

Intermountain Imaging Criteria:

Low Back Pain

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

► Why Focus ON INTERMOUNTAIN IMAGING CRITERIA?

Advanced imaging procedures, including MRI, CT, PET, and nuclear medicine, facilitate rapid and accurate detection and/or diagnosis of disease. The volume of advanced imaging procedures prescribed to patients in the U.S. increased three- to four-fold from 1996–2010 as the technologies became widely available.^{SMI} The inflating costs of advanced imaging outstripped that of any other medical service.^{IGL, GAO} These inflating costs resulted in up to \$20–30 billion in unnecessary advanced imaging spending each year.^{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.^{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.^{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 Intermountain Imaging Criteria approach seeks to avoid these risks.

► GOALS AND MEASURES

Indicates an Intermountain measure



This CPM was developed by Intermountain clinical experts to outline appropriate use criteria (AUC) for advanced imaging for low back 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

► WHAT'S INSIDE?

OVERVIEW: INTERMOUNTAIN IMAGING CRITERIA AUC CONTENT 2

LOW BACK PAIN (LBP) CARE PATHWAY ALGORITHMS. 5

- LBP without complicating features 5
- LBP + weakness (cauda equina syndrome and/or lower motor neuron symptoms) 6
- LBP + weakness (myelopathy/ upper motor neuron symptoms) 7
- LBP + suspected compression fracture 8
- LBP + significant trauma (ED setting) . . . 9
- LBP + minor/moderate trauma (all settings) 10
- LBP without improvement + prior lumbar surgery: NO suspicion of hardware failure. 12
- LBP + prior lumbar surgery: WITH suspicion of hardware failure 13
- LBP + suspected cancer 14
- LBP + suspected infection. 15
- LBP + suspected spondylolysis 16

POINT-OF-ORDER CHECKLISTS 17

RESOURCES 21

BIBLIOGRAPHY 22

REFERENCES 27

▶ OVERVIEW: INTERMOUNTAIN IMAGING CRITERIA APPROPRIATE USE CRITERIA CONTENT

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

The care process model approach

Designed as care process models (CPMs), the Intermountain Imaging Criteria AUC content is a blueprint that logically guides the delivery of evidence-based care via an algorithmic visual presentation (see [pages 5 through 16](#)). Although these Intermountain Imaging Criteria CPMs specifically focus on the appropriate use of advanced imaging, they can be viewed as portions of broader CPMs that guide not only diagnostic but therapeutic interventions for a specific disease or condition.

Ideally, Intermountain Imaging Criteria CPMs are engaged early in the patient encounter and guide the various considerations that lead to the ultimate decision regarding ordering of an imaging study. Point-of-order checklists are also included (beginning on [page 17](#)). These checklist-based guidelines are logically equivalent to the algorithms from which they are derived.

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

Relative imaging cost and radiation risk rankings

To further aid providers, each algorithm includes a ranking of relative costs and radiation risk for each advanced imaging test recommended. The cost scale is derived using global non-facility relative value units (RVUs) published by the Centers for Medicare and Medicaid Services (CMS) as a surrogate for cost.^{CMS2} The radiation risk is derived from data published in 2010 by the Health Physics Society.^{ACR, HPS}

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) 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.^{OCE}
2. The extensively used Fryback and Thornbury conceptual framework, which uses six levels for assessing the efficacy of diagnostic imaging.^{FRY}

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

Using the algorithms and checklists

Under “Care Pathways” on [page 3](#), there is an annotated algorithmic sample for a typical clinical scenario found in this CPM. Under “Point-of-Order Checklist” on [page 4](#), there is an annotated sample of a typical point-of-order checklist for an imaging procedure recommended within the above sample algorithm.

Abbreviations used in this CPM

AS	= ankylosing spondylitis
CPG	= clinical practice guideline
CPM	= care process model
CT	= computed tomography
DISH	= diffuse idiopathic skeletal hyperostosis
MRI	= magnetic resonance imaging
PCP	= primary care provider
PM&R	= pain management and rehabilitation

Care pathways

For each clinical scenario included (e.g., low back pain plus 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 that performing neuroimaging studies for chronic but stable low back pain (i.e., no new features and normal neurologic exam) is not recommended.**

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

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

This symbol indicates a common clinical scenario.

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

The Arabic number in the green box indicates an evidence ranking derived from the OCEBM scale.^{OCE} 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.^{FRT} For this scale, the **higher** the number, the stronger the evidence ranking.

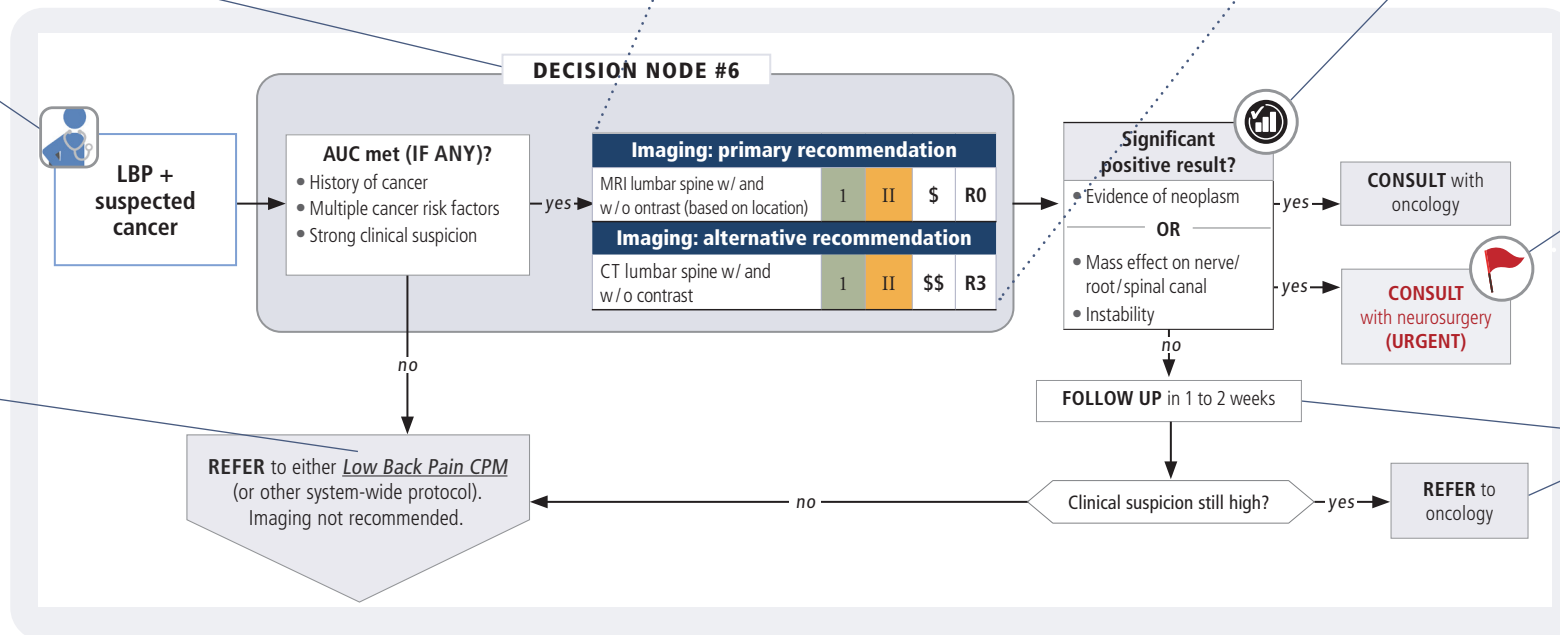
Cost rankings are indicated based on a range developed from the CMS Global Relative Value Units (RVUs) as follows:^{CMS2}
 \$ = 0–5 RVU \$\$\$ = 10–15 RVU
 \$\$ = 5–10 RVU \$\$\$\$ = 15+ RVU

Radiation risk rankings use the scale developed by the American College of Radiology.^{ACR} This rating framework offers the following six levels for adult effective dose range risk:
 R0 = 0 mSv R3 = 1–10 mSv
 R1 = <0.1 mSv R4 = 10–30 mSv
 R2 = 0.1–1 mSv R5 = 30–100 mSv

Imaging: primary recommendation					
MRI lumbar spine w/ and w/o contrast (based on location)	1	II	\$	R0	
Imaging: alternative recommendation					
CT lumbar spine w/ and w/o contrast	1	II	\$\$	R3	

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

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



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

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

Point-of-order checklists

See abbreviations on [page 2](#).

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

Tables included on [pages 17 through 19](#) indicate if the test is a primary recommendation or alternative recommendation.

