

REVIEW

Evaluating and Managing Acute Low Back Pain in the Primary Care Setting

Steven J. Atlas, MD, MPH, Richard A. Deyo, MD, MPH

Acute low back pain is a common reason for patient calls or visits to a primary care clinician. Despite a large differential diagnosis, the precise etiology is rarely identified, although musculoligamentous processes are usually suspected. For most patients, back symptoms are nonspecific, meaning that there is no evidence for radicular symptoms or underlying systemic disease. Because episodes of acute, nonspecific low back pain are usually self-limited, many patients treat themselves without contacting their primary care clinician. When patients do call or schedule a visit, evaluation and management by primary care clinicians is appropriate. The history and physical examination usually provide clues to the rare but potentially serious causes of low back pain, as well as identify patients at risk for prolonged recovery. Diagnostic testing, including plain x-rays, is often unnecessary during the initial evaluation. For patients with acute, nonspecific low back pain, the primary emphasis of treatment should be conservative care, time, reassurance, and education. Current recommendations focus on activity as tolerated (though not active exercise while pain is severe) and minimal if any bed rest. Referral for physical treatments is most appropriate for patients whose symptoms are not improving over 2 to 4 weeks. Specialty referral should be considered for patients with a progressive neurologic deficit, failure of conservative therapy, or an uncertain or serious diagnosis. The prognosis for most patients is good, although recurrence is common. Thus, educating patients about the natural history of acute low back pain and how to prevent future episodes can help ensure reasonable expectations.

KEY WORDS: acute low back pain; evaluation; management; review; primary care.

J GEN INTERN MED 2001;16:120-131.

Nothing certain can be said regarding the diagnosis of such a case (of low back pain) until the lapse of some time has made it clear that nothing else is going to develop. After this we may settle down more or less discontentedly, with the

diagnosis of what some orthopedic specialists call a "functional back." This is a very familiar clinical entity, whatever its real cause and best nomenclature may be.¹

Low back pain is a common and costly medical condition. While low back pain rarely indicates a serious disorder, it is a major cause of pain, disability, and social cost. The annual prevalence of low back pain in the United States is estimated at 15% to 20%,² and the lifetime prevalence is over 60%.^{3,4} The costs associated with low back pain include the direct cost of medical care and the indirect costs of time lost from work, disability payments, and diminished productivity. In the workplace, low back pain is the most costly ailment, with an average cost of \$8,000 per claim, and accounts for one third of workers' compensation costs.⁵ The estimated annual national bill for the care of low back problems is \$38 to \$50 billion.⁶

Low back pain is the fifth most common reason for all physician visits, and is the second most common symptomatic reason (upper respiratory symptoms are first).⁷ Although more than half of visits for low back pain are to primary care physicians, low back pain constitutes the most common reason for visits to orthopedists and neurosurgeons.⁸ Although back pain is a leading reason for visiting health care providers, many affected individuals never seek medical care. In a random telephone survey of North Carolina residents, only 39% of persons with low back pain sought medical care.⁹

Many may not seek medical care for back pain because episodes are typically brief. For patients with acute low back pain in primary care, 75% to 90% report improvement within 1 month.¹⁰⁻¹² Nonetheless, recent studies indicate that persistence of low-grade symptoms or recurrences are more common than previously recognized,¹³⁻¹⁶ with 25% to 50% of patients having additional episodes over the following year.^{14,15,17,18}

Variation in Evaluation and Treatment

Low back pain is managed by many different health care providers. General practitioners, internists, family practitioners, neurologists, rheumatologists, emergency physicians, and orthopedic and neurological surgeons all see patients with back problems. Nonallopathic providers of back care include osteopathic physicians, chiropractors,

From the General Medicine Division and the Medical Practices Evaluation Center, Medical Services, Massachusetts General Hospital, Harvard Medical School, Boston, Mass (SJA); and the Center for Cost and Outcomes Research and the Departments of Medicine and Health Services, University of Washington, Seattle, Wash (RAD).

Address correspondence and reprint requests to Dr. Atlas: General Medicine Division, Massachusetts General Hospital, 50 Staniford St., Boston, MA 02114 (e-mail: satlas@partners.org).

physical therapists, acupuncturists, and massage therapists. Among patients who use alternative medicine, back problems are the most frequently reported medical condition,¹⁹ and the use of alternative medicine is increasing.²⁰ Given the variety of health care providers who manage low back pain, variation in the evaluation and management of back pain is not surprising. Rates of hospitalization and surgery for low back pain vary widely by geographic region.²¹⁻²⁴

Few studies have compared outcomes and costs of acute low back pain among different providers. Depending upon the provider the patient initially sees, differences in the use of diagnostic technology (plain x-rays, computed tomography [CT], or magnetic resonance imaging [MRI] imaging), treatments, and referral to other professionals providing back care may result. In one large study comparing primary care practitioners, chiropractors, and orthopedic surgeons, diagnostic testing, intensity and nature of treatments, overall cost of care, and patient satisfaction were shown to vary widely among different provider groups.²⁵ In spite of differences in resource use and satisfaction with care, patient outcomes were remarkably similar among the different practitioner groups.

Even among similarly trained providers, differences in practice style may influence the quality and cost of care for low back pain. In a large health maintenance organization, the practice styles of 44 primary care physicians were categorized by the frequency of pain medication prescriptions and recommendations for bed rest.²⁶ Although long-term outcomes were similar across physicians, lower costs and higher patient satisfaction

were associated with physicians who prescribed less medication and bed rest.

Given the frequency of the problem, the variation in its evaluation and treatment, and its generally good prognosis, improving the efficiency of care for patients with back pain in primary care is needed.²⁷ Because the etiology of most acute low back pain remains uncertain, the initial evaluation focuses on excluding rare but potentially serious causes, and identifying patients at greater risk for prolonged symptoms. Initial management for most patients includes measures for symptom relief, education, and reassurance about the favorable natural history. For patients with signs of radiculopathy, potentially serious causes of back pain, or risk factors for prolonged symptoms, diagnostic testing, referral, and alternative treatments may be indicated. This review focuses on the majority of patients with acute nonspecific symptoms, but detailed discussions of less common causes of acute low back pain are available.²⁸⁻³²

ETIOLOGY AND PATHOPHYSIOLOGY

Low back pain refers to spinal and paraspinal symptoms in the lumbosacral region. "Acute" typically means a duration of less than 2 to 4 weeks, subacute is up to 12 weeks, and chronic typically refers to more than 12 weeks. Various diagnostic classifications for patients with low back pain exist.^{33,34} The Quebec Task Force on Spinal Disorders categorizes patients based upon history (location and duration of symptoms and working status), clinical findings and response to treatment.³⁴ The differential

Table 1. Differential Diagnosis of Low Back Pain*

Mechanical Low Back Pain	Nonmechanical Spine Disease	Visceral Disease
Lumbar strain or sprain [†]	Neoplasia	Pelvic organs
Degenerative disease	Metastatic carcinoma	Prostatitis
Disks (spondylosis)	Multiple myeloma	Endometriosis
Facet joints [‡]	Lymphoma and leukemia	Chronic pelvic inflammatory disease
Diffuse idiopathic skeletal hyperostosis [‡]	Spinal cord tumors	Renal disease
Spondylolysis [§]	Retropertoneal tumors	Nephrolithiasis
Spondylolisthesis [¶]	Infection	Pyelonephritis
Herniated disk	Osteomyelitis	Perinephric abscess
Spinal stenosis	Septic discitis	Vascular disease
Osteoporosis with compression fracture	Paraspinal or epidural abscess	Abdominal aortic aneurysm
Fractures	Endocarditis	Aortoiliac disease
Congenital disease	Inflammatory arthritis	Gastrointestinal disease
Severe kyphosis	Ankylosing spondylitis	Pancreatitis
Severe scoliosis	Reiter's syndrome	Cholecystitis
Paget's disease	Psoriatic spondylitis	Perforated bowel
	Inflammatory bowel disease	
	Polymyalgia rheumatica	

* Adapted from Deyo.²⁹

[†] A variety of terms are used to refer to muscle or ligament strains or sprains of the low back including lumbago, facet joint syndrome, sacroiliac syndromes, segmental or somatic dysfunction, fibromyalgia, and myofascial syndrome.

