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AN EVIDENCE-BASED APPROACH TO EMERGENCY MEDICINE

# An Evidence-Based Approach To The Evaluation And Treatment Of Low Back Pain In The Emergency Department

## Abstract

Low back pain is the most common musculoskeletal complaint that results in a visit to the emergency department, and it is 1 of the top 5 most common complaints in emergency medicine. Estimates of annual healthcare expenditures for low back pain in the United States exceed $90 billion annually, not even taking lost productivity and business costs into account. This review explores an evidence-based rationale for the evaluation of the patient with low back pain, and it provides guidance on risk stratification pertaining to laboratory assessment and radiologic imaging in the emergency department. Published guidelines from the American College of Physicians and American Pain Society are reviewed, with emphasis on best evidence for pharmacologic treatments, self-care interventions, and more invasive procedures and surgery in management of low back pain. Utilizing effective and proven strategies will avoid medical errors, provide better care for patients, and help manage healthcare resources and costs.

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**CME Objectives**

Upon completion of this article, you should be able to:

1. Develop an approach to the evaluation of patients with low back pain to differentiate patients who are likely to have benign causes of pain from those who will need a medical workup and/or imaging studies.
2. Recognize the red flag signs and symptoms in patients with low back pain.
3. Assess the neuroanatomy of the lower spine and nerve roots and correlate with specific findings on the neurologic examination.
4. Evaluate the strength of data behind recommendations for treatments for low back pain and identify those that are evidence-based.

*Prior to beginning this activity, see the back page for faculty disclosures and CME accreditation information*

## Case Presentations

*A 45-year-old man presents after 7 days of pain in his lower back. He reports that it began the day after he started at a new job site. The pain initially improved with ibuprofen, but he woke up this morning with a severe exacerbation of the pain. He denies a fall or other trauma, and he states that the pain radiates from his left buttock to his left foot. He has had intermittent back pains in the past, but he never required any imaging or interventions. Employed in the construction industry, he has a history of hypertension and is going through a divorce. He is afebrile, has a benign abdominal exam, and displays an antalgic gait. He has intact patella and Achilles reflexes, and he has a positive left straight-leg raise sign and crossed straight-leg raise sign. Strength and sensation, including the perineum, are intact and symmetrical. The patient insists that he needs an MRI and requests a note for 2 weeks off from work...*

*As you are considering your first patient's requests, a 27-year-old woman is placed in the next room, also complaining of lower back pain. You review her past visits and see that she has been to the ED several times in the past 6 months for various complaints, including headache, toothache, and pain after an assault. She has had pain in her upper lumbar area for 1 week, and it is exacerbated with any change in body position. She has no pain in her legs and no weakness or numbness, although she says that it feels as if her back is swollen. She insists she has never had back problems in the past, and there has been no trauma. She has a normal heart and lung exam and no abdominal tenderness. There is no costovertebral angle tenderness, and she seems tender around the L1 area. You write a prescription for NSAIDs and go off to see your next patient. When you return to finish your evaluation, you note that the patient had a fever of 38.9°C. She has already left the ED, and the phone number she left is disconnected; however, before the end of your shift, she is returned to the ED by EMS, with a fever of 39.4°C. You have a sinking feeling that maybe you were too quick to judge this patient's complaint…*

## Introduction

Low back pain is the most common musculoskeletal complaint that is evaluated in the emergency department (ED), and it affects most adults at some point in their lives.[1] The Edwin Smith papyrus, a collection of Egyptian documents from 1600 BC, and one of the oldest medical texts, describes 48 patient cases. It includes a patient with a pulled vertebra and recommends "…you have to put him stretched out… " Unfortunately, this was patient case number 48, the last scroll, and the rest of the scroll is missing; hence the medical field has been without clear guidance for this condition for over 3500 years.[2] In the intervening time, we have developed extraordinary tools to noninvasively visualize spinal anatomy, and we have elucidated a molecular mechanism of neurotransmission, yet we are still challenged by the many elements that constitute how humans feel and interpret pain. Interspersed between the patients with musculoskeletal back pain are patients with back pain who are at risk for permanent neurologic or even life-threatening sequela because they are harboring lesions that require timely diagnosis and treatment. By utilizing a focused approach, the ED clinician will be able to identify these "red flag" symptoms in patients and initiate a workup. This issue of *Emergency Medicine Practice* reviews the progress to date on developing a standardized, focused approach and guides the clinician to rationally and cost-effectively evaluate the patient presenting with low back pain symptoms.

## Critical Appraisal Of The Literature

The study of low back pain is plagued by the fact that it is not a single pathologic entity. In addition, pain is a subjective complaint that can be measured only indirectly, and these measurements are influenced by cognitive and behavioral factors as well as secondary gains. There are many back pain treatments available, and the randomized controlled trials available do not necessarily compare 1 treatment with placebo; instead, 1 treatment is compared with a multitude of other interventions, adding difficulty to making pooled data samples that are typical of systematic reviews and meta-analyses. There are long-term studies available, however, and the natural history of low back pain is very well described, so, for the most part, prognostic conclusions are well supported.

A literature search was performed utilizing PubMed, as well as Ovid MEDLINE® and the Cochrane Database of Systematic Reviews from 1990 to the present. Search terms included *low back pain* and *back pain*, and these terms were joined with imaging medication classes (*NSAID, acetaminophen, muscle relaxant, opioid*), as well as specific therapies (*fusion, diskectomy/discectomy, laminectomy, epidural steroid, injection, acupuncture, spinal manipulation*), and were limited to English literature and human studies. Papers with prospective randomized methodologies were initially reviewed, and references most frequently mentioned in the discussion sections of these papers were reviewed as well. These searches produced guidelines by the American College of Physicians in association with the American Pain Society[3] as well as recommendations from the National Health Service in the United Kingdom,[4] an imaging guideline from the American College of Radiology,[5] and opioid prescription guidelines from the American College of Emergency Physicians.[6] **(See Table 1.)**

## Epidemiology

Low back pain is the most common type of pain reported by adults in the United States, with at least

26% of the population reporting pain lasting at least a day in the past 3 months.[7,8] It is the fifth most common reason for all physician visits, and it is a significant cause of lost work days, with 1% of the United States workforce considered "permanently disabled" by it.[1,9] In 1998, direct healthcare costs attributed to lower back pain were estimated at $90 billion.[10] Approximately 5% of people with low back pain account for 75% of these costs.[11]

## Pathophysiology

The lumbar spine supports significant loads, and it provides mobility in multiple planes. Nature's design includes vertebral bodies, sandwiching intervertebral discs, spinal ligaments, and paraspinal muscles. **Figure 1** reviews the general anatomy of the lumbar spine. Activity and aging lead to recurrent tears in the annulus fibrosus of these discs. As compensation for increases in biomechanical stress, promotion of bone overgrowth, facet hypertrophy, and thickened ligaments occur. These effects contribute to a decreased size of the spinal canal and narrowed foramina, which are traversed by spinal nerve roots. Despite research examining nociceptive pain endings, inflammatory cytokines, and pain-mediating neuropeptides, it has proven difficult to determine the exact causes of pain in patients, even in those with marked abnormalities on imaging, and even with provocative disc injections. The question, "Where is the structure that is actually causing the pain?" though simply stated, does not have a straightforward answer and may prove to be a diagnostic challenge.

Patients with spinal cord injury will initially have flaccid paralysis and commonly will have bilateral findings, a syndrome called spinal shock. As these circuits recover over days to weeks, there is restoration of motor function, albeit without the modifying effects of the damaged upper motor neurons. This results in increased tone and spasticity and increased reflexes, positive Babinski sign, and loss of fine motor coordination.

Patients with injuries to lower motor neurons (nerve roots, cauda equina) will present with weakness or muscle paralysis and loss of reflexes. Over time, there is a denervation syndrome, with muscle fasciculations and atrophy.

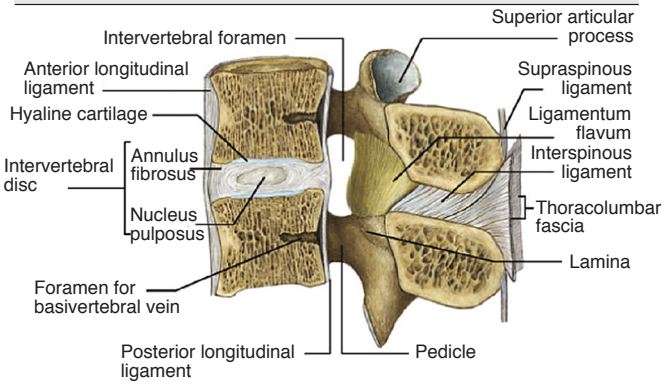
Proper bladder function arises primarily from the interplay between sympathetic and parasympathetic pathways. These fibers are contained within the cauda equina. Sympathetic preganglionic fibers are responsible for the inhibition of bladder wall contracture, the closure of the internal urethral sphincter, and the allowance of bladder filling. When the bladder is full, there is stimulation of the parasympathetics and a decrease in sympathetic activity, leading to bladder contraction and relaxation of the internal urethral sphincter. Unmyelinated smaller parasympathetic fibers are more susceptible to compression. The cauda also contains S2-S4 somatic neurons, which provide sensation to the perineum and voluntary muscle control over the anal sphincter and urethral sphincter.

### Definitions

There is variability in the definitions used in the literature, which makes it difficult, at times, to compare studies. The following are some of the more frequently used terms and definitions:

- **Acute low back pain:** Symptoms usually lasting < 4 weeks but may include pain for up for 3 months.