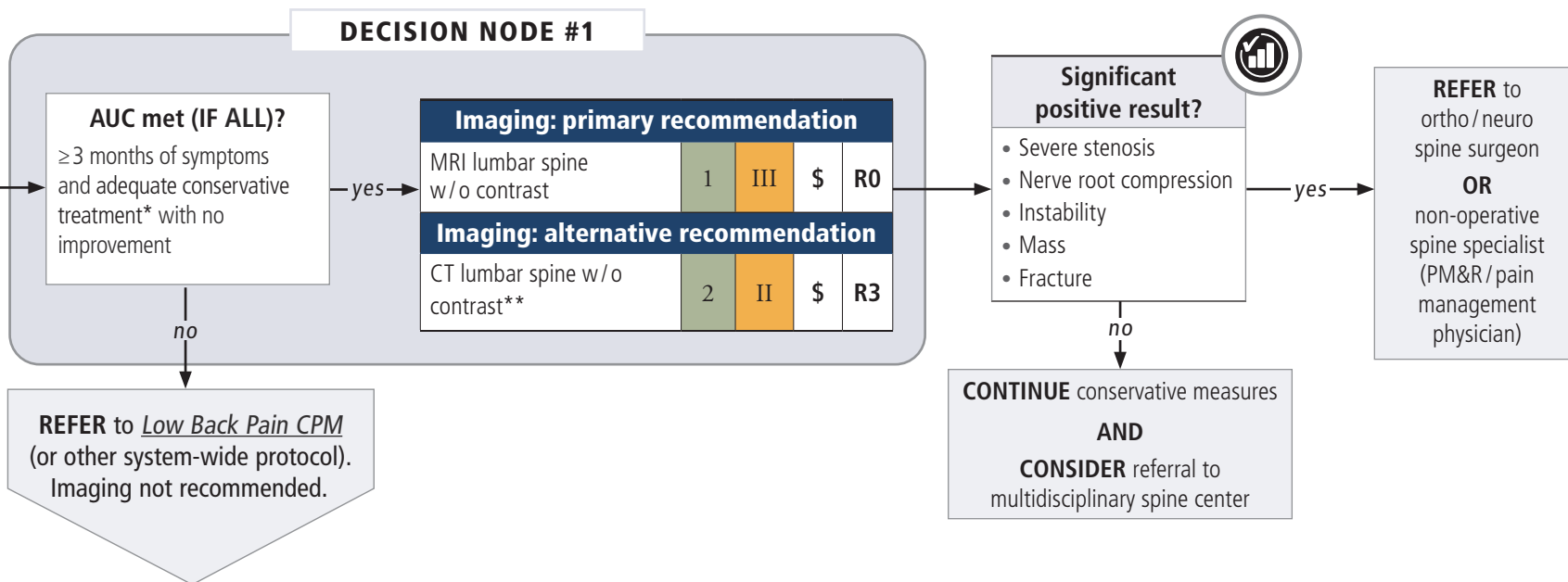
TABLE 2. MRI lumbar spine* WITH AND WITHOUT CONTRAST appropriate use indications	
(PRIMARY recommendation)	
<input type="checkbox"/> LBP without improvement + prior lumbar surgery (NO suspicion of hardware failure) (IF ANY): <input type="checkbox"/> Worsening back pain <input type="checkbox"/> New or acute radiculopathy <input type="checkbox"/> Weakness <input type="checkbox"/> High suspicion for disc disease adjacent to hardware	<input type="checkbox"/> LBP + suspected cancer (IF ANY) <input type="checkbox"/> History of cancer <input type="checkbox"/> Multiple cancer risk factors <input type="checkbox"/> Strong clinical suspicion <input type="checkbox"/> LBP + suspected infection (IF ANY) <input type="checkbox"/> Fever/chills and/or pain with rest or at night <input type="checkbox"/> Other risk factors**
<p>* Or C or T spine based on location ** Other risk factors (e.g., immunocompromised patient, UTI, IV drug use, recent spinal procedure)</p>	

▶ **LOW BACK PAIN (LBP) CARE PATHWAY ALGORITHMS**

See abbreviations on [page 2](#).



LBP without complicating features



* Requires claim for either:

- PT/chiropractic evaluation in preceding 60 days

OR

- Follow-up evaluation and management between 28 and 60 days preceding MRI

** During pregnancy, CT may be contraindicated. Consult with a radiologist.

DECISION NODE #1 KEY EVIDENCE

Chou R, Fu R, Carrino JA, Deyo RA. Imaging strategies for low-back pain: systematic review and meta-analysis. *Lancet*. 2009;373(9662):463-472.

Modic MT, Masaryk T, Boumprey F, Goormastic M, Bell G. Lumbar herniated disk disease and canal stenosis: prospective evaluation by surface coil MR, CT, and myelography. *AJR Am J Roentgenol*. 1986;147(4):757-765.

Thawait SK, Marcus MA, Morrison WB, Klufas RA, Eng J, Carrino JA. Research synthesis: what is the diagnostic performance of magnetic resonance imaging to discriminate benign from malignant vertebral compression fractures? Systematic review and meta-analysis. *Spine (Phila Pa 1976)*. 2012;37(12):E736-E744.

Thornbury JR, Fryback DG, Turski PA, et al. Disk-caused nerve compression in patients with acute low-back pain: diagnosis with MR, CT myelography, and plain CT. *Radiology* 1993;186(3):731-738.

van Rijn RM, Wassenaar M, Verhagen AP, et al. Computed tomography for the diagnosis of lumbar spinal pathology in adult patients with low back pain or sciatica: a diagnostic systematic review. *Eur Spine J*. 2012;21(2):228-239.

Wassenaar M, van Rijn RM, van Tulder MW, et al. Magnetic resonance imaging for diagnosing lumbar spinal pathology in adult patients with low back pain or sciatica: a diagnostic systematic review. *Eur Spine J*. 2012;21(2):220-227.

(For a full list of references for all decision nodes, see bibliography on [pages 22 through 26](#))

LEGEND



Clinical Scenario



Urgent or Emergency Situation



2 OCEBM Level of Evidence



II Fryback & Thornbury Level of Evidence



Intermountain Measure

R0 (0mSv)
\$ (0–5 RVUs)

R3 (1–10 mSv)
\$\$ (5–10 RVUs)

R4 (10–30 mSv)
\$\$\$ (10–15 RVUs)

See page 2–3 for explanation.
\$\$\$\$ (15+ RVUs)

See abbreviations on [page 2](#).



LBP + weakness (cauda equina syndrome and/or lower motor neuron symptoms)

DECISION NODE #2A

AUC met (IF ANY)?

Suspected cauda equina syndrome (signs/symptoms):

- New bowel or bladder dysfunction
- Perineal numbness/saddle anesthesia
- Persistent/increasing lower extremity weakness, numbness, or tingling
- Sudden onset/rapidly progressive flaccid weakness
- Other lower motor neuron symptoms

yes →

EMERGENCY REFERRAL OR emergency spine consult

Imaging: primary recommendation

MRI lumbar spine w/o contrast	2	II	\$	R0
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Imaging: alternative recommendation

CT myelogram lumbar spine*	1	II	\$\$\$	R3
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Significant positive result?

- Severe stenosis
- Compression of cauda equina
- Large disc herniation

yes →

REFER to ortho/neuro spine surgeon (URGENT)

no ↓

CONSIDER (BOTH):

- Clinical alternatives (demyelinating disease and intracranial pathology)
- Referral/consultation with neurology or neurosurgery

no ↓

For upper motor, see Decision Node #2B on [page 7](#).

* During pregnancy, CT may be contraindicated. Consult with a radiologist.

DECISION NODE #2A KEY EVIDENCE

Bell DA, Collie D, Statham PF. Cauda equine syndrome: what is the correlation between clinical assessment and MRI scanning? *BR J Neurosurg.* 2007;21(2):201-203.

Patel ND, Broderick DF, Burns J, et al. ACR Appropriateness Criteria® low back pain. *J Am Coll Radiol.* 2016;13(9):1069-1078.

Kent DL, Haynor DR, Larson EB, Deyo RA. Diagnosis of lumbar spinal stenosis in adults: A meta-analysis of the accuracy of CT, MR, and myelography. *AJR Am J Roentgenol.* 1992;158(5):1135-1144.

(For a full list of references for all decision nodes, see bibliography on [pages 22 through 26](#))

LEGEND



Clinical Scenario



Urgent or Emergency Situation



OCEBM Level of Evidence



Fryback & Thornbury Level of Evidence



Intermountain Measure

R0 (0mSv)

\$ (0-5 RVUs)

R3 (1-10 mSv)

\$\$ (5-10 RVUs)

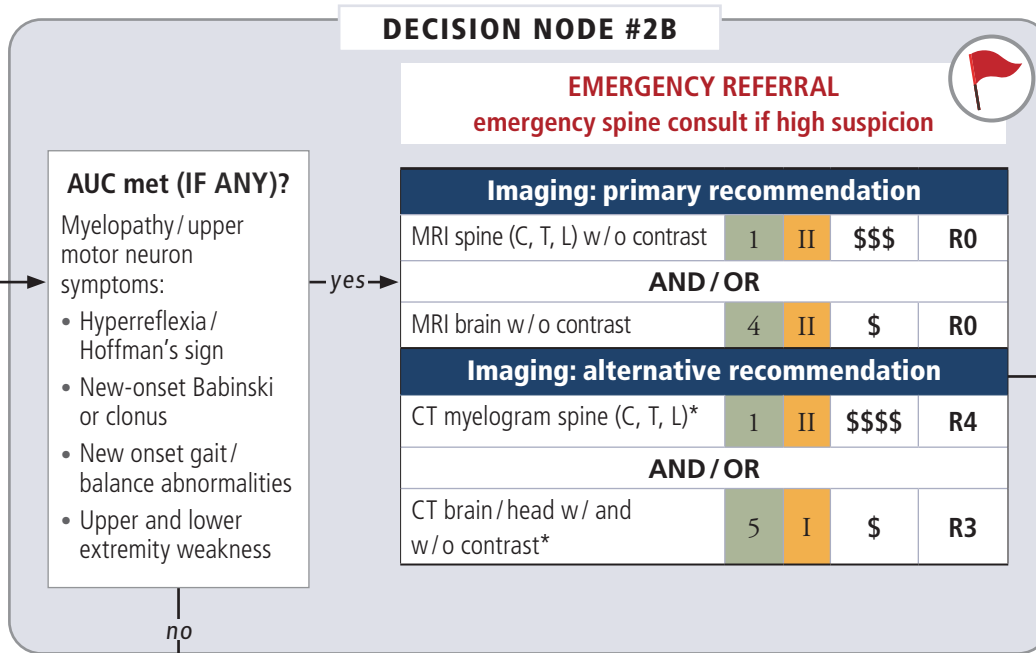
R4 (10-30 mSv) See page 2-3 for explanation.

