American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Low Back Pain**

Variant 1: **Acute, subacute, or chronic uncomplicated low back pain or radiculopathy. No red flags. No prior management.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without IV contrast	2		O
X-ray lumbar spine	2		☢☢☢
X-ray myelography and post myelography CT lumbar spine	2		☢☢☢☢
Tc-99m bone scan with SPECT spine	2	If there is concern for spondylolysis in a young patient, SPECT/CT remains the gold standard.	☢☢☢
CT lumbar spine without IV contrast	2		☢☢☢
CT lumbar spine with IV contrast	2		☢☢☢
MRI lumbar spine without and with IV contrast	2		O
CT lumbar spine without and with IV contrast	1		☢☢☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

Clinical Condition: **Low Back Pain**

Variant 2: **Acute, subacute, or chronic uncomplicated low back pain or radiculopathy. One or more of the following: low velocity trauma, osteoporosis, elderly individual, or chronic steroid use.**

Radiologic Procedure	Rating	Comments	RRL*
X-ray lumbar spine	7	This procedure is recommended as the initial imaging study, especially in patients with osteoporosis or history of steroid use.	☢☢☢
CT lumbar spine without IV contrast	7	If there remains concern for vertebral body fracture, detailed osseous analysis with CT can be performed for further evaluation.	☢☢☢
MRI lumbar spine without IV contrast	7	CT is preferred. MRI can be useful to evaluate for ligamentous injury or worsening neurologic deficit. MRI can depict marrow edema in these scenarios.	O
Tc-99m bone scan with SPECT spine	3	Bone scan with SPECT/CT can be useful for radiographically occult fractures and problem solving.	☢☢☢
CT lumbar spine with IV contrast	3		☢☢☢
CT lumbar spine without and with IV contrast	1		☢☢☢☢
X-ray myelography and post myelography CT lumbar spine	1		☢☢☢☢
X-ray discography and post-discography CT lumbar spine	1		☢☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

Clinical Condition: **Low Back Pain**

Variant 3: **Acute, subacute, or chronic low back pain or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without and with IV contrast	8	Contrast is useful for neoplasia patients suspected of epidural or intraspinal disease.	O
MRI lumbar spine without IV contrast	7	Noncontrast MRI can be sufficient if there is low risk of epidural and/or intraspinal disease.	O
CT lumbar spine with IV contrast	6	MRI is preferred. CT is useful if MRI is contraindicated or unavailable and/or for problem solving.	☢☢☢
CT lumbar spine without IV contrast	6	MRI is preferred. CT is useful if MRI is contraindicated or unavailable and/or for problem solving.	☢☢☢
X-ray lumbar spine	5		☢☢☢
Tc-99m bone scan whole body with SPECT spine	4	SPECT/CT can be useful for anatomic localization and problem solving, in particular if looking for widespread tumor burden. It is valuable when multifocal metastases are suspected.	☢☢☢
FDG-PET/CT whole body	4	MRI is preferred. This procedure can be indicated if MRI is contraindicated or nondiagnostic. It can distinguish benign versus malignant compression fractures.	☢☢☢☢
CT lumbar spine without and with IV contrast	3	MRI is preferred. This procedure can be indicated if MRI is contraindicated or nondiagnostic.	☢☢☢☢
X-ray myelography and post myelography CT lumbar spine	3	MRI is preferred. This procedure can be indicated if MRI is contraindicated or nondiagnostic and can be useful for anatomic localization and problem solving.	☢☢☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

