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.\(^\text{SMI}\) The inflating costs of advanced imaging outstripped that of any other medical service.\(^\text{IGLE, GAO}\) These inflating costs resulted in up to $20–30 billion in unnecessary advanced imaging spending each year.\(^\text{NYDH}\)

- **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.\(^\text{LEV, CMS1}\)
- **Limited effectiveness.** Multiple studies suggest that up to a third of advanced imaging procedures fail to contribute to diagnosis or are clinically inappropriate.\(^\text{NYDH}\)
- **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 hip 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 risk of harm from unwarranted radiation exposure
- Documenting the incidence of a significant positive on advanced imaging tests and aligning with downstream care
PROVEN IMAGING FOR Hip Pain (HP)

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 will 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 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 in the CPMs (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 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 (OCEMB) 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 (the 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.

Abbreviations used in this CPM

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVN</td>
<td>avascular necrosis</td>
</tr>
<tr>
<td>CPM</td>
<td>care process model</td>
</tr>
<tr>
<td>CRP</td>
<td>C-reactive protein</td>
</tr>
<tr>
<td>CT</td>
<td>computed tomography</td>
</tr>
<tr>
<td>ER</td>
<td>external rotation</td>
</tr>
<tr>
<td>ESR</td>
<td>erythrocyte sedimentation rate</td>
</tr>
<tr>
<td>eGFR</td>
<td>glomerular filtration rate</td>
</tr>
<tr>
<td>FABER</td>
<td>flexion abduction and external rotation test</td>
</tr>
<tr>
<td>FADDIR</td>
<td>flexion adduction and internal rotation test</td>
</tr>
<tr>
<td>IV</td>
<td>intravenous</td>
</tr>
<tr>
<td>MARS</td>
<td>metal artifact reduction sequences</td>
</tr>
<tr>
<td>MRI</td>
<td>magnetic resonance imaging</td>
</tr>
<tr>
<td>PCP</td>
<td>primary care provider</td>
</tr>
<tr>
<td>THA</td>
<td>total hip arthroplasty</td>
</tr>
<tr>
<td>WBC</td>
<td>white blood cells</td>
</tr>
</tbody>
</table>

© 2017 INTERMOUNTAIN INTELLECTUAL ASSET MANAGEMENT, LLC, A WHOLLY OWNED SUBSIDIARY OF INTERMOUNTAIN HEALTHCARE. ALL RIGHTS RESERVED.
Care pathways

For each clinical scenario (e.g., chronic hip pain plus proximal hamstring tendinopathy), 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.

Algorithms are grouped as indicated on page 2.

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).

This symbol indicates a common clinical scenario.

AUC met (IF ALL)?
- Symptoms > 3 months
- Primarily deep anterior hip pain
- Positive FADDIR and/or FABER
- Radiographs inconclusive

DECISION NODE #8

CONSIDER these options:
- Re-evaluating the diagnosis
- Managing with conservative measures
- Referring to a hip specialist

Imaging: primary recommendation
- MRI hip arthrogram
  - 1 II $$$ R0
  - OR
- MRI hip w/o contrast (3T)
  - 3 IV $$ R0

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

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 RVUs
- $$ = 5.01 – 10 RVUs
- $$$ = 10.01 – 15 RVUs
- $$$$ = 15.01+ RVUs

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 the incidence of significant positive results on advanced imaging tests.

Downstream care recommendations are general guidelines and are subject to the discretion of individual healthcare providers and the providers’ system protocols.

See abbreviations on page 2.
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 1. MRI hip without contrast appropriate use indications (PRIMARY recommendation)