### Figure 1. General Anatomy Of The Lumbar Spine

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### Table 1. Relevant Practice Guidelines For Low Back Pain

| Guideline | Methodology | Recommendations |
|---|---|---|
| American College of Physicians and American Pain Society Joint Clinical Guideline - diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society.[3] | Literature search, meta-analysis, expert panel | Guidelines for classifying patients, imaging, treatment, and reassessment |
| National Collaborating Centre for Primary Care - low back pain. Early management of persistent nonspecific low back pain.[4] | Expert panel | Assessment, imaging, and treatment |
| American College of Emergency Physicians - clinical policy: critical issues in the prescribing of opioids for adult patients in the emergency department.[6] | Literature search and expert panel review | Nonopioid drugs first, then, if indicated, < 1 wk of opioid drugs (Level C) |

- **Chronic back pain:** Pain syndrome lasting longer than 3 months.
- **Sciatica:** Leg pain that localizes to lumbar sacral nerve roots; sometimes this term also refers to nonspecific radicular patterns; 90% of pathology occurs at L4-L5 and L5-S1 levels.
- **Spondylolisthesis:** A condition where the vertebra slips out of position in relation to the vertebra beneath it.
- **Spondylolysis:** A condition usually related to a defect in the pars interarticularis; it is associated with stress fractures and back pain in adolescents. This condition can be a cause of eventual spondylolisthesis.
- **Spondylosis:** Degenerative arthritis of the spine.
- **Disc protrusion, extrusion, and sequestration:** In protrusion, the disc is intact but out of place. In extrusion, the gelatinous nucleus pulposus is squeezed out from a tear in the annulus fibrosus. In sequestration, some parts of the disc/nucleus pulposus are completely separated from the main disc, which is called a sequestered fragment.
- **Cauda equina syndrome:** These are conditions that cause compression of the cauda (the bundle of nerve roots in the lower spinal canal, with the spinal cord ending at L1). The syndrome affects the lower limbs and can cause a neurogenic bladder, loss of rectal tone, and saddle anesthesia.
- **Spinal stenosis:** A condition where there is crowding of the spinal canal, either by osteoarthritis, osteophytes, ligamentous thickening, and/or bulging intervertebral discs. The narrowing of the canal can cause nerve root and spinal cord compression.
- **Myelitis:** An inflammatory condition that affects the spinal cord. Frequently, white matter and demyelination are involved, as in transverse myelitis. In poliomyelitis, anterior horn/gray matter portions are targeted.
- **Conus medullaris syndrome:** Lesions in the conus medullaris (where the spinal cord tapers and ends, between the first and second lumbar vertebrae, which contain upper motor neurons) can cause increased tone and reflexes.

## Differential Diagnosis

In addition to the vertebral column and muscles, there are structures in the retroperitoneal space that can cause pain referable to the back, so the differential can get somewhat broad when these organ systems are included. **Table 2** provides a summary of the differential diagnosis for back pain. Aortic aneurysm rupture is a time-sensitive emergency, as are pain and signs of spinal cord compression or cauda equina syndrome.

## Epidural Abscess

Epidural abscess is a rare condition (0.2-2.8 cases/10,000 patients/y), and it is most common in the 60- to 70-year age group. Risk factors are diabetes mellitus, alcoholism, AIDS/immunocompromised states, cancer, and intravenous drug use, as well as trauma and spinal surgery. Twenty percent of patients will have no predisposing factors. The most common organism isolated is *Staphylococcus aureus*. Posterior epidural abscesses tend to be related to a distant focus, while anterior infections are generally related to osteomyelitis or discitis (which, in turn, can be related to a distant focus or contiguous spread, such as psoas abscess). The most common findings are nonspecific and include fever, back pain, and malaise. There may

**Table 2. Differential Diagnosis For Lower Back Pain**

| Causes of Back Pain | Key History/Physical Examination Findings |
|---|---|
| **Mechanical Spine-Related Causes of Back Pain** | |
| • Muscle contusion, strain, or spasm<br>• Ligamentous strain<br>• Herniated disc<br>• Foraminal degeneration<br>• Facet arthritis, degeneration<br>• Spinal stenosis<br>• Scoliosis<br>• Osteoporosis-related fracture<br>• Trauma-related fracture | Clear causal event |
| **Nonmechanical Spine-Related Causes of Back Pain** | |
| Metastatic cancer | Prior history of cancer with predilection for metastasis |
| Multiple myeloma | Back pain, hypercalcemia, renal failure |
| Osteomyelitis, discitis | Risk for bacteremia, fever, intravenous drugs |
| Ankylosing spondylitis | Young age, human leukocyte antigen (HLA)-B27 positive |
| Psoriatic spondylitis | Psoriasis |
| Epidural abscess | Bacteremia, fever |
| **Non-Spine-Related Causes of Back Pain** | |
| Renal colic | Hematuria, nausea, diaphoresis |
| Pancreatitis | Alcoholism, prior gallstones |
| Penetrating ulcer | Abdominal pain |
| Aortic aneurysm, dissection | Vascular disease, risk factors, age |
| Retroperitoneal hematoma or mass | Anticoagulation, hematocrit drop |
| Pyelonephritis | Pyuria |
| Prostatitis | Pyuria, tender prostate |
| Endometriosis | Recurrent, cyclical |
| Herpes zoster | Rash |

be focal tenderness and leukocytosis. Magnetic resonance imaging (MRI) or computed tomography (CT) myelogram (if MRI cannot be obtained) are the diagnostic studies of choice. Treatment is usually surgical decompression.

### Abdominal Aortic Aneurysm

An abdominal aortic diameter > 3 cm is considered aneurysmal, occurring in 1/1000 patients. Abdominal aortic aneurysms are uncommon in patients aged < 60 years. An aneurysm's size correlates with risk of rupture; annual rates are 0.5% for aneurysms < 4 cm and 3% to 15% for aneurysms between 5 cm and 5.9 cm. Abdominal aortic aneurysm can become symptomatic by thrombosis, distal embolization, or rupture. A contained rupture can cause abdominal pain, back pain, and groin pain, and it may be associated with nausea, diaphoresis, or syncopal symptoms. It is essential that abdominal aortic aneurysm be considered in older patients with back pain, and it is a simple task to assess aortic size with bedside ED ultrasound. These patients are at risk of exsanguination and/or limb or bowel ischemia. Emergency CT scanning and vascular surgery consultation are key in management.

### Cauda Equina Syndrome

The cauda equina are the nerve roots that provide motor and sensory function to the lower extremities, perineum, and bladder. Lesions involving the cauda can cause permanent paralysis and bladder dysfunction, making early identification and consultation with a spine specialist critical. The most common lesions causing cauda equina syndrome are herniated discs but also include tumors, spinal stenosis, infection, and hematoma. Patients present with lower back pain, most commonly weakness in both lower extremities, saddle anesthesia, and abnormalities in bladder sensation and function (complete versus incomplete syndromes). Patients with any of these symptoms and findings need to have postvoid residual measured, with urinary catheter placement or bladder scan/ED ultrasound. Postvoid residuals > 100 cc can be abnormal, while residual > 300 cc is always abnormal. Emergency MRI or CT myelogram is needed to make this diagnosis.

### Spinal Epidural Hematoma

Spinal epidural hematomas can be spontaneous (very rarely) or they can be related to trauma, postoperative spinal surgery, anticoagulation/thrombolysis, lumbar puncture, epidural anesthesia, vascular malformation, or chiropractic manipulation. These patients present with back pain and possible neurologic complaints, and it will be indistinguishable, based solely on physical examination findings, from other lesions causing back pain. A low threshold for imaging with MRI or CT myelogram is needed in patients suspected of having spinal epidural hematoma in order to identify the hematoma and/or associated vascular malformation. Medical treatment includes reversal of coagulopathy, and patients require an emergent consultation for surgical evacuation.

## Prehospital Care

The goal of the prehospital healthcare provider is to assess for trauma and red flag conditions that may put the patient at a higher risk for the development of progressive neurologic dysfunction or, in the case of aortic emergencies, hemodynamic collapse. Patients who have trauma will need a spine assessment, with documentation of any penetrating lesions, location of tenderness, and impaired sensory or motor abilities. Patients will likely need to be transported on a backboard with immobilization (using log roll precautions) to ensure that no further injury occurs. Care of individuals without trauma will not require immobilization and is mostly supportive, though patients may require medications for pain control. Vigilance is necessary, especially in older patients, since back pain may be the presentation of other medical, nonspine-related processes. Unstable patients will require medical control and transfer to the nearest ED for stabilization. Stable patients with trauma and neurologic findings have a potential need for neurosurgical intervention and will require transport to a center with spine surgery coverage.

## Emergency Department Evaluation

### History And Physical Examination

Emergency healthcare providers are taught that every assessment begins with the evaluation of airway, breathing, and circulation (the ABCs), and this is true for patients with back pain. Review the vital signs to determine whether the patient has an unusually low blood pressure, a fever, or an unexplained tachycardia, as these signs can suggest an etiology of back pain unrelated to musculoskeletal structures. A history of back pain and syncope or lightheadedness and diaphoresis may represent an aortic emergency. Also note if the patient is febrile, and be aware of drug use habits, as endocarditis with consequent epidural abscess can initially present with back pain. The patient with known cancer is also a high-risk patient who may have serious back pathology causing the pain (eg, blastic lesions or lytic lesions causing vertebral fracture). It is essential to be aware of these red flag symptoms and conditions and rapidly triage these patients for emergent evaluations. **(See Table 3, page 6.)**

The patient's history delineates the onset of the pain, precipitating factors, prior episodes of pain,

and information regarding prior treatments, imaging, and surgery. The goal is to risk stratify the patient into 1 of 3 categories:

1. **Patients with red flag symptoms:** This category includes patients with pain related to another medical condition, based on the red flag signs and symptoms summarized in **Table 3**. Even though this group represents a minority of patients, they will need more extensive and emergent evaluation, and missing these other causes of back pain may lead to a catastrophic outcome.
2. **Patients with lumbar radiculopathy:** This category includes patients with a back pain syndrome that includes complaints and possible findings of lumbar radiculopathy. The goal of evaluation in these patients is to determine whether they have significant neurologic deficits that require emergent imaging and spinal consultation. Most of these patients will require pain management, education, and outpatient referral to their primary care physician.
3. **Patients with nonspecific back pain:** These individuals, who comprise 85% of patients with back pain, will have pain in their back that is nonspecific and not clearly related to another medical condition or nerve root impingement syndrome.[3,12] These patients will require pain management and referral back to their primary care physician.