[‡] The relationship between symptoms and objective findings for these conditions is not clearly established.

[§] Spondylolysis is a defect in the pars interarticularis without vertebral slippage.

[¶] Spondylolisthesis is anterior displacement of one vertebra, typically L5, over the one beneath it.

Table 2. Prevalence of Potentially Serious Causes of Acute Low Back Pain in Primary Care*

Etiology	Estimated Prevalence, %
Compression fracture	4
Spondylolisthesis	3
Herniated disk	1 to 3
Neoplasia, primary or metastatic	0.7
Ankylosing spondylitis	0.3
Cauda equina syndrome	0.04
Infection	0.01
Spinal stenosis	Unknown

* Adapted from Deyo et al.³⁶

diagnosis of low back pain is broad and includes mechanical and nonmechanical causes (Table 1).²⁹

For most patients with acute low back pain in primary care, the etiology is thought to be a mechanical cause involving the spine and surrounding structures. Unfortunately, in most cases, a precise pathoanatomic cause cannot be reliably confirmed by physical examination or diagnostic testing. This is due to weak associations among symptoms, examination findings, and anatomic changes. In contrast to the nonspecific etiology of most mechanical causes, nonmechanical causes (such as cancer or infection) can be diagnosed with greater certainty. However, they represent a small fraction of acute low back pain in primary care (Table 2). Thus, for patients with acute low back pain, an exact etiology is identifiable in only about 15%.³⁵

Mechanical Conditions

A wide range of terms are used for nonspecific mechanical causes, including low back pain/strain/sprain, lumbago, facet joint syndrome, sacroiliac syndromes, segmental dysfunction, somatic dysfunction, ligamentous strain, and myofascial syndrome. These typically involve processes in the muscles and/or ligaments that are difficult to reliably identify by physical examination or diagnostic testing.²⁹ Even when back pain is associated with specific imaging findings such as degenerative disk disease, spondylolysis, spondylolisthesis, or osteoporosis, it may be impossible to determine whether the finding is the cause of the patient's symptom (discussed extensively in the Diagnostic Testing section). Occasionally, the source may be the hip joint and musculature.

For initial management, the presence or absence of neurological findings may be a more clinically useful distinction than the extensive differential diagnosis presented in Table 1. In contrast to nonspecific back pain, the etiology of a radiculopathy is often identifiable, with a herniated intervertebral disk the most common.³² The peak incidence is from 30 to 55 years of age, with 98% involving the L4-5 (L5 nerve root) or L5-S1 (S1 nerve root) interspaces. In older individuals, radiculopathy may be due to spinal stenosis, a narrowing of the central spinal canal or

its lateral recesses that impinges on adjacent nerve roots. Other anomalies, such as scoliosis, facet joint synovial cysts, and spondylolisthesis can cause radiculopathy, as can fractures, tumor, infection, or vascular compromise.³² Occasionally, patients have radicular findings without a clear etiology, which may be due to soft tissue processes irritating nerve roots as they exit the spinal interspaces, or hypertrophic degenerative bony changes that compromise the nerve root canal.

Nonmechanical Conditions

Traditionally, much of the evaluation of low back pain has been targeted at finding rare, nonmechanical spine disorders. Broadly, they include neoplasia, infection, and inflammatory arthritis such as ankylosing spondylitis (Table 1). The prevalence of these serious conditions is difficult to estimate (Table 2), especially in the primary care setting, but all are distinctly uncommon. Most conditions associated with other visceral organs involve abdominal, pelvic, or retroperitoneal processes adjacent to the spine (Table 1). Most of these conditions cause symptoms in addition to low back pain. Patients without symptoms or signs suggesting mechanical low back pain should be questioned about gastrointestinal and genitourinary symptoms.

HISTORY AND PHYSICAL EXAMINATION

The epidemiology and etiology of acute low back pain indicate that most patients seen by primary care providers have a self-limited, nonspecific mechanical cause. Thus, the goal of the evaluation is to efficiently exclude potentially serious causes and to identify patients who may be at higher risk for delayed improvement due to abnormal physical findings or psychosocial issues. The extent to which the clinician searches for a specific diagnosis can be determined largely by the patient's history and physical exam.³⁶ Although internists have traditionally spent much of the clinical encounter searching for uncommon causes of back pain, the search is rarely fruitful, and leaves little time to educate patients about self-care.

Ideally, screening for rare underlying diseases should be sensitive enough to identify all cases (true positives), while being specific enough to avoid identifying a large number of individuals who will turn out to have a nonspecific mechanical cause (false-positives).³⁷ There is an inherent tradeoff between increasing sensitivity and decreasing specificity. Because the prevalence of potentially serious causes of acute low back pain is very low in the primary care setting, most patients with suggestive history or examination findings will prove to have a nonspecific mechanical cause on further testing (low positive predictive value).

Recent guidelines for acute low back pain assist with this process of efficiently evaluating patients.²⁷ The history and physical examination can identify patients at risk for

Table 3. History and Physical Examination Findings Associated with an Increased Likelihood for a Serious Back Condition*

Disorder	History	Physical Exam
All	Duration of pain >1 month Bed rest with no relief	
Cancer	Age \geq 50 years Previous cancer history Unexplained weight loss [†]	Neurologic findings* Lymphadenopathy
Compression fracture	Age \geq 50 years (\geq 70 years more specific) Significant trauma [‡] History of osteoporosis Corticosteroid use Substance abuse [§]	
Infection	Fever or chills Recent skin or urinary infection Immunosuppression Injection drug use	Fever (>100°F or 38°C) Tenderness over spinous processes

* Most commonly due to a herniated lumbar disk or lumbar spinal stenosis rather than malignancy.

[†] Unexplained weight loss is defined as more than 10 pounds over the preceding 6 months.

[‡] Significant trauma is a fall from height or external trauma such as a motor vehicle accident.

[§] Substance abuse can increase the risk for fracture through higher rates of trauma. Alcohol abuse can also increase the risk for fracture through decreasing bone density.

serious causes of low back pain and those with neurologic compromise who warrant more detailed evaluation and treatment.³⁶ Additionally, the history and physical exam can identify factors that may influence choice of therapy or may amplify or prolong pain. For most patients, the history and physical exam is sufficient to exclude the "red flags" that suggest serious disorders (Table 3).

The intent of the guidelines is to improve the appropriateness of diagnostic testing in the initial evaluation of acute low back pain, but rigid adherence may increase diagnostic testing compared to what clinicians otherwise do on their own.^{38,39} We recommend that guidelines be used to augment clinical skills and insight rather than be applied rigidly.

Systemic or Visceral Disease

A history of cancer, unexplained weight loss, age over 50 years, or failure of conservative therapy are risk factors for low back pain due to cancer (Table 3).⁴⁰ Most cancer involving the spine is metastatic from the breast, lung, or prostate. Factors associated with spinal infections include a history of recent or ongoing urinary or skin infections, indwelling catheter, or injection drug use. Fever is not a common symptom or finding (low sensitivity), but when present increases the chance of an infectious etiology. Compression fractures of the spine are associated with significant trauma, age over 50 years (though age over 70 years is more specific), corticosteroid use, or osteoporosis. Ankylosing spondylitis is suggested by morning stiffness, improvement with exercise, onset at age less than 40 years, slow onset, and pain for at least 3 months.^{41,42} Other factors such as symptoms unrelated to activity, pain that is worse when lying down, presence of atherosclerosis risk factors, and gastrointestinal or genitourinary symptoms can be help-

ful in suggesting other underlying visceral or systemic etiologies.

