ACP American College of Physicians
Best Practice Advice

CLINICAL GUIDELINE

Diagnostic Imaging for Low Back Pain: Advice for High-Value Health Care From the American College of Physicians

Roger Chou, MD; Amir Qaseem, MD, PhD, MHA; Douglas K. Owens, MD, MS; and Paul Shekelle, MD, PhD, for the Clinical Guidelines Committee of the American College of Physicians*

Diagnostic imaging is indicated for patients with low back pain only if they have severe progressive neurologic deficits or signs or symptoms that suggest a serious or specific underlying condition. In other patients, evidence indicates that routine imaging is not associated with clinically meaningful benefits but can lead to harms. Addressing inefficiencies in diagnostic testing could minimize potential harms to patients and have a large effect on use of resources by reducing both direct and downstream costs. In this area, more testing does not equate to better care. Implementing a selective approach to low back imaging, as suggested by the American College of Physicians and American Pain Society guideline on low back pain, would provide better care to patients, improve outcomes, and reduce costs.

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For author affiliations, see end of text.

Low back pain is very common (1, 2), and many patients with low back pain receive routine spinal imaging (lumbar radiography, computed tomography [CT], or magnetic resonance imaging [MRI]) (3, 4), despite evidence-based recommendations from the American College of Physicians (ACP) and the American Pain Society (APS) that call for imaging only for patients who have severe or progressive neurologic deficits or signs or symptoms that suggest a serious or specific underlying condition (5). This is problematic, because routine imaging does not seem to improve clinical outcomes and exposes patients to unnecessary harms (6, 7).

The overuse of imaging also contributes to the high and growing costs associated with low back pain. In 1998, total U.S. health care expenditures for low back pain were estimated at $90 billion (8). Average total health expenditures for patients with back and neck problems increased from $4795 per year in 1997 to about $6096 per year in 2005, an inflation-adjusted increase of 65% (in 2005 U.S. dollars) (9). This rate was higher than that observed for overall health expenditures. Low back pain also incurs high indirect costs due to lost productivity (10). Reducing unnecessary tests or ineffective treatments (11) is an obvious way to decrease the costs associated with low back pain.

Imaging is an important driver of low back pain costs, not only because of the direct costs of the procedures (**Table 1**) (12, 13) but also the downstream effects (14). Imaging can lead to additional tests, follow-up, and referrals and may result in an invasive procedure of limited or questionable benefit. Of note, the rate of spine MRI increased sharply at the same time as that of lumbar surgeries (7, 15).

Despite increased spending on low back pain, U.S. adults with spine problems reported similar or worse scores for mental health, physical functioning, work or school limitations, and social limitations in 2005 than in 1997 (9). In North Carolina, the proportion of persons who reported chronic low back pain that impaired activity more than doubled between 1992 and 2006, from 3.9% to 10.2% (16).

The appropriateness of many of the low back imaging studies obtained in clinical practice has long been questioned (17), but clinicians are subject to many pressures that promote excessive imaging. This report, based on a systematic review (18) conducted for the 2007 ACP/APS low back pain guideline and a subsequent meta-analysis (6), aims to help clinicians practice high-value health care by following a more rational and cost-conscious diagnostic approach.

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* This paper, written by Roger Chou, MD; Amir Qaseem, MD, PhD, MHA; Douglas K. Owens, MD, MS; and Paul Shekelle, MD, PhD, was developed for the Clinical Guidelines Committee of the American College of Physicians: Paul Shekelle, MD, PhD (*Chair*); Roger Chou, MD; Paul Dallas, MD; Thomas D. Denberg, MD, PhD: Nick Fitterman, MD; Mary Ann Forciea, MD; Robert H. Hopkins Jr., MD; Linda L. Humphrey, MD, MPH; Tanvir P. Mir, MD; Douglas K. Owens, MD, MS; Holger J. Schünemann, MD, PhD; Donna E. Sweet, MD; and David S. Weinberg, MD, MSc. Approved by the ACP Board of Regents on 20 November 2010.