<table>
<thead>
<tr>
<th>POST THA (IF ALL)</th>
<th>NOT POST THA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ HP + suspected psas irritation</td>
<td>□ Chronic HP + suspected gluteus medius / minimus tear</td>
</tr>
<tr>
<td>□ Persistent anterior hip pain provoked by active hip flexion</td>
<td>□ Absence of external snapping and advanced osteoarthritis</td>
</tr>
<tr>
<td>□ Symptoms &gt; 3 months</td>
<td>□ Symptoms &gt; 3 months</td>
</tr>
<tr>
<td>□ No radiographic evidence of hardware failure</td>
<td>□ Pain localized to the peri-trochanter</td>
</tr>
<tr>
<td>□ Failed conservative treatment by hip specialist</td>
<td>□ Negative or nondiagnostic radiographs</td>
</tr>
<tr>
<td>□ HP + suspected ischiofemoral impingement</td>
<td>□ AND ANY OF THESE:</td>
</tr>
<tr>
<td>□ Symptoms &gt; 3 months</td>
<td>□ Trendelenburg gait</td>
</tr>
<tr>
<td>□ Primarily pain in posterior buttock/ischium</td>
<td>□ Pelvic drop during ipsilateral single-leg stand</td>
</tr>
<tr>
<td>□ Painful sitting and walking</td>
<td>□ Abductor weakness</td>
</tr>
<tr>
<td>□ Radiographs indicating narrowed ischiofemoral space</td>
<td>□ Positive hip lag sign</td>
</tr>
<tr>
<td>□ EITHER positive long stride OR ischiofemoral test</td>
<td>□ Chronic HP + suspected proximal hamstring tendinopathy</td>
</tr>
<tr>
<td>□ HP + suspected gluteus medius / minimus tear</td>
<td>□ Symptoms &gt; 3 months</td>
</tr>
<tr>
<td>□ Absence of external snapping and advanced osteoarthritis</td>
<td>□ Primarily pain in posterior buttock/ischium</td>
</tr>
<tr>
<td>□ Symptoms &gt; 3 months</td>
<td>□ Pain with heel strike during gait</td>
</tr>
<tr>
<td>□ Pain localized to the peri-trochanter</td>
<td>□ Positive resisted hamstring at 30 and / or 90 degrees</td>
</tr>
<tr>
<td>□ Negative or nondiagnostic radiographs</td>
<td>□ Painful sitting and walking</td>
</tr>
<tr>
<td>□ AND ANY ONE OR MORE OF THESE:</td>
<td>□ Negative or nondiagnostic radiographs</td>
</tr>
<tr>
<td>□ Trendelenburg gait</td>
<td>□ Acute HP + suspected acute hamstring tear</td>
</tr>
<tr>
<td>□ Pelvic drop during ipsilateral single-leg stand</td>
<td>□ Positive mechanism of injury with painful pop</td>
</tr>
<tr>
<td>□ Abductor weakness</td>
<td>□ Bruising posterior thigh</td>
</tr>
<tr>
<td>□ Positive hip lag sign</td>
<td>□ Hamstring weakness</td>
</tr>
<tr>
<td>□ Chronic HP + suspected ischiofemoral impingement</td>
<td>□ Difficulty with weight bearing</td>
</tr>
<tr>
<td>□ Symptoms &gt; 3 months</td>
<td>□ Negative or nondiagnostic radiographs</td>
</tr>
<tr>
<td>□ Primarily deep anterior hip pain</td>
<td>□ Radiographs positive or equivocal for avulsion fracture</td>
</tr>
<tr>
<td>□ Positive FADDIR and / or FABER</td>
<td>□ Acute HP + suspected avulsion fracture</td>
</tr>
<tr>
<td>□ Radiographs inconclusive</td>
<td>□ Positive mechanism of injury with painful pop or bruising</td>
</tr>
<tr>
<td>□ Chronic HP + suspected femoral acetabular impingement or labrum tear</td>
<td>□ Associated muscle weakness</td>
</tr>
<tr>
<td>□ Symptoms &gt; 3 months</td>
<td>□ Difficulty with weight bearing</td>
</tr>
<tr>
<td>□ Primarily deep anterior hip pain</td>
<td>□ Radiographs positive or equivocal for avulsion fracture</td>
</tr>
<tr>
<td>□ Positive FADDIR and / or FABER</td>
<td>□ Acute HP + suspected stress fracture (femoral head / neck)</td>
</tr>
<tr>
<td>□ Radiographs inconclusive</td>
<td>□ Acute groin pain</td>
</tr>
<tr>
<td>□ Chronic HP + suspected proximal hamstring tendinopathy</td>
<td>□ Positive single-leg hop test</td>
</tr>
<tr>
<td>□ Symptoms &gt; 3 months</td>
<td>□ Painful and weak hip flexion</td>
</tr>
<tr>
<td>□ Primarily pain in posterior buttock/ischium</td>
<td>□ Negative impingement testing</td>
</tr>
<tr>
<td>□ Pain with heel strike during gait</td>
<td>□ Painful weight bearing</td>
</tr>
<tr>
<td>□ Positive resisted hamstring at 30 and / or 90 degrees</td>
<td>□ Radiographs positive or equivocal for avulsion fracture</td>
</tr>
<tr>
<td>□ Painful sitting and walking</td>
<td>□ Acute HP + suspected dislocation, post relocation</td>
</tr>
<tr>
<td>□ Negative or nondiagnostic radiographs</td>
<td>□ Positive mechanism of injury</td>
</tr>
<tr>
<td>□ EITHER positive long stride OR ischiofemoral test</td>
<td>□ Persistent pain</td>
</tr>
<tr>
<td></td>
<td>□ Limited hip motion</td>
</tr>
<tr>
<td></td>
<td>□ Radiographs have been performed to ensure proper reduction</td>
</tr>
</tbody>
</table>
HIP PAIN (HP) CARE PATHWAY ALGORITHMS:
POST TOTAL HIP ARTHROPLASTY (THA)

For patients who HAVE had a total hip arthroplasty (THA) and present with hip pain, clinical scenarios are presented on pages 5 through 10.