In order to complete the physical examination, the patient must be undressed (including shoes, socks, and pants). Review the vital signs for fever, tachycardia, and hypotension. A new heart murmur in a patient with infectious symptoms may suggest bacteremia and endocarditis. Examine the patient's abdomen, looking for tenderness, evidence of bladder distention, and femoral pulses; patients with benign causes of lower back pain should not have abdominal tenderness. As an extension of the physical examination, it can be useful to perform a bedside ultrasound to determine aortic dimensions as well as to assess whether the patient has urinary retention. When examining the patient's back, note whether he has point tenderness directly over the spine or if there is redness, swelling, or warmth. Postoperative patients may have wound infections and drainage. Examine the skin, looking for signs of herpes zoster. Confirm that the patient has symmetric pulses in femoral/popliteal/dorsalis pedis/posterior tibial locations to help evaluate a vascular cause for the lower back pain.

Fundamental to the physical examination of the patient complaining of back pain is a systematic neurologic examination. The neurologic examination provides the baseline from which subsequent healthcare providers will be able to monitor the status of the patient. This baseline includes pertinent negatives and positives regarding strength, sensory, reflexes, gait, and (if relevant) rectal sensation examination and assessment for urinary retention. The physical examination findings (or lack of findings) should be consistent with the decision to forego imaging and refer the patient back to his primary care provider or should support your need for emergency imaging/spine consultation and transfer to a center with a higher level of care specialization. The documentation of the neurologic examination in a patient with a complaint of back pain should never be summarized as "WNL" (within normal limits). Instead, each of the components of the examination should be documented individually.

More than 90% of disc herniations occur at the L4/L5 or L5/S1 levels,[13] so a focused examination begins with the examination of sensory, motor, and reflexes in the foot and ankle. **Table 4** summarizes these findings by lumbar spinal level. The straight-leg examination is performed to assess for evidence of nerve root impingement. The patient lies down, and the symptomatic leg is raised 30° to 70°. A positive test reproduces the sciatica and has a sensitivity of 91% (95% confidence interval [CI], 82%-94%) and specificity of 26% (95% CI, 16%-38%). A positive crossed straight-leg raise test occurs when the unaffected leg is raised and reproduces sciatica symptoms in the unraised leg. This test has significantly more specificity 88% (95% CI, 86%-90%) but less sensitivity 29% (95% CI, 24%-34%). The most common symptom of cauda equina syndrome is urinary retention (90% sensitivity). The chance of having cauda equina syndrome without this symptom is 1:10,000. Cauda equina syndrome prevalence is 0.04% of all patients with back pain. **Figure 2** summarizes the neurologic examination at levels L4-S1.

All of the patient's psychosocial factors may be difficult to determine in the ED, and they rarely

## Table 3. Red Flag History And Physical Examination Findings

| Historical Finding | Concern |
|---|---|
| Age > 50 y or < 20 y | Infection, cancer, vascular disease |
| History of cancer | Metastatic disease |
| History of unexplained weight loss | Cancer or smoldering infection |
| Persistent fevers and/or night sweats | Epidural abscess, osteomyelitis |
| • Immunocompromise, HIV<br>• Prolonged steroid use<br>• Intravenous drug use | Epidural abscess, metastatic spine lesion, osteomyelitis, discitis |
| Recent bacterial infection, bacteremia | Seeding spine or paravertebral structure |
| Known aortic aneurysm | Retroperitoneal rupture |
| Motor neurologic deficit | Cord or root compression |
| Urinary retention, bowel incontinence, saddle anesthesia | Cauda equina syndrome |

influence ED care. Coping skills are important (and frequently overlooked) assessment components. Depression, somatization, job dissatisfaction, and compensation claims have all been associated with poorer resolution of symptoms.[14]

Physical examination maneuvers described by Waddell in 1980 assess whether there are nonorganic components to low back pain complaints. The Waddell signs are summarized in **Table 5** (see page 8). The test is considered positive if the patient scores positive in 3 or more categories. Higher scores are predictive of increases in back-to-work times and disability in the short term; however, this may not be true in the long term.[15]

An additional sign, called the heel tap test, has been described. The patient is seated, with hips and knee flexed at 90°, and the examiner lightly taps the heel with the base of his hand. If the patient complains of back pain, then the test is positive. In 94 patients studied, 32 out of 32 who had a positive test scored > 3 Waddell signs, and out of 22 patients with negative Waddell signs, 21 had a negative heel tap test.[16] It must be emphasized that it is difficult to use the above assessments in the ED, as the goal of the provider is to evaluate for medical emergencies that can masquerade as back pain and to identify which patients have back pain with significant neurologic findings.[17] Malingering and psychosocial causes of persistent pain are, essentially, diagnoses of exclusion.

## Diagnostic Studies

### Imaging

The overuse of imaging is a major contributor to the rise in the growing costs of low back pain care in the United States. It is not just the cost of the study itself, but the downstream costs associated with additional tests, follow-up, and referrals.[18] It is no surprise that the increased rate of spine imaging coincides with the increased rate of lumbar surgery.[19]

The natural history in low back pain is self-resolution of symptoms in the majority of patients in 4 to 6 weeks.[20] Since the majority of cases are in the nonspecific back pain category, imaging is not recommended. A meta-analysis of 6 randomized trials of 1800 patients found no outcome differences between routine care and no imaging and patients who underwent imaging with plain x-ray, CT, or MRI.[21] There does not even appear to be a psychological benefit of having an imaging study performed.

Additionally, MRI reveals many abnormalities in asymptomatic patients. In a study of asymptomatic patients aged ≥ 60, 36% had a herniated disc, 21% had spinal stenosis, and 90% had a degenerated or bulging disc.[22] In another study of patients who were enrolled in a trial of surgery versus conservative therapy, investigators were unable to determine which patients had favorable versus unfavorable outcome based solely on MRI disc herniation findings.[23]

Routine plain films are not indicated, as the yield is extremely low for an intervenable lesion or pathology. In a study of 68,000 radiographs, clinically unsuspected lesions occurred in 1:2500 patients aged 20 to 50 years.[24] There is a risk of accumulated low-dose radiation from lumbar x-rays as well as

**Figure 2. Summary Of Neurologic Examination At L4-S1 Levels**

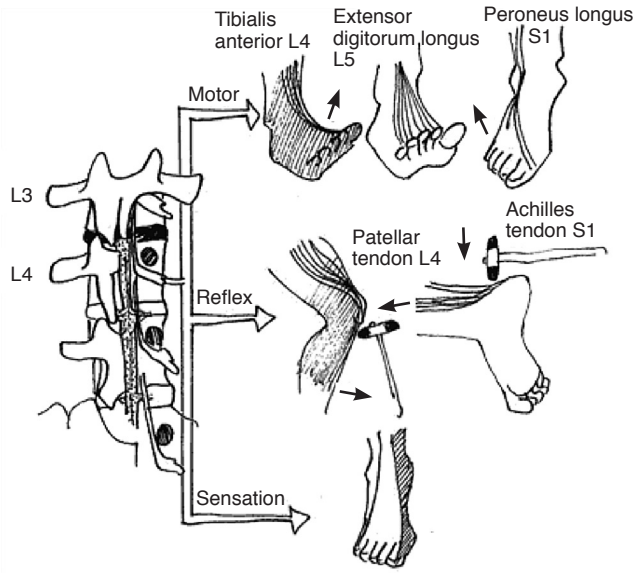


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**Table 4. Affected Nerve Roots And Their Corresponding Neurologic Examination Findings**

| Affected Nerve Root | Reflex | Pain Distribution | Affected Motor Weakness | Affected Sensory Loss |
|---|---|---|---|---|
| L1 | Cremasteric | Inguinal | Hip flexion | Inguinal |
| L2 | Cremasteric, thigh adductor | Inguinal, anterior thigh | Hip flexion and adduction | Anterior thigh |
| L3 | Patellar | Anterior thigh, knee | Quadriceps adductors | Anterior, medial thigh |
| L4 | Patellar | Anterior thigh, medial leg | Knee extension, hip flexion | Anterior leg, first toe, medial malleolus |
| L5 | None | Posterolateral thigh, lateral leg | Great toe dorsiflexion | Dorsal foot, middle 3 toes |
| S1 | Achilles | Posterior thigh and leg, lateral foot | Plantar flexion | Lateral foot, heel |

lumbar spine CT scans, and these tests should not be used as screening tools. Plain radiography is recommended in patients who have direct trauma-related back pain or in patients suspected of having a possible vertebral compression fracture. In addition, plain radiography is indicated in the young patient with lower back pain where ankylosing spondylitis is suspected.[25] In patients with low back pain and radiculopathic symptoms who are still symptomatic after 4 weeks of conservative management and self-care, imaging should be discussed with those deemed to be interventional candidates, as treatment options include injection therapy and surgery. Patients who have progressive or severe neurologic deficits on presentation and red flag signs and symptoms may harbor a lesion that needs to be treated within a certain time frame for good recovery, and they will need emergent imaging (usually an MRI scan).[26,27] **(See Figures 3 and 4.)** MRI scan with gadolinium is recommended when infection or cancer is suspected; otherwise, no contrast is required to evaluate disc disease or spinal stenosis. In patients who cannot undergo MRI imaging, CT scan with myelography can be substituted.

**Table 5. The Waddell Signs And Score**

| Category | Nonorganic Test | Nonorganic Sign |
|---|---|---|
| Tenderness | Superficial | Widespread tenderness to light pinches over lumbar skin |
| | Nonanatomic | Deep tenderness over a wide area, not localized to 1 structure; often extends to thoracic spine, sacrum, or pelvis |
| Simulation | Axial loading | Low back pain reported even when light pressure is given on the patient's head while standing |
| | Rotation | Low back pain reported when the shoulders and pelvis are passively rotated in the same plane as the patient stands with his feet together |
| Distraction | Distraction | Inconsistent limitation of straight leg raising in supine and seated position |
| Regional disturbance | Weakness | Partial cogwheel giving way in many muscle groups |
| | Sensory | Sensory disturbances include diminished sensation to light-touch, pinprick, and sometimes other modalities, in a "stocking" rather than a dermatomal pattern |
| Overreaction | Overreaction | Disproportionate verbalization, facial expression, muscle tension and tremor, collapsing, or sweating during examination |

If 1 nonorganic test in a category is positive, then the category is positive. A Waddell score is positive if ≥ 3 categories are positive.