Table 1. **Costs of Low Back Imaging**

Intervention	Reimbursement, $*	Range of Estimated Charges, $†
Lumbar spine radiography	50	204–286 (in network), 404–565 (out of network)
Lumbar spine computed tomography	381 (without contrast), 459 (with contrast)	1082–1517 (in network), 2091–2928 (out of network)
Lumbar spine magnetic resonance imaging	715 (without contrast), 863 (with contrast)	877–1226 (in network), 1762–2467 (out of network)

* From reference 12.
† From reference 13.

WHAT ARE THE EVIDENCE-BASED RECOMMENDATIONS FOR USE OF IMAGING TESTS IN PATIENTS WITH LOW BACK PAIN?

The ACP/APS low back pain guideline (5) recommends selective imaging for patients in whom it is clinically indicated. Appropriateness criteria from the American College of Radiology (19) are consistent with this guideline. The evidence supporting these recommendations includes the findings of randomized trials of spine imaging strategies; this is one of the relatively few areas of diagnostic imaging for which data are available from multiple randomized trials that reported clinical outcomes. Most studies of diagnostic tests estimate their accuracy at identifying a disease or condition, but even accurate tests may not improve patient outcomes. Well-conducted, randomized trials of diagnostic studies that evaluate patient outcomes provide the most direct information about the benefits and harms of alternative testing strategies (**Table 2**) (20–23).

A meta-analysis of 6 randomized trials (6), which comprised 1804 patients with primarily acute or subacute low back pain and no clinical or historical features that suggested a specific underlying condition, found no differences between routine lumbar imaging (radiography, MRI, or CT) and usual care without routine imaging in terms of pain, function, quality of life, or overall patient-rated improvement (**Table 3**). For short-term outcomes (<3 months), trends slightly favored usual care without routine imaging. Routine imaging was also not associated with psychological benefits (6), despite the perception that it can help alleviate patient anxiety about back pain (24). These results can probably be generalized to some degree to patients with or without radiculopathy, because most of the trials enrolled at least some patients with radiculopathy. The conclusions of the meta-analysis did not seem to be affected by whether radiography or advanced imaging (MRI or CT) was evaluated. On the basis of the systematic review, routine imaging can be considered a low-value health care intervention; because it is more costly than usual care without routine imaging and offers no clear clinical advantages, it cannot be cost-effective (11, 25).

Several factors may explain why routine imaging does not seem beneficial. Most lumbar imaging abnormalities are common in persons without low back pain and are only loosely associated with back symptoms. One systematic review (26) reported odds ratios that ranged from 1.2 to 3.3 for the association between low back pain and disc degeneration on radiography and no association with spondylosis or spondylolisthesis. A randomized trial (27) showed no incremental value of rapid MRI over radiography for evaluating low back pain, which suggests that although advanced imaging can detect more and smaller abnormalities, these abnormalities are not necessarily clinically relevant. Many abnormalities detected with advanced imaging are so common in asymptomatic persons that they could be viewed as normal signs of aging (28–30). In a cross-sectional study (31), 36% of asymptomatic persons aged 60 years or older had a herniated disc, 21% had spinal stenosis, and more than 90% had a degenerated or bulging disc. A prospective study (32) found that among patients with lumbar imaging abnormalities before the onset of low back pain, 84% had unchanged or improved findings after symptoms developed. Thus, it is important to understand that the presence of imaging abnormalities need not mean that the abnormalities are responsible for symptoms.

Routine imaging might also be ineffective because acute low back pain has such a favorable natural history and because the expected yield of routine imaging is low. Most patients with acute back pain, with or without radiculopathy, have substantial improvements in pain and function in the first 4 weeks (33, 34); routine imaging is unlikely to improve on this. About 0.7% of patients with low back pain in primary care settings have metastatic cancer, 0.01% have spinal infection, and 0.04% have the cauda equina syndrome (35, 36). Vertebral compression fractures (4%) and inflammatory back disease (≤5%) may also cause back pain, but these conditions typically carry lower diagnostic urgency (36, 37). Of the small proportion of patients with any of these conditions, almost all have an identifiable risk factor. In a retrospective study of 963 patients with acute low back pain (38), the 8 patients with tumors or fractures all had clinical risk factors. A prospective study (39) found no cases of cancer in 1170 patients younger than 50 years with acute low back pain and no history of cancer, weight loss, other sign of systemic illness, or lack of improvement. Similarly, 4 trials that enrolled 399 patients without risk factors found no missed serious conditions (6).