DECISION NODE #1*

**HP + suspected infection (POST THA)**

**AUC met (IF ALL)?**
- Pain or constitutional symptoms
- Positive lab results (WBC, ESR, CRP)
- Negative or noncontributory radiographs

**Imaging: primary recommendation**
- MRI hip w/ and w/o contrast (MARS)
  - **yes**
    - II
    - $R_0$
  - **no**

**Imaging: alternative recommendation**
- CT hip w/ contrast (MARS)
  - **yes**
    - $R_3$
  - **no**

**Significant positive result (IF ANY)?**
- Osteomyelitis
- Hardware failure (see page 9)
- Joint effusion (simple or complex)

**DECISION NODE #1 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)
**PROVEN IMAGING FOR Hip Pain (HP)**

### DECISION NODE #2

**Imaging: primary recommendation**

- **HP + suspected psoas irritation (POST THA)**
  - AUC met (IF ALL)?
    - Persistent anterior hip pain provoked by active hip flexion
    - Symptoms > 3 months
    - No radiographic evidence of hardware failure
    - Failed conservative treatment by hip specialist
  - yes → MRI hip w/o contrast (MARS)
    - Level of Evidence: 2
    - Cost: $$
    - Radiation Risk: R0 (0 mSv)
  - no → PROVIDE additional care as clinically warranted

**Significant positive result?**

- yes → REFER to hip specialist for management
  - Iliopsoas bursal effusion/inflammation
- no → CONSIDER referral to hip specialist for management

### DECISION NODE #2 KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)

---

* Consider referral to shoulder surgeon prior to any advanced imaging studies.
**DECISION NODE #3**

**AUC met (IF ALL)?**
- Symptoms > 3 months
- Primarily pain in posterior buttock/ischium
- Painful sitting and walking
- Radiographs indicating narrowed ischiofemoral space
- EITHER positive long stride OR ischiofemoral test

---

**Imaging: primary recommendation**

- yes: MRI hip w/o contrast 4 I $\$ R0

---

**Significant positive result (IF ANY)?**
- Edema in or narrowing of the ischiofemoral/quadrate femoral spaces
- Inflammation of the sciatic nerve

---

**DECISION NODE #3 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)
**DECISION NODE #4**

**AUC met (IF ALL)?**
- Absence of external snapping and advanced osteoarthritis
- Symptoms > 3 months
- Pain localized to the peri-trochanter
- Negative or noncontributory radiographs

AND ANY OF THESE:
- Trendelenburg gait
- Pelvic drop during ipsilateral single-leg stand
- Abductor weakness
- Positive hip lag sign

---

**Imaging: primary recommendation**
- MRI hip w/o contrast
  - Level of Evidence: II
  - Measure: $\$\$
  - Radiation Dose: R0 (0 mSv)

**Imaging: alternative recommendation**
- CT hip w/o contrast
  - Level of Evidence: NA*
  - Measure: $\$\$
  - Radiation Dose: R3 (1 – 10 mSv)

---

**Significant positive result?**
- yes → REFER to hip surgeon
- no → PROVIDE additional care as clinically warranted

---

**DECISION NODE #4 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 pages 29 through 31.)
Proven Imaging for Hip Pain (HP)

**Decision Node #5A**

- **AUC met (IF ALL)?**
  - Yes:
    - Imaging: primary recommendation
    - CT hip w/o contrast (MARS)
    - Cost: 5 $, Level of Evidence: I
    - **Ref** to hip surgeon for management
  - No:
    - Provide additional care as clinically warranted

- **Significant positive result (IF ANY)?**
  - Yes:
    - Prosthetic component loosening
    - Other hardware failure
    - **Ref** to hip surgeon for management
  - No:
    - Consider referral to hip surgeon for management

**Decision Node #5B**

- **AUC met? Equivocal CT**
  - Yes:
    - Imaging: alternative recommendation
    - MRI hip w/o contrast
    - Cost: 5 $, Level of Evidence: I
    - **Ref** to hip surgeon for management
    - OR
    - Bone scan
    - Cost: 1 $, Level of Evidence: II

- **Significant positive result?**
  - Yes:
    - Prosthetic component loosening
    - Other hardware failure
    - **Ref** to hip surgeon for management
  - No:
    - Consider referral to hip surgeon for management

*Consider referral to shoulder surgeon prior to any advanced imaging studies.*

---

**Legend**

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

- **Cost:**
  - **$** (0 – 5 RVUs)
  - **$** (5.01 – 10 RVUs)
  - **$** (10.01 – 15 RVUs)
  - **$** (15.01+ RVUs)

- **Level of Evidence**
  - **2**
  - **II**

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PROVEN IMAGING FOR Hip Pain (HP)

DECISION NODE #5A KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)

DECISION NODE #5B KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)
HIP PAIN (HP) CARE PATHWAY ALGORITHMS: NOT POST-THA

For patients who have NOT had a total hip arthroplasty (THA) and present with hip pain, clinical scenarios are grouped as either chronic or acute. Common chronic pain scenarios are covered on pages 11–17. Common acute pain scenarios begin on page 18.

