

# Lumbar Spine Films in Primary Care:

## Current Use and Effects of Selective Ordering Criteria

RICHARD A. DEYO, MD, MPH, ANDREW K. DIEHL, MD, MSc

*Low back pain (LBP) often prompts radiography, although the diagnostic yield of lumbar spine films is low, and many radiographic abnormalities are unrelated to symptoms. Criteria have been proposed for selective x-ray use, but their value and safety are uncertain. To evaluate these criteria, the authors prospectively studied 621 walk-in patients with LBP. The yield of explanatory x-ray findings was over three times greater among patients with indications for radiography than among those without. Furthermore, an indication for x-rays existed for all patients found to have a malignancy, and for 13 of 14 patients with an identified fracture. Actual physician ordering, however, did not correspond well with the recommended indications. Application of selective criteria appears safe and may improve the yield of useful findings. It may not, however, reduce x-ray utilization from current levels without further refinement in the criteria. Key words: low back pain; selective x-ray ordering criteria. J GEN INTERN MED 1986;1:20-25.*

BACK PAIN is the seventh most common reason for visits to internists,<sup>1</sup> and the second most common reason for visits to all office-based physicians.<sup>2</sup> Although evaluation of this problem often includes x-rays, indications for plain spine radiography are controversial. Some authors assert without qualification that lumbosacral spine films are an essential part of every low back pain evaluation,<sup>3, 4</sup> while others suggest that spine radiographs are not necessary for all patients.<sup>5-8</sup> Nonetheless, back pain is the symptom most often associated with x-ray ordering among ambulatory patients in the United States,<sup>9</sup> a fact often cited as exemplifying the overuse of radiologic studies.<sup>10</sup>

Those who discourage "routine" ordering of lumbar spine films emphasize the disadvantages of this strategy: a low yield of useful findings, high gonadal doses of radiation, a poor relationship between radiologic findings and symptoms, and high cost.<sup>5, 11</sup> In general, the purpose of plain spine films is to detect malignancies, infections, inflammatory spondyloarthropathies, or fractures, since these di-

agnoses may require specific therapy. Distinguishing among "mechanical" causes of pain is less important, since initial therapy is almost always symptomatic irrespective of the exact diagnosis. Furthermore, plain films are not helpful in the diagnosis of several mechanical lesions, such as herniated discs and spinal stenosis.

From these considerations, selective criteria for early lumbar spine radiography have been proposed, based on clinical findings.<sup>6, 12, 13</sup> While such criteria have been widely disseminated,<sup>14, 15</sup> there are few data to indicate how many films would be saved by applying them, or how often serious diagnoses might be overlooked.

We therefore collected clinical data prospectively on walk-in patients with low back pain, examined actual x-ray utilization, and assessed the potential effects of applying selective criteria for x-ray utilization.

## METHODS

### Patients and Data Collection

All patients sought treatment for back pain between March 1982 and May 1983 at a walk-in clinic affiliated with the University of Texas Health Science Center at San Antonio. Only patients including back pain in their chief complaint were considered. Patients were examined by housestaff physicians from the departments of Medicine, Family Practice, and Surgery, under the supervision of faculty physicians. History and physical examination data (65 items) were recorded on a standard coding form adapted from previous studies of back pain.<sup>6, 8</sup>

The decision to order x-rays was in each case made by the houseofficer, without faculty consultation. Since x-rays could have been ordered on a recent previous visit or might be ordered for a follow-up visit, we reviewed computerized radiology records to identify any lumbar spine films obtained during periods six months before and six months after the index visit. Most of these "study" films (84%) were obtained on the day of the index visit or within six days thereafter.

We used official x-ray reports as the source of x-ray diagnoses. These interpretations were performed by faculty radiologists or housestaff radiologists with faculty supervision. The radiolo-

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Address correspondence and reprint requests to Dr. Deyo: Department of Medicine, University of Texas Health Science Center at San Antonio, 7703 Floyd Curl Drive, San Antonio, TX 78284.

gists had available any clinical history provided by the primary physician. In each case, anteroposterior and lateral views of the lumbar spine were available, and additional views were obtained in some cases.

Patients were excluded if maximal pain occurred above T12, or if there was evidence of probable urinary tract disease. Women less than 45 years old who were not practicing contraception and whose last menstrual periods had occurred more than ten days previously were also excluded. Finally, 130 patients for whom x-ray use was constrained by participation in a clinical trial of back pain therapy were excluded. (These patients were nearly identical to the patients described here with regard to age, sex distribution, percentage seeking care for the first time, duration of pain, prior surgery, and x-ray findings.)

