The Usefulness of X-Ray Examinations in the Evaluation of Patients with Back Pain

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Process and outcome data from 440 patients with back pain were analyzed. As a part of their care, 106 patients (24 percent) had back x-ray examinations. The non-x-rayed group of patients was used as a naturally occurring control group to determine what contribution back radiographs made to the cost, to the diagnoses and therapeutic decisions of providers, and to the outcome and satisfaction of patients. Although back x-rays contributed more to the cost of patient care than any other diagnostic study, their contribution to diagnosis was minimal, and had little effect on therapeutic decisions. Patients receiving back x-rays were more likely to have had prolonged symptoms at their first visit, and less likely to be symptom-free at four weeks, but were more likely to be satisfied with their care. The authors conclude that, for patients under 50, back x-ray examinations have negligible diagnostic value and their use could be reduced without decreasing the quality of medical care.

At some time during their active life, 80 percent of people will experience back pain.[1] Men and women are afflicted with equal frequency, as are white-collar workers and laborers.[1] A retrospective survey of 250 unselected people of preretirement age, 62 to 65 years, found that 60 percent had had low back pain of sufficient severity to warrant medical attention.[2]

Back pain is the fourth most common complaint among adults with acute symptoms,[3] and is a common reason for loss of time from work. In the United States, the annual number of workdays lost is 1,400 per 1,000 workers.[1] The incidence of the condition among industrial workers is strikingly uniform in England, the United States, Canada, Israel, and Sweden: approximately 50 per 1,000 workers per year.[1] In most industry, low back disability is the most frequent reason for compensation payments.[4] Recent studies in California and Sweden have shown low back pain to be the most costly ailment in the 30-to-60-year age group.[1]

Although backache is an extremely frequent complaint, except for a limited number of relatively uncommon conditions such as infections, tumors, spondylitis, and severe developmental defects, there is little medical agreement as to a predominant cause. Physiatrists regard weak trunk muscles as the primary cause of most backache;[5] psychiatrists report situational problems as the root of back disability;[6-8] and neurosurgeons and orthopedists describe mechanical defects, eg, herniated discs, as the etiological key.[1,9] Both

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0094-3509/78/0901-0455$02.75

psychosocial and mechanical stresses are probably clinically important, but genetic predisposition[10] and immunological factors[11] may contribute as well.

A recent epidemiologic study showed that suburbanites who drive to work are at twice the risk of severe back pain as those who do not drive, while truck drivers are at three times the risk.[12] Populations whose members sleep on the ground, sit on the floor, and squat while working have a negligible incidence of back pain, and their lumbar spines do not develop disc-narrowing with age.[13]

Medical evaluations of patients with back pain frequently include x-ray examinations. In a Kaiser walk-in clinic, physicians obtained x-ray examinations on 18 percent of adult patients with this acute problem.[14] In a family practice unit affiliated with the Medical College of Virginia, 39 percent of patients presenting with low back pain once or twice within one year received lumbosacral x-rays, while 74 percent of those presenting three or more times a year were x-rayed.[15] US Public Health Service figures indicate that three million lumbar back x-ray examinations are done per year,[16] at an annual cost of $150 million. (The procedure costs about $50 for routine views).

Low back x-rays constitute the largest single contributor to gonadal irradiation in the United States,[16] and, in women, there is also the risk of fetal irradiation in an early, unsuspected pregnancy. In susceptible fetuses, diagnostic x-rays during pregnancy may increase by tenfold the relative risk of subsequent childhood leukemia.[17] It has been calculated that low-level gonadal irradiation (5 rems over 30 years) could eventually cause a 2.5 to 25 percent increase in the burden of mutation-caused diseases.[18] Therefore, low back x-rays represent both a significant monetary cost and a potential health risk.

Several studies have questioned the clinical usefulness of back x-rays in the evaluation of patients with back pain.[4,19-21] In this study the authors have attempted to assess, in a primary care setting, the usefulness of back x-rays in the management of 440 patients with back pain. The following questions were asked:

1. What are the diagnoses associated with back pain and what is the clinical course of the patients?
2. How much do back x-ray examinations contribute to the cost of patient care?
3. Do back radiographs provide information useful for therapeutic decisions?
4. Do back radiographs affect patients' course or outcome?
5. Is patient satisfaction related to back x-ray use?