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## Emergency Department Ultrasound

ED ultrasound is an excellent tool to rapidly assess for abdominal aortic aneurysm. Test characteristics by emergency physicians are excellent, with sensitivity of 100%, specificity 98%, positive predictive value 93%, and negative predictive value 100%.[28] An ED ultrasound can also be utilized to evaluate for urinary retention and postvoid residuals in patients suspected of having cauda equina syndrome.

## Laboratory Testing

Blood testing may be indicated if patients are being worked up for medical conditions causing their back pain. Patients with fever and suspected spine infection (most likely hematogenous, such as endocarditis) should have an erythrocyte sedimentation rate

**Figure 3. Osteomyelitis And Abscess**


Magnetic resonance imaging reveals edema of paraspinal muscles and a fluid collection near L3-L4 with possible osteomyelitis (see arrow). The patient underwent interventional radiology abscess drainage that grew methicillin-sensitive *Staphylococcus aureus.* He was treated with 6 weeks of intravenous nafcillin.

Image courtesy of Pierre Borczuk, MD.

(ESR) test, as this is a sensitive, albeit nonspecific, test. An elevated ESR can also be present in patients with cancer and multiple myeloma. An elevated creatinine and elevated calcium may also be clues leading to the diagnosis of multiple myeloma.

In some patients, a urinalysis will be needed to evaluate for pyelonephritis and renal colic, although these conditions usually present with other signs (fever, vomiting, colicky pain) that distinguish them from more musculoskeletal etiologies.

## Treatment

In order to understand outcome assessment in therapy for low back pain, there are several concepts that need review. First of all, what is the definition of a "meaningful change?" Is the change in symptoms that is reported a statistic alone (usually interpreted as the minimal detectable change) or a clinical change – one that is most likely to be impactful on the patient's life? These may include physical examination findings and scales that assess patient function. Scales utilized to measure status can suffer from ceiling or floor effects. For example, measuring status in an athlete and asking about daily living function may not reflect the degree of functional loss at his premorbid activity level; the ability to sprint or reach personal best times may be better assessment variables. The same is true with patients who are severely impaired at baseline, and a scale that is too optimistic may not accurately reflect degrees of improvement. In this review, the author will examine a multitude of pooled data analyses leading to conclusions; it is important to note whether the researchers have done a balanced search of the literature to find studies to pool and that they have not biased their search and data collection.[29] Given these caveats, the next section will examine evidence on treatment modalities.

**Figure 4. Posterior Disc Herniation**


Magnetic resonance imaging (MRI) T2 sagittal images without contrast demonstrates a L5-S1 posterior disc herniation in a patient with back pain and sciatica symptoms. Since his symptoms had been ongoing for 3 months, were resistant to medical therapy, and had concordant MRI findings, he underwent epidural steroid injection treatment. The asterisk is over the L5 vertebral body; the arrow points to the herniated disc.

Image courtesy of Pierre Borczuk, MD.

### Measuring Effectiveness Of Treatment

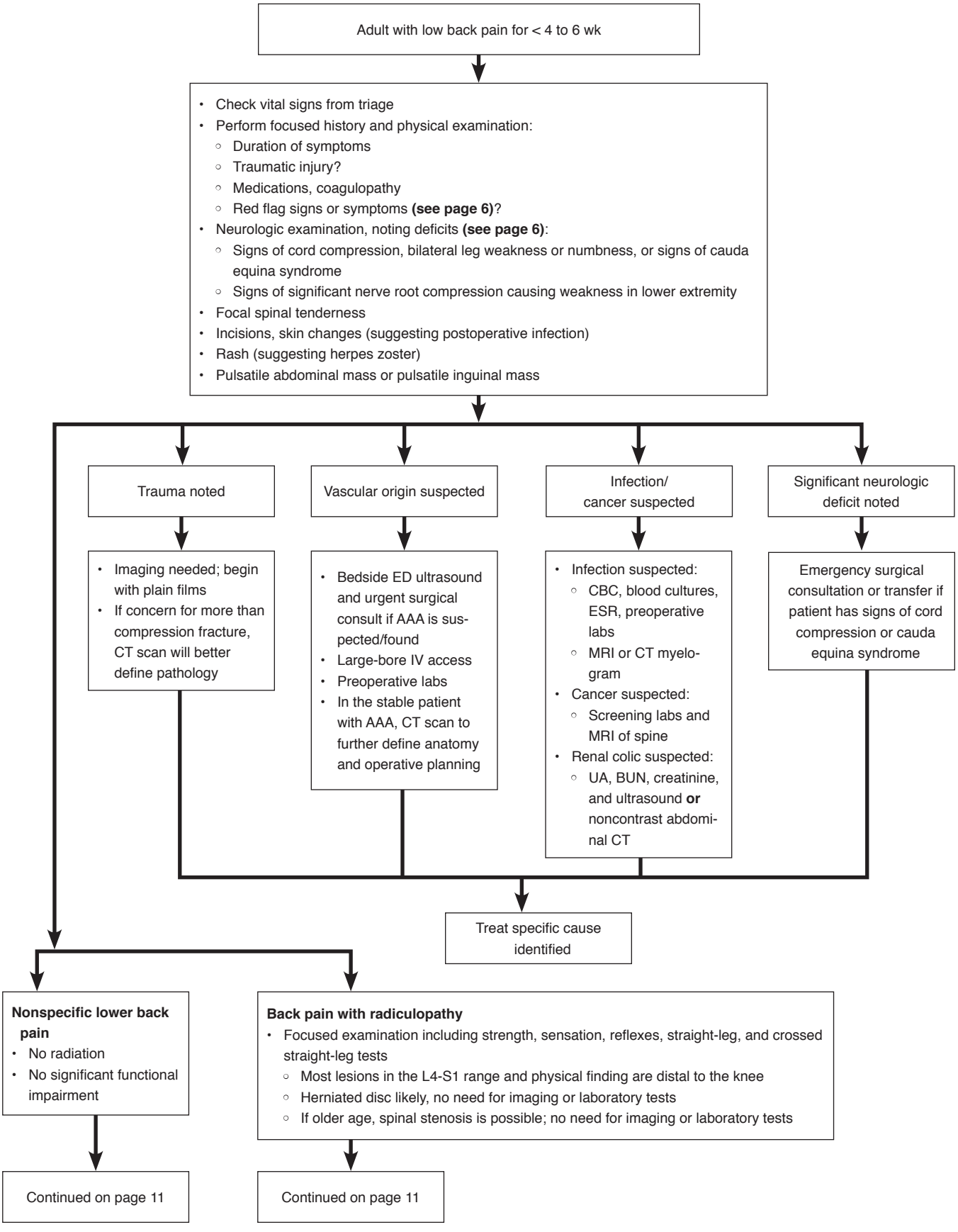
Visual analog scales are commonly used for reporting pain. On a 0 to 100 visual analog scale, small changes are considered to be changes of 5 to 10 points, medium changes to be 10 to 20 points, and large changes to be > 20 points. Another measure that is used in medication trials is the standard mean difference (SMD), which is calculated using the formula:

SMD = (drug improvement - placebo improvement) ÷ standard deviation

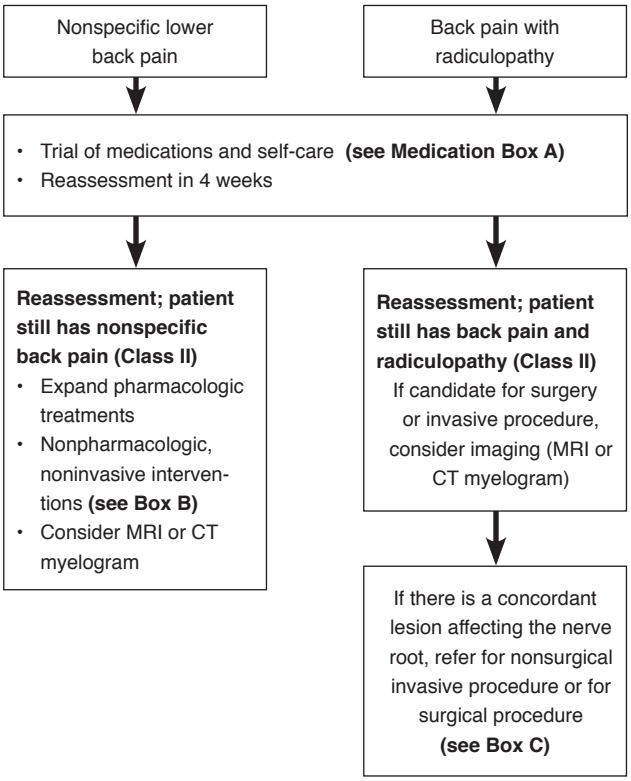
The denominator attempts to take into account variability between trials and allows one to compare them. Positive SMD means that the medication is more efficacious than placebo, and negative SMD means that the medication is less efficacious than placebo. In terms of absolute quantities, it is convention that changes of 0.2 are small, 0.5 are medium, and 0.8 are large.[30]

A questionnaire is another tool utilized to measure effectiveness of therapy. The 2 most commonly utilized are the Roland-Morris Disability Questionnaire (available at http://www.rmdq.org/) and the Oswestry Low Back Pain Disability Index (available at: http://www.outcomesdatabase.org/node/674). The Roland-Morris Disability Questionnaire contains 24 yes/no questions, each scored with 1 point, and includes items such as "I find it difficult to turn over in bed because of my back," and, "Because of my back, I use a handrail to get upstairs." A difference of 30% pretreatment and posttreatment is considered a minimal clinically important change.[31] The Oswestry Low Back Pain Disability Index has multiple questions and is split up into sections, including directed pain questions relating to sitting, standing, personal care, and social life. A 4-point difference is considered the minimal change that is clinically significant. The United States Food and Drug Administration (FDA) has used a 15-point minimal difference of the Oswestry Low Back Pain Disability Index in the evaluation of spinal fusion outcomes.[30,32] All of these have limited usefulness in the ED.

