging: alternative recommendation
CT cervical spine w/o contrast

3 II $ R3

no → REFER to the Neck Pain CPM or other system-wide protocol

*Requires claim for either:
• PT/chiropractic evaluation in preceding 60 days
OR
• Follow-up evaluation and management between 28 and 60 days preceding MRI

DETECTION NODE #1 KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 23 through 26.)
PROVEN IMAGING FOR **Neck Pain (NP)**

### DECISION NODE #2A

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

- **AUC met?**
  - Yes
    - **Imaging: primary recommendation**
      - MRI cervical, thoracic, and lumbar spine w/o contrast
        - Level of Evidence: II
        - Measure: $$$
        - Radiation Dose: R0
      - MRI brain w/o contrast
        - Level of Evidence: II
        - Measure: $\$\$
        - Radiation Dose: R0
    - **Imaging: alternative recommendation**
      - CT myelogram cervical and thoracic spine
        - Level of Evidence: III
        - Measure: $$$
        - Radiation Dose: R4
      - CT brain/head w/ and w/o contrast
        - Level of Evidence: II
        - Measure: $\$
        - Radiation Dose: R3
  - No
    - REFER to the **Neck Pain CPM** or other system-wide protocol

- **Significant positive result?**
  - Yes
    - **Refer to** ortho/neuro spine surgeon (URGENT)
    - **Significant positive result?**
      - Yes
        - **Consult** with neurology
      - No
        - **Consider** consultation with neurology
  - No

**DECISION NODE #2A KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 23 through 26.)
PROVEN IMAGING FOR Neck Pain (NP)

DECISION NODE #2B

**Imaging: primary recommendation**
- MRI cervical, thoracic, and lumbar spine w/o contrast
  - Level of Evidence: II
  - RVUs: $$$
  - R0
- AND/OR
- MRI brain w/o contrast
  - Level of Evidence: II
  - RVUs: $
  - R0

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

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

**Significant positive result?**
- Cord signal change not associated with cord compression or spinal canal stenosis
- Findings consistent with MS
- Inflammation / infection

**DECISION NODE #2B KEY EVIDENCE**

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

American College of Radiology. ACR Appropriateness Criteria® Focal Neurologic Deficit.


(For a full list of references for all decision nodes, see bibliography on pages 23 through 26.)
PROVEN IMAGING FOR Neck Pain (NP)

DECISION NODE #3A-1

NP + significant trauma (ED setting)

AUC met?

Significant trauma

yes

EMERGENCY trauma evaluation

Imaging: primary recommendation

CT cervical spine w/o contrast

3 II $ R3

Significant positive result?

yes

no

REFER to ortho/uro spine surgeon (URGENT)

no

REFER to the Neck Pain CPM or other system-wide protocol

no

no

MANAGE in the ED per clinical judgment

DECISION NODE #3A-2

AUC met?*

• Persistent neurologic deficit not explained by CT findings in head or cervical spine
  OR
  • High suspicion of ligament injury

yes

Imaging: primary recommendation

MRI cervical spine w/o contrast

5 I $ R0

no

no

yes

no

DECISION NODE #3A KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 23 through 26.)
PROVEN IMAGING FOR Neck Pain (NP)

DECISION NODE #3B-1

AUC met (IF ALL)?
- Mild/moderate trauma
- Suspected cervical fracture
- Questionable findings or inadequate coverage on cervical spine radiograph
  OR
- Elevated clinical suspicion with negative radiograph
  OR
- Known spondyloarthropathy (e.g., AS or DISH)

yes ➔ URGENT care or PCP evaluation

Imaging: primary recommendation
- CT cervical spine w/o contrast

no ➔ REFER to ortho/neuro spine surgeon (URGENT)

Significant positive result?
- Fracture
- Dislocations
- Unstable alignment

yes ➔ REFER to ortho/neuro spine surgeon (URGENT)

no ➔ FOLLOW UP (non-surgical) in 1 to 2 weeks

DECISION NODE #3B-2

AUC met?*
- Questionable findings or inadequate coverage on cervical spine radiograph
  OR
- Elevated clinical suspicion with negative radiograph
  OR
- Known spondyloarthropathy (e.g., AS or DISH)

yes ➔ Imaging: primary recommendation
- MRI cervical spine w/o contrast

no ➔ REFER to the Neck Pain CPM or other system-wide protocol

Significant positive result (ANY)?
- Fractures
- Evidence of ligamentous injury
- Acute disc herniation/nerve compression
- Instability

yes ➔ REFER to ortho/neuro spine surgeon (URGENT)

no ➔ FOLLOW UP (non-surgical) in 1 to 2 weeks

* MRI not usually needed for trauma

LEGEND

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PROVEN IMAGING FOR Neck Pain (NP)

DECISION NODE #3B KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 23 through 26.)