Routine imaging may have little effect on clinical outcomes because imaging results rarely affect treatment plans. A review of 68 000 lumbar radiographs (40) estimated that clinically unsuspected findings occurred in 1 of every 2500 patients between 20 and 50 years of age. In 2 studies of

about 100 patients each (41, 42), lumbar radiography affected management in only 1 or 2 patients. Similarly, a randomized trial of routine advanced imaging versus no imaging (43) found no differences in diagnoses or treatment plans. The limited therapeutic effect could be due to the largely unknown clinical significance of most imaging abnormalities. No evidence suggests that selecting therapies on the basis of the presence of the most common imaging findings improves outcomes compared with a generalized approach (5).

Any potential benefits of routine imaging may also be offset by potential harms. Lumbar radiography and CT contribute to cumulative low-level radiation exposure, which could promote carcinogenesis. Lumbar spine CT is associated with an average effective radiation dose of 6 mSv (44). On the basis of the 2.2 million lumbar CT scans performed in the United States in 2007, 1 study (45) projected 1200 additional future cases of cancer. Another study (46) estimated 1 additional case of cancer for every 270 women aged 40 years who had coronary angiography, a procedure associated with a radiation dose similar to that of lumbar spine CT (44). A woman aged 20 years would have an approximately doubled risk. Lumbar CT also involves the use of iodinated contrast, which is associated with hypersensitivity reactions and nephropathy.

Because lumbar radiography is performed much more frequently than lumbar CT, it accounts for a greater proportion of the total radiation dose from medical imaging procedures in the United States (3.3% vs. 0.7%), despite having a lower average effective radiation dose (1.5 mSv) (44). The average radiation exposure from lumbar radiography is 75 times higher than for chest radiography (44). This is of particular concern in young women because of the proximity to the gonads, which are difficult to effectively shield. The amount of female gonadal irradiation from lumbar radiography has been estimated as equivalent to having chest radiography daily for several years (36).

Telling patients that they have a back imaging abnormality could result in unintended harms related to labeling (47). In an acute low back pain trial that performed lumbar spine MRI on all patients (48), patients randomly assigned to routinely receive their results reported smaller improvements in general health than those who were blinded to their results. In another trial (49), patients with back pain of at least 6 weeks' duration who had routine radiography reported more pain and worse overall health status after 3 months than those who did not have radiography and were more likely to seek follow-up care. Knowledge of clinically irrelevant imaging findings might hinder recovery by causing patients to worry more, focus excessively on minor back symptoms, or avoid exercise or other recommended activities because of the fear that they could cause more structural damage (47).

Imaging might also lead to unnecessary procedures. Visual evidence can be very compelling, despite the uncertainties related to interpretation of most spinal imaging abnormalities, and imaging abnormalities may be viewed as targets for surgery or other interventions (50). The association between rates of advanced spinal imaging and rates of spinal surgery seems strong (15), although causality is difficult to establish. In a randomized trial, patients with low back pain who had rapid MRI had spine surgery about twice as often as those who had radiography, although the difference did not reach statistical significance (risk difference, 0.34 [95% CI, −0.06 to 0.73]) (27). One observational study (7) showed that variation in rates of spinal MRI accounted for 22% of the variability in overall spinal surgery rates among Medicare beneficiaries, or more than double the variability accounted for by differences in patient characteristics. Another study (51) found that for work-related acute low back pain, MRI within the first month was associated with more than an 8-fold increase in risk for surgery and more than a 5-fold increase in subsequent total medical costs compared with propensity-matched control patients who did not have early MRI.

DOES PRACTICE FOLLOW THE EVIDENCE?