# Clinical Pathway For Management Of Low Back Pain In The Emergency Department (Continued on page 11)



# Clinical Pathway For Management Of Low Back Pain In The Emergency Department (Continued from page 10)




**Box A: Medication and Self-Care (Class II)**
- Patient education on low back pain
- Remain active
- Superficial heat
- Acetaminophen 650-1000 mg q6h, not to exceed 4 g/day; use caution in patients with liver disease
- Ibuprofen 400-600 mg q6h with food; use caution in patients with diabetes, renal disease, or ulcer disease/GERD or in patients on antiplatelet therapy or anticoagulants
- Skeletal muscle relaxants: diazepam 5 mg q8h or tizanidine 4-8 mg bid; caution patients that these medications can cause dizziness/drowsiness and that they should not perform dangerous activities or drive
- Tramadol for breakthrough pain: 50 mg q12h, titrated up to 400 mg/day; there is a potential for opiate addiction. Other opioid pain relievers can be used in limited quantities

**Box B: Nonpharmacologic Interventions (Class III)**
- Spinal manipulation
- Physical therapy
- Acupuncture
- Massage
- Cognitive behavioral therapy

**Box C: Invasive interventions (Class II)**
- Epidural steroid injection
- Discectomy
- Decompressive surgery for spinal stenosis

Abbreviations: AAA, abdominal aortic aneurysm; bid, 2 times per day; BUN, blood urea nitrogen; CBC, complete blood count; CT, computed tomography; ED, emergency department; ESR, erythrocyte sedimentation rate; IV, intravenous; GERD, gastroesophageal reflux disease; q, every; MRI, magnetic resonance imaging; UA, urinalysis.

## Class Of Evidence Definitions

Each action in the clinical pathways section of *Emergency Medicine Practice* receives a score based on the following definitions.

**Class I**
- Always acceptable, safe
- Definitely useful
- Proven in both efficacy and effectiveness

*Level of Evidence:*
- One or more large prospective studies are present (with rare exceptions)
- High-quality meta-analyses
- Study results consistently positive and compelling

**Class II**
- Safe, acceptable
- Probably useful

*Level of Evidence:*
- Generally higher levels of evidence
- Nonrandomized or retrospective studies: historic, cohort, or case control studies
- Less robust randomized controlled trials
- Results consistently positive

**Class III**
- May be acceptable
- Possibly useful
- Considered optional or alternative treatments

*Level of Evidence:*
- Generally lower or intermediate levels of evidence
- Case series, animal studies, consensus panels
- Occasionally positive results

**Indeterminate**
- Continuing area of research
- No recommendations until further research

*Level of Evidence:*
- Evidence not available
- Higher studies in progress
- Results inconsistent, contradictory
- Results not compelling

Significantly modified from: The Emergency Cardiovascular Care Committees of the American Heart Association and representatives from the resuscitation councils of ILCOR: How to Develop Evidence-Based Guidelines for Emergency Cardiac Care: Quality of Evidence and Classes of Recommendations; also: Anonymous. Guidelines for cardiopulmonary resuscitation and emergency cardiac care. Emergency Cardiac Care Committee and Subcommittees, American Heart Association. Part IX. Ensuring effectiveness of community-wide emergency cardiac care. *JAMA*. 1992;268(16):2289-2295.

A summary of the evidence levels, grade of evidence, and benefit of the most-used interventions for low back pain is presented in **Table 6.**

## Pharmacologic Treatment

Choosing the right medication to help with a patient's symptoms requires individualization and must balance the benefits and efficacy of the drug with its potential side effects as well as its interactions with the patient's other medical and psychosocial conditions.[33,34] This section will review the major classes of medications used in patients with acute and chronic lower back pain syndromes.

### Acetaminophen

Based upon studies on osteoarthritis, there is evidence that acetaminophen (paracetamol) is a useful drug for treating patients with pain, though there are incomplete data for patients with low back pain. One trial showed no difference when compared to placebo, and another showed inferiority to nonsteroidal anti-inflammatory drugs (NSAIDs).[35,36] The longest time frame that has been studied is 5 weeks, with sample sizes of < 60 patients. The most common doses studied were 4 g/day and 2 g/day. Given its favorable side-effect profile and safety in pregnancy, it remains a good initial choice. Care must be used in patients with a history of liver disease.

### Nonsteroidal Anti-Inflammatory Drugs

Besides providing an analgesic effect, this class of drugs has the added effect of combating inflammation. There are > 60 trials (> 11,000 patients) examining the effect of NSAIDs, of which 28 trials are considered to be high quality, and this class of drugs has been the topic of Cochrane reviews.[37,38] These medications are useful in back pain management and are less useful at relieving radicular pain. The most commonly studied NSAIDs are ibuprofen, naproxen, indomethacin, diclofenac, piroxicam, and diflunisal. The medications are superior to placebo in both acute and chronic back pain. There is conflicting information regarding efficacy when compared to acetaminophen, though there are data demonstrating that NSAIDs have more side effects. These drugs do not modify the process that has caused the back pain, do not decrease time to return to work, and do not decrease the chronicity of symptoms in patients who have chronic pain syndromes. Also, there are newly described cardiovascular risks to this class of drugs (in addition to the known renal and gastrointestinal side effects). There does not appear to be any difference between selective and nonselective cyclooxygenase (COX) NSAIDs for pain relief; however, the COX-2 selective NSAIDs have shown decreased gastrointestinal effects in these studies.[37]

### Muscle Relaxants

Muscle relaxants comprise a heterogeneous category of medications that also includes benzodiazepines. Commonly used muscle relaxants are cyclobenzaprine, tizanidine, metaxalone, and diazepam.[39] Tizanidine is an alpha-2 adrenergic agonist that acts on supraspinal neurons at the spinal level to decrease spasticity, and it has been shown that it can reduce the need for other analgesic medication.[40]

**Table 6. Low Back Pain Interventions, Summary Of Evidence Level And Grade[3]**

| Intervention | Level of Evidence* | Grade | Net Benefit† |
|---|---|---|---|
| Acetaminophen | Fair | B (acute) | Moderate |
| NSAIDs | Good | B (acute) | Moderate |
| Muscle relaxants | Good | B (acute) | Moderate |
| Tramadol | Fair | B | Moderate |
| Opioids | Fair | B (acute) | Moderate |
| Neuropathic pain medications | Fair | C (chronic) | Small |
| Antidepressants | Good | B/C (chronic) | Small to moderate |
| Systemic steroids | Fair | D | None |
| Bed rest | Good | D | None |
| Heat | Fair | C | Small |
| Exercise | Good | B | Moderate |
| Acupuncture | Fair | B (chronic) | Moderate |
| Massage | Fair | B (chronic) | Moderate |
| Individualized education | Fair | B (chronic) | Moderate |
| Interdisciplinary physical therapy | Good | B (chronic) | Moderate |
| Psychological therapy | Good | B (chronic) | Moderate |
| Traction | Fair | C | None |
| TENS | Poor | Insufficient evidence | Unknown |
| Spinal manipulation | Good | B (chronic) | Moderate |
| Prolotherapy | Good to fair | C | None |
| Trigger point injections | Good to fair | C | None |
| Facet joint injections | Good to fair | C | None |
| Epidural steroid injections | Fair | B | Moderate |
| Spinal cord stimulation | Fair | B | Moderate |

*A level of "fair" requires studies good enough to determine an effect; "poor" means studies are insufficient to assess effects due to low power, inconsistencies, or trial design flaws.

†Net benefit is based on pain scale, standard mean difference changes, or Oswestry Disability Index improvements.

Abbreviations: NSAIDs, nonsteroidal anti-inflammatory drugs; TENS, transcutaneous electrical nerve stimulation.

Reprinted and adapted from: Chou R, Qaseem A, Snow V, et al. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. *Annals of Internal Medicine*. 2007;147. Used with permission of American College of Physicians.

In a high-quality trial, Berry and Hutchinson included cyclobenzaprine (versus tizanidine and placebo), and they found that it had no effects superior to placebo.[40] In a double-blind randomized controlled trial with 20 patients, cyclobenzaprine was found to be equivalent to diazepam for paravertebral spasms,[41] and it was shown to be superior to baclofen in a double-blind randomized controlled trial of 100 patients with multiple sclerosis.[42] This drug has anticholinergic side effects and can cause dry mouth, and it should be used cautiously in patients with bladder outlet obstruction.

A systematic review of 30 trials (23 of which were high quality and mostly on acute back pain) revealed strong evidence that muscle relaxants are better than placebo after 2 to 4 days (relative risk [RR] 0.8; 95% CI, 0.71-0.89). There was a significant increase in the number of central nervous system-related side effects in patients treated with these drugs (RR, 2.04; 95% CI, 1.23-3.37). Considering their side effects and minimal outcome, there is very little evidence to suggest that muscle relaxants should be a standard form of therapy in the ED for chronic low back pain. There was no difference in performance among the various categories of muscle relaxants.[39]

**Topical Medications**

The lidocaine 5% patch was approved by the FDA for postherpetic neuralgia and has been used in patients with other painful syndromes, including lower back pain. The studies performed are small and nonrandomized, but they do show a small improvement in pain scores.[43,44] Topical NSAIDs have been available outside the United States for some time, and the FDA approved topical diclofenac in 2007. There are good data from 34 trials and over 7600 patients demonstrating efficacy of topical diclofenac versus placebo for over 50% relief of pain due to chronic musculoskeletal conditions. There does not appear to be any difference in pain control when compared with oral NSAIDs; however, there are fewer gastrointestinal side effects. Local skin irritation can result from the use of these formulations.[45]

**Neuropathic Pain Medications**

Neuropathic pain medications are drugs that affect ion channels and alter the effects of the neurotransmitter inhibitor gamma aminobutyric acid. These medications include gabapentin (Gralise®, Horizant,® Neurontin®), divalproex sodium (Depakote®), lamotrigine (Lamictal®), pregabalin (Lyrica®), and topiramate (Topamax®), which have primarily been used as anticonvulsants. While these drugs have been studied for treatment of postherpetic neuralgia, fibromyalgia, and diabetic neuropathy, they have not been systematically studied for the treatment of acute lower back pain. There is 1 trial that demonstrated a small effect of gabapentin on patients with radicular pain.[46]