DECISION NODE #6

**Chronic HP + suspected avascular necrosis (AVN) or osteonecrosis**

**AUC met (IF ALL)?**
- Nonspecific hip pain
- Painful limited hip range of motion
- Antalgic gait
- Radiographs inconclusive

**Imaging: primary recommendation**
- MRI hip w/ and w/o contrast (3T) 1 V $$$ R0

**Imaging: alternative recommendation**
- MR hip arthrogram (1.5T) 3 IV $$ $$ $$ R0
- CT hip w/o contrast 4 IV $$ $$ R3
- MRI hip w/o contrast 1 II $$ $$ R0

**Significant positive result?**
- yes → REFER to hip surgeon
- no → RE-EVALUATE diagnosis
- OR
- CONSIDER referral to hip specialist

Provide additional care as clinically warranted

RESTORE

DECISION NODE #6 KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)
# PROVEN IMAGING FOR Hip Pain (HP)

## DECISION NODE #7

**Chronic HP + inflammatory or nonspecific arthropathy**

**AUC met (IF ALL)?**
- Nonspecific hip pain
- Limited hip range of motion
- Radiographs inconclusive
- Positive lab workup for inflammatory arthritis

**Imaging: primary recommendation**

<table>
<thead>
<tr>
<th>Test</th>
<th>Level of Evidence</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI hip w/o contrast</td>
<td>II</td>
<td>$$(0 - 5)$$ RVUs</td>
</tr>
</tbody>
</table>

**OR**

<table>
<thead>
<tr>
<th>Test</th>
<th>Level of Evidence</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI hip w/ and w/o contrast (depending on expertise)</td>
<td>I</td>
<td>$$5.01 - 10$$ RVUs</td>
</tr>
</tbody>
</table>

**Imaging: alternative recommendation**

<table>
<thead>
<tr>
<th>Test</th>
<th>Level of Evidence</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT hip w/o contrast</td>
<td>II</td>
<td>$$10.01 - 15$$ RVUs</td>
</tr>
</tbody>
</table>

---

**Significant positive result?**

- Synovitis
- Articular cartilage loss

**YES**

**REFER** to rheumatologist or hip surgeon (if already under rheumatologist care)

**NO**

**CONSIDER** referral to rheumatologist

**PROVIDE** additional care as clinically warranted

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### DECISION NODE #7 KEY EVIDENCE


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**PROVEN IMAGING FOR Hip Pain (HP)**

---

**DECISION NODE #8**

### Chronic HP + mild osteoarthritis

**AUC met (IF ALL)?**
- Symptoms > 3 months
- Primarily deep anterior hip pain
- Positive FADDIR and/or FABER
- Radiographs inconclusive

**DECISION NODE #8 KEY EVIDENCE**


---

**Imaging: primary recommendation**

- MRI hip arthrogram
  - Level of Evidence: II
  - Measure: $$$ (0 – 5 RVUs)
  - Radiation Exposure: R0 (0 mSv)

- OR

- MRI hip w/o contrast (3T)
  - Level of Evidence: IV
  - Measure: $ (5.01 – 10 RVUs)
  - Radiation Exposure: R3 (1 – 10 mSv)

**Imaging: alternative recommendation**

- CT hip w/o contrast*
  - Level of Evidence: II
  - Measure: $ (0 – 5 RVUs)
  - Radiation Exposure: R0

---

**DECISION NODE #8 KEY EVIDENCE**

(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)

---

**LEGEND**

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

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**PROVEN IMAGING FOR Hip Pain (HP)**

**DECISION NODE #9**

**Chronic HP + suspected femoral acetabular impingement or labrum tear**

- Symptoms > 3 months
- Primarily deep anterior hip pain
- Positive FADDIR and/or FABER
- Negative or noncontributory radiographs

**AUC met (IF ALL)?**

- yes → **Imaging: primary recommendation**
  - MRI hip arthrogram:
    - 1 II $$$ R0
  - OR
    - MRI hip w/o contrast (3T):
      - 2 II $ R0

- no → PROVIDE additional care as clinically warranted

**Imaging: alternative recommendation**

- CT hip arthrogram*:
  - 1 II $$$ R3

**Significant positive result (IF ANY)?**

- yes → REFER to hip preservation surgeon
  - → ARTICULAR cartilage loss
  - → ABNORMAL bone morphology
  - → LABRUM tear
  - → AVN

- no → MANAGE with conservative measures AND CONSIDER other causes for pain

---

**DECISION NODE #9 KEY EVIDENCE**


*Also appropriate as pre-operative planning tool*

(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)
**DECISION NODE #10 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)
PROVEN IMAGING FOR Hip Pain (HP)

DECISION NODE #11

Chronic HP + suspected gluteus medius / minimus tear

AUC met (IF ALL)?
- Absence of external snapping and advanced osteoarthritis
- Symptoms > 3 months
- Pain localized to the peri-trochanter
- Negative or noncontributory radiographs

AND ANY OF THESE:
- Trendelenburg gait
- Pelvic drop during ipsilateral single-leg stand
- Abductor weakness
- Positive hip lag sign

Imaging: primary recommendation
- MRI hip w/o contrast

Significant positive result?
- Tear of the gluteus medius / minimus

yes → REFER to hip surgeon

no → RE-EVALUATE diagnosis OR MANAGE with conservative measures

P R O V I D E additional care as clinically warranted

DECISION NODE #11 KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)
PROVEN IMAGING FOR Hip Pain (HP)

