American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Low Back Pain**

Variant 1: **Uncomplicated acute low back pain and/or radiculopathy, nonsurgical presentation. No red flags. (Red flags defined in text.)**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	2		None
X-ray lumbar spine	2		Med
Myelography and postmyelography CT lumbar spine	2	In some cases postinjection CT imaging may be done without myelography.	High
X-ray myelography lumbar spine	2		Med
Tc-99m bone scan with SPECT spine	2		Med
CT lumbar spine without contrast	2		Med
MRI lumbar spine without and with contrast	2		None
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Variant 2: **Low velocity trauma, osteoporosis, and/or age >70 years.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	8		None
CT lumbar spine without contrast	6	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	Med
X-ray lumbar spine	6		Med
Tc-99m bone scan with SPECT spine	4		Med
MRI lumbar spine without and with contrast	3		None
Myelography and postmyelography CT lumbar spine	1	In some cases postinjection CT imaging may be done without myelography.	High
X-ray myelography lumbar spine	1		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Clinical Condition: **Low Back Pain**

Variant 3: **Suspicion of cancer, infection, or immunosuppression.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without and with contrast	8	See statement regarding contrast in text under "Anticipated Exceptions."	None
CT lumbar spine without contrast	6	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	Med
X-ray lumbar spine	5		Med
Tc-99m bone scan whole body with optional targeted SPECT spine	5		Med
X-ray myelography lumbar spine	2		Med
Myelography and postmyelography CT lumbar spine	2	In some cases postinjection CT imaging may be done without myelography.	High
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 4: **Low back pain and/or radiculopathy, surgery or intervention candidate.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	8		None
CT lumbar spine without contrast	5	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	Med
MRI lumbar spine without and with contrast	5	Indicated if noncontrast MRI is nondiagnostic or indeterminate. See statement regarding contrast in text under "Anticipated Exceptions."	None
Myelography and postmyelography CT lumbar spine	5	MRI preferred. May be indicated if MRI is contraindicated or nondiagnostic. In some cases postinjection CT imaging may be done without myelography.	High
X-ray lumbar spine	4	Usually not sufficient for decision making without MR and/or CT imaging.	Med
Tc-99m bone scan with SPECT spine	4	May be particularly useful for facet arthropathy, stress fracture, and spondylolysis.	Med
X-ray myelography lumbar spine	2		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Clinical Condition: **Low Back Pain**

Variant 5: **Prior lumbar surgery.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without and with contrast	8	Differentiate disc versus scar. See statement regarding contrast in text under "Anticipated Exceptions."	None
CT lumbar spine without contrast	6	Most useful in postfusion patients or when MRI is contraindicated or indeterminate.	Med
MRI lumbar spine without contrast	6	Contrast often necessary.	None
Myelography and postmyelography CT lumbar spine	5	In some cases postinjection CT imaging may be done without myelography.	High
X-ray lumbar spine	5	Flex/extension may be useful.	Med
Tc-99m bone scan with SPECT spine	5	Helps detect and localize painful pseudoarthrosis.	Med
X-ray myelography lumbar spine	2		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 6: **Cauda equina syndrome.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	9	Use of contrast depends on clinical circumstances.	None
MRI lumbar spine without and with contrast	8	Use of contrast depends on clinical circumstances. See statement regarding contrast in text under "Anticipated Exceptions."	None
Myelography and postmyelography CT lumbar spine	6	Useful if MRI is nondiagnostic or contraindicated. In some cases postinjection CT imaging may be done without myelography.	High
CT lumbar spine with or without contrast	5	May be indicated if MRI is confusing or contraindicated and myelography is not feasible. Use of contrast depends on clinical circumstances.	Med
X-ray lumbar spine	4		Med
Tc-99m bone scan with SPECT spine	2		Med
X-ray myelography lumbar spine	2		Med
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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Summary of Literature Review

Acute low back pain (LBP) with or without radiculopathy is one of the most common health problems in the United States and is the leading cause of disability for persons younger than age 45. The cost of evaluating and treating acute LBP runs into billions of dollars annually, not including time lost from work [1].