Clinical Condition: **Low Back Pain**

Variant 4: **Acute, subacute, or chronic low back pain or radiculopathy. Surgery or intervention candidate with persistent or progressive symptoms during or following 6 weeks of conservative management.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without IV contrast	8		O
CT lumbar spine with IV contrast	5	MRI is preferred. CT is useful if MRI is contraindicated or unavailable and/or for problem solving.	☢☢☢
CT lumbar spine without IV contrast	5	MRI is preferred. CT is useful if MRI is contraindicated or unavailable and/or for problem solving.	☢☢☢
MRI lumbar spine without and with IV contrast	5	This procedure is indicated if noncontrast MRI is nondiagnostic or indeterminate. Contrast is indicated if patient has history of prior lumbar surgery. See variant 5.	O
X-ray myelography and post myelography CT lumbar spine	5	MRI is preferred. This procedure can be indicated if MRI is contraindicated or nondiagnostic.	☢☢☢☢
X-ray lumbar spine	4	This procedure is usually not sufficient for decision making without MR and/or CT imaging but can be helpful in surgical planning.	☢☢☢
Tc-99m bone scan with SPECT spine	4	This procedure can be particularly useful for facet arthropathy or stress fracture. SPECT/CT can be useful for anatomic localization and problem solving.	☢☢☢
X-ray discography and post-discography CT lumbar spine	3	Although controversial, this can be useful in patients with >3 months of LBP (chronic LBP patients).	☢☢☢
CT lumbar spine without and with IV contrast	3		☢☢☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

Clinical Condition: **Low Back Pain**

Variant 5: **Low back pain or radiculopathy. New or progressing symptoms or clinical findings with history of prior lumbar surgery.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without and with IV contrast	8	This procedure can differentiate disc from scar.	O
CT lumbar spine with IV contrast	6	This is most useful in postfusion patients or when MRI is contraindicated or indeterminate.	☢☢☢
CT lumbar spine without IV contrast	6	This is most useful in postfusion patients or when MRI is contraindicated or indeterminate.	☢☢☢
MRI lumbar spine without IV contrast	6	Contrast is often necessary.	O
X-ray myelography and post myelography CT lumbar spine	5		☢☢☢☢
X-ray lumbar spine	5	Flexion and extension views can be useful.	☢☢☢
Tc-99m bone scan with SPECT spine	5	This procedure helps detect and localize painful pseudarthrosis. SPECT/CT can be useful for anatomic localization and problem solving.	☢☢☢
X-ray discography and post-discography CT lumbar spine	5		☢☢☢
CT lumbar spine without and with IV contrast	3		☢☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 6: **Low back pain with suspected cauda equina syndrome or rapidly progressive neurologic deficit.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without IV contrast	9	Use of contrast depends on clinical circumstances.	O
MRI lumbar spine without and with IV contrast	8	Use of contrast depends on clinical circumstances.	O
X-ray myelography and post myelography CT lumbar spine	6	This procedure is useful if MRI is nondiagnostic or contraindicated.	☢☢☢☢
CT lumbar spine with IV contrast	5		☢☢☢
CT lumbar spine without IV contrast	5		☢☢☢
X-ray lumbar spine	3		☢☢☢
CT lumbar spine without and with IV contrast	3		☢☢☢☢
Tc-99m bone scan with SPECT spine	2		☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

LOW BACK PAIN

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Summary of Literature Review

Introduction/Background

In the United States, acute low back pain (LBP) with or without radiculopathy is the leading cause of years lived with disability and the third ranking cause of disability-adjusted life years [1]. It is the second most common reason for a physician visit and affects 80%–85% of people over their lifetime [1].

The American College of Physicians and the American Pain Society classify LBP into the following broad categories: nonspecific LBP, back pain potentially associated with radiculopathy or spinal stenosis, and back pain potentially associated with another specific spinal cause [2]. Additionally, guidelines from the American College of Physicians and the American Pain Society [2,3] emphasize a focused history and physical examination, reassurance, initial pain management medications if necessary, and consideration of physical therapies without routine imaging in patients with nonspecific LBP. Duration of symptoms also helps guide treatment algorithms in patients with acute, subacute, or chronic LBP. Additionally, assessment of psychosocial risk factors when obtaining patient history is a strong predictor of patients who are predisposed to developing chronic disabling LBP problems [2].

Although there is great variability in the definition of acute and subacute LBP, for the purposes of this guideline, we will use the Institute for Clinical Systems Improvement definitions of 0–6 weeks to definite acute LBP, 6–12 weeks for subacute LBP, and >12 weeks to define chronic LBP [4].