\$\$\$ (10-15 RVUs) \$\$\$\$ (15+ RVUs)

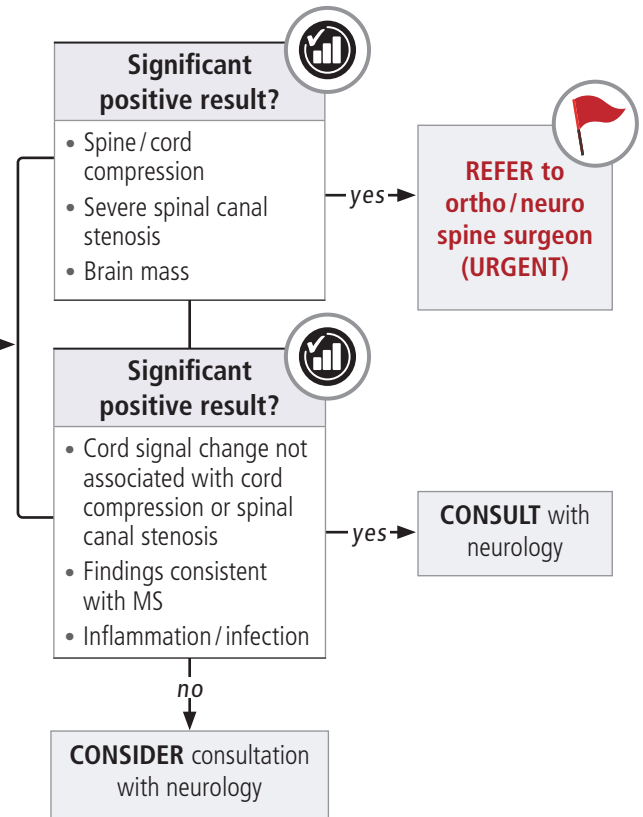
See abbreviations on [page 2](#).



LBP + weakness (myelopathy/upper motor neuron symptoms)



REFER to either Low Back Pain CPM OR Low Back Pain in the ED CPM (or other system-wide protocol). Imaging not recommended.



* During pregnancy, CT may be contraindicated. Consult with a radiologist.

DECISION NODE #2B KEY EVIDENCE

Roth CJ, Angevine PD, Aulino JM, et al. ACR Appropriateness Criteria® myelopathy. *J Am Coll Radiol.* 2016;13(1):38-44.

Wippold FJ 2nd, Cornelius RS, Aiken AH, et al. ACR Appropriateness Criteria® focal neurologic deficit. American College of Radiology. <https://acsearch.acr.org/docs/69480/Narrative>. Updated 2012. Accessed August 31, 2017.

(For a full list of references for all decision nodes, see bibliography on pages 22 through 26)

LEGEND



Clinical Scenario



Urgent or Emergency Situation



OCEBM Level of Evidence



Fryback & Thornbury Level of Evidence



Intermountain Measure

R0 (0mSv)
\$ (0-5 RVUs)

R3 (1-10 mSv)
\$\$ (5-10 RVUs)

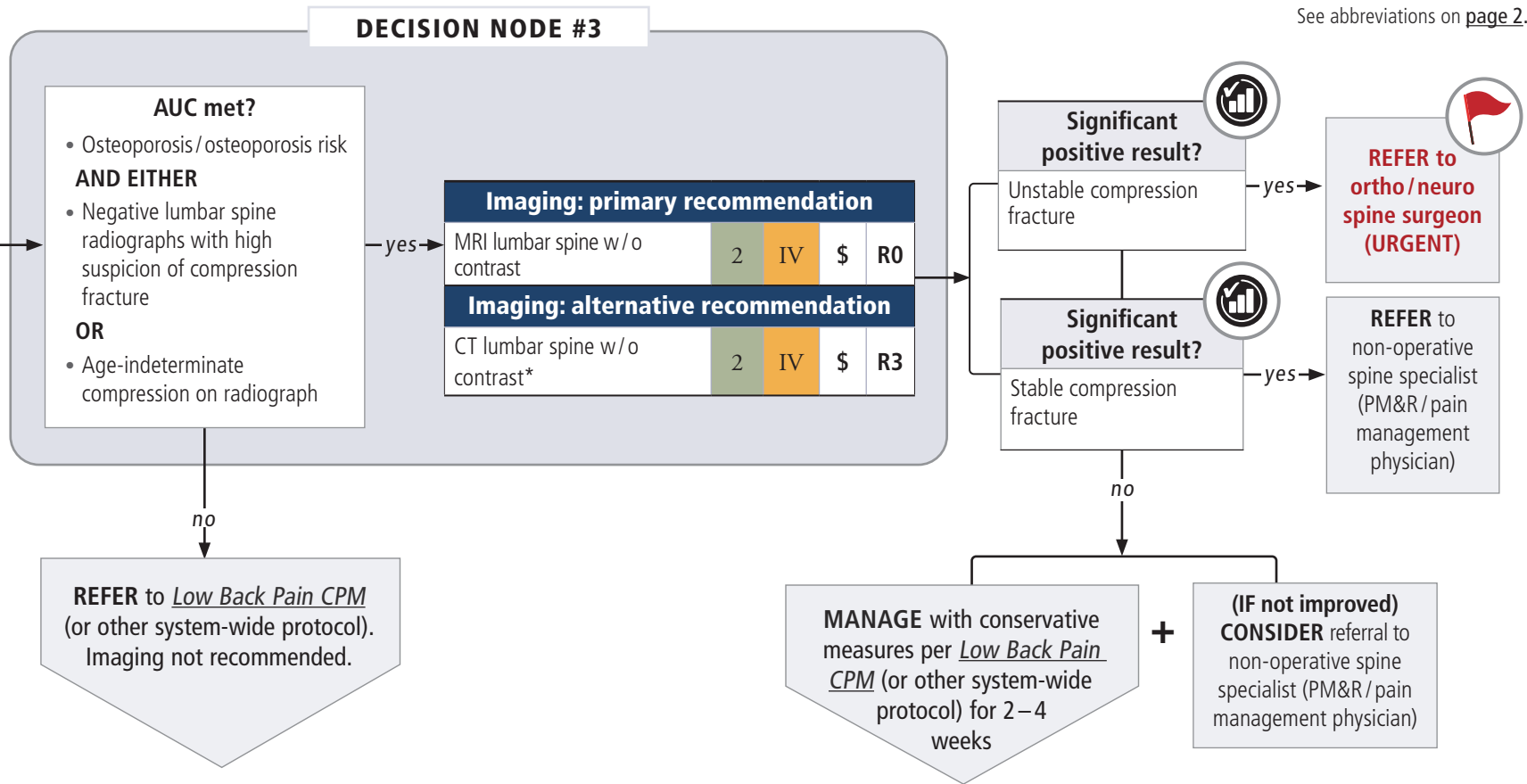
R4 (10-30 mSv)
\$\$\$ (10-15 RVUs)

See page 2-3 for explanation.
\$\$\$\$ (15+ RVUs)

See abbreviations on [page 2](#).



LBP + suspected compression fracture



* During pregnancy, CT may be contraindicated. Consult with a radiologist.

DECISION NODE #3 KEY EVIDENCE

Abdel-Wanis ME, Solyman MT, Hasan NM. Sensitivity, specificity and accuracy of magnetic resonance imaging for differentiating vertebral compression fractures caused by malignancy, osteoporosis, and infections. *J Orthop Surg (Hong Kong)*. 2011;19(2):145-150.

Pizones J, Izquierdo E, Alvarez P, et al. Impact of magnetic resonance imaging on decision making for thoracolumbar traumatic fracture diagnosis and treatment. *Eur Spine J*. 2011;20(Suppl 3):390-396.