Because of the high prevalence and high cost of dealing with this problem, government agencies have sponsored extensive studies that are now part of the growing body of literature on this subject. One of the earlier comprehensive studies was carried out in Quebec and was reported in the journal *Spine* in 1987 [2]. The U.S. Department of Health and Human Services convened a 23-member multidisciplinary panel of experts to review all of the literature on this subject, grade it, and develop a "Clinical Practice Guideline," which was published in December 1994 [3]. States have also convened similar panels in recent years, largely because of the rapidly rising workers' compensation claim burden being imposed on state budgets by LBP management [4].

It is now clear from the above studies and others that *uncomplicated* acute LBP or radiculopathy is a benign, self-limited condition that does not warrant any imaging studies [5-8]. The vast majority of these patients are back to their usual activities within 30 days [1-3]. The challenge for the clinician, therefore, is to distinguish that small segment within this large patient population that should be evaluated further because of suspicion of a more serious problem.

Indications of a more complicated status, often termed "red flags," include the following [2,9]:

1. Recent significant trauma, or milder trauma, age >50
2. Unexplained weight loss
3. Unexplained fever
4. Immunosuppression
5. History of cancer
6. IV drug use
7. Prolonged use of corticosteroids, osteoporosis
8. Age >70
9. Focal neurologic deficit with progressive or disabling symptoms
10. Duration longer than 6 weeks

Radiographs

Radiographs are recommended when any of the above red flags are present [3,4]. Lumbar radiographs may be sufficient for the initial evaluation of the following red flags [3,4], with futher imaging indicated for treatment planning: if findings are abnormal or inconclusive.

1. Recent significant trauma (at any age)
2. Osteoporosis
3. Age >70

The initial evaluation of the LBP patient may also require further imaging if other red flags such as suspicion of cancer or infection are present [3,4].

Isotope Bone Scans

The role of the isotope bone scan in patients with acute LBP has changed in recent years with the wide availability of magnetic resonance imaging (MRI) and especially contrast-enhanced MRI. The bone scan is a moderately sensitive test for detecting the presence of tumor, infection, or occult fractures of the vertebrae but not for specifying the diagnosis [3,4]. For spondylolysis or stress fracture in athletes, bone scintigraphy with single photon emission computed tomography (SPECT), followed by limited computed tomography (CT) if scintigraphy is positive, is more sensitive than MRI [10]. Bone scintigraphy with SPECT can be useful to identify symptomatic facet disease in patients treated with facet injection [11].

High-resolution isotope imaging, including SPECT, may localize the source of pain in patients with articular facet osteoarthritis prior to therapeutic facet injection [12]. Similar scans may be helpful in detecting and localizing the site of painful pseudoarthrosis following lumbar spinal fusion [13]. The test is contraindicated in pregnancy.

Plain and contrast-enhanced MRI has the ability to demonstrate inflammatory, neoplastic, and most traumatic lesions as well as to show anatomic detail not available on isotope studies [14]. Gadolinium-enhanced MRI reliably shows the presence and extent of spinal infection and is

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useful in assessing therapy [15]. MRI has therefore taken over the role of the isotope scan in many cases where the location of the lesion is known. The isotope scan remains invaluable when a survey of the entire skeleton is indicated (eg, for metastatic disease).

Magnetic Resonance Imaging, Computed Tomography, Myelography, Myelography/CT

Uncomplicated acute LBP and/or radiculopathy (no red flags) do not warrant the use of any of these imaging studies [2-4]. The early indiscriminate use of expensive imaging procedures in this common clinical setting has caused large increases in workers' compensation costs and in some cases has led to the perception that CT and MRI of the lumbar spine are not worth the cost [7,14,16]. Adding to this controversy is the fact that nonspecific lumbar disc abnormalities are common and can be demonstrated readily on myelography, CT, and MRI, even in asymptomatic patients [17-20].