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PROVEN IMAGING FOR Neck Pain (NP)

DECISION NODE #4A

AUC met?
- Acute head and/or neck trauma
- Headache or facial pain
- Neurologic deficit(s) and/or stroke
- Horner syndrome: miosis, ptosis, anhidrosis

Consider EMERGENCY referral

Yes

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

No

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

AUC met?
- Questionable CTA findings
- High clinical suspicion with negative CTA

Yes

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

No

CONSULT with neurology and/or interventional radiology

Yes

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

No

NO

See Decision Node #4B on page 12

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

DECISION NODE #4A KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 23 through 26.)
PROVEN IMAGING FOR Neck Pain (NP)

**DECISION NODE #4B**

**NP + suspected cervical artery dissection (not acute trauma)**

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

Consider EMERGENCY referral
- Imaging: primary recommendation
  - CTA head and neck
    - **3** II $$$$ R3

Significant positive result?
- Intracranial and/or cervical artery dissection
  - yes
    - CONSULT with neurology and/or interventional radiology
  - no

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

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

Significant positive result?
- Intracranial and/or cervical artery dissection
  - yes
  - no

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

**DECISION NODE #4B KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 23 through 26.)

See abbreviations on page 2.
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 → Imaging: primary recommendation
MRI cervical spine w/ and w/o contrast

URGENT SPINE SURGERY REFERRAL
if radiculopathy with weakness/disabling

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

yes → REFER to ortho/neuro spine surgeon

no → REFER to ortho/neuro spine surgeon or multidisciplinary spine center

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

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

DECISION NODE #5A KEY EVIDENCE

(For a full list of references for all decision nodes, see bibliography on pages 23 through 26.)
**PROVEN IMAGING FOR Neck Pain (NP)**

**DECISION NODE #5B**

NP + prior cervical neck surgery (with suspicion of hardware failure)

AUC met (IF ALL)?
- Neck pain with suspicion of hardware failure
  AND EITHER:
  - Negative cervical spine radiograph with flex/ex lateral + AP/lateral
  OR
  - Equivocal plain film findings

**Imaging: primary recommendation**
- CT cervical spine w/o contrast
  - Level of Evidence: 2
  - Intermountain Measure: $ (5 – 10 RVUs)
  - Radiation Risk: R3 (1 – 10 mSv)

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

**Significant positive result?**
- Hardware failure
- Halo around screws
- Evidence of incomplete or failed fusion
- New fractures

**Refer** to ortho/neuro spine surgeon

**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 #5B KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 23 through 26.)
### 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 23 through 26.)
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 S$ 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

CONSULT with neurosurgery and / or spine surgery (EMERGENCY)

yes →

Osteomyelitis / discitis

REFER to infectious disease

no →

FOLLOW UP in 1 to 2 weeks

Clinical suspicion still high?

yes →

REFER to the Neck Pain CPM or other system-wide protocol

no →

DECISION NODE #7A KEY EVIDENCE


* Other risk factors include immuno-compromised patient, other site of infection, and IV drug use.

(For a full list of references for all decision nodes, see bibliography on pages 23 through 26.)

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**PROVEN IMAGING FOR Neck Pain (NP)**

**DECISION NODE #7B**

**NP + suspected meningitis***

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

**Imaging: primary recommendation**

<table>
<thead>
<tr>
<th>Imaging: primary recommendation</th>
<th>Level of Evidence</th>
<th>Intermountain Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI brain w/ and w/o contrast</td>
<td>II</td>
<td>$ (0 – 5 RVUs) $</td>
</tr>
</tbody>
</table>

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

**DECISION NODE #7B KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 23 through 26.)

---

**LEGEND**

- Clinical Scenario
- Urgent or Emergency Situation
- OCEBM Level of Evidence
- Fryback & Thornbury Level of Evidence
- Intermountain Measure

+ RO (0 mSv) $ (0 – 5 RVUs) + R 3 (1 – 10 mSv) $ $ (5 – 10 RVUs) + R 4 (10 – 30 mSv) $ $ $ (10 – 15 RVUs) + $ $ $ $ (15+ RVUs)

---

*Imaging not generally indicated for meningitis without associated neurologic symptoms

---

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

### POINT-OF-ORDER CHECKLISTS

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 1. MRI cervical spine WITHOUT CONTRAST appropriate use indications