(For a full list of references for all decision nodes, see bibliography on pages 22 through 26)

LEGEND



Clinical Scenario



Urgent or Emergency Situation



2 OCEBM Level of Evidence



II Fryback & Thornbury Level of Evidence



Intermountain Measure

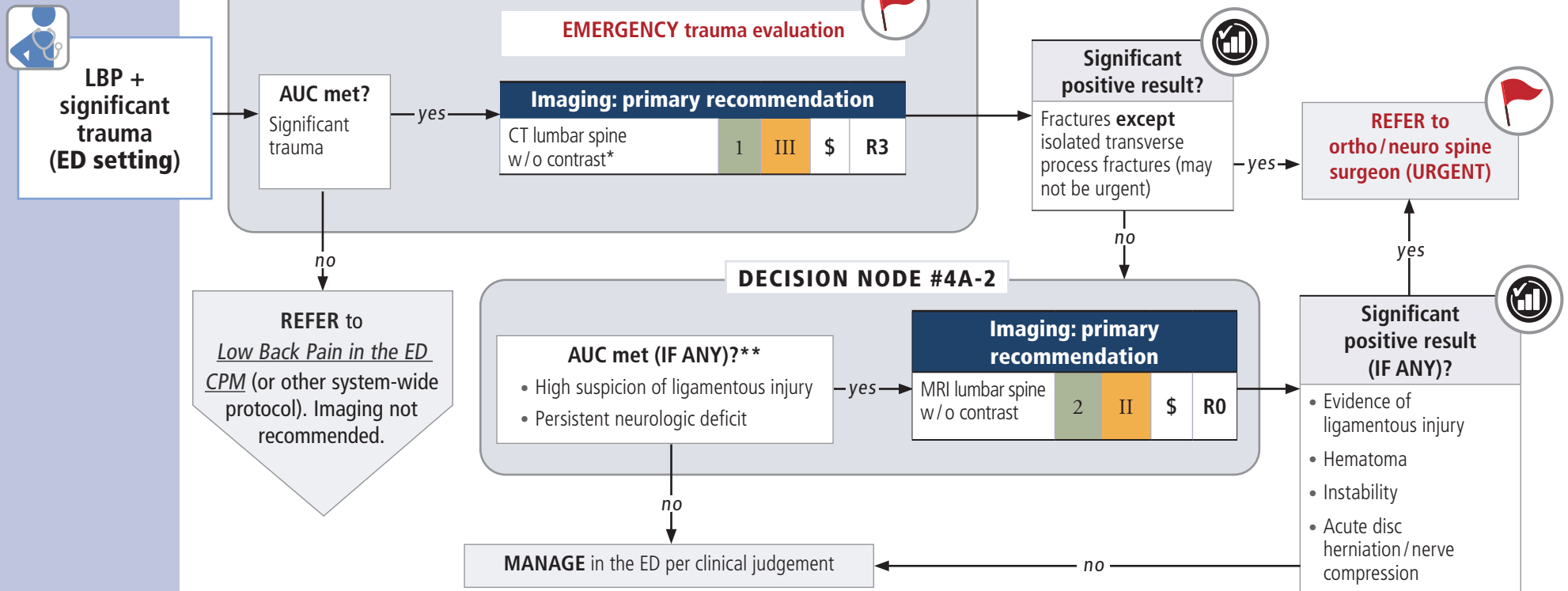
R0 (0mSv)
\$ (0–5 RVUs)

R3 (1–10 mSv)
\$\$ (5–10 RVUs)

R4 (10–30 mSv)
\$\$\$ (10–15 RVUs)

See page 2–3 for explanation.
\$\$\$\$ (15+ RVUs)

See abbreviations on [page 2](#).



* During pregnancy, CT may be contraindicated. Consult with a radiologist.
**MRI not usually needed for trauma.

DECISION NODE #4A KEY EVIDENCE

Daffner RH, Hackney DB. ACR Appropriateness Criteria® suspected spine trauma. *J Am Coll Radiol.* 2007;4(11):762-765.

Hauser CJ, Visvikis G, Hinrichs C, et al. Prospective validation of computed tomographic screening of the thoracolumbar spine in trauma. *J Trauma.* 2003;55(2):228-235.

Diaz JJ Jr, Cullinane DC, Altman DT, et al; EAST Practice Management Guideline Committee. Practice management guidelines for the screening of thoracolumbar spine fracture. *J Trauma.* 2007;63(3):709-718.

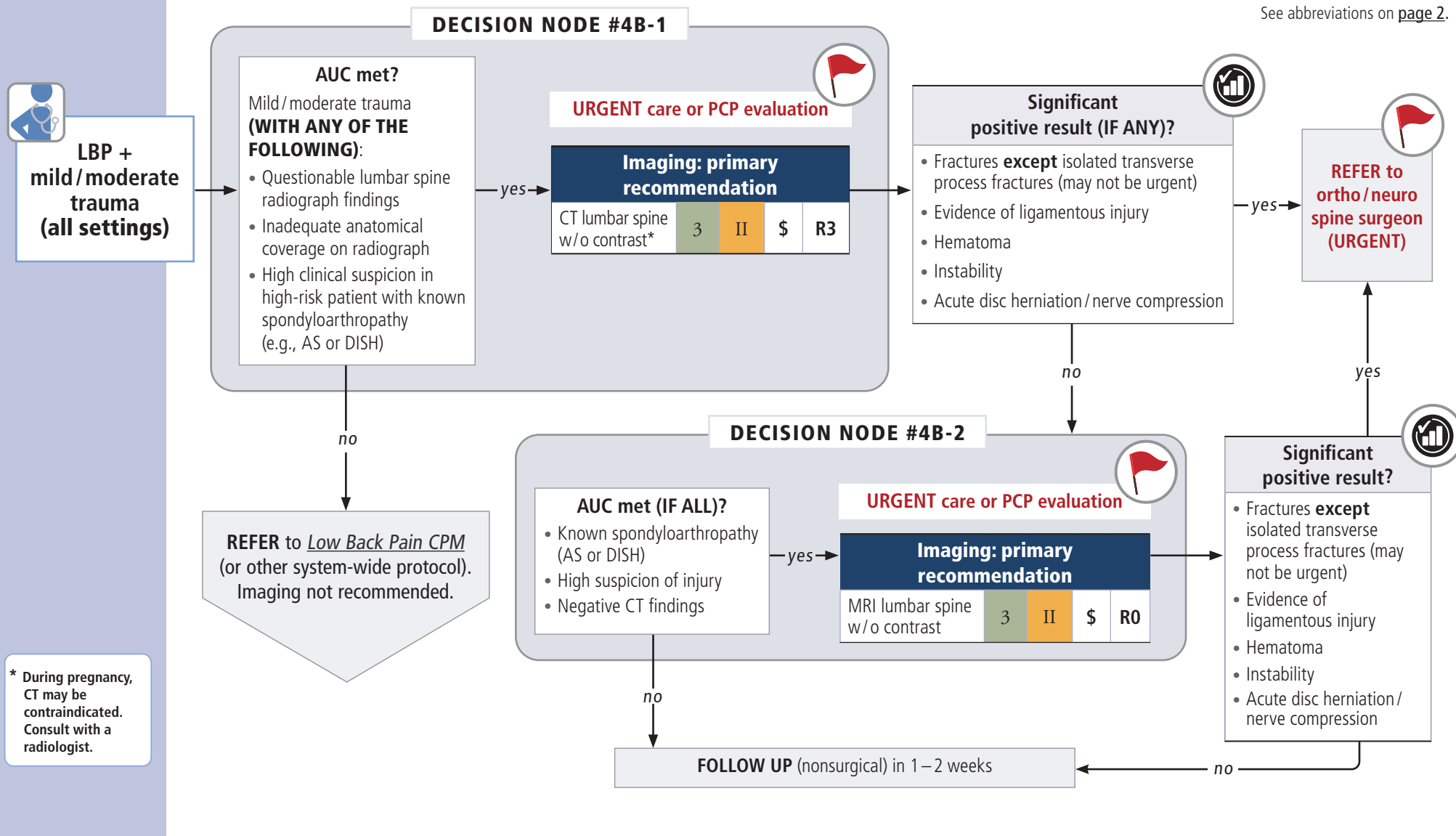
Herzog C, Ahle H, Mack MG, et al. Traumatic injuries of the pelvis and thoracic and lumbar spine: does thin-slice multidetector-row CT increase diagnostic accuracy? *Eur Radiol.* 2004;14(10):1751-1760.

(For a full list of references for all decision nodes, see bibliography on pages 22 through 26)

LEGEND

Clinical Scenario |
 Urgent or Emergency Situation |
 2 OCEBM Level of Evidence |
 II Fryback & Thornbury Level of Evidence |
 Intermountain Measure |
 R0 (0mSv) \$ (0-5 RVUs) |
 R3 (1-10 mSv) \$\$ (5-10 RVUs) |
 R4 (10-30mSv) \$\$\$ (10-15 RVUs) |
 See page 2-3 for explanation. \$\$\$\$ (15+ RVUs)

See abbreviations on [page 2](#).



* During pregnancy, CT may be contraindicated. Consult with a radiologist.

LEGEND

Clinical Scenario	Urgent or Emergency Situation	OCEBM Level of Evidence 2	Fryback & Thornbury Level of Evidence II	Intermountain Measure	R0 (0mSv) \$ (0–5 RVUs)	R3 (1–10 mSv) \$\$\$ (5–10 RVUs)	R4 (10–30mSv) \$\$\$\$ (10–15 RVUs)	See page 2–3 for explanation.
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DECISION NODE #4B-1 KEY EVIDENCE

Callaway DW, Wolfe R. Geriatric trauma. <i>Emerg Med Clin N Am.</i> 2007;25(3):837-860.	Thorngren KG, Liedberg E, Aspelin P. Fractures of the thoracic and lumbar spine in ankylosing spondylitis. <i>Arch Orthop Trauma Surg.</i> 1981;98(2):101-107.
Daffner RH, Hackney DB. ACR Appropriateness Criteria® suspected spine trauma. <i>Am Coll Radiol.</i> 2007;4(11):762-765.	Wang YF, Teng MM, Chang CY, Wu HT, Wang ST. Imaging manifestations of spinal fractures in ankylosing spondylitis. <i>AJNR Am J Neuroradiol.</i> 2005;26(8):2067-2076.
Shih TT, Chen PQ, Li YW, Hsu CY. Spinal fractures and pseudoarthrosis complicating ankylosing spondylitis: MRI manifestation and clinical significance. <i>J Comput Assist Tomogr.</i> 2001;25(2):164-170.	