### X-ray Ordering and Patient Follow-up

X-rays were not obtained for every study subject for three reasons: 1) we wanted to describe actual utilization patterns, 2) we were financially unable to provide uniform x-rays as a research procedure, and 3) we could not justify requiring uniform radiography for clinical purposes alone.

Half the subjects did not receive x-rays. Because of this, and because x-rays may be falsely negative, we sought to identify all subjects with malignancy or osteomyelitis whether or not x-rays had been obtained. The hospital tumor registry and discharge records were used to identify patients found to have a malignancy or osteomyelitis during the six months after the initial visit, and the medical records of all febrile patients were reviewed after six months. While this method might fail to identify subjects who later sought care elsewhere, it is likely that most patients obtained follow-up for a particular illness at the same facility; in a separate study of back pain patients attending this clinic, 75% described our facility as their only source of care.

The entire sample of subjects (621) was used as the study population. However, for x-ray-dependent diagnoses such as fracture or spondylolisthesis, the study sample was limited to those (311) who received study films.

### Selective Criteria for X-ray Use

A list of 11 clinical findings and other indications, any one of which should prompt early radiography, was developed from criteria proposed by others<sup>6, 12, 13</sup>:

1. *Age more than 50 years.* Patients in this age range are more likely than younger patients to have under-

lying malignancy, osteoporosis, and compression fractures. The low yield often cited for lumbosacral radiography generally applies to patients under age 50.<sup>5</sup>

2. *Significant trauma.* A fall from height or external trauma (such as a motor vehicle accident) increases the risk of a fracture. For this study, lifting, pushing, bending, or a fall from standing were not considered significant trauma. While such lesser injuries may be important for older patients, age itself would be an indication.

3. *Neuromotor deficits.* Many such patients have herniated discs (not visible on plain radiography), but lesions such as spondylolisthesis or malignancy should be excluded. Isolated sensory deficits were not an indication.

4. *Unexplained weight loss.* An unexplained weight loss of more than 10 pounds over the preceding six months warrants consideration of malignancy or osteomyelitis.

5. *Suspicion of ankylosing spondylitis.* Calin et al. devised five screening questions for ankylosing spondylitis.<sup>16</sup> A positive response to at least four questions constituted a sensitive and moderately specific screen for ankylosing spondylitis. A patient with four or more positive responses and limitation of spinal motion (unable to touch floor on forward flexion) warrants x-ray examination.

6. *Drug or alcohol abuse.* Intravenous drug use is an important risk factor for pyogenic vertebral osteomyelitis. Severe alcoholism is associated with osteoporosis. Both drug and alcohol abusers are at risk for sustaining major injuries while intoxicated, often with inadequate recall.

7. *History of cancer.* A history of cancer (other than skin cancer) should prompt an examination for metastatic disease.

8. *Use of corticosteroids.* Corticosteroids may cause osteoporosis and increase susceptibility to infection.

9. *Temperature  $\geq 100^{\circ}\text{F}$  ( $37.8^{\circ}\text{C}$ ).* Fever often accompanies spinal epidural abscess or osteomyelitis.

10. *Recent visit for same problem and not improved.* Up to 90% of patients with acute back pain improve within four weeks.<sup>17</sup> Failure to improve may indicate unsuspected systemic illness. A patient who reports being seen for the same problem within the past month, whose condition has not improved, should receive x-ray examination.

11. *Patients seeking compensation for back pain.* These patients usually require radiographic evidence as a part of any legal proceedings. Physicians may also be concerned that these are especially litigious individuals.

This list of suggested indications was distributed with other materials to housestaff physicians in the walk-in clinic. More intensive instruction was not conducted, and x-ray ordering was not constrained.

**TABLE 1**  
Characteristics of Study Patients ( $n = 621$ )

Characteristic	Mean or Number (%)
Mean age, years	40.5 (range: 15-86)
Sex	
Men	293 (47)
Women	328 (53)
First medical care for back pain	332 (53)
Previous back surgery	20 (3)
Previous spine x-rays	192 (31)
Duration of pain	
<1 month	447 (72)
$\geq 1$ month	146 (24)
Unknown	28 (4)
X-ray findings*	311 (50)
Normal	135 (43)†
Disc narrowing or unspecified degenerative change, multiple levels	50 (16)
Single disc space narrowing	13 (4)
Osteophytes without disc narrowing	19 (6)
Osteopenia without fractures	27 (9)
Compression fracture	10 (3)
Other fracture	4 (1)
Spondylolisthesis >grade I or unspecified	6 (2)
Lytic or blastic lesions	2 (0.6)
Gunshot injury	1 (0.3)
Ankylosing spondylitis	0 (0)
Severe scoliosis	0 (0)
Other findings‡	44 (14)

\* Listed by major finding only (in cases of multiple radiologic abnormalities).