Neurologic Compromise

Sciatica refers to sharp or burning pain radiating down the posterior or lateral aspect of 1 or both legs, usually to the foot or ankle, and is highly sensitive (95%) for nerve root involvement, typically due to a herniated lumbar disk. The pain is worse when changing positions or when coughing or sneezing. Sciatica due to spinal stenosis is more typical in older patients and symptoms are more often bilateral. Neurogenic or pseudo-claudication, a related symptom seen in spinal stenosis, results in leg pain (can be radicular or not) that occurs when standing or walking and is relieved by sitting. Unlike ischemic leg pain, neurogenic claudication is not relieved by standing still, and may be worse when walking downhill. Neurogenic claudication suggests spinal stenosis, but not all patients with spinal stenosis will describe neurogenic claudication (modest sensitivity, but quite specific).⁴³

Although rare, severe neurologic compromise from the cauda equina syndrome is a true surgical emergency.^{28,44} It is due to any large space-occupying lesion centrally located in the spinal canal. It is suggested by severe or progressive nerve root injury. Patients may report urinary retention or incontinence, progressive leg or foot weakness (often bilateral), or bowel incontinence. Internists may see this symptom complex most often due to cord compression from malignancy, but it also occurs with massive midline disk herniation.

Physical Examination

Because most patients will not report radiating leg symptoms or other risk factors for a serious back condition,

Table 4. Physical Examination Findings Associated with Specific Nerve Root Impingement

Nerve Root	Strength	Sensation	Reflex
L2	Iliopsoas	Anterior thigh, groin	None
L3	Quadriceps	Anterior/lateral thigh	Patellar
L4	Quadriceps, ankle dorsiflexion (heel walking)	Medial ankle/foot	Patellar
L5*	First toe dorsiflexion	Dorsum of foot	None
S1*	Ankle plantarflexion (toe walking)	Lateral plantar foot	Achilles

* Most commonly involved in patients with sciatica due to a herniated lumbar disk.

“red flags,” a brief physical exam is usually sufficient. Patients should be assessed when standing and unclothed for spine symmetry, posture, and flexibility. Palpation can assess spinal (bone) versus paraspinal (soft tissue) pain and its severity. Unfortunately, the presence and location of soft tissue tenderness are poorly reproducible from physician to physician. An abdominal and/or pelvic exam may be indicated if the history is suggestive of pathology in these areas. For back pain associated with buttock or groin symptoms, the hip should be assessed for pain and range of motion.

For patients with leg symptoms, the remainder of the exam is meant to identify neurologic findings. The straight leg raise test is a fair screening test for nerve root irritation because it is modestly sensitive though not specific. The test can be done seated or supine by straightening the symptomatic limb with the ankle dorsiflexed and the knee fully extended. A positive response reproduces radiating leg pain when the limb is raised to less than 60°. Raising a leg and eliciting symptoms of buttock or leg pain on the contralateral side (crossed straight leg raise test) is very specific for nerve root irritation, but many patients do not report it (not sensitive).

For patients with symptoms of sciatica or a positive straight leg raise test, a more detailed lower extremity motor, sensory, and reflex examination is warranted (Table 4).⁴⁵ The examination often can be focused based upon the history obtained. For example, an otherwise healthy working age patient with sciatica is most likely to have a herniated disk as the etiology of his/her symptoms. Because over 95% of herniated disks involve the L4-5 or L5-S1 interspace, the L5 or S1 nerve root are involved in the great majority of herniated disks causing sciatica.

Motor weakness or diminished deep tendon reflexes, especially when asymmetric, can help identify the involved nerve root (Table 4). Decreased cutaneous sensation is a nonspecific finding unless it is in a unilateral, dermatomal distribution. Involvement of the L3 or L4 nerve root is suggested by quadriceps weakness (screen by squatting and then rising or by straightening a bent knee against resistance while seated), a diminished patellar reflex, and decreased sensation involving the anterior and lateral thigh across to the medial ankle and foot. Weakness of great toe and ankle dorsiflexors (have the patient heel walk) and abnormal sensory findings involving the dorsum of the foot suggest L5 nerve root involvement. No reflex test is available for L5. Evaluating the strength of plantar foot

flexion (have the patient walk on his or her toes) and checking the Achilles reflex assess involvement of S1. Finally, the lateral plantar foot is innervated by S1.

Examination findings consistent with the cauda equina syndrome include severe unilateral or bilateral weakness, progressive weakness from a previous exam, or a distended bladder. Saddle anesthesia and diminished anal sphincter tone may be absent initially but if present reflect progressive nerve damage.

Social and Psychological Factors

The history and physical exam are also helpful in identifying patients at high risk for persistent symptoms because of social or psychological stressors. A history of previous back pain, depression or other measures of psychological distress, substance abuse, pending or past litigation or disability compensation, low socioeconomic status, and work dissatisfaction have been shown to increase the likelihood of persistent low back pain.⁴⁶⁻⁴⁹ The physical exam may also be helpful in identifying patients who are more likely to have persistent symptoms. Waddell reported on certain physical findings in patients with chronic low back pain that predicted poor response to subsequent treatment (Table 5).⁵⁰

Whether early identification of patients at high risk for persistent symptoms can be used to improve outcomes of care is uncertain (e.g., early treatment of underlying depression, substance abuse, or other psychological stressors), but the hypothesis is rational and attractive. In the absence of proven strategies, we suggest earlier referral of

Table 5. Physical Examination Findings Associated with Prolonged Back Symptoms and Poor Response to Treatment*

Physical Examination Finding
1. Inconsistent performance of seated versus supine straight leg raise test
2. Tenderness that is superficial or widespread (light back touch or pain radiating up back)
3. Pain on simulated axial loading (top of head pressure) or spine rotation of the pelvis and shoulders in the same plane without spinal movement
4. Sensory or motor findings without anatomic distribution (stocking sensory or regional weakness)
5. General overreaction during exam

* Adapted from Waddell et al.⁵⁰

these patients for physical or cognitive behavioral therapy. Contact with employers may help to identify remediable social stressors or ergonomic demands in the workplace and to encourage light duty options for return to work.

DIAGNOSTIC TESTING

When considering whether a diagnostic test should be performed for a patient with acute low back pain, it is helpful to consider how the information will influence management. The focus here is on imaging studies, because they are most commonly performed and more costly than most laboratory tests.

Why Radiographic Imaging May Not Be Helpful

Radiographic imaging may not be helpful in identifying the cause of a patient's complaint of low back pain or in determining management for a variety of reasons. The two most compelling reasons are that imaging findings are poorly associated with symptoms (i.e., not specific), and important causes cannot be identified with plain radiographs (i.e., not sensitive).

Findings from both plain radiographs and advanced imaging studies are poorly associated with low back pain symptoms.^{2,51-55} The prevalence of lumbar disk degeneration increases with age beginning in the fourth decade and is common in patients without low back pain. A third of patients less than 30 years old have disk degeneration, as do 60% between 40 and 60 years and almost all patients over 60 years.⁵⁴ Similar findings are found for patients with vertebral osteophytes (spondylosis) and facet joint arthritis.² Spondylolisthesis (anterior displacement of one vertebra, typically L5, over the one beneath it) is found in 1% to 5% of normal subjects, and whether it is more common in symptomatic patients is controversial.⁵³ Mild degrees of slippage (grade 1, less than 25% of vertebral width) are the most common and appear to be as common in asymptomatic persons as those with back pain. More severe degrees of slippage (greater than 25%) are probably associated with symptoms, but are distinctly uncommon. Spondylolysis (defect involving the pars interarticularis) is equally prevalent in normal and symptomatic subjects. Other findings including congenital anomalies, disk calcification, Schmorl nodes (disk material within a vertebral body), and mild-moderate scoliosis are also found in both asymptomatic and symptomatic persons.⁵⁵