Although clinicians vary substantially in how frequently they obtain low back pain imaging (7, 52), some

Table 2. **Types of Diagnostic Evaluation Research, From Least to Most Informative, for Understanding Effects of Diagnostic Tests on Patient Outcomes**

Question Addressed by Diagnostic Studies	Low Back Pain Imaging Example
Does the test meet technical standards in laboratory settings? (technological efficacy)	What are the technical standards needed to obtain high-quality lumbar radiographs?
Does the test distinguish asymptomatic from symptomatic patients? (diagnostic accuracy)	What is the relative risk of lumbar radiography to detect or rule out facet joint arthritis in persons with versus persons without low back pain?
Does the test accurately distinguish persons with a disorder from those without among those in whom it is clinically reasonable to suspect the disorder? (diagnostic accuracy)	In patients with low back pain, what is the sensitivity and specificity of lumbar radiography for detecting or ruling out facet joint arthritis in patients with pain that originates from the facet joint?
Do the test results help guide management decisions? (therapeutic impact)	Do patients with low back pain who undergo routine radiography for low back pain receive different treatments from those who receive usual care without routine imaging?
Do patients who undergo the test fare better than similar untreated patients? (clinical efficacy)	Do patients with low back pain who undergo routine radiography for low back pain experience better pain or functional outcomes than those who receive usual care without routine imaging?

Table 3. **Results From Meta-analysis of Randomized, Controlled Trials of Routine Imaging Versus Usual Care Without Routine Imaging***

Outcome	Short Term (<3 Months)		Long Term (>6 Months to ≤1 Year)	
	Results, by Specific Scale	Analysis (95% CI)	Results, by Specific Scale	Analysis (95% CI)
Pain	SF-36 bodily pain (0 to 100 scale): 3.0 (−2.0 to 8.0), 2 trials; VAS (0 to 10 scale): 1.0 (0.46 to 1.54), 1 trial	Pooled SMD: 0.19 (−0.01 to 0.39); 3 trials	SF-36 bodily pain: −2.1 (−5.1 to 0.80), 3 trials; VAS: 0.08 (−0.02 to 0.18), 1 trial	Pooled SMD: −0.04 (−0.15 to 0.07); 4 trials
Function	RDQ (0 to 24 scale): 0.48 (−1.4 to 2.3), 3 trials	Pooled SMD: 0.11 (−0.29 to 0.50); 3 trials	RDQ: 0.34 (−0.65 to 1.3), 3 trials; Aberdeen low back score (0 to 100 scale): −3.1 (−4.2 to −2.0), 1 trial	Pooled SMD: 0.01 (−0.17 to 0.19); 4 trials
Quality of life	EQ-5D (0 to 1 scale): −0.10 (−0.17 to −0.03), 1 trial; EuroQoL subjective score (0 to 100 scale): 2.0 (−1.5 to 5.5), 1 trial	Pooled SMD: −0.10 (−0.53 to 0.34); 2 trials	EQ-5D: −0.005 (−0.06 to 0.05), 2 trials; EuroQoL subjective score: −7.0 (−10 to −3.7), 1 trial	Pooled SMD: −0.15 (−0.33 to 0.04); 3 trials
Mental health	SF-36 mental health (0 to 100 scale): 2.3 (−6.3 to 11), 2 trials	Pooled SMD: 0.12 (−0.37 to 0.62); 2 trials	SF-36 mental health: 0.61 (−4.4 to 5.6), 3 trials	Pooled SMD: 0.01 (−0.32 to 0.34); 3 trials
Overall improvement†	Risk difference: −7.8% (−14% to −1.3%)	Relative risk: 0.83 (0.65 to 1.06); 4 trials	Risk difference: −7.8% (−17% to 1.8%)	Relative risk: 0.82 (0.64 to 1.05); 1 trial

EQ-5D = European Quality of Life—5 Dimensions; EuroQoL = European Quality of Life; RDQ = Roland Disability Questionnaire; SF-36 = Short Form-36; SMD = standardized mean difference; VAS = visual analogue scale.
* From reference 6. Negative results favor routine imaging for pain and function, whereas positive results favor routine imaging for quality of life and mental health.
† Dichotomous outcome, defined as back pain resolved, normal activities resumed, and patient rating of "symptoms much improved" or at least "very pleased."

continue to order imaging routinely or without a clear clinical indication. In a survey (3), about 40% of family practice and 13% of internal medicine physicians reported ordering routine diagnostic imaging for acute low back pain. Another survey (4) found that in the absence of any worrisome features, 22% of physicians would obtain lumbar spine radiography for acute low back pain without sciatica and 62% would do so for low back pain with sciatica. Data on actual imaging practices support these survey results. Among 35 000 Medicare beneficiaries with acute low back pain and no diagnostic code indicating a serious underlying condition, nearly 30% had lumbar radiography within 28 days (53), even though the ACP/APS guideline (5) suggests a trial of management without imaging in adults with no risk factors other than older age. An Australian study (54) showed a slight increase in imaging rates in general practice for patients with new low back pain, despite the publication of guidelines that recommend against routine imaging.