† Percentage of x-ray findings.

‡ Includes degenerative changes of facets, spondylolysis, Schmorl's nodes, mild scoliosis, transitional vertebrae, and other congenital anomalies.

### Classification of X-ray Findings

We classified radiographic findings according to their therapeutic importance (would they affect initial therapy?) and their diagnostic value (could they at least explain symptoms?). We did not attempt to measure an effect on actual health outcomes. Like Liang and Komaroff,<sup>7</sup> we assumed that specific treatment might reduce days of suffering for patients found to have osteomyelitis, malignancies, vertebral fractures, and inflammatory spondyloarthropathies. We assumed that spondylolisthesis would result in specific therapy only if neurologic deficits were present, since a trial of conservative therapy is otherwise indicated.<sup>18, 19</sup> We assumed that other radiologic diagnoses would result initially in symptomatic and conservative therapy, and that any delay in their identification would not prolong suffering. Examples are degenerative disc or apophyseal joint disease, transitional vertebrae, spondylolysis, and mild to moderate scoliosis.

The diagnostic value of x-ray findings was characterized by labeling them as very likely to

cause pain, unlikely to cause pain, or questionably related to pain. For this purpose, we used a classification proposed by Nachemson<sup>5</sup> and modified by White and Panjabi.<sup>20</sup> In this scheme, findings "very likely" to cause pain include spondylolisthesis (moderate to severe), multiple narrowed intervertebral disc spaces, congenital kyphosis, severe scoliosis, osteoporosis, ankylosing spondylitis, and Scheuermann's disease. For completeness, we added to this list lytic or blastic lesions, fractures, gunshot wounds, and certain combinations of findings. An x-ray was said to show "explanatory" findings only if these diagnoses were made. Findings classified as having questionable or no relation to symptoms included spina bifida occulta, single disc narrowing, osteophytes, facet arthrosis, sacralization of a lumbar vertebra, Schmorl's nodes, spondylolysis, grade I spondylolisthesis, and mild to moderate scoliosis.

When x-ray interpretations were ambiguous, one investigator (RAD) classified findings as explanatory or therapeutic. The decision usually favored an "explanatory" or "therapeutically important" rating, so that our results would, if anything, overestimate the yield of x-rays.

### RESULTS

The history and physical coding form was completed for 1,108 patients. Of these, 487 were excluded for the following reasons: 187 had maximal pain above T12; 79 had evidence of urinary tract disease; 131 were women less than 45 years old who were not practicing contraception and had not had a menstrual period within ten days; 130 were participants in a clinical trial which constrained x-ray ordering; and 37 had unlocated x-ray or laboratory results (some patients had more than one exclusion criterion). The study sample therefore included 621 patients, of whom 311 (50%) received lumbar spine x-rays. Characteristics of the study patients are shown in Table 1.

Actual physician ordering of x-rays did not correspond well with the selected criteria described above. There were 390 patients (63%) with a criterion for spine films, but only 227 (58%) of these actually received x-rays. Of 231 patients who had no indication for radiography, 84 (36%) received films nonetheless.

### Patients with Indications for Radiography

Table 2 shows the frequencies of the various indications for radiography, along with their associated x-ray use and yields of important findings. By indication, the percentages of patients actually receiving films ranged from a low of 36% for patients with alcohol or drug abuse to a high of

TABLE 2

X-Ray Indications, Actual X-Ray Use, and Yield of Therapeutically or Diagnostically Important Findings (Total N = 621)