Materials and Methods

Clinical Site

Brooke Army Medical Center (BAMC), located in San Antonio, Texas, is a large teaching medical center providing medical care to 250,000 eligible patients in five specialty clinics, 48 subspecialty clinics, the Acute Minor Illness Clinic (AMIC), and the Emergency Room. All adult walk-in patients presenting to BAMC are first seen in the screening section of the Emergency Room where trained clerks interview each patient using physician-specified algorithms, determined by the patient's chief complaint. Based on the patients' responses to these screening questions, the clerks direct them either to (1) medical-surgical areas of the adjacent Emergency Room (2,500 patients per month), (2) other clinics in the hospital (500 patients per month), (3) a "walk-in physician" (1,000 patients per month), or (4) the Acute Minor Illness Clinic (3,500 patients per month).

The Acute Minor Illness Clinic (AMIC) is staffed by 14 acute minor illness specialists (Amosists), 3 first year residents, and 1 attending staff internist. The clinic is open 16 hours a day, seven days a week. Centralized source-oriented medical records at BAMC contain discharge summaries and ambulatory care data from all military medical facilities where a patient receives health care services.

Amosists

The Amosists at BAMC are all military corpsmen whose additional training consisted of four weeks of classroom work and nine weeks of supervised clinical experience. During this time they are taught those skills necessary to use clini-

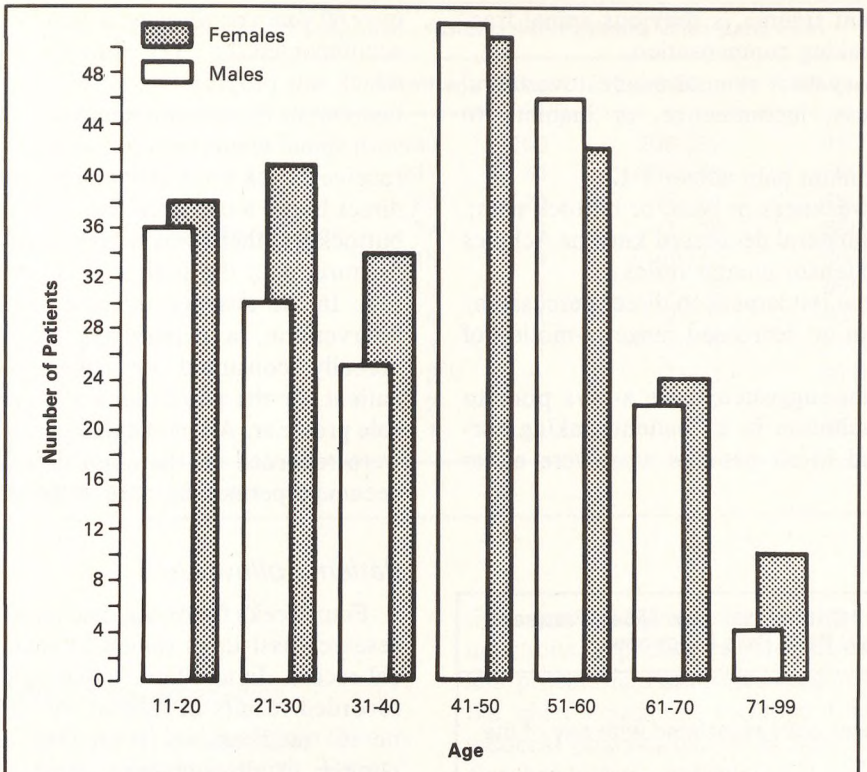

Figure 1. Age and Sex Distribution of 440 Patients With Back Pain

cal algorithms in the evaluation and treatment of common acute problems.

Patient Selection

Adult walk-in patients with back pain were triaged by the trained clerks as follows: if there was a history of direct trauma within the previous 24 hours, the patient was seen in the surgical Emergency Room. If back pain was accompanied by dysuria, frequency, hematuria, nausea, vomiting, diarrhea, or abdominal pain, further triage occurred, and the patient may have been referred to the medical or surgical Emergency Room. If there was a history of gynecologic problems causing similar pain, or if the patient thought a gynecologic problem could be the cause of her back pain, she was seen by a physician who may have directed her either to the gynecologic clinic, the Emergency Room, or the AMIC. However, about 75 percent of patients with back pain had none of these problems and were sent directly to the AMIC. This study is of patients with the chief complaint of back pain evaluated in the AMIC between December 1975 through July 1976.

Patient Evaluation

Amosists evaluated all patients with back pain using a clinical algorithm to guide their data collection and decision making. The Amosists collected and recorded on a checklist a defined historical and physical examination data base.