Use of advanced spinal imaging, which is far more expensive than lumbar radiography (**Table 1**), is increasing rapidly. Among Medicare Part B beneficiaries, lumbar MRI scans increased by about 4-fold between 1994 and 2005 (55). Similarly, the rate of MRI tripled between 1997 and 2006 in a large health care organization (46). In North Carolina, more than one third of patients with chronic low back pain received either MRI or CT in the past year (56), and other studies show even higher rates (57).

What Forces Promote the Overuse of Imaging in Patients With Low Back Pain?

Patient expectations and preferences about diagnostic testing, when communicated to physicians, can affect clinical decisions (24). Patients expect a clear diagnosis for their low back pain (58). They want to know what is causing their symptoms and may equate a decision to not obtain imaging or provide a precise diagnosis with low-quality care (59) or as a message that their pain is not legitimate or important (50). Wanting diagnostic testing is a frequent reason for repeated office visits for chronic back pain (60). In 1 study (61), use of low back pain imaging was strongly associated with how intensely patients believed imaging was necessary. A survey of U.S. physicians (62) found that more than one third would order lumbar MRI for uncomplicated acute low back pain if a patient insisted on it even after the physician explained that it was unnecessary.

Linking financial performance incentives to patient satisfaction could augment such tendencies. In randomized trials, patients expressed more satisfaction when they received routine lumbar imaging (49) or advanced imaging instead of radiography (27), even when their clinical outcomes were no better. A study of Medicare beneficiaries found earlier use of imaging and more advanced imaging when clinician incentives were based on patient satisfaction (53). A trial showed that patients randomly assigned to receive routine imaging became more likely to believe it was necessary, despite experiencing no clinical benefit (63).

Greater availability of imaging resources seems to correlate with increased use. One study (64) found a strong correlation between the number of MRI units added in a geographic area and the number of MRI scans performed, with about 40 additional lumbar MRI scans for each new unit over a 5-year period. The number of MRI scanners in the United States tripled from 2000 to 2005, from 7.6 to 26.6 per million persons (64). In 2006, about 7000 U.S.

sites offered MRI (65), almost twice as many per capita as any other industrialized country and more than 4 times as many as Canada or the United Kingdom (65). In 2006, western Pennsylvania had almost as many MRI machines (140 units) as all of Canada (151 units) (66).

Financial incentives can also influence imaging decisions. Top-of-the-line MRI units can cost at least $2 million to purchase and about $800 000 a year to operate (64, 66). However, advanced imaging offers a high profit margin. Relative to actual costs, Medicare provides far greater reimbursement for MRI than for conventional radiography (reimbursement–cost ratio, 2.3 vs. 0.9) (67). A 2009 report from the Medicare Payment Advisory Commission (68) reported an association between physician ownership or investment in imaging facilities and rates of use. An earlier study of worker's compensation cases (69) found more inappropriate imaging requests from physicians who self-referred.

In addition, the overuse of back imaging could be related to the perceived risk for missing a serious diagnosis. *Defensive medicine* refers to alteration of clinical behavior owing to concerns over malpractice liability. In 1 study (70), more than 90% of Pennsylvania physicians from 6 specialties reported defensive medicine practices, and almost one half of those with positive responses reported unnecessary imaging as their most recent defensive act. When a legal claim related to the back pain is more likely or when patients express dissatisfaction, the likelihood of such practices probably increases. Low back pain imaging is a typical part of the evaluation in worker's compensation and disability cases, despite the absence of evidence that it improves outcomes in these situations.

Finally, clinicians are pressed for time. Ordering an imaging test may be viewed as more expedient than explaining to a patient why imaging is not necessary (23, 71).

How Can Physicians Reduce Overuse of Imaging for Low Back Pain?