<table>
<thead>
<tr>
<th>(PRIMARY recommendation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Neck pain without complicating features</td>
</tr>
<tr>
<td>□ ≥ 3 months of symptoms and adequate conservative treatment* with no improvement</td>
</tr>
<tr>
<td>□ Significant trauma (ED setting) (IF ALL)</td>
</tr>
<tr>
<td>□ Significant trauma</td>
</tr>
<tr>
<td>□ Negative CT</td>
</tr>
<tr>
<td>□ High suspicion of ligament injury</td>
</tr>
<tr>
<td><strong>AND/OR</strong></td>
</tr>
<tr>
<td>□ Persistent neurologic deficit</td>
</tr>
<tr>
<td>□ Mild/moderate trauma (all settings) (IF ALL)</td>
</tr>
<tr>
<td>□ Suspected cervical fracture</td>
</tr>
<tr>
<td>□ Questionable findings or inadequate anatomical coverage on cervical spine radiograph</td>
</tr>
<tr>
<td><strong>OR</strong></td>
</tr>
<tr>
<td>□ High clinical suspicion with negative radiograph</td>
</tr>
<tr>
<td><strong>OR</strong></td>
</tr>
<tr>
<td>□ High clinical suspicion in high risk patient (known spondyloarthropathy, e.g. AS or DISH)</td>
</tr>
<tr>
<td><strong>AND</strong></td>
</tr>
<tr>
<td>□ Persistent neurologic deficit</td>
</tr>
<tr>
<td><strong>AND/OR</strong></td>
</tr>
<tr>
<td>□ Negative CT cervical spine</td>
</tr>
<tr>
<td><strong>AND</strong></td>
</tr>
<tr>
<td>□ High suspicion of ligament injury</td>
</tr>
</tbody>
</table>

* Requires claim for either: PT/chiropractic evaluation in preceding 60 days OR follow-up evaluation and management between 28 and 60 days preceding test.

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

<table>
<thead>
<tr>
<th>(PRIMARY recommendation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Neck pain without improvement + prior cervical spine surgery (NO suspicion of hardware failure) (IF ANY)</td>
</tr>
<tr>
<td>□ Worsening neck pain</td>
</tr>
<tr>
<td>□ New or acute radiculopathy</td>
</tr>
<tr>
<td>□ Weakness</td>
</tr>
<tr>
<td>□ High suspicion of disc disease adjacent to hardware</td>
</tr>
<tr>
<td>□ Suspected cancer (IF ANY)</td>
</tr>
<tr>
<td>□ History of cancer</td>
</tr>
<tr>
<td>□ Multiple cancer risk factors</td>
</tr>
<tr>
<td>□ High suspicion of cancer</td>
</tr>
<tr>
<td>□ Suspected spinal infection (IF ANY)</td>
</tr>
<tr>
<td>□ Fever/chills and/or pain with rest or at night</td>
</tr>
<tr>
<td>□ Other risk factors (ANY): immunocompromised patient, other site of infection, IV drug use</td>
</tr>
</tbody>
</table>

See abbreviations on page 2.
### TABLE 3. MRI Brain WITH AND WITHOUT contrast appropriate use indications

(PRIMARY recommendation)

- Suspected infection (meningitis) (IF ALL)
  - Fever
  - Neurologic symptoms (ALOC, cranial neuropathy)

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

(PRIMARY recommendation)

- Weakness (sudden onset upper motor neuron symptoms and/or myelopathy)
  - Sudden onset, rapidly progressive flaccid weakness

  AND ANY
  - Hyperreflexia/Hoffman’s sign
  - New onset Babinski or clonus
  - New onset gait/balance abnormalities
  - Upper extremity weakness

- Weakness (gradual onset upper motor neuron symptoms and/or myelopathy)
  - Gradual onset myelopathy/flaccid weakness (spinal canal stenosis)

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

(PRIMARY recommendation)

- Weakness (sudden onset upper motor neuron symptoms and/or myelopathy)
  - Sudden onset rapidly progressive flaccid weakness

  AND ANY OF THESE:
  - Hyperreflexia/Hoffman’s sign
  - New onset Babinski or clonus
  - New onset gait/balance abnormalities
  - Upper extremity weakness

### TABLE 6. MRA head and neck WITHOUT contrast appropriate use indications

(PRIMARY recommendation)

- Suspected cervical artery dissection (acute trauma)
  - Acute head and/or neck trauma

  AND EITHER:
  - Questionable CTA
  - High clinical suspicion with negative CTA

  OR
  - Headache or facial pain
  - Neurologic deficit(s)
  - Horner syndrome: miosis, ptosis, anhidrosis

- Suspected cervical artery dissection (not acute trauma)
  - Questionable CTA

  OR
  - High clinical suspicion with negative CTA

  AND ANY OF THESE:
  - Headache or facial pain
  - Neurologic deficit(s) and/or stroke
  - Horner syndrome: miosis, ptosis, anhidrosis
### TABLE 7. CTA Head and neck appropriate use indications