The back pain clinical algorithm logic used by the Amosists called for physician intervention if the patient:

(1) was younger than 15 years or older than 60 years;

or (2) had a history of malignancy;

or (3) was taking corticosteroids or anticoagulants;

or (4) had fever, chills, or a temperature greater than 37.8 C (100 F);

or (5) had nausea or vomiting, abdominal pain, or tenderness;

or (6) had recent trauma, a previous spinal fracture, or was seeking compensation;
or (7) had urinary tract symptoms, costovertebral angle tenderness, incontinence, or inability to void;
or (8) had maximum pain above T-12;
or (9) had leg weakness or pain, or buttock pain;
or (10) had a unilateral decreased knee or Achilles reflex, or an extensor plantar reflex;
or (11) had spinal tenderness to direct percussion;
or (12) had pain or decreased range-of-motion of the hip.

The algorithm suggested spine x-rays prior to physician consultation in all patients taking corticosteroids and in all patients who were either over 60 years or who had a history of malignancy if accompanied by: (1) abdominal pain; (2) pain which was progressive, severe, or unresponsive to bedrest; or (3) spinal tenderness. Also, any patient with spinal tenderness as a result of trauma was to receive a back x-ray if the injury was the result of a direct blow, a car accident, or a fall on to feet or buttocks, if there was a history of previous spinal fracture, or if the patient was seeking compensation. In the absence of indications for physician intervention, a supervising physician could be verbally consulted or asked to examine the patient, or the physician's assistant could be the sole provider. All medical data, actions, and plans were recorded on the algorithm checklist, which became a permanent part of the medical record.

Appendix 1. Criteria for the Most Frequent Low Back Pain Diagnoses

Sciatica:
Acute onset back pain associated with any of the following:
1. Leg weakness, unilateral or bilateral
2. Loss of sensation in the legs/toes
3. Asymmetrically absent or decreased ankle/knee jerks
4. Buttock/leg pain constantly and/or brought out by coughing/sneezing
5. Tingling/numbness in the buttocks/legs
6. Straight leg raising test positive
7. Myelogram positive for herniated nucleus pulposis

(Also check possible coexistent diagnoses: Vertebral fracture, osteoporosis, vertebral dislocation, degenerative joint disease, herniated nucleus pulposis)

Herniated nucleus pulposis:
Sciatica including positive myelogram.

Lumbago:
Back pain and abnormal back examination, but sciatica is not present (Items 1 through 6 are negative or not present) *and* spinal x-ray is done and negative.

Vertebral Fracture:
Spinal x-ray reveals a fractured vertebra.

Osteoporosis:
Spinal x-ray reveals osteoporosis.

Degenerative Joint Disease:
Spinal x-ray reveals degenerative joint disease.

Patient Follow-Up

Four weeks following discharge from the clinic, research assistants reviewed each patient's medical record. In addition to demographic data, they recorded results of laboratory and x-ray studies, noted medications prescribed, recorded the number of all outpatient clinic visits during the preceding year, and noted any hospitalizations or follow-up visits since the initial visit. The research assistants also attempted to interview each patient by telephone, using a standardized checklist to ascertain symptom status, disability duration, self-referred visits to another physician for the same symptoms, and satisfaction with the entire care process. If a patient expressed any dissatisfaction with the care, he/she was asked to elaborate his complaints.

A fourth internist, not involved in the clinic operations, the study, or the patient management, reviewed all the collected data, and used predefined criteria (Appendix 1) to assign final diagnoses to each patient. (Since the diagnostic criteria were not mutually exclusive, some patients had more than one diagnosis.) All data were then entered into a computer for later analysis.

Statistical Methods

Discrete data were compared by chi-square analysis without Yates' correction for continuity. Data containing continuous variables were compared by use of Student's t-test. Only those P values less than .05 were accepted as statistically significant.

Table 1. Distribution of Diagnoses Among 440 Patients With Back Pain

	Number	Percent	Males:Females	Mean Age*
Total patients	440	100	208:232	41(16)
Unable to diagnose	281	64	136:145	39(16)
Sciatica	86	20	45: 51	43(14)
Degenerative Joint Disease of Spine	37	8	17: 20	58(13)
Lumbago	18	4	6: 12	38(20)
Osteoporosis	5	1	0: 5	66(7)
Hip Disease	4	1	2: 2	63(11)
Vertebral Fracture	3	1	2: 1	61(10)
Herniated Disc	2	—	1: 1	41(11)
Urolithiasis	2	—	0: 2	54(4)
Metastatic Cancer	1	—	0: 1	56

* Standard deviation in parentheses

Results

Patient Population Characteristics

Most patients (72 percent) had back pain for one week or less at the time of their first visit. The age and sex of the population is seen in Figure 1. The mean age of the 440 patients was 41 years and ages ranged from 13 to 92. There were more women than men in each decade except between ages 41 and 60. The bimodal distribution results from a mix of relatively young active duty Army personnel and their dependents and older retired military personnel and their dependents.