It is now clear that *uncomplicated* acute LBP and/or radiculopathy is a benign, self-limited condition that does not warrant any imaging studies [3,5,6]. Imaging is considered in those patients who have had up to 6 weeks of medical management and physical therapy that resulted in little or no improvement in their back pain. It is also considered for those patients presenting with red flags raising suspicion for a serious underlying condition, such as cauda equina syndrome (CES), malignancy, fracture, or infection (see Table 1).

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The American College of Radiology seeks and encourages collaboration with other organizations on the development of the ACR Appropriateness Criteria through society representation on expert panels. Participation by representatives from collaborating societies on the expert panel does not necessarily imply individual or society endorsement of the final document.

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Table 1. Red Flags: Indications of a more complicated status include back pain/radiculopathy in the following settings (adapted from [7]).

Red Flag	Potential Underlying Condition as Cause of LBP
• History of cancer • Unexplained weight loss • Immunosuppression • Urinary infection • Intravenous drug use • Prolonged use of corticosteroids • Back pain not improved with conservative management	• Cancer or infection
• History of significant trauma • Minor fall or heavy lift in a potentially osteoporotic or elderly individual • Prolonged use of steroids	• Spinal fracture
• Acute onset of urinary retention or overflow incontinence • Loss of anal sphincter tone or fecal incontinence • Saddle anesthesia • Global or progressive motor weakness in the lower limbs	• Cauda equina syndrome or severe neurologic compromise

Previous guidelines have suggested that imaging be performed in adults older than 50 years who present with LBP. A recent study found no statistically significant difference in primary outcome after 1 year for older adults who had spine imaging within 6 weeks after an initial visit for care for LBP versus similar patients who did not undergo early imaging [8]; thus, this panel does not include age older than 50 as an independent red flag.

Additionally, for those patients without neurologic compromise and who present with minor risk factors for cancer, inflammatory back disease (eg, ankylosing spondylitis), vertebral compression fracture, or symptomatic spinal stenosis, imaging should be considered after a trial of therapy [3].

In the majority of patients, no specific pathology for LBP can be identified. Previous studies have shown imaging abnormalities in a substantial number of people without back pain [9-11]. The challenge for the clinician, therefore, is to distinguish the small segment within this large patient population that should be evaluated further because of suspicion of a more serious problem.

Overview of Imaging Modalities

Many imaging modalities are available to the clinician and radiologist for evaluating LBP. Application of these modalities largely depends on the working diagnosis, the urgency of the clinical problem, and comorbidities of the patient. Radiographs of the lumbar spine are not routinely recommended in acute nonspecific LBP because they are of limited diagnostic value. Radiography is the initial imaging study of choice for assessing LBP in patients with a history of trauma and patients suspected of possible vertebral compression fracture. Flexion and extension views can be performed to evaluate for spine stability.

In addition, radiographs are recommended to evaluate a young patient for ankylosing spondylitis. Those deemed to be interventional candidates, with LBP lasting for >6 weeks having completed conservative management with persistent radiculopathic symptoms, may seek magnetic resonance imaging (MRI). Patients with severe or progressive neurologic deficit on presentation and red flags should be evaluated with MRI.

Computed tomography (CT) scans provide superior bone detail but are not as useful in depicting extradural soft-tissue pathologies such as disc disease when compared with multiplanar MRI. Intradural and cord pathologies are poorly assessed on CT but are well seen with MRI. CT with multiplanar reformatted sagittal and coronal planes is useful for revealing bone structural problems such as spondylolysis, pseudarthrosis, fracture, scoliosis, and stenosis and for postsurgical evaluation of bone graft integrity, surgical fusion, and instrumentation [12]. In patients who cannot undergo MRI, CT with myelography can be performed to assess the patency of the spinal

canal/thecal sac and of the neural foramen. Myelography suffers the disadvantage that it requires an invasive procedure to introduce intrathecal contrast agents.

The use of provocative injections in the lumbar spine to identify a discogenic source of pain remains controversial. Discography is a subjective test, relying entirely on the patient's description of pain during the procedure. The role of the isotope bone scan in patients with acute LBP has changed in recent years with the wide availability of MRI and especially contrast-enhanced MRI. Tc-99m-MDP bone scan with single-photon emission computed tomography (SPECT) is a sensitive test for detecting the presence of infection or occult fractures of the vertebrae, but not for specifying the diagnosis.