(PRIMARY recommendation)

- Suspected cervical artery dissection (acute trauma)
  - Acute head and/or neck trauma
- AND ANY OF THESE:
  - Headache or facial pain
  - Neurologic deficit(s)
  - Horner syndrome: miosis, ptosis, anhidrosis
- Suspected cervical artery dissection (not acute trauma) (IF ANY)
  - Headache or facial pain
  - Neurologic deficit(s) and/or stroke
  - Horner syndrome: miosis, ptosis, anhidrosis

### TABLE 8. CT cervical spine WITHOUT contrast appropriate use indications

(PRIMARY recommendation)

- Significant trauma (ED setting)
  - Significant trauma
- Mild/moderate trauma (all settings) (IF ALL)
  - Mild/moderate trauma
  - Suspected cervical fracture
  - Inadequate coverage or questionable findings on cervical spine radiograph
  - OR
    - High clinical suspicion with negative radiograph
  - OR
    - High-risk patient with known spondyloarthropathy (e.g., AS or DISH)
- Prior cervical neck surgery (with suspicion of hardware failure)
  - Neck pain with suspicion of hardware failure
- AND EITHER:
  - Negative cervical spine radiograph with flex/ex lateral + AP/lateral
  - OR
    - Equivocal plain film findings

(ALTERNATIVE recommendation)

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

* Requires claim for either: PT/chiropractic evaluation in preceding 60 days OR follow-up evaluation and management between 28 and 60 days preceding test.

### TABLE 9. CT Brain/head WITHOUT contrast appropriate use indications

(PRIMARY recommendation)

- Suspected cervical artery dissection (acute trauma)
  - Acute head and/or neck trauma
- AND ANY OF THESE:
  - Headache or facial pain
  - Neurologic deficit(s)
  - Horner syndrome: miosis, ptosis, anhidrosis

(ALTERNATIVE recommendation)

- Weakness (sudden onset upper motor neuron symptoms and/or myelopathy)
  - Sudden onset rapidly progressive flaccid weakness
- AND ANY OF THESE:
  - Hyperreflexia/Hoffman’s sign
  - New onset Babinski or clonus
  - New onset gait/balance abnormalities
  - Upper extremity weakness
- Weakness (gradual onset upper motor neuron symptoms and/or myelopathy)
  - Gradual onset myelopathy/flaccid weakness (spinal canal stenosis)
### TABLE 10. CT Brain/head WITH AND WITHOUT contrast appropriate use indications

(Alternation recommendation)

- Weakness (sudden onset upper motor neuron symptoms and/or myelopathy)
- Sudden onset rapidly progressive flaccid weakness

And any of these:

- Hyperreflexia/Hoffman's sign
- New onset Babinski or clonus
- New onset gait/balance abnormalities
- Upper extremity weakness

- Weakness (gradual onset upper motor neuron symptoms and/or myelopathy)
- Gradual onset myelopathy/flaccid weakness (spinal canal stenosis)

### TABLE 11. CT Myelogram cervical and thoracic spine appropriate use indications

(Alternation recommendation)

- Weakness (sudden onset upper motor neuron symptoms and/or myelopathy)
- Sudden onset rapidly progressive flaccid weakness

And any of these:

- Hyperreflexia/Hoffman's sign
- New onset Babinski or clonus
- New onset gait/balance abnormalities
- Upper extremity weakness

- Weakness (gradual onset upper motor neuron symptoms and/or myelopathy)
- Gradual onset myelopathy/flaccid weakness (spinal canal stenosis)

### TABLE 12. CT cervical spine WITH AND WITHOUT contrast appropriate use indications

(Alternation recommendation)

- Suspected cancer (IF ANY)
- History of cancer
- Multiple cancer risk factors
- High suspicion of cancer

- 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.
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
- Managing Chronic Pain
- Pain Med Tracking Sheet

Fact sheets:
- Cervical Spine Injury: Neck Brace
- Spinal Nerve Decompression
- Discography

Related Care Process Models (CPMs):
- Neck Pain CPM
- Prescribing Opioids for Chronic Pain CPM
- Imaging Radiation Exposure CPM
# BIBLIOGRAPHY

## NODE #1


## NODE #2


## NODE #3


PROVEN IMAGING FOR Neck Pain (NP)

BIBLIOGRAPHY, CONTINUED


NODE #4


NODE #5A


BIBLIOGRAPHY, CONTINUED

NODE #5B


NODE #6


NODE #7A


BIBLIOGRAPHY, CONTINUED

NODE #7B

REFERENCES (from pages 1 through 3)


Proven Imaging Development Group

- Jordan Albritton, PhD
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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.