Diagnosis Frequency

The final diagnoses assigned by retrospective chart review are presented in Table 1. The diagnostic criteria for some conditions were x-ray dependent. For example, diagnoses of "degenerative joint disease," "osteoporosis," or "vertebral fracture" were based upon typical x-ray findings and the diagnosis of "lumbago" was made only when the back radiograph was normal. As a result, the frequency of some diagnoses reflects x-ray examination use and not necessarily their true prevalence in this population. In the absence of an x-ray examination, no specific diagnoses could be retrospectively assigned to most patients.

Other diagnoses not listed on the table included six cases of bacteriuria and one case each of infectious hepatitis, hepatomegaly with ascites, and prostatitis. Additional diagnoses unrelated to the chief complaint included four of nonstreptococcal pharyngitis, three head colds, two tension headaches, and one each of bursitis, serous otitis, streptoccal pharyngitis, flu syndrome, acute bronchitis and cough.

The most serious illness presenting as acute back pain was metastatic breast cancer in a 56-year-old woman with a previous mastectomy. The diagnosis was suspected clinically, and confirmed by x-ray examination.

Telephone follow-up of 400 of 440 (90 percent) found only three patients who expressed dissatisfaction because they felt that a diagnosis had been overlooked:

(1) A 56-year-old male patient with a fever of 38.6 C was seen by both an Amosist and a physician on the first visit to the Acute Minor Illness Clinic. He was diagnosed as having the flu syndrome after normal initial and repeat blood counts, urinalysis, and a negative urine culture. Dissatisfied with his care, he saw a private practitioner, and was told he had a "kidney problem."

(2) A 36-year-old female with a fever (38.4 C), chills, back pain, hematuria, and bacteriuria was diagnosed and initially treated for a urinary tract infection, but the urine culture was negative. On return visit, a diagnosis of infectious hepatitis was made clinically and confirmed by laboratory studies.

Table 2. Relation of Patient Characteristics and Symptom Duration* to Spine X-Ray

	Spine X-Ray	No Spine X-Ray	P Value
Number of Patients	106	334	
Males	50(47%)	158(47%)	NS
Mean Age	45 ± 18	40 ± 16	P<.01
* Duration of Symptoms			
1 day or less	13(12%)	80(23%)	P=.01
2 to 7 days	55(52%)	168(49%)	NS
8 to 29 days	19(18%)	52(16%)	NS
30 or more days	19(18%)	34(10%)	P<.05

* At first visit

(3) A 22-year-old male could not be assigned a specific diagnosis retrospectively, but was told that he had a "pulled muscle" on his initial visit. Although he missed no work, his symptoms remained unchanged and he consulted a chiropractor. He was told his back pain was "not just a pulled muscle, but had to do with the skeletal system."

Diagnostic Tests: Use and Costs

On the first visit, 21 percent of patients (93/440) had back x-rays taken. Amosists, who used a clinical algorithm to help their decision making, requested back radiographs in 51 patients. Physicians, using their clinical judgment, approved of obtaining 40 (78 percent) of the Amosist-requested x-rays, and ordered an additional 53. All nine patients with serious, x-ray dependent diagnoses (carcinoma, osteoporosis, or fracture) were referred by the Amosist to the physician as suggested by the clinical algorithm. In four of these patients, the algorithm logic suggested x-rays prior to physician consultation. On subsequent visits, another 13 patients received back x-rays. Therefore, of the 440 patients, 106 (24 percent) received x-rays of their spines on the first or subsequent visit.