**DECISION NODE #12**

**Chronic HP + suspected proximal hamstring tendinopathy**

AUC met (IF ALL)?
- Symptoms > 3 months
- Primarily pain in posterior buttock/ischium
- Pain with heel strike during gait
- Positive resisted hamstring at 30 and/or 90 degrees
- Painful sitting and walking
- Negative or noncontributory radiographs

**Imaging: primary recommendation**
- MRI hip w/o contrast

**Imaging: alternative recommendation**
- CT hip w/o contrast

**Significant positive result (IF ANY)?**
- Tendinopathy of hamstring origin
- Edema of the ischiofemoral space
- Inflammation of the sciatic nerve

**Yes**
- REFER to hip surgeon

**No**
- PROVIDE additional care as clinically warranted
- RE-EVALUATE diagnosis
- OR MANAGE with conservative measures

**DECISION NODE #12 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)
For patients who have NOT had a total hip arthroplasty (THA) and present with hip pain, clinical scenarios are grouped as either chronic or acute. Common chronic pain scenarios were covered on pages 11–17. For common acute pain scenarios, see pages 18–22.

**DECISION NODE #13**

**Acute HP + suspected acute hamstring tear**

- MRI hip w/o contrast

**Significant positive result?**

- Avulsion of hamstring origin

**Refer** to hip surgeon

**MANAGE** with conservative measures

**PROVIDE** additional care as clinically warranted

**DECISION NODE #13 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)
**PROVEN IMAGING FOR Hip Pain (HP)**

**DECISION NODE #14**

**Acute HP + suspected avulsion fracture***

- Positive mechanism of injury with painful pop or bruising
- Associated muscle weakness
- Difficulty with weight bearing
- Radiographs positive or equivocal for avulsion fracture

**Imaging: primary recommendation**

- MRI hip w/o contrast
  - Positive result: Avulsion fracture with significant displacement
  - No positive result: PROVIDE additional care as clinically warranted

**Imaging: alternative recommendation**

- CT hip w/o contrast
  - Positive result: Avulsion fracture with significant displacement
  - No positive result: PROVIDE additional care as clinically warranted

---

**DECISION NODE #14 KEY EVIDENCE**


*Avulsion fractures include fractures of the ischium, lesser trochanter, and ASIS (anterior superior iliac spine).*

See abbreviations on page 2.
**PROVEN IMAGING FOR Hip Pain (HP)**

**DECISION NODE #15**

Acute HP + suspected stress fracture (femoral head/neck)

### Imaging: primary recommendation
- MRI hip w/o contrast

**Imaging: alternative recommendation**
- CT hip w/o contrast

### Significant positive result?

- Stress fracture

- Refer to hip surgeon

- Manage with conservative measures

### Decision Criteria

- **AUC met (IF ALL)?**
  - Acute groin pain
  - Positive single-leg hop test
  - Painful and weak hip flexion
  - Negative impingement testing
  - Painful weight bearing
  - Radiographs positive or equivocal for fracture

- **Significant positive result?**
  - Yes
  - No

- **Refer to hip surgeon**

#### PROVIDE additional care as clinically warranted

---

**DECISION NODE #15 KEY EVIDENCE**


---

(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)
**PROVEN IMAGING FOR Hip Pain (HP)**

**DECISION NODE #16**

**Acute HP + suspected dislocation (post relocation)?**
- Positive mechanism of injury
- Persistent pain
- Limited hip motion
- Radiographs have been performed to ensure proper reduction

**Imaging: primary recommendation**
- MRI hip w/o contrast (3 T)
  - Level of Evidence: 1
  - Measure: $ (0 – 5 RVUs)
  - Radiation Dose: R0
  - OR
- MRI hip arthrogram (1.5 T)
  - Level of Evidence: 4
  - Measure: $$$ (10.01 – 15 RVUs)
  - Radiation Dose: R0

**Imaging: alternative recommendation**
- CT hip w/o contrast
  - Level of Evidence: 2
  - Measure: $ (0 – 5 RVUs)
  - Radiation Dose: R3

**Significant positive result (IF EITHER)?**
- Osteochondral injury
- Loose bodies

**DECISION NODE #16 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)
**DECISION NODE #17**

**Acute HP + suspected septic arthritis or osteomyelitis**

- **AUC met (IF ALL)?**
  - Yes
    - MRI hip w/ and w/o contrast
    - Imaging: primary recommendation
      - 1 II $$ R0 $$
  - No
    - PROVIDE additional care as clinically warranted

- **Significant positive result (IF EITHER)?**
  - Yes
    - REFER to hip surgeon
  - No
    - CONSIDER referral to hip surgeon

**Imaging: alternative recommendation**

- Bone scan
  - 1 II $$ R3 $$

(For a full list of references for all decision nodes, see bibliography on pages 29 through 31.)