(For a full list of references for all decision nodes, see bibliography on pages 22 through 26)

DECISION NODE #4B-2 KEY EVIDENCE

Callaway DW, Wolfe R. Geriatric trauma. <i>Emerg Med Clin N Am.</i> 2007;25(3):837-860.	Shih TT, Chen PQ, Li YW, Hsu CY. Spinal fractures and pseudoarthrosis complicating ankylosing spondylitis: MRI manifestation and clinical significance. <i>J Comput Assist Tomogr.</i> 2001;25(2):164-170.
Chaudhary SB, Hullinger H, Vives MJ. Management of acute spinal fractures in ankylosing spondylitis. <i>ISRN rheumatol.</i> 2011;2011:150484.	Thorngren KG, Liedberg E, Aspelin P. Fractures of the thoracic and lumbar spine in ankylosing spondylitis. <i>Arch Orthop Trauma Surg.</i> 1981;98(2):101-107.
Daffner RH, Hackney DB. ACR Appropriateness Criteria® suspected spine trauma. <i>Am Coll Radiol.</i> 2007;4(11):762-765.	Wang YF, Teng MM, Chang CY, Wu HT, Wang ST. Imaging manifestations of spinal fractures in ankylosing spondylitis. <i>AJNR Am J Neuroradiol.</i> 2005;26(8):2067-2076.
Nakstad PH, Server A, Josefsen R. Traumatic cervical injuries in ankylosing spondylitis. <i>Acta Radiol.</i> 2004;45(2):222-226.	

(For a full list of references for all decision nodes, see bibliography on pages 22 through 26)

LEGEND



Clinical Scenario



Urgent or Emergency Situation



OCEBM Level of Evidence



Fryback & Thornbury Level of Evidence



Intermountain Measure

R0 (0mSv)

\$ (0–5 RVUs)

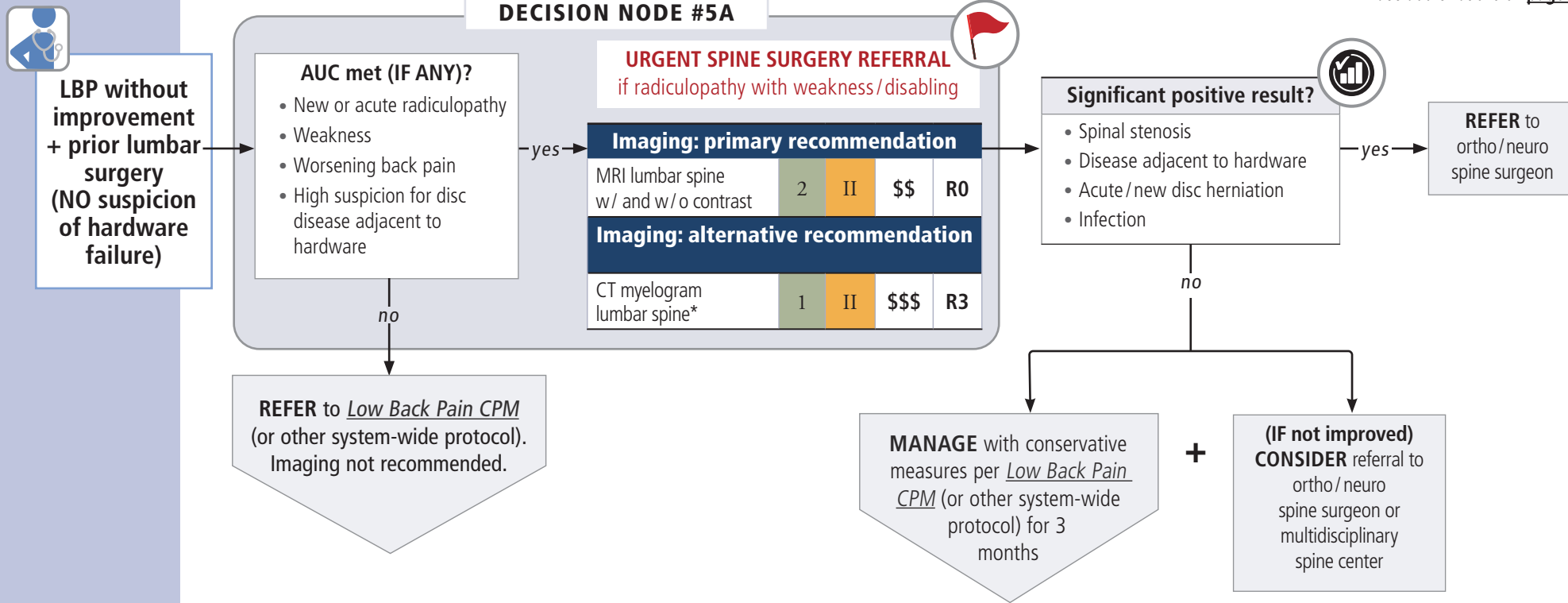
R3 (1–10 mSv)

\$\$\$ (5–10 RVUs)

R4 (10–30mSv) See page 2–3 for explanation.

\$\$\$\$ (10–15 RVUs) **\$\$\$\$\$** (15+ RVUs)

See abbreviations on [page 2](#).



* During pregnancy, CT may be contraindicated. Consult with a radiologist.

DECISION NODE #5A KEY EVIDENCE

Grane P, Lindqvist M. Evaluation of the post-operative lumbar spine with MR imaging. The role of contrast enhancement and thickening in nerve roots. *Acta Radiol.* 1997;38(6):1035-1042.

Hamm B, Häring B, Traupe H, Mayer M. The diagnostic role of contrast medium-enhanced MR tomography in the diagnosis of the post-discectomy syndrome. A prospective study of 109 patients. *Rofo.* 1993;159(3):269-277. [German].

(For a full list of references for all decision nodes, see bibliography on pages 22 through 26)

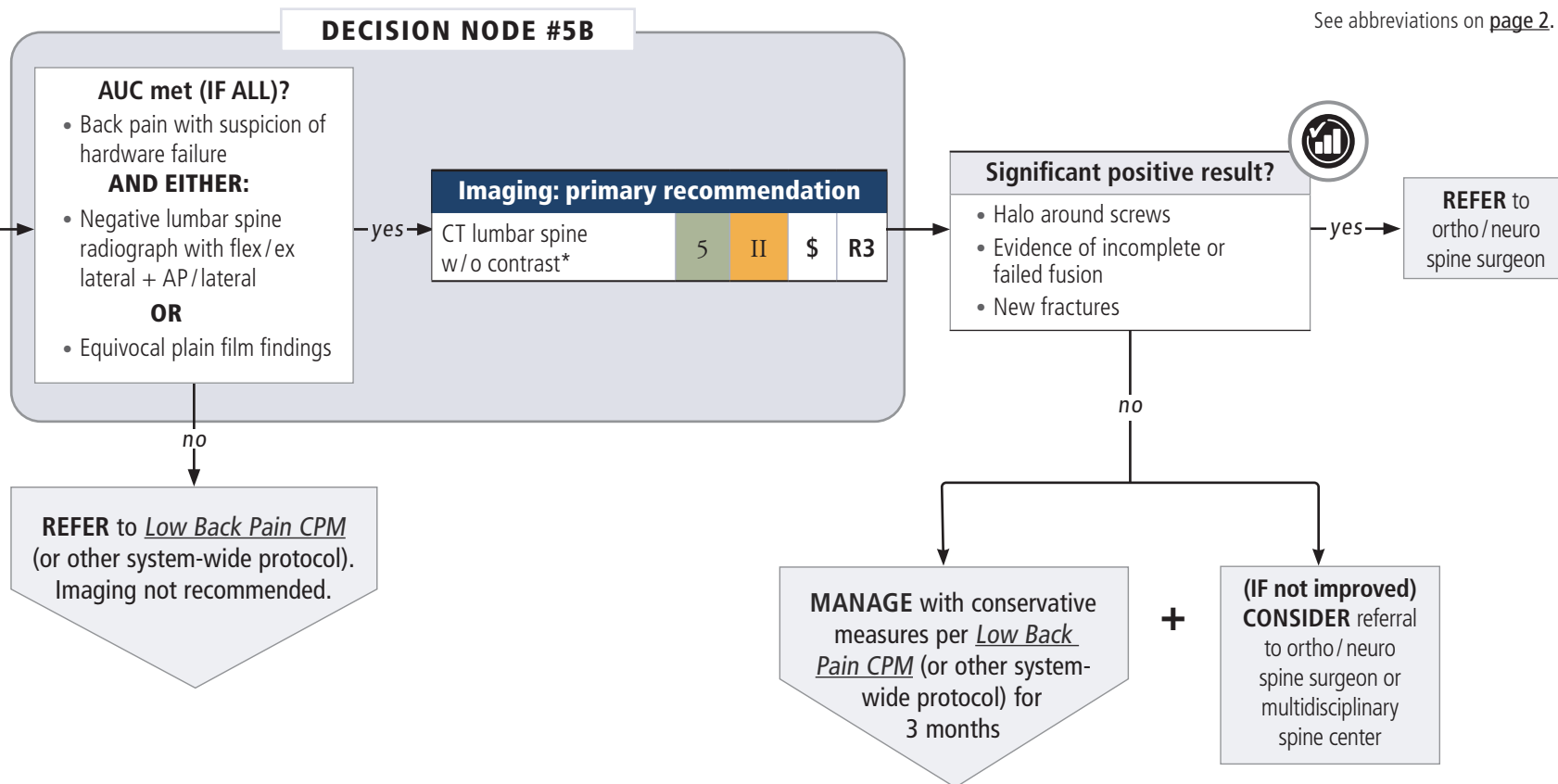
LEGEND

Clinical Scenario |
 Urgent or Emergency Situation |
 2 OCEBM Level of Evidence |
 II Fryback & Thornbury Level of Evidence |
 Intermountain Measure |
 R0 (0mSv) \$ (0-5 RVUs) |
 R3 (1-10 mSv) \$\$ (5-10 RVUs) |
 R4 (10-30 mSv) \$\$\$ (10-15 RVUs) |
 See page 2-3 for explanation. \$\$\$\$ (15+ RVUs)

See abbreviations on [page 2](#).