Lumbar disk herniation or spinal stenosis are radiographically detected only with advanced imaging such as CT or MRI. These findings have been observed in asymptomatic patients. In one study of subjects without a history of present or past back pain, a bulging disk was found in 40% to 50%, while a herniated disk was noted in 20% to 30%, with both findings more common in older subjects.⁵² Spinal stenosis, a common cause of back and leg pain in elderly patients, has been found in over 20% of normal subjects over 60 years old.^{51,52}

Plain radiographs are often obtained to help rule out serious causes of low back pain. Because such serious causes are distinctly uncommon in the primary care setting, the yield from radiographic studies is low.⁵⁶ In one review of plain lumbosacral radiographs, the yield of unexpected findings was only 1 in 2,500 for adult patients under age 50 years.⁵⁷ More importantly, however, the most common causes of nerve root irritation, a herniated intervertebral disk or spinal stenosis, cannot be diagnosed from plain radiographs. Among other serious causes of low back pain, plain radiographs may miss early tumors and spinal infections. A cost-effectiveness analysis showed small benefits associated with higher costs and additional gonadal radiation exposure.⁵⁸

Radiographic Testing: When and What to Get

Use of radiography among physicians is highly variable.⁵⁹ To improve appropriate diagnostic testing, clinical guidelines for the use of radiographs have been developed,^{27,56} but it is unclear whether they will improve appropriateness or decrease overall utilization.^{38,39,56,60}

Plain Radiographs. Routine plain lumbosacral spine radiographs are appropriate when risk factors for vertebral fracture are present (Table 3), or if the patient is not improving after a course of conservative treatment. Initial radiographs should include 2 views only, an anteroposterior and lateral.^{56,61} Obtaining additional views may be appropriate when the patient has had a fusion procedure and instability may be the cause of pain (include lumbosacral flexion/extension series), or after consultation with a radiologist.

Advanced Radiographic Studies. Studies such as CT or MRI should be obtained in patients with a history, examination, or prior tests that strongly suggest a serious cause for back pain, such as cauda equina syndrome, infection, or tumor. For patients with sciatica likely due to a herniated disk or spinal stenosis, unless major neurologic abnormalities are identified, early imaging is unnecessary because many patients will improve with conservative treatment.^{32,61} If such patients do not improve with a course of conservative care, imaging studies are appropriate. However, primary care providers may reasonably refer patients who may be surgical candidates (see Referral section) to orthopedic or neurological surgeons prior to obtaining a study, as surgeons may wish to order a specific test to assist with surgical planning.

Evidence supporting one advanced imaging technique over another for disk herniation is lacking.⁶² Computed tomography (without contrast) may be the preferred test if: (1) there is a need to evaluate bones (i.e., if suspect fracture, facet joint abnormality, severe degenerative changes); (2) a metallic object in patient precludes use of MRI; or (3) the patient has severe claustrophobia. Magnetic resonance imaging may be the preferred test if the patient

has had previous noninstrumented spine surgery (with gadolinium) or there is a history and examination suggestive of spinal stenosis, osteomyelitis, epidural abscess, tumor, or recent nondisplaced fracture.⁶³ Magnetic resonance imaging has the advantage of not using ionizing radiation and providing better resolution. Radionuclide bone scans can be used to evaluate for infection or fracture not noted on plain radiographs. However, MRI provides similar or better diagnostic accuracy without radiation exposure.⁶⁴ Myelography has few indications and should generally not be ordered by primary care providers.⁶²

Meeting Patient Expectations. Patient expectations may be another reason to consider performing a diagnostic test. However, this is rarely a good indication unless efforts by the physician are not able to dissuade the patient. Information about why such a test is not indicated is usually sufficient for most patients.⁶⁵ For patients insistent on an advanced imaging study, referring the patient to a conservative specialist may be an appropriate alternative. Patients with acute low back pain with pending litigation or disability compensation may request certain imaging procedures. Because of the poor association between symptoms and findings noted previously, the ordering of imaging studies for medicolegal reasons when the clinical evaluation does not support such testing should be documented in the clinical note.

Other Laboratory Studies

Other laboratory tests such as the erythrocyte sedimentation rate (ESR), complete blood count, or urinalysis can be helpful screening tests for infection, tumor, or nonspinal causes of low back pain.^{56,66} As is the case for radiographic imaging, routine laboratory testing for patients with low back pain is not needed. Selective use is appropriate when the history or examination suggests a neoplastic, inflammatory, or infectious process. The ESR is probably the most helpful test to screen for malignancy or infection when the suspicion is low (more sensitive than plain radiographs, but nonspecific).⁵⁶ Urinalysis is reasonable if bladder or kidney infection is suspected, but test strips for protein are not sensitive for Bence-Jones protein in multiple myeloma. Other tests such as gallium/indium scan, electromyography, or diskography (controversial for any use) should generally be performed only in consultation with a specialist.⁶¹

TREATMENT

Many therapeutic options are available for patients with low back pain, but few have been rigorously studied (Table 6). Attempts to meta-analyze the literature on various conservative treatments have been of limited value because the original studies are of poor methodological quality.^{27,67} Nevertheless, the primary emphasis of treatment should be conservative care, reassurance, and

Table 6. Conservative Treatments for Low Back Pain

Treatment	Strength of Evidence*
Oral drugs	
Nonnarcotic analgesics [†]	
Acetaminophen	C
Aspirin	B
Nonsteroidal anti-inflammatory agents	B
Narcotic analgesics [‡]	C
Muscle relaxants [‡]	C
Antidepressants [§]	C
Corticosteroids	C
Physical measures	
Bed rest	B
Activity modification [†]	D
Exercise [¶]	C
Manipulation [†]	B
Local heat	
Superficial (hot packs)	C
Deep (ultrasound or diathermy)	C
Local cold	C
Massage, mobilization, and other soft-tissue techniques	C
Corsets	D
Traction	B
Injection drugs	
Anesthetics (epidural and facet joint)	(D,C)
Corticosteroids (epidural and facet joint)	(D,C)
Intradiskal chymopapain	
Stimulation	
Acupuncture	D
Transcutaneous electrical nerve stimulation (TENS) [§]	C
Implanted neurostimulators [§]	C
Other	
Biofeedback [§]	C
Back school [§]	C
Behavioral therapy [§]	C

* Research-based evidence rating system from acute low back pain expert panel.²⁷ A, strong (multiple relevant and high-quality scientific studies); B, moderate (1 relevant, high-quality scientific study or multiple adequate scientific studies); C, limited (at least 1 adequate scientific study); D, no study meeting panel inclusion criteria.

[†] Recommended treatments for acute low back pain.²⁷

[‡] In selected patients, may be considered as appropriate treatments for acute low back pain.

[§] Generally reserved for chronic low back pain.

[¶] Exercise is not recommended during the acute phase, only after the acute symptoms subside.

education to offer symptom relief and allow patients time to improve on their own.