Adhering to the ACP/APS recommendations on use of imaging could reduce overuse. Most patients do not need immediate imaging, and an initial trial of therapy before imaging is warranted in many cases (**Table 4**). A key principle of the guideline is that a thorough history and physical examination are necessary to guide imaging decisions. No randomized trial data are available to guide optimal diagnostic strategies for patients with clinical risk factors. However, imaging is recommended when features suggest the cauda equina syndrome or vertebral infection. Although these conditions are rare and the prevalence of risk factors is low (72), timely diagnosis may prevent serious sequelae related to compression of the spinal cord or cauda equina. Key clinical features include new urine retention, saddle anesthesia, fecal incontinence, or fever (especially in patients with risk factors for bacteremia). Imaging is also indicated for severe or progressive neurologic deficits (such as objective or progressive motor weakness at a single level or deficits at multiple spinal levels).

Other risk factors are associated with specific conditions, such as cancer, vertebral compression fracture, ankylosing spondylitis, herniated disc, or symptomatic spinal stenosis (**Table 4**). The traditional approach has been to use imaging to act on all clinical risk factors. However, this would result in high imaging rates with low positive pre-

Table 4. **Suggestions for Imaging in Patients With Acute Low Back Pain***

Imaging Action and Clinical Situation	Suggestions for Initial Imaging
Immediate imaging	
Radiography plus erythrocyte sedimentation rate†	Major risk factors for cancer (new onset of low back pain with history of cancer, multiple risk factors for cancer, or strong clinical suspicion for cancer)
Magnetic resonance imaging	Risk factors for spinal infection (new onset of low back pain with fever and history of intravenous drug use or recent infection) Risk factors for or signs of the cauda equina syndrome (new urine retention, fecal incontinence, or saddle anesthesia) Severe neurologic deficits (progressive motor weakness or motor deficits at multiple neurologic levels)
Defer imaging after a trial of therapy	
Radiography with or without erythrocyte sedimentation rate	Weaker risk factors for cancer (unexplained weight loss or age >50 y) Risk factors for or signs of ankylosing spondylitis (morning stiffness that improves with exercise, alternating buttock pain, awakening because of back pain during the second part of the night, or younger age [20 to 40 y]) Risk factors for vertebral compression fracture (history of osteoporosis, use of corticosteroids, significant trauma, or older age [>65 y for men or >75 y for women])
Magnetic resonance imaging	Signs and symptoms of radiculopathy (back pain with leg pain in an L4, L5, or S1 nerve root distribution or positive result on straight leg raise or crossed straight leg raise test) in patients who are candidates for surgery or epidural steroid injection Risk factors for or symptoms of spinal stenosis (radiating leg pain, older age, or pseudoclaudication) in patients who are candidates for surgery
No imaging	No criteria for immediate imaging and back pain improved or resolved after a 1-mo trial of therapy Previous spinal imaging with no change in clinical status

* Adapted from reference 5.
† Consider magnetic resonance imaging if the initial imaging result is negative but a high degree of clinical suspicion for cancer remains.

Figure. **American College of Physicians best practice advice: diagnostic imaging for low back pain.**

ACP American College of Physicians *Best Practice Advice*

Summary of the American College of Physicians Best Practice Advice: Diagnostic Imaging for Low Back Pain