LBP + prior lumbar surgery (WITH suspicion of hardware failure)



* During pregnancy, CT may be contraindicated. Consult with a radiologist.

DECISION NODE #5B KEY EVIDENCE

Berquist TH. Imaging of the postoperative spine. *Radiol Clin North Am.* 2006;44(3):407-418.

Hayeri MR, Tehranzadeh J. Diagnostic imaging of spinal fusion and complications. *Applied Radiology.* 2009. <http://appliedradiology.com/articles/diagnostic-imaging-of-spinal-fusion-and-complications>

(For a full list of references for all decision nodes, see bibliography on pages 22 through 26)

LEGEND



Clinical Scenario



Urgent or Emergency Situation



OCEBM Level of Evidence



Fryback & Thornbury Level of Evidence



Intermountain Measure

R0 (0mSv)
\$ (0-5 RVUs)

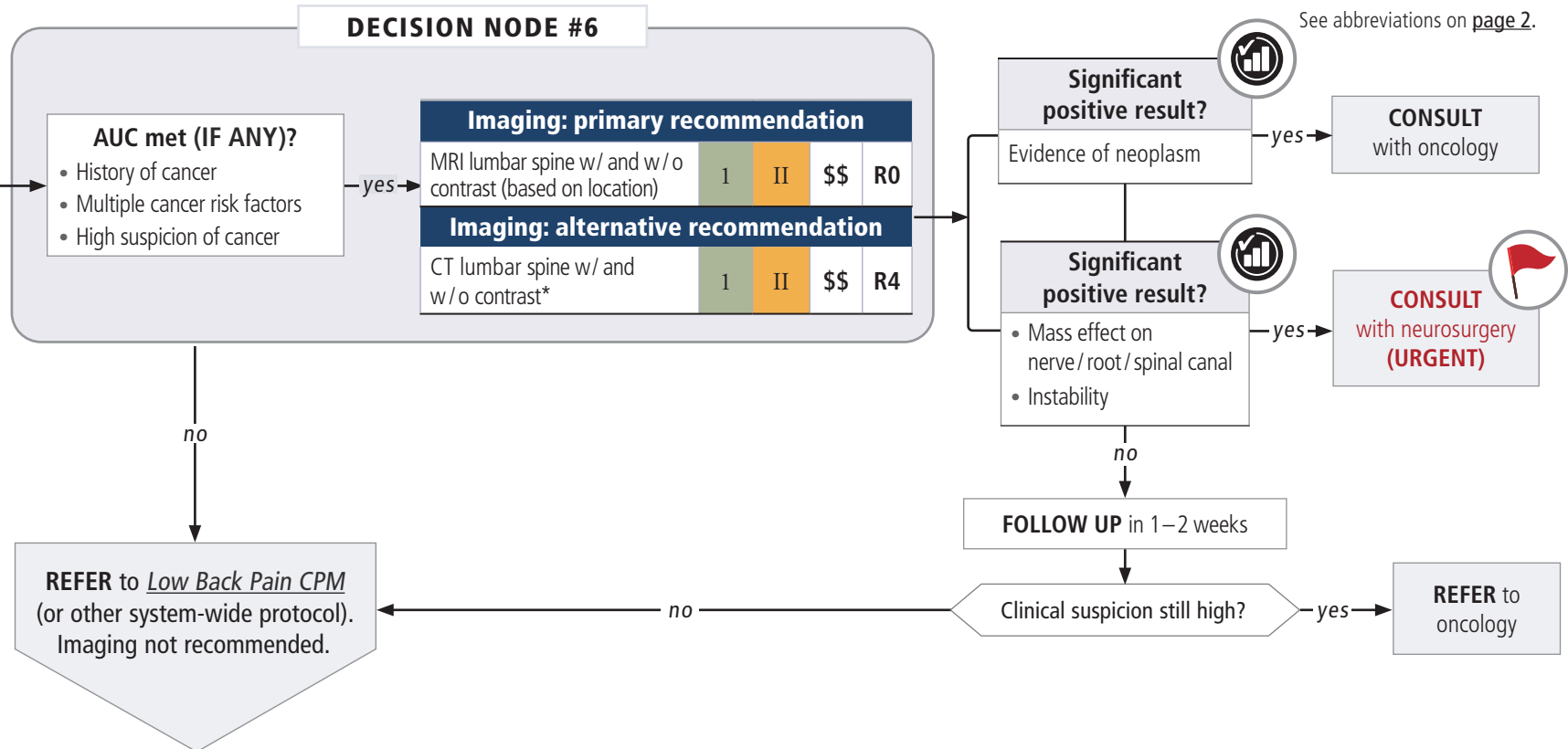
R3 (1-10 mSv)
\$\$ (5-10 RVUs)

R4 (10-30 mSv)
\$\$\$ (10-15 RVUs)

See page 2-3 for explanation.
\$\$\$\$ (15+ RVUs)



LBP + suspected cancer



* During pregnancy, CT may be contraindicated. Consult with a radiologist.

DECISION NODE #6 KEY EVIDENCE

Buhmann Kirchoff S, Becker C, Duerr HR, Reiser M, Baur-Melnyk A. Detection of osseous metastases of the spine: comparison of high resolution multi-detector-CT with MRI. *Eur J Radiol.* 2009;69(3):567–573

Modic MT, Feiglin D, Piraino D, et al. Vertebral osteomyelitis: assessment using MR. *Radiology.* 1985;157(1):157-166.

Thawait SK, Marcus MA, Morrison WB, Klufas RA, Eng J, Carrino JA. Research synthesis: what is the diagnostic performance of magnetic resonance imaging to discriminate benign from malignant vertebral compression fractures? Systematic review and meta-analysis. *Spine (Phila Pa 1976).* 2012;37(12):E736-E744.

(For a full list of references for all decision nodes, see bibliography on [pages 22 through 26](#))

LEGEND



Clinical Scenario



Urgent or Emergency Situation



OCEBM Level of Evidence



Fryback & Thornbury Level of Evidence



Intermountain Measure

R0 (0mSv)

\$ (0–5 RVUs)

R3 (1–10 mSv)

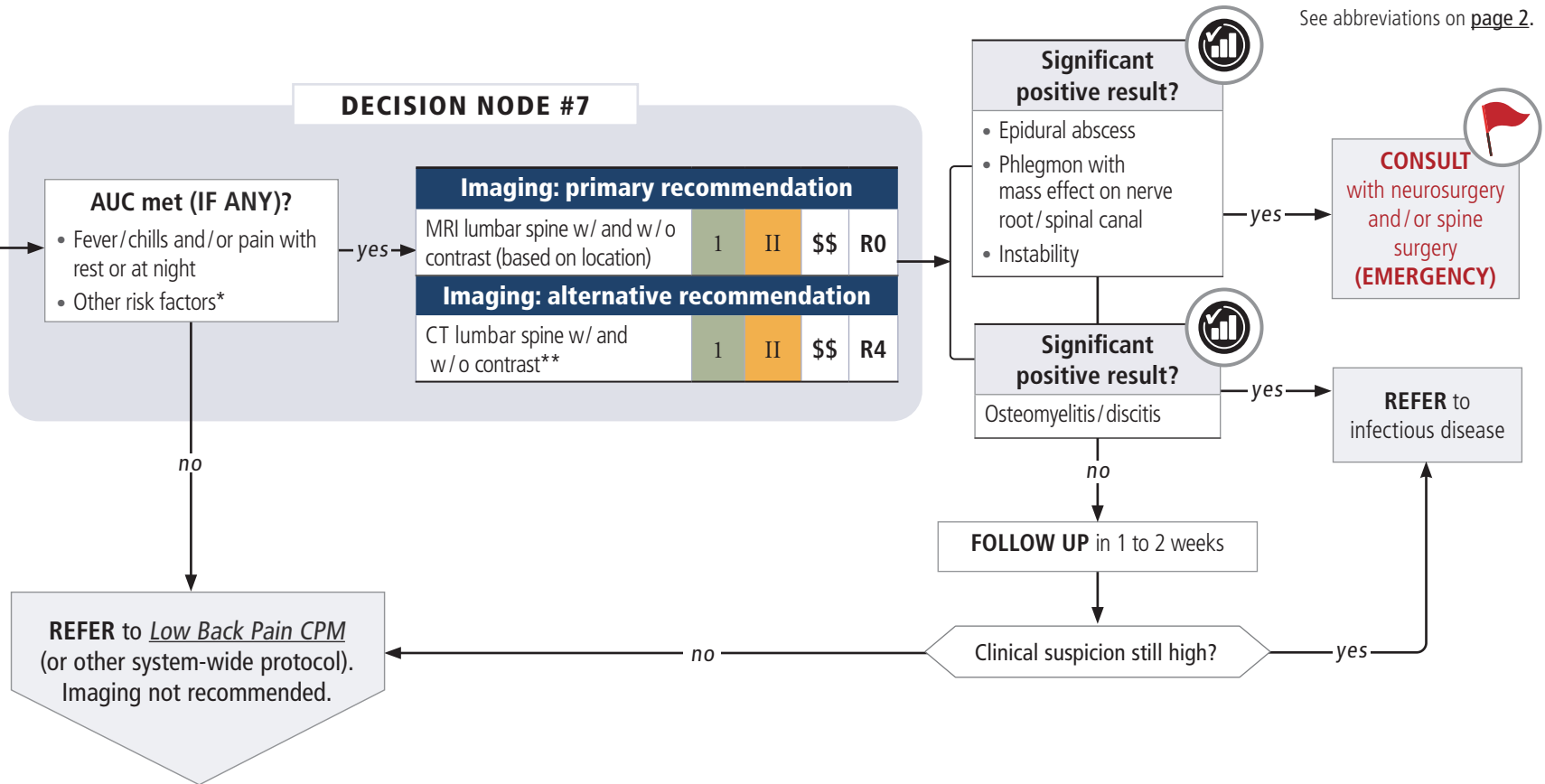
\$\$ (5–10 RVUs)