Discussion of Imaging Modalities by Variant

Variant 1: Acute, subacute, or chronic uncomplicated low back pain or radiculopathy. No red flags (red flags defined in Table 1). No prior management.

The natural history of acute LBP, with or without radiculopathy, is considered a self-limiting condition in most patients. Additionally, imaging patients with acute LBP of <6 weeks' duration and no red flag symptoms provides no clinical benefit [5]. Numerous studies have shown that routine imaging is not beneficial. The majority of disc herniations reabsorb or regress by 8 weeks after symptom onset [13].

Similarly, in patients with chronic LBP who do not present with red flags, first-line treatment remains conservative therapy with both pharmacologic and nonpharmacologic (eg, exercise, remaining active) therapy without imaging [14].

A prospective study by Carragee et al [11] found that among patients with lumbar imaging abnormalities before the onset of LBP, 84% had unchanged or improved findings after symptoms developed. Adding to this controversy, nonspecific lumbar disc abnormalities are common in asymptomatic patients and can be demonstrated readily on MRI, CT, x-ray myelography, and post myelography CT of the lumbar spine [9].

Recently, a systematic review of 33 articles [10] found an increasing prevalence of degenerative spine findings in asymptomatic patients of increasing age. For example, disk protrusion prevalence increased from 29% of those 20 years of age to 43% of those 80 years of age in this asymptomatic population.

In a young patient with suspicion for lumbar spondylolysis, the gold standard in detection of radiographically occult active spondylolysis has been SPECT. There are disadvantages of this method, related not only to the invasive injection of a radiotracer but also to the concurrent radiation exposure. Recently, Kobayashi et al [15] have similarly shown the utility of MRI in diagnosing active spondylolysis in radiographically occult spondylolysis.

Variant 2: Acute, subacute, or chronic uncomplicated low back pain or radiculopathy. One or more of the following: low velocity trauma, osteoporosis, elderly individual, or chronic steroid use.

In patients with history of osteoporosis or with history of steroid use, initial evaluation with radiographs is recommended [16]. Radiography with anteroposterior and lateral radiographs is the initial imaging study of choice for assessing LBP in patients with a low suspicion of trauma and patients suspected of possible vertebral compression fracture. Flexion and extension views can be performed to evaluate for spine stability. Disadvantages of lumbar radiography include gonadal exposure. Additionally, evaluation of the extent of vertebral body comminution is limited on radiography.

As recommended by the ACR Appropriateness Criteria® on "Suspected Spine Trauma," [17] any patient meeting the high-risk criteria for having a vertebral injury should undergo CT. CT provides a detailed analysis of fractures extending to the posterior column of the vertebra or for evaluating the integrity of pedicles and the posterior cortex. Additionally, CT with multiplanar reformatted sagittal and coronal planes can help detect subtle fractures.

In trauma patients, MRI can be useful in evaluating the appearance of the stabilizing spinal ligaments; in assessing for presence of hemorrhage in the epidural, subdural, subarachnoid, and intramedullary locations; and in demonstrating spinal canal compromise, for example, from disc herniations and displaced fractures. Traumatic injuries are usually imaged with T1, T2, and short tau inversion recovery (STIR) sequences. Acuity of fracture, as evidenced by bone marrow edema, can be assessed on STIR sequences. Additionally, the distinction between malignant and benign compression fractures can be assessed on MRI. The visualization of the convex posterior vertebral body border, extension into the posterior elements, and abnormal marrow signal are suggestive of pathologic fracture [18]. In patients with suspicion for disk herniation and in whom MRI is contraindicated or

nondiagnostic, x-ray myelography and post myelography CT could be performed.

Nuclear medicine has a limited role in the evaluation of patients suspected of lumbar spine trauma.

Variant 3: Acute, subacute, or chronic low back pain or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression.