---

**DECISION NODE #17 KEY EVIDENCE**

### TABLE 1. MRI hip without contrast appropriate use indications (PRIMARY recommendation)

<table>
<thead>
<tr>
<th>POST THA (IF ALL)</th>
<th>NOT POST THA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ HP + suspected psoas irritation</td>
<td>☐ Chronic HP + suspected gluteus medius / minimus tear</td>
</tr>
<tr>
<td>☐ Persistent anterior hip pain provoked by active hip flexion</td>
<td>☐ Absence of external snapping and advanced osteoarthritis</td>
</tr>
<tr>
<td>☐ Symptoms &gt; 3 months</td>
<td>☐ Pain &gt; 3 months</td>
</tr>
<tr>
<td>☐ No radiographic evidence of hardware failure</td>
<td>☐ Pain localized to the peri-trochanter</td>
</tr>
<tr>
<td>☐ Failed conservative treatment by hip specialist</td>
<td>☐ Negative or nondiagnostic radiographs</td>
</tr>
<tr>
<td>☐ HP + suspected ischiofemoral impingement</td>
<td>☐ AND ANY OF THESE:</td>
</tr>
<tr>
<td>☐ Symptoms &gt; 3 months</td>
<td>☐ Trendelenburg gait</td>
</tr>
<tr>
<td>☐ Primarily pain in posterior buttock/ischium</td>
<td>☐ Pelvic drop during ipsilateral single-leg stand</td>
</tr>
<tr>
<td>☐ Painful sitting and walking</td>
<td>☐ Abductor weakness</td>
</tr>
<tr>
<td>☐ Radiographs indicating narrowed ischiofemoral space</td>
<td>☐ Positive hip lag sign</td>
</tr>
<tr>
<td>☐ EITHER positive long stride OR ischiofemoral test</td>
<td>☐ Chronic HP + suspected femoral acetabular impingement or labrum tear</td>
</tr>
<tr>
<td>☐ HP + suspected gluteus medius / minimus tear</td>
<td>☐ Symptoms &gt; 3 months</td>
</tr>
<tr>
<td>☐ Absence of external snapping and advanced osteoarthritis</td>
<td>☐ Primarily deep anterior hip pain</td>
</tr>
<tr>
<td>☐ Symptoms &gt; 3 months</td>
<td>☐ Positive FADDIR and/or FABER</td>
</tr>
<tr>
<td>☐ Pain localized to the peri-trochanter</td>
<td>☐ Radiographs inconclusive</td>
</tr>
<tr>
<td>☐ Negative or nondiagnostic radiographs</td>
<td>☐ Chronic HP + suspected gluteus medius / minimus tear</td>
</tr>
<tr>
<td>☐ AND ANY ONE OR MORE OF THESE:</td>
<td>☐ Absence of external snapping and advanced osteoarthritis</td>
</tr>
<tr>
<td>☐ Trendelenburg gait</td>
<td>☐ Pain &gt; 3 months</td>
</tr>
<tr>
<td>☐ Pelvic drop during ipsilateral single-leg stand</td>
<td>☐ Pain localized to the peri-trochanter</td>
</tr>
<tr>
<td>☐ Abductor weakness</td>
<td>☐ Negative or nondiagnostic radiographs</td>
</tr>
<tr>
<td>☐ Positive hip lag sign</td>
<td>☐ Chronic HP + suspected proximal hamstring tendinopathy</td>
</tr>
<tr>
<td>☐ Chronic HP + suspected ischiofemoral impingement</td>
<td>☐ Symptoms &gt; 3 months</td>
</tr>
<tr>
<td>☐ Symptoms &gt; 3 months</td>
<td>☐ Primarily pain in posterior buttock/ischium</td>
</tr>
<tr>
<td>☐ Primarily pain in posterior buttock/ischium</td>
<td>☐ Pain with heel strike during gait</td>
</tr>
<tr>
<td>☐ Painful sitting and walking</td>
<td>☐ Positive resisted hamstring at 30 and/or 90 degrees</td>
</tr>
<tr>
<td>☐ Radiographs indicating narrowed ischiofemoral space</td>
<td>☐ Painful sitting and walking</td>
</tr>
<tr>
<td>☐ EITHER positive long stride OR ischiofemoral test</td>
<td>☐ Negative or nondiagnostic radiographs</td>
</tr>
</tbody>
</table>

**PROVEN IMAGING FOR Hip Pain (HP)**

**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

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### TABLE 2. MRI hip without contrast appropriate use indications (ALTERNATIVE recommendation)

<table>
<thead>
<tr>
<th>POST THA (IF ALL)</th>
<th>NOT POST THA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ HP + suspected hardware failure</td>
<td></td>
</tr>
<tr>
<td>□ Hip and thigh pain</td>
<td></td>
</tr>
<tr>
<td>□ Negative or nondiagnostic radiographs</td>
<td></td>
</tr>
<tr>
<td>□ Equivocal CT</td>
<td></td>
</tr>
<tr>
<td>□ Chronic HP + inflammatory or nonspecific arthropathy</td>
<td></td>
</tr>
<tr>
<td>□ Nonspecific hip pain</td>
<td></td>
</tr>
<tr>
<td>□ Limited hip range of motion</td>
<td></td>
</tr>
<tr>
<td>□ Positive lab workup for inflammatory arthritis</td>
<td></td>
</tr>
<tr>
<td>□ Chronic HP + suspected avascular necrosis (AVN) or osteonecrosis</td>
<td></td>
</tr>
<tr>
<td>□ Nonspecific hip pain</td>
<td></td>
</tr>
<tr>
<td>□ Radiographs inconclusive</td>
<td></td>
</tr>
<tr>
<td>□ Antalgic gait</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 3. MRI hip with and without contrast appropriate use indications (PRIMARY recommendation)