R4 (10–30 mSv) See page 2–3 for explanation.

\$\$\$ (10–15 RVUs) **\$\$\$\$** (15+ RVUs)



LBP + suspected infection



* Other risk factors include immunocompromised patient, UTI, IV drug use, recent spinal procedure.

** During pregnancy, CT may be contraindicated. Consult with a radiologist.

DECISION NODE #7 KEY EVIDENCE

Buhmann Kirchoff S, Becker C, Duerr HR, Reiser M, Baur-Melnyk A. Detection of osseous metastases of the spine: comparison of high resolution multi-detector-CT with MRI. *Eur J Radiol.* 2009;69(3):567-573

Modic MT, Feiglin D, Piraino D, et al. Vertebral osteomyelitis: assessment using MR. *Radiology.* 1985;157(1):157-166.

Thawait SK, Marcus MA, Morrison WB, Klufas RA, Eng J, Carrino JA. Research synthesis: what is the diagnostic performance of magnetic resonance imaging to discriminate benign from malignant vertebral compression fractures? Systematic review and meta-analysis. *Spine (Phila Pa 1976).* 2012;37(12):E736-E744.

(For a full list of references for all decision nodes, see bibliography on [pages 22 through 26](#))

LEGEND



Clinical Scenario



Urgent or Emergency Situation



OCEBM Level of Evidence



Fryback & Thornbury Level of Evidence



Intermountain Measure

R0 (0mSv)
\$ (0-5 RVUs)

R3 (1-10 mSv)
\$\$ (5-10 RVUs)

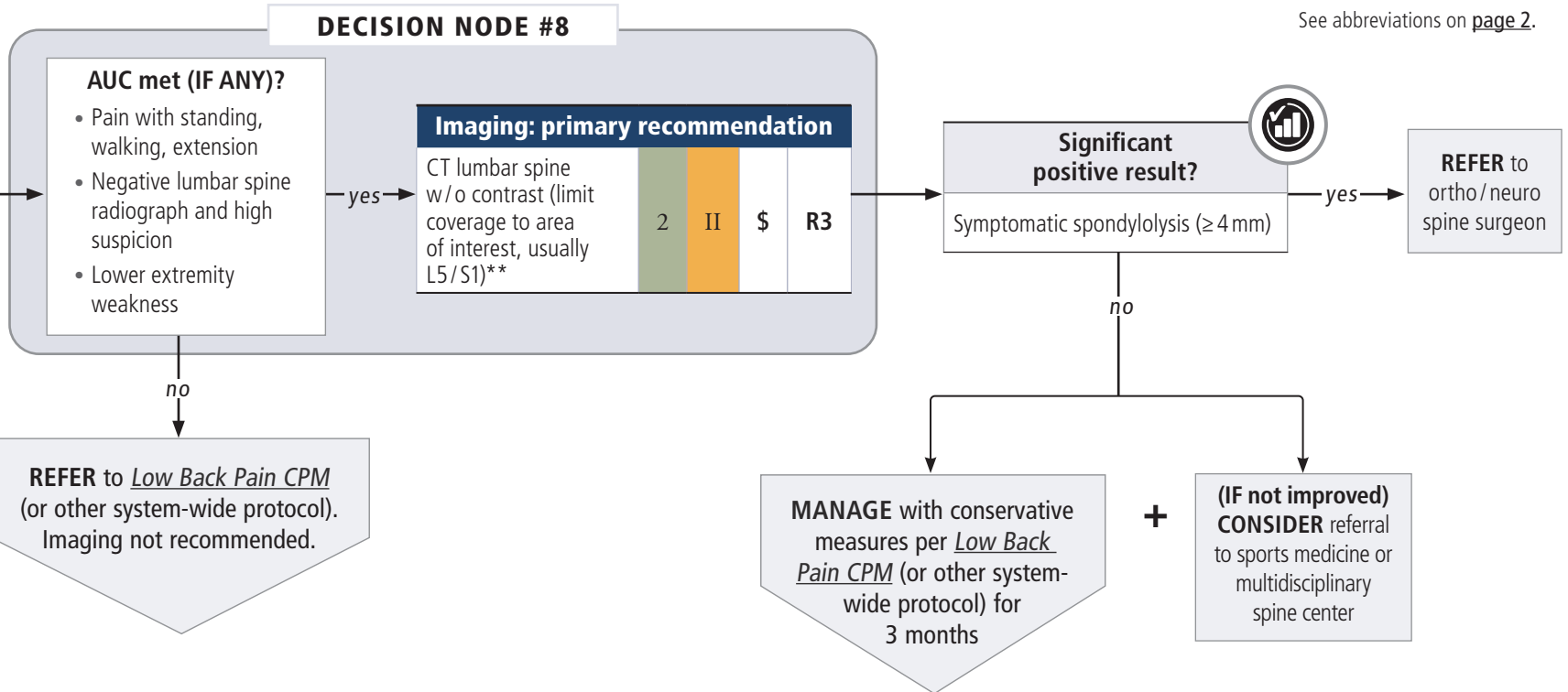
R4 (10-30 mSv)
\$\$\$ (10-15 RVUs)

See page 2-3 for explanation.
\$\$\$\$ (15+ RVUs)

See abbreviations on [page 2](#).



LBP + suspected spondylolysis*



* Occurs most often in those age < 20 and in athletes and dancers.

** During pregnancy, CT may be contraindicated. Consult with a radiologist.

DECISION NODE #8 KEY EVIDENCE

Campbell RS, Grainger AJ, Hide IG, Papastefanou S, Greenough CG. Juvenile spondylolysis: a comparative analysis of CT, SPECT and MRI. *Skeletal Radiol.* 2005;34(2):63-73.

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(For a full list of references for all decision nodes, see bibliography on [pages 22 through 26](#))

LEGEND



Clinical Scenario



Urgent or Emergency Situation



OCEBM Level of Evidence



Fryback & Thornbury Level of Evidence



Intermountain Measure

R0 (0mSv)
\$ (0–5 RVUs)

R3 (1–10 mSv)
\$\$ (5–10 RVUs)

R4 (10–30 mSv) See page 2–3 for explanation.
\$\$\$ (10–15 RVUs) \$\$\$\$ (15+ RVUs)

▶ **POINT-OF-ORDER CHECKLISTS**

See abbreviations on [page 2](#).

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 lumbar spine* WITHOUT CONTRAST appropriate use indications

(PRIMARY recommendation)

LBP without complicating features (IF ALL):

- ≥3 months of symptoms
- Adequate conservative therapy** with no improvement

LBP + weakness: Cauda equina syndrome and/or lower motor neuron symptoms (IF ANY):

- New bowel or bladder dysfunction
- Perineal numbness/saddle anesthesia
- Persistent/increasing lower extremity weakness, numbness, or tingling
- Sudden onset/rapidly progressive flaccid weakness (lower motor neuron symptoms)
- Sudden onset/rapidly progressive flaccid weakness
- Other lower motor neuron symptoms

LBP + weakness: Myelopathy/upper motor neuron symptoms (IF ANY):

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

LBP + suspected compression fracture (IF ANY):

- Osteoporosis/osteoporosis risk

AND EITHER

- Negative lumbar spine radiographs with high suspicion of compression fracture

OR

- Age-indeterminate compression on radiograph

LBP + significant trauma in the ED setting:

- No significant positive on CT lumbar spine

AND EITHER:

- High suspicion of ligamentous injury

OR

- Persistent neurologic deficit

LBP + mild/moderate trauma in any setting (IF ALL):

- Known spondyloarthropathy (AS or DISH)
- High suspicion of injury
- Negative CT findings

* Or C or T spine based on location

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

▶ **POINT-OF-ORDER CHECKLISTS, CONTINUED**

See abbreviations on [page 2](#).