Telephone Evaluation and Management

Many patients with acute low back pain initially contact their health care providers by telephone. Changes in physician payment (such as capitated care as opposed to fee-for-service reimbursement) and practice patterns (group practices in large, integrated health plans) have encouraged alternatives to office visits.⁶⁸ Few studies have examined the effectiveness of telephone-based triage or management for common, benign conditions such as low

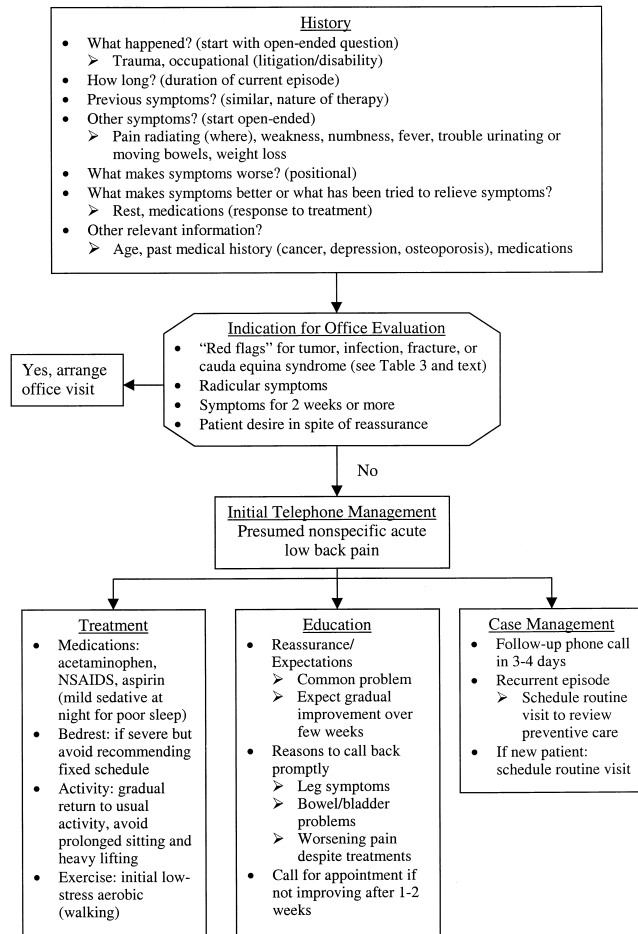


FIGURE 1. Clinical algorithm for the initial telephone triage and management of acute low back pain.

back pain.⁶⁹⁻⁷¹ Telephone evaluation by trained health care providers can identify patients who are likely to have self-limited low back pain that can be managed without an office visit, as well as identify those patients requiring an office evaluation. Figure 1 provides an algorithm for such telephone decision making, though such criteria for low back pain have not been validated.

Bed Rest for Brief Periods

Since the 1950s, bed rest has been one of the cornerstones of low back pain treatment based largely on expert opinion⁷² and on physiologic studies showing that disk pressures are minimized in the supine position.⁷³ By the early 1980s, bed rest recommendations were being questioned.⁷⁴ Randomized trials have tested the effect of varying recommendations for bed rest in patients with acute low back pain without radicular leg symptoms. Two versus 7 days of recommended bed rest resulted in similar outcomes, except those patients recommended 2 days of bed rest returned to work sooner.⁷⁵ Subsequent trials have compared no formal bed rest recommendation to 2 to 4 days of bed rest.⁷⁶⁻⁷⁸ These studies have shown improved outcomes, especially decreased work loss, are associated

with recommending usual activity as opposed to 2 to 4 days of bed rest. Thus, clinical trials have tested the effect of progressively less bed rest. Continuation of usual activity with no formal recommendation for any bed rest appears to be associated with better outcomes.

For patients with sciatica, bed rest remains a common recommendation.³² A recent randomized trial of 2 weeks of recommended bed rest versus maintaining activity as tolerated (bed rest not prohibited) found similar outcomes through 12 weeks.⁷⁹ Pending additional studies, limiting bed rest to periods of severe pain, encouraging early ambulating, and avoiding activities that provoke pain appear reasonable.

Activity Modification

As bed rest has been deemphasized, a more active approach to physical activity has been recommended. These recommendations are similar to those at the turn of the past century when the "disuse syndrome" was viewed as a prominent cause of low back pain.⁸⁰ The most common situations to avoid are prolonged sitting or standing. To avoid prolonged sitting at work or in a vehicle, patients should be instructed to get up at regular intervals (every 30 minutes) to walk and move their backs. Because changing positions can increase pain, attention while getting up or sitting down and doing it slowly may avoid recurrent back spasm.

Low-stress aerobic activities, especially walking, is the best early activity. Although evidence is meager, most experts recommend common sense activity modification.²⁷ Patients should generally avoid strenuous activity such as heavy lifting, climbing, or jogging until symptoms are improving over a period of a few days. Specific back exercises during the acute phase are not likely to help and may worsen symptoms.^{77,81} However, exercise may be important in preventing future back pain episodes and improving symptoms for those with chronic low back pain.^{82,83}

Medications

Nonsteroidal anti-inflammatory drugs (NSAIDs) and acetaminophen are the medications of choice for treating acute low back pain.^{27,84} Acetaminophen and nonsteroidal agents have been shown to be equally efficacious in treating knee osteoarthritis,⁸⁵ but no similar studies have been performed for back pain. Nonsteroidal agents are most commonly prescribed,⁸⁶ but acetaminophen is preferred in those with dyspepsia or known intolerance to aspirin or other nonsteroidal agents.

Muscle relaxants and opioids are commonly prescribed for low back pain, but have not been shown to be more effective than acetaminophen and NSAIDs in well-controlled studies.^{84,86} For patients without severe pain, muscle relaxants (drugs like diazepam or cyclobenzaprine) and narcotic painkillers (acetaminophen with codeine or oxycodone) offer few advantages and have more side

effects. When muscle relaxants and opioids are used, they should be prescribed for short, clearly defined periods (typically up to 1 to 2 weeks). For more severe pain that prevents restful sleep, sedatives, including antihistamines such as diphenhydramine, can be helpful. Muscle relaxants that cause sedation can also help with nighttime discomfort, and narcotic painkillers may be prescribed for short periods on a regular basis, especially for people with pain that radiates into the leg.

Physical Treatments

Several physical treatments are used in patients with acute low back pain, and referral for therapeutic exercise and manual therapy is common. Some of these treatments, including spinal manipulation,⁸⁷ may modestly hasten recovery but outcomes after 3 to 6 months and beyond are no different than for patients conservatively treated.^{88,89} Nonetheless, patient satisfaction with physical treatments is often higher than for physician-directed care.^{25,88} Physicians often refer patients to physical therapists, but similar forms of treatment may be sought from chiropractors and massage therapists, usually without the physician being aware.¹⁹

The optimal timing of referral, frequency, and duration of physical treatments are not clearly established.²⁷ Early referral to physical therapists may involve patient instruction about self-care and positioning rather than physical treatments, but has not been shown to be associated with better outcomes.^{77,90} Symptoms resolve in most individuals with acute low back pain within 2 to 4 weeks, and higher costs and similar long-term outcomes are associated with physical treatments, so therapy should be reserved for patients not responding adequately to initial conservative treatment. Additionally, physical treatment for more than 1 month and “preventive” treatments are unproven. Other physical treatments such as massage and ultrasound have not been well studied. The safety of spinal manipulation in patients with significant radicular symptoms is uncertain, and caution is warranted.

Other Treatments

Many other treatments are available for low back pain, but few have been systematically studied. Randomized trials of epidural steroid injections for patients with sciatica have shown conflicting results.^{27,91,92} The most recent study showed mild to moderate short-term improvement in leg pain and sensory deficit.⁹¹ Although epidural steroids are sometimes used as a means to avoid surgery, no study has been able to demonstrate this.⁹¹ Injections for acute low back pain without sciatica, including epidural, facet joints, trigger points, or ligamentous injections, are unproven. Randomized controlled trials of facet joint injections for chronic low back pain have shown no advantage over placebo injections.^{93,94} Other unproven treatments such as oral steroids, transcutaneous electrical nerve

stimulation (TENS), biofeedback, and traction should not be recommended in acute low back pain,²⁷ and their efficacy for chronic pain is uncertain.

Acupuncture has long been used in the treatment of pain, including low back pain.^{95,96} Few high-quality studies have examined the role of acupuncture in acute low back pain.²⁷ Like epidural steroid injections, acupuncture is used to treat sciatica that has not responded to other conservative treatments. Whether it can decrease the need for surgery is unknown. Acupuncture for nonspecific acute low back pain remains unproven.^{95,96}

WHEN TO REFER TO A SPECIALIST

Specialty referral should be considered for potential surgical candidates, those for whom the diagnosis is uncertain, or those unresponsive to therapy.