The appropriate use of these imaging procedures is an important challenge that has been extensively addressed in the major reviews referenced herein [2-4]. For example, LBP complicated by "red flags" suggesting infection or tumor may justify early use of CT or MRI even if radiographs are negative [3]. The most common indication for the use of these imaging procedures, however, is the clinical setting of LBP complicated by radiating pain (radiculopathy, sciatica) or cauda equina syndrome (bilateral leg weakness, urinary retention, saddle anesthesia), usually due to herniated disc and/or canal stenosis.

Magnetic Resonance Imaging

MRI of the lumbar spine has become the initial imaging modality of choice in complicated LBP, displacing myelography and CT in recent years. Multidisciplinary agreement on terminology facilitates reporting of MRI findings [21]. Although disc abnormalities are common on MRI in asymptomatic persons, acute back pain with radiculopathy suggests the presence of demonstrable nerve root compression on MRI [22]. MRI findings of Modic endplate change [23], anterolisthesis, or disc extrusion are more strongly associated with low back pain than disc degeneration without endplate change [24-28]. A randomized controlled trial showed that depiction of stenosis and/or nerve root compression on MRI in the first 48 hours after acute back pain or radiculopathy onset did not affect outcome after 6 weeks of conservative management [8]. MRI is particularly efficacious for detecting "red flag" diagnoses, particularly using the short tan inversion recovery (STIR) and fat-saturated T2 fast-spin-echo sequences. MRI with contrast is useful for suspected infection and neoplasia. In postoperative patients, enhanced MRI allows distinction between disc and scar when tissue extends beyond the interspace.

Computed Tomography

CT scans provide superior bone detail but are not quite as useful in depicting disc protrusions when compared with multiplanar MRI. With the added value associated with high-quality reformatted sagittal and coronal plane images, CT is useful for depicting spondylolysis, pseudoarthrosis, and scoliosis, and for postsurgical evaluation of bone graft integrity, surgical fusion, and instrumentation [29].

Myelography/CT

"Plain" myelography was the mainstay of lumbar herniated disc diagnosis for decades. It is now usually combined with postmyelography CT. The *combined* study is complementary to plain CT or MRI and occasionally more accurate in diagnosing disc herniation, but it suffers the disadvantage of requiring lumbar puncture and contrast injection [30-33]. It may also be useful in surgical planning.

Thermography, Discography, CT Discography

Expert panels have agreed that these imaging modalities are either too nonspecific (thermography) or carry additional risk (discography) that is not warranted in view of the efficacy of other less invasive imaging procedures [3,4]. When other studies fail to localize the cause of pain, discography may occasionally be helpful. Although the images often depict nonspecific aging or degenerative changes, the injection itself may reproduce the patient's pain, which may have diagnostic value [34].

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (ie, <30 mL/min/1.73m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73m^2. For more information, please see the ACR *Manual on Contrast Media* [35].

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

Relative Radiation Level Designations	
Relative Radiation Level	**Effective Dose Estimate Range**
None	0
Minimal	< 0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv

Supporting Document(s)

- ACR Appropriateness Criteria® Overview
- Evidence table under review

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The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

Appendix 1. Definitions

Acute low back pain	Lumbosacral pain of less than 6-weeks duration or with progressive or disabling symptoms.
Radiculopathy	Dysfunction of a nerve root, usually caused by compression or irritation of the root.
Spinal stenosi	Narrow bony canal that may cause radiculopathy, or cauda equina syndrome.
Herniated disc	Herniation of the disc material beyond the confines of the interspace.
Sciatica	Pain radiating down the leg(s) below the knee along the distribution of the sciatic nerve, usually due to mechanical pressure and/or inflammation of lumbosacral nerve root(s).
Cauda equina syndrome	Compression of multiple nerve roots, often resulting in bilateral motor weakness (legs), urine retention, saddle anesthesia.