TABLE 2. MRI lumbar spine* WITH AND WITHOUT CONTRAST appropriate use indications

(PRIMARY recommendation)	
<ul style="list-style-type: none"> <input type="checkbox"/> LBP without improvement + prior lumbar surgery (NO suspicion of hardware failure) (IF ANY): <input type="checkbox"/> Worsening back pain <input type="checkbox"/> New or acute radiculopathy <input type="checkbox"/> Weakness <input type="checkbox"/> High suspicion for disc disease adjacent to hardware 	<ul style="list-style-type: none"> <input type="checkbox"/> LBP + suspected cancer (IF ANY): <input type="checkbox"/> History of cancer <input type="checkbox"/> Multiple cancer risk factors <input type="checkbox"/> Strong clinical suspicion <input type="checkbox"/> LBP + suspected infection (IF ANY): <input type="checkbox"/> Fever/chills and/or pain with rest or at night <input type="checkbox"/> Other risk factors**

* Or C or T spine based on location

** Other risk factors (e.g., immunocompromised patient, UTI, IV drug use, recent spinal procedure)

TABLE 3. MRI brain WITHOUT CONTRAST appropriate use indications

(PRIMARY recommendation)
<ul style="list-style-type: none"> <input type="checkbox"/> LBP + weakness: Myelopathy/upper motor neuron symptoms (IF ANY) <input type="checkbox"/> Hyperreflexia/Hoffman’s sign <input type="checkbox"/> New-onset Babinski or clonus <input type="checkbox"/> New-onset gait/balance abnormalities <input type="checkbox"/> Upper and lower extremity weakness

▶ POINT-OF-ORDER CHECKLISTS, CONTINUED

See abbreviations on [page 2](#).

TABLE 4. CT lumbar spine* WITHOUT CONTRAST appropriate use indications

(PRIMARY recommendation)

<ul style="list-style-type: none"> <input type="checkbox"/> LBP + significant trauma (in the ED setting) <input type="checkbox"/> LBP + mild/moderate trauma in any setting (WITH ANY OF THE FOLLOWING): <ul style="list-style-type: none"> <input type="checkbox"/> Questionable lumbar spine radiograph findings <input type="checkbox"/> Inadequate anatomical coverage on radiograph <input type="checkbox"/> High clinical suspicion in high-risk patient with known spondyloarthropathy (e.g., AS or DISH) 	<ul style="list-style-type: none"> <input type="checkbox"/> LBP + prior lumbar surgery (with suspicion of hardware failure) (IF ALL): <ul style="list-style-type: none"> <input type="checkbox"/> Back pain with clinical concern for hardware failure AND EITHER: <input type="checkbox"/> Negative lumbar spine radiograph with flex/ex lateral + AP/lateral OR <input type="checkbox"/> Equivocal plain film findings 	<ul style="list-style-type: none"> <input type="checkbox"/> LBP + suspected spondylolysis (IF ANY)** <ul style="list-style-type: none"> <input type="checkbox"/> Pain with standing, walking, extension <input type="checkbox"/> Negative lumbar spine radiograph and high suspicion <input type="checkbox"/> Lower extremity weakness
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(ALTERNATIVE recommendation)

<ul style="list-style-type: none"> <input type="checkbox"/> LBP without complicating features (IF ALL) <ul style="list-style-type: none"> <input type="checkbox"/> ≥3 months of symptoms <input type="checkbox"/> Adequate conservative therapy*** with no improvement 	<ul style="list-style-type: none"> <input type="checkbox"/> LBP + suspected compression fracture (IF ANY) <ul style="list-style-type: none"> <input type="checkbox"/> Osteoporosis/osteoporosis risk AND EITHER <input type="checkbox"/> Negative lumbar spine radiographs with high suspicion of compression fracture OR <input type="checkbox"/> Age-indeterminate compression on radiograph
---	--

* Or C or T spine based on location

** Limit coverage to area of interest, usually L5/S1.

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

▶ **POINT-OF-ORDER CHECKLISTS, CONTINUED**

See abbreviations on [page 2](#).

TABLE 5. CT lumbar* spine WITH and WITHOUT CONTRAST appropriate use indications

(ALTERNATIVE recommendation)

- LBP + suspected cancer (IF ANY):**
 - History of cancer
 - Multiple cancer risk factors
 - Strong clinical suspicion
- LBP + suspected infection (IF ANY):**
 - Fever/chills and/or pain with rest or at night
 - Other risk factors**

* Or C or T spine based on location

** Other risk factors (e.g., Immunocompromised patient, UTI, IV drug use, recent spinal procedure)

TABLE 6. CT myelogram* appropriate use indications

(ALTERNATIVE recommendation)

- LBP + weakness: Cauda equina syndrome and/or sudden onset lower motor symptoms (IF ANY):**
 - New bowel or bladder dysfunction
 - Perineal numbness/saddle anesthesia
 - Persistent/increasing lower extremity weakness, numbness, or tingling
 - Sudden-onset/rapidly-progressive flaccid weakness (lower motor)
 - Sudden onset/rapidly progressive flaccid weakness
 - Other lower motor neuron symptoms
- LBP + weakness: Myelopathy/upper motor neuron symptoms (IF ANY):**
 - Hyperreflexia/Hoffman’s sign
 - New-onset Babinski or clonus
 - New-onset gait/balance abnormalities
 - Upper and lower extremity weakness
- LBP without improvement + prior lumbar surgery (NO suspicion of hardware failure) (IF ANY):**
 - Worsening back pain
 - New or acute radiculopathy
 - Weakness
 - High suspicion for disc disease adjacent to hardware

* Or C/T/L spine based on location

TABLE 7. CT brain/head WITH AND WITHOUT CONTRAST appropriate use indications

(ALTERNATIVE recommendation)

- LBP + weakness: Myelopathy/upper motor neuron symptoms (IF ANY)**
 - Hyperreflexia/Hoffman’s sign
 - New-onset Babinski or clonus
 - New-onset gait/balance abnormalities
 - Upper and lower extremity weakness

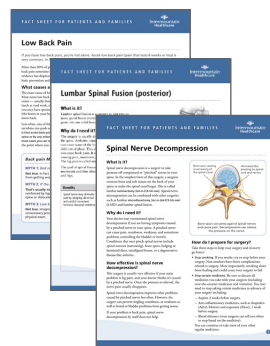
▶ RESOURCES

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.

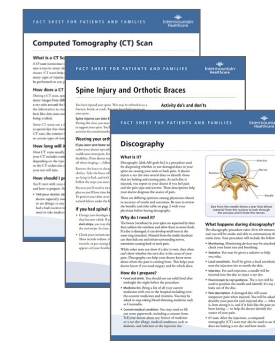
Intermountain's care process models (CPMs) outline evidence-based guidelines for patient care. In addition to the suite of Intermountain Imaging Criteria CPMs, Intermountain provides topical CPMs that have been developed by expert clinical teams. They can be accessed by navigating to intermountainphysician.org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

To access Intermountain's Imaging Criteria CPMs and supporting materials, visit: <https://intermountainhealthcare.org/services/imaging-services/intermountain-imaging-criteria/>.



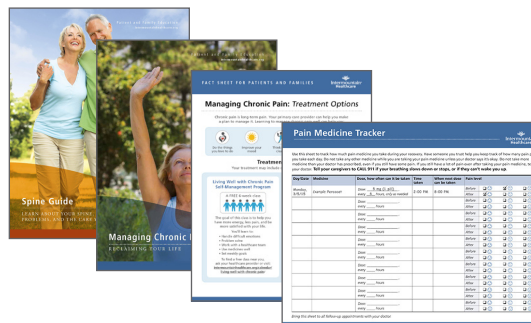
Fact sheets:

- [Low Back Pain \(English\) / \(Spanish\)](#)
- [Lumbar Spinal Fusion \(posterior\) \(English\) / \(Spanish\)](#)
- [Spinal Nerve Decompression \(English\) / \(Spanish\)](#)



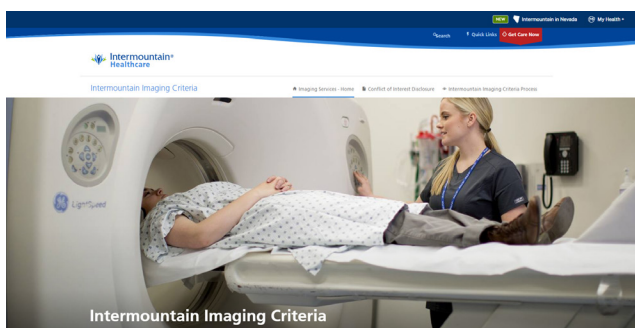
Fact sheets:

- [CT Scan \(English\) / \(Spanish\)](#)
- [Spine Injury and Orthotic Braces \(English\) / \(Spanish\)](#)
- [Discography \(English\) / \(Spanish\)](#)



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):

Low Back Pain CPM

Prescribing Opioids for Chronic Non-Cancer Pain CPM

Imaging Radiation Exposure CPM

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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.