Disease or condition	Imaging for low back pain
Target audience	Internists, family physicians, and other clinicians
Target patient population	Adults with low back pain
Interventions	Radiography Computed tomography Magnetic resonance imaging
Indications for diagnostic imaging	Immediate imaging is recommended in patients with acute low back pain who have major risk factors for cancer, risk factors for spinal infection, risk factors for or signs of the cauda equina syndrome, or severe or progressive neurologic deficits Imaging after a trial of therapy is recommended in patients with minor risk factors for cancer, risk factors for inflammatory back disease, risk factors for vertebral compression fracture, signs or symptoms of radiculopathy, or risk factors for or symptoms of symptomatic spinal stenosis Repeated imaging is only recommended in patients with new or changed low back symptoms
Evidence that expanding imaging to patients without these indications does not improve outcomes	Randomized trials of routine imaging versus usual care without routine imaging in patients without indications for diagnostic imaging suggest no clinically meaningful benefits on outcomes related to pain, function, quality of life, or mental health Other supporting evidence includes the weak correlation between most imaging findings and symptoms, the favorable natural history of acute low back pain with or without imaging, the low prevalence of serious or specific underlying conditions, and unclear effects of imaging on treatment decisions
Harms of unnecessary imaging	Radiation exposure (for lumbar radiography and computed tomography) Labeling Hypersensitivity reactions and contrast nephropathy (for iodinated contrast with computed tomography) Potential association with subsequent unnecessary, invasive, and expensive procedures
Approaches to overcome barriers to evidence-based practice	Patient expectations or preferences for routine imaging: Use talking points based on evidence-based guidelines to aid in patient education Time constraints: Use evidence-based online or print education material to supplement face-to-face education Clinician uncertainty: Recognize the low likelihood of serious conditions in the absence of clinical risk factors and the evidence that shows no benefit associated with routine imaging Clinician incentives based on patient satisfaction: Advocate for incentives that are based on providing appropriate care
Talking points for clinicians when discussing low back pain imaging with patients	Risk factor assessment can almost always identify patients who require imaging The prevalence of serious underlying conditions is low in patients without risk factors The natural history of acute low back pain is quite favorable, but patients require reevaluation if they are not better after about 1 month Routine imaging does not improve clinical outcomes but increases costs and may lead to potentially unnecessary invasive treatments, such as surgery Imaging abnormalities are extremely common, especially in older adults, but most are poorly correlated with symptoms In most cases, treatment plans do not change after imaging studies Back imaging is associated with radiation exposure, which can increase the risk for cancer in the case of lumbar radiography and computed tomography

dictive values (38, 73). One study of 1172 patients with acute back pain in primary care (73) found that one quarter were older than 55 years, about one quarter had morning back stiffness, and about one third had pain that improved with exercise. All are considered risk factors for cancer or ankylosing spondylitis, but no cases of either condition were identified.

A more efficient strategy would be to use likelihood ratios to inform imaging decisions. For instance, the prevalence, or pretest probability, of cancer in a primary care population is about 0.7% (39). A history of cancer is the strongest risk factor for a spinal tumor (positive likelihood ratio, 15) (39). Unexplained weight loss, lack of improvement after 1 month, and age older than 50 years are weaker

risk factors (positive likelihood ratio, 2.7 to 3.0). On the basis of these likelihood ratios, the probability of cancer in a patient with a history of cancer would increase to approximately 9%, or high enough to warrant immediate imaging (a strong clinical suspicion for cancer would give a similar result [72]). In patients with any of the other 3 risk factors, the posttest probability increases only marginally, to 1.2%. Imaging could be reasonably deferred in most cases unless symptoms did not improve after several weeks (38, 74). For patients with no signs of neurologic compromise who have risk factors for vertebral compression fracture, ankylosing spondylitis, herniated disc, or spinal stenosis, a trial of therapy before imaging would also be warranted. Diagnostic rules based on the evaluation of multiple risk factors could help better inform imaging decisions, but they are in the early stages of development (72).

Advanced imaging should be reserved for situations in which findings are more likely to affect clinical decision making, such as major trauma, severe neurologic compromise, or vertebral infection (5). If available, MRI is usually preferred over CT because it involves less radiation exposure and has better soft-tissue visualization. In cases in which only weak risk factors for cancer and no neurologic signs are present, initial imaging with lumbar radiography and evaluation of erythrocyte sedimentation rate is a reasonable approach (74). For persistent radicular symptoms or spinal stenosis without severe neurologic compromise, advanced imaging should be performed after a 1-month trial of therapy in candidates for surgery or an epidural steroid injection (5). For suspected vertebral compression fracture or ankylosing spondylitis, lumbar radiography is recommended. Decisions regarding repeated imaging should be based on the development of new or changed clinical features, such as new or progressive neurologic symptoms or recent trauma.

Although patient expectations regarding back imaging are frequently at odds with the evidence (58), this need not be the case. Most patients do not want unnecessary or potentially harmful tests. Patient education could help bring expectations more in line with the evidence. In addition, effective education may be less burdensome than assumed. One randomized trial (63) found that a brief educational intervention regarding back imaging took fewer than 5 minutes and resulted in similar satisfaction with overall care (and similar clinical outcomes) to that of routine radiography. Supplementing face-to-face information with patient handouts, self-care education books (75), online materials (76, 77), mass media educational campaigns (78), or other methods could be an efficient strategy for reinforcing or expanding on key points.