When to Refer for Surgical Evaluation

The cauda equina syndrome is a spinal emergency and requires immediate evaluation by an orthopedic or neurological surgeon. Otherwise, surgery for patients with sciatica due to a herniated lumbar disk or spinal stenosis is almost always elective. It is appropriate to consider a patient for surgery if he/she has a severe or progressive neurologic deficit, or meets all four of the following criteria: (1) leg pain is equal to or worse than back pain; (2) positive straight leg raise test; (3) no response to conservative therapy for 4 to 6 weeks for patients with a herniated lumbar disk or 8 to 12 weeks for those with spinal stenosis; and (4) imaging shows lesion corresponding to symptoms.

When to Refer for Diagnostic Evaluation for Persistent Low Back Pain

It is appropriate to consider referral if a serious spine condition (tumor, infection, fracture, or other suspected space-occupying lesion) is suspected. For patients with sciatica and equivocal or absent nerve root findings (abnormal strength, sensation, reflex) who are not improving with conservative therapy, referral to a neurologist, physiatrist, or orthopedic or neurological surgeon is appropriate. Referral may be appropriate for certain patients simply to provide reassurance.

For acute low back pain that is not improving, initial referral is usually for physical treatments. Patients with persistent symptoms despite physical treatments are often referred to orthopedists or rheumatologists for diagnostic evaluation. While reasonable, these evaluations are often unrevealing and the patient returns to the primary care provider with the label chronic back pain. The management of these patients is beyond the scope of this review.

PATIENT EXPECTATIONS: THE ROLE FOR EDUCATION

Because low back pain is self-limited in most primary care patients, an important goal is to establish reasonable

Table 7. Educational Teaching: What Patients Need to Know*

Content Domain	Key Points
Acute issues	
Etiology	Likely cause is nonspecific musculoligamentous strain
Natural history	Gradual improvement over few weeks
Evaluation	History and physical examination usually sufficient, testing rarely helpful initially
Treatment recommendations	Usual activity, minimize bed rest, analgesics; physical treatments if slow resolution
Work issues	Recommendations focus on job accommodation, avoid heavy lifting and prolonged sitting
Follow-up	When to contact primary care provider
Specialist referral	Abnormal progressive findings or not improving (especially if sciatica present)
Long-term issues	
Natural history	Recurrence common
Prevention	Back-friendly cardiovascular exercise (swimming, stationary bicycling, walking)
Work issues	Discuss career plans if work physically demanding or recurrent pain

* Patient information brochures are available from several sources on the Internet: <http://www.ahcpr.gov/consumer>, <http://orthoinfo.aaos.org>, <http://www.intelihealth.com/IH/ihdH/WSAUS000/331/9519.html>, and <http://www.rheumatology.org/patients/factsheet/backpain.html>.

patient expectations. Patient interest in alternative medicine providers may reflect concerns about the adequacy of care in the primary care setting. Besides offering different treatments, many alternative providers make very specific diagnoses and communicate this certainty to patients. This may account for greater satisfaction among patients of chiropractic compared with patients of primary care allopathic clinicians.^{25,88}

It is important to provide the patient with clear, concise information that emphasizes treatment as being time to heal and reassurance that the pain will improve. Education should include information on causes of back pain, pain resolution, why testing is rarely needed, usual activity/work and other treatment recommendations, when to contact the clinician, when referral is appropriate, and prevention (Table 7). Written material can reinforce verbal information. Despite the common sense view that patient education can improve outcomes, rigorous studies have been disappointing.⁹⁷⁻⁹⁹ However, for patients with sciatica considering surgery, those randomized to view an educational videodisc felt better informed, had equally good outcomes and were less likely to choose surgery than patients who received usual care.^{100,101}

CONCLUSIONS

The epidemiology and etiology of acute low back pain indicate that a self-limited, nonspecific mechanical cause is found in most primary care patients. Serious causes of low back pain are distinctly uncommon and an exhaustive search is rarely needed. An efficient history and physical examination can determine the likely cause of the complaint, whether diagnostic tests are needed, and which treatments are warranted. This leaves time to discuss conservative treatments and provide education that patients need to cope with their symptoms while they improve. Radiographic studies and laboratory tests should not be routinely ordered for patients with acute low back pain. Rather, selective use of tests should be based upon the history and physical examination and

initial response to treatment. For patients who are not improving with initial conservative care after 2 to 4 weeks, referral for physical treatments is appropriate. Surgical evaluation is usually reserved for patients with progressive neurologic findings or radicular pain that has not improved with conservative care. Patients with nonradicular back pain that has not improved with conservative physical treatments, or in whom the diagnosis is uncertain, may also be appropriate for specialist evaluation.

Supported in part by grants from the Agency for Health Care Policy and Research (HS-06344, HS-08194, and HS-09804).

REFERENCES

1. Cabot RC. Differential diagnosis. Presented through an analysis of 383 cases. Philadelphia, PA: W.B. Saunders: 1911:99.
2. Andersson GBJ. The epidemiology of spinal disorders. In: Frymoyer JW, Ducker TB, Hadler NM, Kostuik JP, Weinstein JN, Whitecloud TS, eds. *The Adult Spine: Principles and Practice*. Philadelphia, PA: Lippincott-Raven: 1997:93-141.
3. Cassidy JD, Carroll LJ, Cote P. The Saskatchewan health and back pain survey. The prevalence of low back pain and related disability in Saskatchewan adults. *Spine*. 1998;23:1860-7.
4. Leboeuf-Yde C, Lauritsen JM. The prevalence of low back in the literature. A structured review of 26 Nordic studies from 1954 to 1993. *Spine*. 1995;20:2112-28.
5. Webster BS, Snook SH. The cost of 1989 compensation low back pain claims. *Spine*. 1994;19:1111-6.
6. Frymoyer JW, Durett CL. The economics of spinal disorders. In: Frymoyer JW, Ducker TB, Hadler NM, Kostuik JP, Weinstein JN, Whitecloud TS, eds. *The Adult Spine: Principles and Practice*. Philadelphia, PA: Lippincott-Raven: 1997:143-50.
7. Hart LG, Deyo RA, Cherkin DC. Physician office visits for low back pain. Frequency, clinical evaluation, and treatment patterns from a U.S. national survey. *Spine*. 1995;20:11-9.
8. Cypress BK. Characteristics of physician visits for back symptoms: A national perspective. *Am J Public Health*. 1983;73:389-95.
9. Carey TS, Evans AT, Hadler NM, et al. Acute severe low back pain. A population-based study of prevalence and care-seeking. *Spine*. 1996;21:339-44.
10. Coste J, Delecoeuillerie G, Cohen de Lara A, Le Parc JM, Paolaggi JB. Clinical course and prognostic factors in acute low back pain:

- an inception cohort study in primary care practice. *BMJ*. 1994;308:577-80.
11. Deyo RA, Phillips WR. Low back pain. A primary care challenge. *Spine*. 1996;21:2826-32.
 12. Kelsey JL. *Epidemiology of musculoskeletal disorders*. New York, NY: Oxford University Press; 1992.
 13. Cherkin DC, Deyo RA, Street JH, Barlow W. Predicting poor outcomes for back pain seen in primary care using patients' own criteria. *Spine*. 1996;21:2900-7.
 14. Croft PR, Macfarlane GJ, Papageorgiou AC, Thomas E, Silman AJ. Outcome of low back pain in general practice: a prospective study. *BMJ*. 1998;316:1356-9.
 15. van den Hoogen HJ, Koes BW, van Eijk JT, Bouter LM, Deville W. On the course of low back pain in general practice: a one year follow up study. *Ann Rheum Dis*. 1998;57:13-9.
 16. Von Korff M, Saunders K. The course of back pain in primary care. *Spine*. 1996;21:2833-7.
 17. Carey TS, Garrett JM, Jackman A, Hadler. Recurrence and care seeking after acute back pain: results of a long-term follow-up study. *Med Care*. 1999;37:157-64.
 18. Von Korff M, Deyo RA, Cherkin D, Barlow W. Back pain in primary care. Outcomes at 1 year. *Spine*. 1993;18:855-62.
 19. Eisenberg DM, Kessler RC, Foster C, et al. Unconventional medicine in the United States. Prevalence, costs, and patterns of use. *N Engl J Med*. 1993;328:246-52.
 20. Eisenberg DM, Davis RB, Ettner SL, et al. Trends in alternative medicine use in the United States, 1990-1997: results of a follow-up national survey. *JAMA*. 1998;280:1569-75.
 21. Cherkin DC, Deyo RA, Loeser JD, Bush T, Waddell G. An international comparison of back surgery rates. *Spine*. 1994;19:1201-6.
 22. Ciol MA, Deyo RA, Howell E, Kreif S. An assessment of surgery for spinal stenosis: time trends, geographic variations, complications, and reoperations. *J Am Ger Soc*. 1996;44:285-90.
 23. Taylor VM, Deyo RA, Cherkin DC, Kreuter W. Low back pain hospitalization. Recent United States trends and regional variations. *Spine*. 1994;19:1207-13.
 24. Volinn E, Mayer J, Diehr P, Van Koeveering D, Connell FA, Loeser JD. Small area analysis of surgery for low-back pain. *Spine*. 1992;17:575-81.
 25. Carey TS, Garrett J, Jackman A, McLaughlin C, Fryer J, Smucker DR. The outcomes and costs of care for acute low back pain among patients seen by primary care practitioners, chiropractors, and orthopedic surgeons. *N Engl J Med*. 1995;333:913-7.
 26. Von Korff M, Barlow W, Cherkin D, Deyo RA. Effects of practice style in managing back pain. *Ann Intern Med*. 1994;121:187-95.
 27. Bigos SJ, Bowyer OR, Braen GR, et al. Acute low back problems in adults. *Clinical Practice Guideline no. 14*. Rockville, Md: Department of Health and Human Services; 1994. AHCPR publication no. 95-0642.
 28. Batchelor TT, Louis DN. A 67-year-old woman with the cauda equina syndrome. *N Engl J Med*. 1997;337:1829-37.
 29. Deyo RA. Early diagnostic evaluation of low back pain. *J Gen Intern Med*. 1986;1:328-38.
 30. Deyo RA, Loeser JD, Bigos SJ. Herniated lumbar intervertebral disk. *Ann Intern Med*. 1990;112:598-603.
 31. Fritz JM, Delitto A, Welch WC, Erhard RE. Lumbar spinal stenosis: a review of current concepts in evaluation, management, and outcomes measurements. *Arch Phys Med Rehabil*. 1998;79:700-8.
 32. Frymoyer JW. Back pain and sciatica. *N Engl J Med*. 1988;318:291-300.
 33. Fardon DF. Differential diagnosis of low back disorders. Principles of classification. In: Frymoyer JW, Ducker TB, Hadler NM, Kostuik JP, Weinstein JN, Whitecloud TS, eds. *The Adult Spine: Principles and Practice*. Philadelphia, Pa: Lippincott-Raven; 1997:1745-68.
 34. Spitzer WO. Scientific approach to the assessment and management of activity-related spinal disorders: A monograph for clinicians. Report of the Quebec Task Force on Spinal Disorders. *Spine*. 1987;12(7 Suppl):1-59.
 35. White AA, Gordon SL. Synopsis: Workshop on idiopathic low-back pain. *Spine*. 1982;7:141-9.
 36. Deyo RA, Rainville J, Kent DL. What can the history and physical examination tell us about low back pain? *JAMA*. 1992;268:760-5.
 37. Lurie JD, Sox HC. Principles of medical decision making. *Spine*. 1999;24:493-8.
 38. Schroth WS, Schectman JM, Elinsky EG, Panagides JC. Utilization of medical services for the treatment of acute low back pain: conformance with clinical guidelines. *J Gen Intern Med*. 1992;7:486-91.
 39. Suarez-Almazor ME, Belseck E, Russell AS, Mackel JV. Use of lumbar radiographs for the early diagnosis of low back pain. Proposed guidelines would increase utilization. *JAMA*. 1997;277:1782-6.
 40. Deyo RA, Diehl AK. Cancer as a cause of back pain: frequency, clinical presentation, and diagnostic strategies. *J Gen Intern Med*. 1988;3:230-8.
 41. Calin A, Porta J, Fries JF, Schurman DJ. Clinical history as a screening test for ankylosing spondylitis. *JAMA*. 1977;237:2613-4.
 42. Gran JT. An epidemiological survey of the signs and symptoms of ankylosing spondylitis. *Clin Rheumatol*. 1985;4:161-9.
 43. Katz JN, Dalgas M, Stucki G, et al. Degenerative lumbar spinal stenosis. Diagnostic value of the history and physical examination. *Arthritis Rheum*. 1995;38:1236-41.
 44. Kostuik JP, Harrington I, Alexander D, Rand W, Evans D. Cauda equina syndrome and lumbar disc herniation. *J Bone Joint Surg Am*. 1986;68:386-91.
 45. Andersson GB, Deyo RA. History and physical examination in patients with herniated lumbar discs. *Spine*. 1996;21:10S-18S.
 46. Deyo RA, Diehl AK. Psychosocial predictors of disability in patients with low back pain. *J Rheumatol*. 1988;15:1557-64.
 47. Engel CC, von Korff M, Katon WJ. Back pain in primary care: predictors of high health-care costs. *Pain*. 1996;65:197-204.
 48. Linton SJ, Hallden. Can we screen for problematic back pain? A screening questionnaire for predicting outcomes in acute and subacute back pain. *Clin J Pain*. 1998;14:209-15.
 49. Thomas E, Silman AJ, Croft PR, Papageorgiou AC, Jayson MIV, Macfarlane GJ. Predicting who develops chronic low back pain in primary care: a prospective study. *BMJ*. 1999;318:1662-7.
 50. Waddell G, McCulloch JA, Kummel E, Venner RM. Nonorganic physical signs in low back pain. *Spine*. 1980;5:117-25.
 51. Boden SD, McCowin PR, Davis DO, Dina TS, Mark AS, Wiesel S. Abnormal magnetic-resonance scans of the lumbar spine in asymptomatic subjects. *J Bone Joint Surg Am*. 1990;72:1178-84.
 52. Jensen MC, Brant-Zawadzki MN, Obuchowski N, Modic MT, Malkasian D, Ross JS. Magnetic resonance imaging of the lumbar spine in people without back pain. *N Engl J Med*. 1994;331:69-73.
 53. Osterman K, Schlenska D, Poussa M, Seitsalo S, Virta L. Isthmic spondylolisthesis in symptomatic and asymptomatic subjects, epidemiology, and natural history with special reference to disk abnormality and mode of treatment. *Clin Orthop*. 1993;297:65-70.
 54. Powell MC, Wilson M, Szypryt P, Symonds EM, Worthington BS. Prevalence of lumbar disc degeneration observed by magnetic resonance in symptomless women. *Lancet*. 1986;2:1366-7.
 55. van Tulder MW, Assendelft WJ, Koes BW, Bouter LM. Spinal radiographic findings and nonspecific low back pain. A systematic review of observational studies. *Spine*. 1997;22:427-34.
 56. Deyo RA, Diehl AK. Lumbar spine films in primary care: current use and effects of selective ordering criteria. *J Gen Intern Med*. 1986;1:20-5.
 57. Nachemson A. The lumbar spine: an orthopaedic challenge. *Spine*. 1976;1:59-71.
 58. Liang M, Komaroff AL. Roentgenograms in primary care patients with acute low back pain: a cost-effectiveness analysis. *Arch Intern Med*. 1982;142:1108-12.