**Antidepressants**

These categories of medicines are classified into 2 general types: cyclic antidepressants and selective serotonin reuptake inhibitors. The cyclic antidepressants have been used to treat neuropathic pain, presumably via their effects on sodium channels as well as by modifying adrenergic synaptic activity in brainstem pain pathways. There are few trials of these drugs in low back pain. In 1 meta-analysis, there appears to be benefit over placebo with a SMD relief of pain of 0.41 (95% CI, 0.22-0.61) for pooled data. The treatment times studied ranged from 4 to 6 weeks.[47] In a Cochrane review of 10 trials and pooled data, there was no difference in pain relief when compared to placebo (SMD, -0.04; 95% CI, -0.25 to 0.17).[48]

There are little data on selective serotonin reuptake inhibitors and back pain. Duloxetine (Cymbalta®), one of the selective serotonin-norepinephrine reuptake inhibitors, was approved in 2010 for the treatment of musculoskeletal pain. This industry-sponsored study was performed in patients with chronic lower back pain who were treated for 13 weeks with duloxetine.[49]

**Opioid Analgesics**

There are few studies of opioids alone for the treatment of lower back pain, and most trials excluded patients who were deemed to be at a high risk for abuse. Studies looking at opioids versus placebo, not surprisingly, showed benefit for opioids in pain control. Trials included comparisons of propoxyphene to placebo and long-acting morphine and long-acting oxycodone to placebo (difference in 100-point visual analog scale of -18.21 [morphine] and -18.55 [oxycodone]).[50] One study (50 patients, 24-day follow-up) examined codeine versus acetaminophen and demonstrated decreased mean back-to-work times that were statistically significant (10.7 vs 13 days).[51] Most research examined short-acting versus long-acting opioids, included patients who were opioid-experienced, measured changes to visual analog scales, quantitated the use of rescue medications, and examined side effects. The bottom line was that there was little difference in any of these medications. These reviews did not address the issue of addiction.

Tramadol has been studied in chronic low back pain versus placebo, and it is moderately effective, with a SMD of 0.71 for pain control (95% CI, 0.39-1.02) and a SMD of 0.17 for functional improvement (95% CI, 0.04-0.30).[52] The largest study included 254 patients receiving tramadol 200 to 400 mg per day with significantly lower ($P <= .0001$) mean pain visual analog scores (on a 10-cm scale) among tramadol patients (3.5 cm) compared to placebo patients (5.1 cm) at the final visit.[53] The American College of Emergency Physicians has published a clinical policy for opioid use in the ED, and it specifically mentions patients with low back pain, with recommendations

to restrict treatment with opioids (classified as a Level C recommendation) to patients with severe pain, and even then, with limited amounts of medications (specifically < 7-day courses).[5] The emergency clinician should consider the risks of misuse, abuse, and diversion of medication.

### Systemic Steroids

There are no meta-analyses examining the use of steroids in the treatment of lower back pain. One study on the use of oral steroid tapers and single injectable (intramuscular) steroids demonstrated no clinical benefit of these treatments for sciatica.[54] There are small trials (placebo-controlled and of higher quality) of oral and intramuscular steroids for the treatment of patients with sciatica pain (< 70 patients) that show no benefits of systemic steroids when compared to placebo.[54,55]

## Nonpharmacologic Treatment For Acute And Chronic Lower Back Pain

Another treatment category available for patients with lower back pain is nonpharmacologic therapies, and there is significant clinician variability in recommending these treatments, alone or in adjunct with medications.[56] "Physical therapy" is a broad term that includes the following: exercise therapy, transcutaneous electrical nerve stimulation (TENS), low-level laser therapy, massage, traction, lumbar support, and heat/cold treatments. We will review most of these elements in the following sections. There is no evidence that traction, low-level laser light therapy, or lumbar supports are useful in treating back pain. Interdisciplinary rehabilitation and back schools score high on patient satisfaction scales and may play a larger role in future management of chronic pain syndromes.[57,58]

### Bed Rest

With regard to both pain and functional improvement, there are small, consistent improvements at 3 to 4 weeks from staying active versus bed rest in patients with nonspecific back pain. A 2000 Cochrane review included 9 randomized controlled trials.[59] These were moderate-quality trials and included the landmark study by Malmivaara et al in which the SMD (pain) of 0.22 (95% CI, 0.02-0.41) and the SMD (function) of 0.31 (95% CI, 0.06-0.55) showed improvement with activity over bed rest and exercises.[60] However, when bed rest was studied in patients with sciatica (low-quality trials), there was no benefit with pain (SMD, -0.03; 95% CI, -0.24 to 0.18) or functional status (SMD, 0.19; 95% CI, -0.02 to 0.41) between the groups.[61] Strict bed rest is not indicated as a usual form of therapy.

### Education And Back Schools

Does individual patient education affect outcomes in low back pain? This was the question for a Cochrane review that included 24 studies (of which 14 were of high quality) and examined education versus no intervention as well as education incorporated with other treatments. There is strong evidence that a 2.5-hour individual session is effective in decreasing return-to-work times, though less-intensive sessions were no more effective than no intervention. Education is as effective as other therapies in patients with chronic pain, as measured by functional status.[62] There have been 19 randomized controlled trials (totaling approximately 3500 patients) of the use of back schools in chronic pain management. Six trials are of higher quality, and there is moderate evidence that targeted education is better than placebo to improve function, decrease pain, and decrease back-to-work times.[63]

### Behavioral Therapy

Behavioral interventions aim at identifying psychological obstacles to recovery from low back pain. Based on Roland-Morris Disability Questionnaires and a logistic regression analysis on 1500 patients with low back pain, 1 study identified the following 4 patient perception factors as the greatest predictors of outcomes: (1) that the pain will last well into the future, (2) that many other symptoms they are having are related to their back pain, (3) that there is little they can do to control this problem, and (4) that they have low confidence in their ability to perform normal activities.[64] The cognitive-behavioral model emphasizes the role patients can have in controlling their pain and it includes relaxation techniques, pain distraction techniques, improvement of coping skills, and instruction of patients in dealing with a wider and wider range of daily situations. There are 7 trials examining cognitive therapy, with improvements in pain control (SMD, 0.62; 95% CI, 0.25-98) and other moderate-quality randomized controlled trials of biofeedback and relaxation (SMD 0.84; 95% CI, 0.35-1.15).[65] However, there are no quality data comparing behavioral therapy against other treatment modalities, or how long these effects last, so there are no definitive recommendations.

### Exercise Therapy And Yoga

Supervised stretching and strengthening can decrease return-to-work time and may have small effects on pain.[66] A Cochrane review of 9 studies and 1113 patients revealed moderate-quality evidence that an exercise program is useful to prevent recurrences of low back pain episodes but not as a primary treatment.[67] There are no systematic reviews on yoga and low back pain.

### Massage

A Cochrane review identified 8 trials that included massage (using hands or a mechanical device) versus other active therapies (exercise, physical therapy, and education).[68] Most of these data are not of high

enough quality to be conclusive. One trial that was of higher quality suggested that, at 1-month follow-up, the effect of massage plus education is better than education alone.[69]

### Traction

This procedure involves mechanical stretching of the spine, with a therapist or a device with weight, and also includes devices from which the patient suspends, utilizing gravity to stretch the back. The hypothesis is that this technique will relax muscles and improve impingement. There have been 25 randomized controlled trials, including 1045 patients, examining traction in patients with acute pain/chronic pain and sciatica. When these studies are pooled, there does not appear to be any benefit to traction in these groups.[70]

### Heat

According to a prospective randomized parallel single-blind placebo-controlled multicenter clinical trial of 219 patients by Nadler et al, heatwrap therapy was shown to provide significant pain relief for treatment of low back pain.[71] There is 1 Cochrane review of heat versus cold that concluded that heat wraps can decrease pain in 3 to 7 days, and, in some patients, provide better relief than acetaminophen or ibuprofen (Roland-Morris Disability Questionnaire score changes of 2 points, an amount that is usually below what is felt to be clinically significant).[72] This review included 9 trials of 1100 patients, and it was of moderate quality.

### Transcutaneous Electrical Nerve Stimulation

TENS devices are portable devices that deliver an electric current to the skin surface with the notion that nerve stimulation can modify pain interpretation. A randomized study of 145 patients found that there was no benefit to TENS with regard to pain control function or amount of back flexion. In patients who stopped exercising, any improvement related to exercise was transient.[73] A Cochrane review of 4 high-quality randomized controlled trials that included 585 patients demonstrated no improvement in functional status or healthcare utilization from TENS treatments.[74]

### Acupuncture

Based upon a Cochrane review, there are 35 randomized controlled trials for this intervention and only 3 trials in acute low back pain.[75] The acute pain trials had small numbers of patients and were inconclusive. Acupuncture had moderate effects in the treatment of chronic back pain and functional status when compared to no treatments (SMD, 0.62; 95% CI, 0.19-0.78), but there are conflicting trials,[76] and many showed no changes when compared to sham acupuncture.

### Spinal Manipulation

There have been over 60 trials and multiple systematic reviews looking at spinal manipulation in both acute and chronic pain. These interventions have small effects over placebo in pain control, and, in some studies, they appear to be as effective as acetaminophen or NSAIDs and perhaps worth 5 points on a 0 to 100 visual analog scale. The risk for a serious adverse effect for lower back manipulation is estimated to be 1 per 1 million patient visits.[77,78] In a Cochrane review of 26 randomized controlled trials of 6070 patients, there was no clinically significant change in pain relief (SMD, -4.16; 95% CI, -6.97 to -1.37) or functional status (SMD, -22; 95% CI, -36 to -0.07) when compared to other interventions in patients with chronic back pain.[79]

## Nonsurgical Invasive Therapies

This category includes injections and other therapies that are typically performed by orthopedists, physiatrists, and pain management specialists.