<table>
<thead>
<tr>
<th>POST THA (IF ALL)</th>
<th>NOT POST THA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□HP + suspected infection</td>
<td></td>
</tr>
<tr>
<td>□ Pain or constitutional symptoms</td>
<td></td>
</tr>
<tr>
<td>□ Positive lab results (WBC, ESR, CRP)</td>
<td></td>
</tr>
<tr>
<td>□ Negative or nondiagnostic radiographs</td>
<td></td>
</tr>
<tr>
<td>□ Chronic HP + suspected avascular necrosis (AVN) or osteonecrosis</td>
<td></td>
</tr>
<tr>
<td>□ Nonspecific hip pain</td>
<td></td>
</tr>
<tr>
<td>□ Painful limited hip range of motion</td>
<td></td>
</tr>
<tr>
<td>□ Antalgic gait</td>
<td></td>
</tr>
<tr>
<td>□ Radiographs inconclusive</td>
<td></td>
</tr>
<tr>
<td>□ Chronic HP + inflammatory or nonspecific arthropathy (depending on expertise)</td>
<td></td>
</tr>
<tr>
<td>□ Nonspecific hip pain</td>
<td></td>
</tr>
<tr>
<td>□ Limited hip range of motion</td>
<td></td>
</tr>
<tr>
<td>□ Radiographs inconclusive</td>
<td></td>
</tr>
<tr>
<td>□ Positive lab workup for inflammatory arthritis</td>
<td></td>
</tr>
<tr>
<td>□ Acute HP + suspected septic arthritis or osteomyelitis</td>
<td></td>
</tr>
<tr>
<td>□ Atypical hip pain</td>
<td></td>
</tr>
<tr>
<td>□ Constitutional symptoms</td>
<td></td>
</tr>
<tr>
<td>□ Elevated ESR, CRP, or WBC</td>
<td></td>
</tr>
<tr>
<td>□ Negative or nondiagnostic radiographs</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 4. MRI hip arthrogram appropriate use indications (PRIMARY recommendation)

<table>
<thead>
<tr>
<th>NOT POST THA (IF ALL)</th>
<th>POST THA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Chronic HP + suspected avascular necrosis (AVN) or osteonecrosis</td>
<td></td>
</tr>
<tr>
<td>□ Nonspecific hip pain</td>
<td></td>
</tr>
<tr>
<td>□ Painful limited hip range of motion</td>
<td></td>
</tr>
<tr>
<td>□ Antalgic gait</td>
<td></td>
</tr>
<tr>
<td>□ Radiographs inconclusive</td>
<td></td>
</tr>
<tr>
<td>□ Chronic HP + mild osteoarthritis</td>
<td></td>
</tr>
<tr>
<td>□ Symptoms &gt; 3 months</td>
<td></td>
</tr>
<tr>
<td>□ Primarily deep anterior hip pain</td>
<td></td>
</tr>
<tr>
<td>□ Positive FADDIR and/or FABER</td>
<td></td>
</tr>
<tr>
<td>□ Radiographs inconclusive</td>
<td></td>
</tr>
<tr>
<td>□ Chronic HP + suspected femoral acetabular impingement or labrum tear</td>
<td></td>
</tr>
<tr>
<td>□ Symptoms &gt; 3 months</td>
<td></td>
</tr>
<tr>
<td>□ Primarily deep anterior hip pain</td>
<td></td>
</tr>
<tr>
<td>□ Positive FADDIR and/or FABER</td>
<td></td>
</tr>
<tr>
<td>□ Negative or nondiagnostic radiographs</td>
<td></td>
</tr>
<tr>
<td>□ Acute HP + suspected dislocation, post relocation</td>
<td></td>
</tr>
<tr>
<td>□ Positive mechanism of injury</td>
<td></td>
</tr>
<tr>
<td>□ Persistent pain</td>
<td></td>
</tr>
<tr>
<td>□ Limited hip motion</td>
<td></td>
</tr>
<tr>
<td>□ Radiographs have been performed to ensure proper reduction</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 5. CT hip without contrast appropriate use indications (PRIMARY recommendation)

<table>
<thead>
<tr>
<th>POST THA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ HP + suspected hardware failure</td>
</tr>
<tr>
<td>□ Hip and thigh pain</td>
</tr>
<tr>
<td>□ Negative or nondiagnostic radiographs</td>
</tr>
<tr>
<td>□ Equivocal CT</td>
</tr>
</tbody>
</table>