59. Cherkin DC, Deyo RA, Wheeler K, Ciol MA. Physician variation in diagnostic testing for low back pain. Who you see is what you get. *Arthritis Rheum*. 1994;37:15-22.
60. Freeborn DK, Shye D, Mullooly JP, Eraker S, Romeo J. Primary care physicians' use of lumbar spine imaging tests: effects of guidelines and practice pattern feedback. *J Gen Intern Med*. 1997;12:619-25.
61. Deyo RA, Bigos SJ, Maravilla KR. Diagnostic imaging procedures for the lumbar spine. *Ann Intern Med*. 1989;111:865-7.
62. Herzog RJ. The radiologic assessment for a lumbar disc herniation. *Spine*. 1996;21(24 Suppl):19S-38S.
63. Edelman RR, Warach S. Magnetic resonance imaging (1). *N Engl J Med*. 1993;328:708-16.
64. Unger E, Moldofsky P, Gatenby R, Hartz W, Broder G. Diagnosis of osteomyelitis by MR imaging. *AJR Am J Roentgenol*. 1988;150:605-10.
65. Deyo RA, Diehl AK, Rosenthal M. Reducing roentgenography use. Can patient expectations be altered? *Arch Intern Med*. 1987;147:141-5.
66. van den Hoogen HM, Koes BW, van Eijk JT, Bouter LM. On the accuracy of history, physical examination, and erythrocyte sedimentation rate in diagnosing low back pain in general practice. A criteria-based review of the literature. *Spine*. 1995;20:318-27.
67. van Tulder MW, Koes BW, Bouter LM. Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions. *Spine*. 1997;22:2128-56.
68. Wasson J, Gaudette C, Whaley F, Sauvigne A, Baribeau P, Welch HG. Telephone care as a substitute for routine clinic follow-up. *JAMA*. 1992;267:1788-93.
69. Balas EA, Jaffrey F, Kuperman GJ, et al. Electronic communication with patient. Evaluation of distance medicine technology. *JAMA*. 1997;278:152-9.
70. Delichatsios H, Callahan M, Charlson M. Outcomes of telephone medical care. *J Gen Intern Med*. 1998;13:579-85.
71. Lattimer V, George S, Thompson F, et al. Safety and effectiveness of nurse telephone consultation in out of hours primary care: randomized controlled trial. The South Wiltshire Out of Hours Project (SWOOP) Group. *BMJ*. 1998;317:1054-9.
72. Volinn E. Between the idea and the reality: research on bed rest for uncomplicated acute low back pain and implications for clinical practice patterns. *Clin J Pain*. 1996;12:166-70.
73. Nachemson A. The load on lumbar disks in different positions of the body. *Clin Orthop*. 1966;45:107-22.
74. Nachemson A. Work for all. For those with low back pain as well. *Clin Orthop*. 1983;(179):77-85.
75. Deyo RA, Diehl AK, Rosenthal M. How many days of bed rest for acute low back pain? *N Engl J Med*. 1986;315:1064-70.
76. Gilbert JR, Taylor SW, Hildebrand A, Evans C. Clinical trial of common treatments for low back pain in family practice. *Br Med J (Clin Res Ed)*. 1985;291:791-4.
77. Malmivaara A, Hakkinen U, Aro T, et al. The treatment of acute low back pain—bed rest, exercises, or ordinary activity? *N Engl J Med*. 1995;332:351-5.
78. Wilkinson MJ. Does 48 hours' of bed rest influence the outcome of acute low back pain. *Br J Gen Pract*. 1995;45:481-4.
79. Vroomen P, de Krom M, Wilmink JT, Kester AD, Knottnerus JA. Lack of effectiveness of bed rest for sciatica. *N Engl J Med*. 1999;340:418-23.
80. Atlas SJ, Volinn E. Classics for the spine literature revisited: a randomized trial of 2 versus 7 days of recommended bed rest for acute low back pain. *Spine*. 1997;22:2331-7.
81. Faas A, Chavannes AW, van Eijk JT, Gubbels JW. A randomized, placebo-controlled trial of exercise therapy in patients with acute low back pain. *Spine*. 1993;18:1388-95.
82. Faas A. Exercises: which ones are worth trying, for which patients, and when? *Spine*. 1996;21:2874-8.
83. Lahad A, Malter AD, Berg AO, Deyo RA. The effectiveness of four interventions for the prevention of low back pain. *JAMA*. 1994;272:1286-91.
84. Koes BW, Scholten RJ, Mens JM, Bouter LM. Efficacy of non-steroidal anti-inflammatory drugs for low back pain: a systematic review of randomised clinical trials. *Ann Rheum Dis*. 1997;56:214-23.
85. Bradley JD, Brandt KD, Katz BP, Kalasinski LA, Ryan SI. Comparison of an antiinflammatory dose of ibuprofen, an analgesic dose of ibuprofen, and acetaminophen in the treatment of patients with osteoarthritis of the knee. *N Engl J Med*. 1991;325:87-91.
86. Cherkin DC, Wheeler K, Barlow W, Deyo RA. Medication use for low back pain in primary care. *Spine*. 1998;23:607-14.
87. Shekelle PG, Adams AH, Chassin MR, Hurwitz EL, Brook RH. Spinal manipulation for low-back pain. *Ann Intern Med*. 1992;117:590-8.
88. Cherkin DC, Deyo RA, Battie M, Street J, Barlow W. A comparison of physical therapy, chiropractic manipulation, and provision of an educational booklet for the treatment of patients with low back pain. *N Engl J Med*. 1998;339:1021-9.
89. Skargren EI, Carlsson PG, Oberg BE. One-year follow-up comparison of the cost and effectiveness of chiropractic and physiotherapy as primary management for back pain. Subgroup analysis, recurrence, and additional health care utilization. *Spine*. 1998;23:1875-83.
90. Sinclair SJ, Hogg-Johnson SH, Mondloch MV, Shields SA. The effectiveness of an early active intervention program for workers with soft-tissue injuries. The Early Claimant Cohort Study. *Spine*. 1997;22:2919-31.
91. Carette S, Leclaire R, Marcoux S, et al. Epidural corticosteroid injections for sciatica due to herniated nucleus pulposus. *N Engl J Med*. 1997;336:1634-40.
92. Cuckler JM, Bernini PA, Wiesel SW, Booth RE Jr, Rothman RH, Pickens GT. The use of epidural steroids in the treatment of lumbar radicular pain. A prospective, randomized, double-blind study. *J Bone Joint Surg Am*. 1985;67:63-6.
93. Carette S, Marcoux S, Truchon R, et al. A controlled trial of corticosteroid injections into facet joints for chronic low back pain. *N Engl J Med*. 1991;325:1002-7.
94. Lilius G, Laasonen EM, Myllynen P, Harilainen A, Gronlund G. Lumbar facet joint syndrome. A randomized clinical trial. *J Bone Joint Surg Br*. 1989;71:681-4.
95. NIH Consensus Conference. Acupuncture. *JAMA*. 1998;280:1518-24.
96. van Tulder MW, Cherkin DC, Berman B, Lao L, Koes BW. The effectiveness of acupuncture in the management of acute and chronic low back pain. *Spine*. 1999;24:1113-23.
97. Cherkin DC, Deyo RA, Street JH, Hunt M, Barlow W. Pitfalls of patient education: Limited success of a program for back pain in primary care. *Spine*. 1996;21:345-55.
98. Daltroy LH, Iversen MD, Larson MG, et al. A controlled trial of an educational program to prevent low back injuries. *N Engl J Med*. 1997;337:322-8.
99. van Poppel MN, Koes BW, van der Ploeg T, Smid T, Bouter LM. Lumbar supports and education for the prevention of low back pain in industry: a randomized controlled trial. *JAMA*. 1998;279:1789-94.
100. Deyo RA, Cherkin DC, Weinstein J, et al. Involving patients in clinical decisions: impact of an interactive video program on outcomes and use of back surgery. Presented at the International Society for the Study of the Lumbar Spine, Kona, Hawaii, June 1999.
101. Spunt BS, Deyo RA, Taylor VM, Leek KM, Goldberg HI, Mulley AG. An interactive videodisc program for low back pain patients. *Health Educ Res*. 1996;11:535-41.