Efforts to decrease imaging overuse should also address external barriers to change. For example, clinician incentives based on patient satisfaction could reward unnecessary testing and be counterproductive (53). Incentives should instead be based on whether clinicians deliver appropriate care. Efforts are under way to curb overuse related to physician self-referral and to revise reimbursement schedules to provide fair compensation without excessive incentives for advanced imaging (65, 68, 79).

Active and individualized methods will probably be more effective at changing clinician behavior than passive ones, such as distributing guidelines (80, 81). Many health insurers have imposed authorization requirements for advanced imaging, but these are often viewed as onerous (65). As a potential alternative, a randomized trial (82) found that an educational session by local clinical leaders followed by individualized clinician audit and feedback was more effective than no intervention for reducing inappropriate lumbar imaging. Another promising method is a computer-based decision support tool (65) that provides information at the time of ordering, such as whether the patient has had a recent imaging study, and compares a physician's ordering patterns with that of his or her peers.

Conclusion

Health care practices associated with high costs and limited or no benefits provide little value (11). Good evidence indicates that routine back imaging is not associated with clinically meaningful benefits and exposes patients to unnecessary harms, but imaging remains overused. Implementation of the ACP/APS recommendations on judicious and selective low back imaging would improve patient care while reducing costs. To be most effective, efforts to reduce use of imaging should be multifocal and address clinician behaviors, patient expectations, and financial incentives. The mindset that more testing means better care must be abandoned in favor of a more evidence-based approach.

ACP Best Practice Advice

The ACP has found strong evidence that routine imaging for low back pain by using radiography or advanced imaging methods is not associated with a clinically meaningful effect on patient outcomes. Unnecessary imaging exposes patients to preventable harms, may lead to additional unnecessary interventions, and results in unnecessary costs. Diagnostic imaging studies should be performed only in selected, higher-risk patients who have severe or progressive neurologic deficits or are suspected of having a serious or specific underlying condition. Advanced imaging with MRI or CT should be reserved for patients with a suspected serious underlying condition or neurologic deficits, or who are candidates for invasive interventions. Decisions about repeated imaging should be based on development of new symptoms or changes in current symptoms. Patient education strategies should be used to inform patients about current and effective standards of care. The **Figure** summarizes this advice.

From Oregon Health & Science University, Portland, Oregon; American College of Physicians, Philadelphia, Pennsylvania; Veterans Affairs Palo Alto Health Care System and Stanford University, Palo Alto, California; and Veterans Affairs Greater Los Angeles Healthcare System, Los Angeles, California.

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Requests for Single Reprints: Amir Qaseem, MD, PhD, MHA, American College of Physicians, 190 N. Independence Mall West, Philadelphia, PA 19106; e-mail, aqaseem@acponline.org.

Current author addresses and author contributions are available at www.annals.org.

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Current Author Addresses: Dr. Chou: Oregon Health & Science University, 3181 Southwest Sam Jackson Park Road, Mailcode BICC, Portland, OR 97239.
Dr. Qaseem: American College of Physicians, 190 N. Independence Mall West, Philadelphia, PA 19106.
Dr. Owens: Veterans Affairs Palo Alto Healthcare System, 3801 Miranda Avenue, Palo Alto, CA 94304.
Dr. Shekelle: Veterans Affairs Greater Los Angeles Healthcare System, 11301 Wilshire Boulevard, Los Angeles, CA 90073.

Author Contributions: Conception and design: R. Chou, A. Qaseem, D. Owens, P. Shekelle.
Analysis and interpretation of the data: R. Chou, A. Qaseem, D. Owens.
Drafting of the article: R. Chou, A. Qaseem, D. Owens.
Critical revision of the article for important intellectual content: R. Chou, A. Qaseem, D. Owens, P. Shekelle.
Final approval of the article: R. Chou, A. Qaseem, D. Owens, P. Shekelle.
Administrative, technical, or logistic support: A. Qaseem.
Collection and assembly of data: R. Chou.