Indication	No. of Patients	No. (%) of Patients Actually Receiving X-rays	No. (%) of Patients with X-ray Findings Related to Malignancy or Fracture (Therapeutically Important)	No. (%) of Patients with Explanatory Findings on X-ray
Age greater than 50 years	188	119 (63)	13 (10.9)	78 (65)
Seeking compensation	87	58 (67)	4 (6.9)	11 (19)
Seen within preceding month, not improved	60	37 (62)	1 (2.7)	13 (35)
Significant trauma	57	36 (63)	3 (8.3)	8 (22)
Neuromotor deficits	55	32 (58)	0 (0)	11 (34)
Suspicion of ankylosing spondylitis	38	19 (50)	0 (0)	8 (42)
Unexplained weight loss	37	19 (51)	0 (0)	7 (37)
Drug or alcohol abuse	38	10 (36)	0 (0)	1 (10)
History of cancer	13	10 (77)	1 (10)	6 (60)
Temperature $\geq 100^{\circ}\text{F}$	7	3 (43)	0 (0)	1 (33)
Using steroids	3	2 (67)	0 (0)	0 (0)
Total number with indications (some with more than one indication)	390	227 (58)	15 (6.6)	91 (40)
None of the above indications	231	84 (36)	0* (0)	10 (12)
Muscle spasm, in absence of above indications	80	41 (51)	0 (0)	6 (15)
Severe pain, in absence of above indications	29	15 (52)	0 (0)	3 (20)

\* One patient had transverse process fractures apparently sustained with major trauma two years previously, of no therapeutic importance.

77% for patients with a history of previous cancer.

Among the 227 patients with an indication who received films, 91 (40%) had x-ray findings that could explain their symptoms. There were 15 patients (6.6%) with therapeutically important x-ray findings, including two with lytic or blastic lesions and 13 with vertebral fractures. The indication with the highest diagnostic yield was age over 50 years, with 65% of films showing explanatory findings. Patients over 50 also accounted for 13 of the 15 therapeutically important findings (87%). In many cases, explanatory findings were unrelated to the indication. For example, ankylosing spondylitis was not encountered in the group with a high suspicion of this disease, and no patient with fever was found to have osteomyelitis. In every group, many of the explanatory findings were age-related (e.g., degenerative changes, osteopenia).

#### Patients without Indications for Radiography

Among the 84 patients who received spine films despite the lack of indications, only ten (12%) had radiographic findings that would explain their symptoms. Thus, explanatory findings were over three times more common among those with indications than those without ( $p < 0.0001$ , chi-square).

No patient in this group had therapeutically important x-ray findings by our definitions. Of the ten with radiographic findings that might explain symptoms, nine had osteopenia or mechanical lesions (degenerative changes, spondylolisthesis without neurologic deficits). The tenth patient had

two transverse process fractures attributed to a rodeo injury two years previously, at which time x-rays had been done.

#### Patients with Therapeutically Important Diagnoses

After review of the tumor registry and hospital discharge records, we identified four patients with underlying cancer, and none with osteomyelitis. All four with malignancies had an indication for radiography. Three were over age 50 (range: 52-56) and the fourth was a young woman whose pain had not responded to conservative therapy. Two of the older patients also had signs of systemic disease: weight loss or lymphadenopathy. Histologic diagnoses included two lymphomas, one metastatic prostatic cancer, and one retroperitoneal liposarcoma. Two of the four had lytic or blastic lesions, but two had normal lumbar spine films. While all four ultimately received lumbar spine films, cancer was not suspected or mentioned in the physician's note in three cases. If we assume our ascertainment of cancer was complete for all 621 subjects, the selective criteria were 100% sensitive (four of four) but only 37% specific (231 of 617) for identifying persons with malignancies.

Of the 14 patients identified with any fracture, 13 had indications for x-ray. Eleven were over age 50, five had recent trauma, and three were seeking compensation. The one fracture patient lacking an indication had transverse process fractures sustained two years earlier, as described above. We do

not know whether fractures were present among the patients who did not receive x-rays. However, among patients who received x-rays, the selective criteria were 93% sensitive (13 of 14) and 28% specific (83 of 297) in identifying fractures. No cases of inflammatory spondyloarthropathy were identified, though cases may have been missed among patients who were not x-rayed.

For the subjects who received x-rays, we can summarize by calculating the sensitivity and specificity of the selective criteria in identifying patients with therapeutically important x-ray findings. In our study, these were limited to malignancies (two positive films) and fractures (14). If we assume the old transverse process fractures were not therapeutically important, then the sensitivity of the criteria was 100% (15 of 15), but the specificity only 28% (84 of 296). For explanatory findings, the criteria were 90% sensitive (91 of 101) and 35% specific (74 of 210).