### Injections External To The Spine

Local injections, trigger point injection, botulinum injections, and prolotherapy (injecting a chemical irritant) have all been tried to alleviate back pain symptoms. There are no randomized controlled trials of prolotherapy available.[80] There are no high-quality trials suggesting that any of these techniques are useful in low back pain management.[81]

### Injection Therapy, Spine-Related

A Cochrane review of injection therapy in patients with subacute and chronic pain examined 18 trials (1179 patients), with varied injection sites (epidural, facet, local/trigger sites), with corticosteroids and local anesthetics. There was no strong evidence that injection therapy was useful, with the caveat that perhaps future research can identify a subgroup of patients that might show improvement.[82]

### Facet Joint Injections

Based on studies done in the 1960s and 1970s, the facet joint was believed to be the source of back pain symptoms.[83,84] Naturally, investigators have tried facet injections with lidocaine and steroids. Carette et al examined facet methylprednisolone injections versus placebo in 95 patients and found no beneficial differences between placebo in the short term and no long-term benefit (> 6 months).[85] A larger study of 454 patients also found no significant improvement in patients with facet injections and commented on the multiple psychosocial issues that contributed to the back pain syndrome as explanation for the lack of efficacy.[86] Pooled studies have also demonstrated lack of efficacy for this procedure.[82]

### Epidural Steroid Injections

These are procedures where steroids and an anesthetic are placed in close approximation to the nerve root believed to be responsible for the patient's symptoms. There are over 40 trials and dozens of placebo-controlled studies examining this procedure. Carette et al performed a double-blind placebo-controlled study in patients with sciatica related to a herniated disc. Patients had improvement for 6 weeks, but at 3-month follow-up, there was no difference in the 2 groups in terms of pain, sciatica symptoms, or the need for back surgery.[87] There are trials that show moderate effects (improvement in straight-leg-raising-induced symptoms) at 1 year,[88] and 1 study showed a decreased need for surgery, recommending injections prior to surgical consideration.[89] A Cochrane review of pooled data from 4 trials that included epidural injections found no difference in epidural steroid injection in patients with sciatica (duration > 4 wk) for short-term (< 6 wk) pain relief (RR, 0.93; 95% CI, 0.79-1.09).[90] Another systematic review found that epidural steroid injections were superior in symptom improvement to placebo in a group of patients with acute and chronic sciatica.[91] These are conflicting data in the short term, but they all support the conclusion that there is no long-term benefit to this procedure.[92] There are no studies that examined epidural steroid injections versus sham injections.

### Other Procedures

There are several other procedures, including percutaneous intradiscal radiofrequency thermocoagulation (PIRFT), and radiofrequency denervation intradiscal electrothermal therapy (IDET) that are described. There are no placebo-controlled studies and no clear patient improvements with these therapies.

### Spinal Cord Stimulation

This procedure involves the implantation of epidural electrodes and a subcutaneous generator, and it has been used in patients who have chronic pain syndromes despite back surgery (failed back surgery syndrome). Data support the use of this device, as there is a decrease in pain reported after follow-up of almost 3 years in addition to a decrease in adjunct opiate use.[93,94] There are no data to support the use of these devices in patients with chronic pain syndromes without prior surgery.[95] Complications of this procedure include electrode migration, electrode infection, pocket infections, and other lead problems; these complications have occurred in 26% to 32% of patients in randomized trials.

### Vertebroplasty

This procedure is specific for patients with vertebral compression fractures and involves injection of bone cement into the vertebral bodies, with or without prior kyphoplasty (insertion of a balloon to augment the vertebral body and allow space for the cement). Vertebral compression fractures without neurologic findings were traditionally treated with pain control. These procedures were introduced as a way to rapidly improve symptoms, but when they were studied in randomized, blinded, sham injection controls, there were no differences in pain control at 1 week, 3-month, and 6-month follow-up.[96,97]

## Surgical Treatment Of Back Pain

The United States has the highest rate of back pain surgery in the world, with procedures that include spinal fusion for degenerative joint disease-related pain, discectomy for herniated discs, and laminectomy for spinal stenosis. There are significant regional variations in back surgery rates (up to 8-fold) within the United States, which is the largest seen with any surgical procedure. In the decade from 1992 to 2002, Medicare spending for lumbar fusions rose 500%, to $482 million per year, and it accounted for 47% of spending for back surgery care.[98] Back surgery can be divided into procedures to treat pain versus procedures to treat radiculopathy. Obviously, these procedures cannot be blinded, which is a limitation to research protocols.[99,100]

### Fusion

Spinal fusion is a procedure for nonradicular back pain due to degenerative disease changes. The goal of the procedure is to limit movement and, therefore, to eliminate the presumed cause of the pain. There are multiple trials examining this procedure versus nonsurgical therapy. Interpretation of results is limited by small sample sizes, different fusion techniques utilized, and different comparison arms of nonsurgical treatments. Overall, the results are inconsistent, and no significant benefit can be attributed to a surgical approach.[101] A randomized controlled 2-year trial of 294 patients from the Swedish lumbar spine study group (surgery versus physical therapy) showed improvement in pain in the surgery group that lasted 6 months.[102]

### Surgery For Radiculopathy

There are high-quality trials examining patients with sciatica who had surgery on a radiologically confirmed concordant herniated disc. In a study of 283 patients with sciatica for 6 to 12 weeks who were randomly assigned to microdiscectomy versus conservative management, there was faster improvement in relief of the leg pain, but both groups were equivalent after 1 year.[103] In the Spine Patient Outcomes Research Trial (SPORT), 501 patients with at least 6 weeks of radiculopathic pain and confirmed disc herniations were randomized to open discectomy versus various nonsurgical therapies. There was no significant difference between these 2

groups at any follow-up time interval.[104] The Maine lumbar study is a prospective cohort group that observed nonrandomized patients treated with surgery versus conservative therapy. The surgical patients, at baseline, had more severe lesions on imaging. At 1-year follow-up, there was significantly greater improvement in pain and leg symptoms in the surgical group than the nonoperative group, although there was no difference in degree of employment or workers' compensation claims.[105] At the 10-year mark, there was still better pain control and/or resolution of pain as well as better patient satisfaction in the surgically treated group.[106] In a review of randomized controlled trials for the surgical management of disc prolapse, results from 40 randomized controlled trials concluded that discectomy provides faster relief of pain than conservative management and that this improvement showed benefit at the 1-year mark. However, there was no difference in long-term follow-up at 4 and 10 years. The authors felt that microdiscectomy procedures were comparable to standard discectomy.[99]

#### Decompressive Surgery For Spinal Stenosis

The SPORT trial also evaluated this group of patients in a cohort study of 654 patients with surgery versus medical therapy. At follow-up in 3 months, 1 year, and 2 years, there was benefit in the surgical group regarding pain and function. There were no differences in these 2 groups with respect to disability on an Oswestry Low Back Pain Disability Index scale.[107] These changes persisted at 4-year follow-up.[108]

## Special Circumstances

### The Pediatric Patient

Pediatric back pain is an uncommon presentation, and, historically, all pediatric patients are considered to be, as a matter of age alone, red flag patients. While most cases are not serious, this group of patients is more likely than adults to have underlying pathology as a cause of their pain. Tumors, discitis, and malignancy are more common causes of back pain in children aged < 10 years. In a 7-year review of 87 patients with thoracic and lumbar back pain (mean age 13.4 years), 31% had a specific diagnosis. The top 5 diagnoses were spondylolisthesis, herniated disc, scoliosis, spondylolysis, and osteoid osteoma.[109] Osteoid osteoma is a common benign tumor of bone, occurring anywhere is the body, and 90% occur in patients under the age of 25.

Another category of pediatric patient is the athlete with back pain, and in this group, one needs to consider the pars interarticularis fracture, or spondylolysis, which most commonly occurs at L5.[110] Workup of the pediatric patient with back pain may include plain films for trauma, laboratory tests (ie, erythrocyte sedimentation rate) to evaluate for infection, and more specific studies for the workup of ankylosing spondylitis.

## Controversies And Cutting Edge

Despite being universally recommended for back pain, acetaminophen has never been studied in a randomized placebo-controlled trial. The PACE trial will be the first trial to examine the use of acetaminophen in low back pain, and it has enrolled 1600 patients with interval follow-up for up to 12 weeks.[111]

Another issue in back pain evaluation revolves around drug abuse. Prescription drug abuse is a serious and growing problem in the United States, and it is estimated that 20% of the population have used prescription drugs for nonmedical reasons.[112] In 2009, there were more than 200 million prescriptions written for opioids. As frontline healthcare providers, emergency clinicians need to be cognizant of this problem and be more vigilant with medication prescriptions. There are guidelines from the Ameri-

## Time- And Cost-Effective Strategies

- The overwhelming majority of patients with lower back pain and back pain with sciatica symptoms will get better in 4 to 6 weeks with conservative therapy. These patients do not need laboratory workup or imaging.
- MRIs are, essentially, preoperative imaging tests and should be reserved for patients who have neurologic findings that will require assessment for surgery or possibly one of the injection therapy treatments. Emergency use of MRI should be limited to patients with signs and symptoms of cord compression, cauda equina syndrome, or multilevel findings of weakness. In addition, patients with suspected spinal infection and impending cord compression related to cancer will also need emergent imaging.
- Plain radiography/CT scanning is useful to evaluate for vertebral fractures; however, they are not the studies of choice for the majority of patients without trauma. Plain films can be useful for the evaluation of vertebral compression fractures in patients at risk for osteoporosis.
- Most patients can be managed by their primary healthcare provider and do not require specialty consultation in the ED or specialty outpatient referral.
- Adherence to widely published guidelines will decrease imaging, laboratory ordering, and treatments that have not been shown to be efficacious.

## Risk Management Pitfalls For Low Back Pain

1. **"I didn't realize that he had a prior history of melanoma that was resected 2 years ago."**
   Red flag signs, symptoms, and history are essential in the management of these patients. While some of these syndromes (eg, cauda equina syndrome, epidural abscess) are uncommon in the general population, they become a real possibility in the patient with metastatic cancer or in the patient who injects drugs.

2. **"My 70-year-old male patient with back pain had syncope in the waiting room and was rushed to the trauma bay. I thought the systolic pressure of 70 mm Hg was just an error, as the repeat was 120 mm Hg."**
   More thought needs to be given to older patients with back pain, as their symptoms may be arising not from typical muscular/discogenic/degenerative joint disease sources; they may be harboring a leaking abdominal aortic aneurysm or metastatic cancer. Consider systemic symptoms such as weight loss, fever, abdominal pain, and syncope as well as risk for peripheral vascular disease.