A systematic review examining studies that used red flags as an indication for screening found that of all the red flags, only a history of cancer has been shown to increase the probability of finding spinal malignancy [19]. In a patient suspected of having cancer, MRI with contrast is considered superior in evaluation of localizing disease (intramedullary, intradural-extramedullary, extradural) as well as assessing extent of the lesion. Intradural and cord pathologies are poorly depicted on CT. CT can be performed to evaluate osseous involvement of tumor. MRI offers greater specificity than bone scan, with comparable sensitivity and the added advantage of providing anatomic detail [20]. Bone scan remains invaluable when a survey of the entire skeleton is indicated (eg, for metastatic disease). Although osseous destruction as well as identifying lytic or sclerotic lesions can be detected on radiography, at least half of the bone must be eroded before there is a noticeable change on radiographs. It has been noted that fluorine-18-2-fluoro-2-deoxy-D-glucose positron emission tomography (FDG-PET) can be useful in differentiating benign from malignant compression fractures [21]. This modality could be of benefit in patients unable to undergo MR evaluation.

In a patient with suspected spinal infection, MRI is preferred due to its high sensitivity and specificity. MRI can localize the site of infection and assess the extent of extradural/epidural and paravertebral involvement. The addition of intravenous contrast with fat suppression is invaluable in identifying abscess formation [21]. Again, MRI allows the diagnosis of infection before bone destruction is evident on either CT or radiography. Noncontrast 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 [22]. Thus, MRI has taken over the role of the isotope scan in many cases where the location of the lesion is known.

Variant 4: Acute, subacute, or chronic low back pain or radiculopathy. Surgery or intervention candidate with persistent or progressive symptoms during or following 6 weeks of conservative management.

Patients presenting with acute, subacute, or chronic LBP and radiculopathy who have failed 4–6 weeks of conservative care and with physical examination signs of nerve root irritation should be imaged if they are believed to be candidates for surgery or if diagnostic uncertainty remains. MRI of the lumbar spine has become the initial imaging modality of choice in complicated LBP, displacing myelography and CT in recent years. Accurate diagnosis of disc disease can be provided by MRI [6]. Multidisciplinary agreement on terminology facilitates reporting of MRI findings [23], although inter-rater reliability of reporting using lumbar disc terminology has achieved only modest agreement [24,25].

Although disc abnormalities are common on MRI in asymptomatic patients, acute back pain with radiculopathy or clinical signs of spinal stenosis suggests the presence of demonstrable nerve root compression on MRI [11]. In a study of symptomatic patients, there was a higher prevalence of herniation, 57% in patients with LBP and 65% in patients with radiculopathy, than the 20%–28% prevalence reported in asymptomatic series [6]. Interestingly, the size and type of disc herniation and location and presence of nerve root compression were not related to patient outcome [6]. A recent study found no statistically significant difference in primary outcome after 1 year for older adults who had spine imaging within 6 weeks after an initial visit for care for LBP versus similar patients who did not undergo early imaging [8].

In the absence of red flags, first-line treatment for chronic LBP remains conservative therapy with both pharmacologic and nonpharmacologic (eg, exercise, remaining active) therapy [14]. It is well documented that imaging patients with chronic LBP is often not beneficial and similar imaging findings are often present in asymptomatic individuals [6,9,11]. Additionally, patients with new episodes of LBP and previous MRI scans are unlikely to detect changes in disc protrusion, annular fissures, high-intensity zones, or end-plate signal changes with repeated MRI [11].

CT can be performed if a contraindication exists to performing MRI. Additionally, in patients who cannot undergo MRI, x-ray myelography with post myelography CT of the spine can be performed to assess the patency of the spinal canal/thecal sac and of the neural foramen. Radiography is usually not sufficient for decision making without MRI and/or CT imaging, though it can be of benefit for surgical planning.

Although the usefulness of discography in patients with LBP remains controversial, a recent systematic review by Manchikanti et al [26] provides fair evidence supporting the accuracy and usefulness of lumbar discography in patients with chronic LBP. Nuclear medicine has a limited role in the evaluation of patients with persistent or progressive symptoms during or following 6 weeks of conservative management.