#### Utilization under Different Strategies

If x-rays had been ordered for all patients, as some authors advocate, 621 lumbar spine studies would have been performed. Strict use of the selective criteria proposed here would have resulted in 390 studies, a substantial savings over the strategy of uniform x-ray use. However, the clinic physicians actually ordered even fewer studies (311) than the selective strategy, since many patients with indications did not receive x-rays. If repeat films could be shown to be unnecessary for most patients with prior studies, the selective strategy might prove more parsimonious, since 38% of patients with x-ray indications reported having previous films.

### DISCUSSION

In this walk-in clinic, a surprisingly large proportion of patients with low back pain (nearly two thirds) had indications for radiography according to previously proposed criteria, but many of these did not actually receive x-rays. The number of patients with indications was greater than the number who received x-rays. Thus, use of the selective criteria might not result in reductions over current practice.

Our data suggest that use of the selective criteria would be safe, rarely overlooking therapeutically important findings. This confirms the impressions and data of others.<sup>5-8</sup> Indeed, use of these indications might reduce the chance of missing important findings in comparison with the less systematic pattern of ordering actually used by the clinic physicians. Although the housestaff were informed of recommended indications for radiogra-

phy, their ordering decisions did not correspond well with these indications. The physicians appeared to use their estimates of pain severity and the presence of muscle spasm in decision-making, but these findings in isolation were not associated with the presence of malignancies or fractures.

Among the x-ray criteria we used, the age criterion had the highest diagnostic (and potential therapeutic) yield. While several of the individual x-ray indications did not provide any therapeutically important x-ray findings (e.g., neuromotor deficits, weight loss, fever), there were few patients in these groups. The estimate of yield is therefore unstable, and we would be reluctant to eliminate these as indications for radiography.

If we assume that malignancies and vertebral fractures were the only radiographic diagnoses requiring specific therapy, then their prevalence in patients with radiographic indications was at least 3.8% (15 of 390: 2 films demonstrating cancer, 13 with fractures). This figure might be somewhat higher if all patients had received x-rays. Based on the cost-benefit analysis of Liang and Komaroff, performing x-rays in this group would cost between \$91 and \$246 per day of suffering averted.<sup>7</sup> Among patients without indications, there were no malignancies, and the only fracture was a transverse process fracture discovered two years earlier, not requiring therapy. We could not argue for any therapeutic benefit among these patients.

There are some important limitations to our data. We cannot be sure that our ascertainment of serious diseases among the study patients was complete. If patients with cancer or osteomyelitis sought care elsewhere after the index visit, they might not appear in our tumor registry or discharge data. However, we believe that this is an unlikely possibility because another study found that most patients using our clinic described our facility as their only source of care. We had no independent means of identifying patients with fractures, spondylolisthesis, or spondyloarthropathies, and these may have been missed in patients who were not x-rayed. Thus, we are less confident about the sensitivity of the selective criteria in identifying patients with these conditions. Furthermore, diagnoses such as ankylosing spondylitis and osteomyelitis are quite rare, probably occurring in fewer than one per thousand patients with acute low back pain.<sup>21</sup> It is not surprising that none were found in a study of this size, and we cannot draw conclusions about the sensitivity of the selective criteria for these conditions.

It should be noted that even expert radiologists often disagree on the presence or absence of many lumbar spine abnormalities.<sup>7</sup> In addition, the clinical history provided on the radiology request form

may bias interpretations. Thus, even the presence of a given abnormality may sometimes be debatable, let alone its explanatory or therapeutic importance.

Although we collected clinical data in a prospective manner, the x-ray criteria were applied retrospectively. There is no way to know what would have happened if these criteria had been explicitly used by physicians in their decision-making. In fact, a combination of clinical judgment with the criteria might lead to better results than we estimated. As with any patient care algorithm, use of these criteria is not intended to supplant clinical judgment, but to help inform that judgment.

Our clinical population, which is largely indigent and Hispanic, is not representative of the general population. If care-seeking patterns among our patients differ substantially from those of other patient groups, the yield of important radiographic findings may also differ. For example, if poverty or cultural factors delay seeking care for back pain, our sample may include an unusually large proportion of patients with indications for x-ray or with important radiographic lesions. Studies in other locations are needed to determine the generalizability of our findings.

Our data support the safety and value of applying selective x-ray ordering criteria in the evaluation of patients with low back pain. These criteria are most appropriate for use in primary care. Their application may not result in a substantial change in the current volume of x-ray use, however, unless a clinical policy regarding repeat radiography is added to the criteria presented here. Since as many as 96% of repeat studies reveal either no change or expected healing or degenerative processes,<sup>22</sup> this may be one way to refine the selective criteria to further limit the number of studies performed.

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