3. **"I remember seeing this patient 4 times this past year for toothache and headache. Now he has back pain! He does have a fever this time though, very clever!"**
   Even patients who are drug-seeking have real back pain. Some patients who inject drugs have infections that are the cause of this pain. There is no single laboratory test or examination finding that will rule out vertebral osteomyelitis or discitis.

4. **"The patient in bay 3 status post motor vehicle collision looks familiar. Oh yes, I just saw him for low back pain."**
   The medications prescribed for back pain can cause sedation; especially muscle relaxants in combination with opioids. Be sure to remind patients that they should not drive or perform dangerous tasks while using them.

5. **"While I was waiting for the patient to be discharged, he had a tonic-clonic seizure."**
   Know the side effects of the medications that you prescribe. Tramadol can decrease the seizure threshold and should not be used in patients who are at risk for seizure.

6. **"The patient told me he has had back pain and urinated on himself. I was very concerned and transferred him for emergency MRI. The MRI was normal, and I don't understand why."**
   Overflow incontinence and urinary retention are worrisome findings and do require emergent evaluation. However, sometimes patients just cannot make it to the bathroom because of back pain and physical limitations. Determining the cause of incontinence and assessing for postvoid residuals will improve imaging utilization.

7. **"The patient was just seen by the pain management specialist and had an epidural steroid injection yesterday. He is here again with back pain, and he cannot walk. He seems weak in his legs, but that's just pain."**
   Patients who are status postprocedure are at increased risk for developing complications that include epidural hematoma and spinal infection. These patients need imaging if they have new neurologic findings.

8. **"This patient has new paraspinal back pain and atrial fibrillation and is on warfarin. He has a hematocrit of 25, down 10 points, and is guaiac negative. His international normalized ratio is 4.8. His neurologic examination is unrevealing. I am going to send him home."**
   Be more vigilant in patients with other medical problems who are on medications that cause bleeding. This patient could return to the ED after a syncopal episode and have a retroperitoneal hemorrhage.

9. **"I just saw a 36-weeks' pregnant female with paraspinal/flank pain and mild nausea. I evaluated her baby with bedside ultrasound, and things seemed normal. I planned to discharge her, but then I found she had a fever of 38.3°C."**
   While back pain and sciatica are common in pregnancy, you should consider other causes in your differential. This patient could also have a urinary tract infection.

10. **"I should have thought of other causes of urinary retention in this 67-year-old male patient before placing the catheter and sending him home for urology follow-up."**
    Advanced age is a red flag sign; instead of benign prostatic hyperplasia with back pain, he could have had prostate cancer with spinal metastasis and cauda equina syndrome.

can College of Emergency Physicians specifically for low back pain that recommend that opioids not be routinely prescribed for patients with low back pain and that they be reserved for the most severe cases, for limited amounts, and for periods < 7 days.[5]

On a more positive note, there are new surgical and biologic treatments for degenerative disc disease. Total disc replacements are experimental procedures, intended to be an alternative to spinal fusion to restore flexibility to the intervertebral joint. Allogenic disc transplants have already occurred, and there is research on tissue engineering an intervertebral disc. Research is also being done using stem cells and growth factors to promote biologic repair.[113]

## Disposition

In our world of instant gratification and speed-of-light messaging, it may be disappointing for patients to hear that it can take weeks for their symptoms to resolve, but emergency clinicians can provide patients with self-care recommendations as well as medications that will help them get past the worst of their painful symptoms. It should be emphasized that MRI scans are used as preprocedure imaging studies and that, in the absence of significant neurologic findings, they are not indicated in the acute setting and will not alter management. Patients will need to resume normal activity, and they will need follow-up with their outpatient healthcare provider. **(See Figure 5.)**

Individuals with red flag symptoms, signs, or history will need further workup in the ED. Those patients with signs of cauda equina syndrome or cord compression will need emergency imaging, input from a spine specialist, and possibly a radiation oncologist, and these patients will require admission. This can either be obtained in the ED or the patient will need to be transferred to an institution that can provide that level of care. There is little downside to empiric steroid treatment for presumed cord compression if any delay is anticipated before diagnosis is made.

### Figure 5. Sample Discharge Instructions

Low back pain is discomfort in the lower back that may be due to injury to muscles and ligaments around the spine. Occasionally, it may be caused by a problem to a part of the spine called a disc. The pain may last several days or a week; however, most patients get completely well in 4 weeks.

**Self-care:** The application of heat can help soothe the pain. Maintaining your daily activities, including walking, is encouraged, as it will help you get better faster than just staying in bed.

Medications are also useful to help with pain control. A commonly prescribed medication includes acetaminophen. This medicine is generally safe, though you should not take more than 8 of the extra-strength (500 mg) pills a day.

**Nonsteroidal anti-inflammatory medications, including ibuprofen and naproxen:** These medications help both pain and swelling and are very useful in treating back pain. They should be taken with food, as they can cause stomach upset, and more seriously, stomach bleeding.

**Muscle relaxants:** These medications can help with muscle tightness that is a cause of lower back pain. Most of these medications can cause drowsiness, and it is not safe to drive or use dangerous machinery while taking them.

You will need to follow up with your primary healthcare provider in 1 to 2 weeks for reassessment.

Be aware that if you develop new symptoms, such as fever, leg weakness, difficulty with or loss of control of your urine or bowels, abdominal pain, or more severe pain, you will need to seek medical attention and/or return to the emergency department.

## Summary

The evaluation of the patient with low back pain is an exercise the emergency clinician performs multiple times during a shift, and it should be done in a focused, caring, but also cost-efficient manner. While there are still questions to be answered as to which treatments are best in which subgroup of patients, it is clear that the majority of patients get better in 4 weeks. The goal of the evaluation is to identify the patient who is harboring a life-threatening problem or a condition that can lead to permanent disability. Remembering the red flag symptoms and performing a focused neurologic examination are essential elements in patient risk stratification and will define the extent of workup and imaging. There are well-documented clinical guidelines that will support your decision-making process. NSAIDs and muscle relaxants are useful therapeutics in patients with acute pain, and all patients will benefit from some degree of back pain education. Chronic back pain patients may benefit from physical therapy, behavioral therapy, and more formal back pain classes. Procedures for back pain are generally useful for short-term relief of pain and radiculopathy; however, many do not alter prognosis after 1 year, when compared to nonsurgical therapies.

## Case Conclusions

*You wanted to be sure your 45-year-old construction worker patient had no red flag signs or symptoms, so you specifically asked him if he had any prior history of cancer and inquired into his habits (including illicit drug use) and told him that use of intravenous drugs would alter your management. Your physical exam was consistent with a radiculopathy. You inquired about bowel or bladder abnormalities, and he reported all was good on that*

*front. You made a diagnosis of lumbar radiculopathy, and you decided to treat with NSAIDs and a muscle relaxant. You explained that no imaging or blood testing was needed and informed him that his symptoms needed to be reassessed in 4 weeks, as more than 85% of patients are better by then. He asked for extra pain medication, and you agreed to a short course of tramadol. He will follow up with his workers' compensation clinic, and they will determine when he can return to work.*

*Management of your second patient was challenging on many levels because of her drug use and medical noncompliance. In addition to noting that she had several red flag findings and was at high risk for a medical cause of her back pain (bacteremia, endocarditis, epidural abscess, osteomyelitis, discitis), she was at risk for leaving against advice, mid-evaluation. You needed to assess for decision-making capacity and prevent flight from the ED. She needed an MRI with gadolinium and antibiotic with Staphylococcus coverage. An epidural abscess at T12-L1 was discovered, and you referred her for an evaluation for drainage procedure by a spine surgeon.*

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Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study will be included in bold type following the reference, where available. In addition, the most informative references cited in this paper, as determined by the authors, are noted by an asterisk (*) next to the number of the reference.


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## CME Questions


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**1. Which of the following is NOT a red flag symptom of low back pain?**
a. Age > 50 years
b. Pain > 2 weeks' duration
c. Intravenous drug use
d. Corticosteroid use

**2. Most disc pathology in the spine occurs at levels:**
a. T9-T11
b. T11-L1
c. L2-L4
d. L4-S1

**3. Regarding examination findings, which statement is TRUE?**
a. The crossed straight-leg examination is sensitive but not specific.
b. The crossed straight-leg examination is specific but not sensitive.
c. The straight-leg examination is neither sensitive or specific.
d. Loss of strength with right great toe dorsiflexion implies a right-sided L4 root impingement.

**4. Which physical examination finding might you find in a patient with a right S1 nerve root compression?**
a. Lateral leg pain
b. Loss of right patellar reflex
c. Loss of right ankle reflex
d. Weakness in knee extension

5. **An emergent MRI is indicated when:**
   a. You suspect a vertebral compression fracture.
   b. The patient has been having pain > 6 weeks.
   c. The patient presents with 1 week of back pain and right leg numbness.
   d. The patient has back pain and dribbles urine.

6. **Which statement is FALSE?**
   a. Epidural steroid injection therapy can be effective for short-term symptom relief.
   b. Fusion back surgery leads to long-term improvement in back pain versus nonsurgical therapies.
   c. Microdiscectomy is comparable to standard discectomy.
   d. There are long-term studies demonstrating the usefulness of spinal decompression for spinal stenosis.

7. **Your 85-year-old patient has a T12 vertebral compression fracture but no neurologic complaints. The next step is:**
   a. Refer for vertebroplasty intervention.
   b. Check calcium level to rule out osteoporosis.
   c. Treat with NSAIDs or acetaminophen.
   d. Obtain an MRI to evaluate for spinal cord injury.

8. **One cause of back pain that is more common in the pediatric athlete is:**
   a. Spondylosis
   b. Spondylolisthesis
   c. Vertebral body fracture
   d. Spondylolysis

9. **Which treatment plan for chronic back pain is NOT evidence-based as effective?**
   a. Bed rest for 2 days, then short walks twice a day.
   b. Apply heat to the lumbar area.
   c. Muscle relaxants are helpful.
   d. NSAIDs are helpful for pain control.

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