### TABLE 6. CT hip with contrast appropriate use indications (ALTERNATIVE recommendation)

<table>
<thead>
<tr>
<th>POST THA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ HP + suspected infection</td>
</tr>
<tr>
<td>□ Pain or constitutional symptoms</td>
</tr>
<tr>
<td>□ Positive lab results (WBC, ESR, CRP)</td>
</tr>
<tr>
<td>□ Negative or noncontributory radiographs</td>
</tr>
</tbody>
</table>
**TABLE 7. CT hip without contrast appropriate use indications (ALTERNATIVE recommendation)**

<table>
<thead>
<tr>
<th>POST THA (IF ALL)</th>
<th>NOT POST THA (IF ALL)</th>
</tr>
</thead>
</table>
| □ HP + suspected gluteus medius / minimus tear  
  □ Absence of external snapping and advanced osteoarthritis  
  □ Symptoms > 3 months  
  □ Pain localized to the peri-trochanter  
  □ Negative or nondiagnostic radiographs  
  **AND ANY ONE OR MORE OF THESE:**  
  □ Trendelenburg gait  
  □ Pelvic drop during ipsilateral single-leg stand  
  □ Abductor weakness  
  □ Positive hip lag sign  | □ Acute HP + suspected avulsion fracture  
  □ Positive mechanism of injury with painful pop or bruising  
  □ Associated muscle weakness  
  □ Difficulty with weight bearing  
  □ Positive radiographs for avulsion fracture  |
| □ Chronic HP + suspected avascular necrosis (AVN) or osteonecrosis  
  □ Nonspecific hip pain  
  □ Painful limited hip range of motion  
  □ Antalgic gait  
  □ Positive radiographs  | □ Acute HP + suspected stress fracture (femoral head/neck)  
  □ Acute groin pain  
  □ History of running or high-impact sports  
  □ Positive single-leg hop test  
  □ Painful and weak hip flexion  
  □ Negative impingement testing  
  □ Painful weight bearing  
  □ Radiographs have been performed  |
| □ Chronic HP + inflammatory or nonspecific arthropathy  
  □ Nonspecific hip pain  
  □ Limited hip range of motion  
  □ Radiographs inconclusive  
  □ Positive lab workup for inflammatory arthritis  | □ Acute HP + suspected dislocation, post relocation  
  □ Positive mechanism of injury  
  □ Persistent pain  
  □ Limited hip motion  
  □ Radiographs have been performed to ensure proper reduction |
| □ Chronic HP + suspected proximal hamstring tendinopathy  
  □ Symptoms > 3 months  
  □ Primarily pain in posterior buttock / ischium  
  □ Pain with heel strike during gait  
  □ Positive resisted hamstring at 30 and/or 90 degrees  
  □ Painful sitting and walking  
  □ Negative or nondiagnostic radiographs  | |
### TABLE 8. CT arthrogram appropriate use indications (ALTERNATIVE recommendation)

<table>
<thead>
<tr>
<th>NOT POST THA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Chronic HP + suspected femoral acetabular impingement or labrum tear</td>
</tr>
<tr>
<td>□ Symptoms &gt; 3 months</td>
</tr>
<tr>
<td>□ Primarily deep anterior hip pain</td>
</tr>
<tr>
<td>□ Positive FADDIR and/or FABER</td>
</tr>
<tr>
<td>□ Negative or nondiagnostic radiographs</td>
</tr>
</tbody>
</table>

### TABLE 9. Bone scan appropriate use indications (ALTERNATIVE recommendation)

<table>
<thead>
<tr>
<th>POST THA (IF ALL)</th>
<th>NOT POST THA (IF ALL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ HP + suspected hardware failure</td>
<td></td>
</tr>
<tr>
<td>□ Hip and thigh pain</td>
<td></td>
</tr>
<tr>
<td>□ Negative or nondiagnostic radiographs</td>
<td></td>
</tr>
<tr>
<td>□ Equivocal CT</td>
<td></td>
</tr>
<tr>
<td>□ Acute HP + suspected septic arthritis or osteomyelitis (at the discretion of the hip surgeon)</td>
<td></td>
</tr>
<tr>
<td>□ Atypical hip pain</td>
<td></td>
</tr>
<tr>
<td>□ Constitutional symptoms</td>
<td></td>
</tr>
<tr>
<td>□ Elevated ESR, CRP, or WBC</td>
<td></td>
</tr>
<tr>
<td>□ No significant positive finding on MRI</td>
<td></td>
</tr>
</tbody>
</table>
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:
- Managing Chronic Pain
- Pain Med Tracking Sheet

Related Care Process Models (CPMs):
- Prescribing Opioids for Chronic Pain CPM
- Imaging Radiation Exposure CPM
- Geriatric Hip Fracture CPM
- Management of Total Hip and Knee Replacement Surgery CPM

Fact sheets:
- Hip Replacement Surgery: Home instructions
- Surgery for Hip Fracture (Geriatric)
- Treatment for Hip Fracture: A decision guide
- CT Scan
- Radiation Exposure in Medical Tests
- Intravenous (IV) Contrast Material


NODE #5


NODE #6


NODE #7


NODE #8


NODE #9

BIBLIOGRAPHY, CONTINUED


NODE #10


NODES #11 – 13


NODES #14 – 16


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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