Variant 5: Low back pain or radiculopathy. New or progressing symptoms or clinical findings with history of prior lumbar surgery.

There are many causes of back pain following surgery. Some of the more frequent etiologies diagnosed with imaging include free disc or bone fragments, postoperative scarring, failure of bone graft for fusion, and recurrent disc protrusion. Contrast-enhanced MRI allows the distinction between recurrent disc herniation and scar when abnormal tissue extends beyond the disc interspace. In patients who cannot undergo MRI or in whom anatomy is distorted secondary to artifacts from surgical hardware, x-ray myelography with a post myelography CT spine study is complementary to MRI and is occasionally more accurate in diagnosing nerve root compression in the lateral recess, but it suffers the disadvantage of requiring lumbar puncture and intrathecal contrast injection [27]. Evaluation of bone graft integrity, surgical fusion, and instrumentation can readily be performed with CT. Radiographs have a role in evaluation of alignment and instability and in the postoperative evaluation of instrumentation and fusion.

Variant 6: Low back pain with suspected cauda equina syndrome or rapidly progressive neurologic deficit.

Cauda equina syndrome (CES) is rare and results from dysfunction of the sacral and lumbar nerve roots within the vertebral canal, producing impairment of the bladder, bowel, or sexual function and perianal or saddle numbness. Back pain with or without radicular symptoms, weakness in the lower limbs, sensory changes or numbness in the lower limbs, or absent lower limb reflexes are other symptoms that have been described [28]. A review of physical examination findings reported by Fairbanks et al [29] illustrates that the most common physical finding in patients with the diagnosis of CES was LBP. A prospective cohort study by Bell et al [30] recommends urgent MRI assessment in all patients who present with new-onset urinary symptoms in the context of LBP or sciatica. The most common cause of CES is lumbar disc herniation at the L4-L5 and L5-S1 levels. Multifocal deficits and progressive neurologic deficits can be caused by a number of other etiologies, such as neoplasm, infection, or other space-occupying lesions. The imaging study of choice in the evaluation of suspected CES, multifocal deficit, or progressive neurologic deficit remains MRI due to its ability to accurately depict soft tissue pathology, assess vertebral marrow, and assess the spinal canal patency. For those patients with nondiagnostic MRI or in whom MRI is contraindicated, x-ray myelography with post myelography CT of the spine can be used as an alternative.

Summary of Recommendations

- Uncomplicated acute LBP and/or radiculopathy are benign, self-limited conditions that do not warrant any imaging studies.
- MRI of the lumbar spine should be considered for those patients presenting with red flags raising suspicion for a serious underlying condition, such as cauda equina syndrome (CES), malignancy, or infection.
- In patients with a history of low-velocity trauma, osteoporosis, or chronic steroid use, initial evaluation with radiographs is recommended.
- In the absence of red flags, first-line treatment for chronic LBP remains conservative therapy with both pharmacologic and nonpharmacologic (eg, exercise, remaining active) therapy.
- If there are persistent or progressive symptoms during or following 6 weeks of conservative management and the patient is a surgery or intervention candidate or diagnostic uncertainty remains, MRI of the lumbar spine has become the initial imaging modality of choice in evaluating complicated LBP.
- MRI is the imaging procedure of choice in patients suspected of cord compression or spinal cord injury.
- Patients with recurrent low back pain and history of prior surgical intervention should be evaluated with contrast-enhanced MRI.

Summary of Evidence

Of the 30 references cited in the *ACR Appropriateness Criteria® Low Back Pain* document, all of them are categorized as diagnostic references including 3 well designed studies, 2 good quality studies, and 7 quality studies that may have design limitations. There are 18 references that may not be useful as primary evidence.

The 30 references cited in the *ACR Appropriateness Criteria® Low Back Pain* document were published from 1990-2015.

While there are references that report on studies with design limitations, 5 well designed or good quality studies provide good evidence.

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. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults (see Table below). 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*	**Adult Effective Dose Estimate Range**	**Pediatric Effective Dose Estimate Range**
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies".		

Supporting Documents

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

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