Total diagnostic test costs were $19.99 per patient. Back x-ray examinations were the most costly diagnostic study and accounted for 40 percent of the overall costs. Each back radiograph costs the Army $32; thus, in these patients a total of $3,392 or $7.71 per patient was spent for this diagnostic study. Other diagnostic tests included a $9 urinary culture, obtained in 209 patients for an average cost of $4.27 per patient; and a $4 urinalysis performed on 223 occasions for an average cost of $2.03 per patient. The back radiograph and the urine tests accounted for 70 percent ($14.01/$19.99) of the total diagnostic test costs.*

Relationship of Back X-Ray to Patient Care and Costs

The x-rayed patients were, on average, five years older than the non-x-rayed patients (Table 2). Among the x-rayed patients, fewer had short-duration symptoms (one day or less) and more had symptoms present for over 30 days. Diagnostic test costs were significantly higher in the x-rayed group, even when the cost of the back radiograph was excluded (Table 3). Other diagnostic tests averaged $5.75 (53 percent) more in the x-rayed group than in the non-x-rayed group. Additional radiographic procedures, especially the hip radiograph, accounted for most of this difference.

Obtaining a back radiograph had no demonstrable effect on therapy except in the one patient with metastatic cancer. As Table 4 shows, both the x-rayed group and non-x-rayed group received remarkably similar treatment. Analgesic and muscle relaxants (diazepam), as well as physical measures, were prescribed with equal frequency in both groups. In the eight patients with os-

*In other nongovernmental practice settings, where back x-ray examinations cost $50, urine cultures $10, and urinalysis $5, these three procedures, if obtained with this frequency, would have cost $24 per patient.

Table 3. Frequency and Cost of Additional Laboratory Tests in Relation to Spine X-Ray

Test	Average Cost per Patient X-Rayed	Average Cost per Patient not X-Rayed	P Value
Hip X-Rays	$ 3.05 ± 6.55	$ .61 ± 3.17	P<.001
Other X-Rays	$ 3.45	$ 1.70	
No X-Rays	$10.14	$ 8.58	
Total	$16.64 ± 17.79	$10.89 ± 12.92	P<.005
Total with Spine X-Ray	$48.64 ± 17.79	$10.89 ± 12.92	

teoporosis and/or vertebral fracture, chart review revealed that the x-ray examination confirmed the clinically suspected diagnosis, but resulted in no changes in clinical management.

As previously mentioned, 90 percent (400/440) of the patients were interviewed by telephone to determine illness outcome and patient satisfaction (Table 5). The follow-up rates were not significantly different between the group of patients who received back x-rays and those who did not (87 percent and 92 percent, respectively). There were no differences between the groups in days patients lost from their usual activity, but significantly more non-x-rayed patients were asymptomatic at the four-week telephone follow-up (132/308, 43 percent, vs 29/92, 32 percent, P<.05). However, in both groups, 85 percent reported their symptoms to be gone or improved and 15 percent reported their symptoms to be the same or worse. A similar percentage of both groups (63 percent and 66 percent) missed less than three days from work and also had symptomatically improved by the four-week telephone follow-up.

Less than ten percent of patients (38/400) expressed any dissatisfaction with their medical care. Even fewer, four percent (18/400), consulted another physician. However, significantly more patients complained about care and/or saw another physician in the non-x-rayed group (15 percent vs 6.5 percent, P<.05). Not surprisingly, satisfaction was also related to symptom status. Of the patients whose symptoms were absent or improved at telephone follow-up, 92 percent expressed satisfaction, whereas only 82 percent of those whose symptoms had continued or worsened were satisfied (P=.01).

Discussion

There are several limitations to this study. The patient population is characteristic of a large, military, medical center, but may differ from patients seen at other medical care facilities. Not all patients presenting with back pain have been included because about 25 percent of patients with specific associated symptoms were triaged to other departments. Most of the history and physical examination data were collected by nonphysicians, and although there was close physician supervision, no formal study was done of the Amosists' data collecting reliability. The history and physical findings on which the final diagnoses often were based might, therefore, have been different if physicians had been the principal data collectors. Since only 24 percent of all patients were x-rayed, nothing can be said about what x-rays might have discovered in the remainder. The diagnostic criteria used may be different from those used by others. Since follow-up was for only four weeks and was only on 90 percent of patients, there is a small possibility that patients with clinically important diagnoses were overlooked. Despite these deficiencies, there are several conclusions which can be drawn from this study.

Diagnoses and Clinical Course

In these patients, there were few serious musculoskeletal conditions presenting as back pain. There were only nine patients (two percent) having potentially serious diagnoses that were x-ray-dependent (carcinoma, osteoporosis, or fracture). There were only two patients with herniated

Table 4. Relation of Treatment to Spine X-Ray

	Spine X-Ray	No Spine X-Ray	P Value
Total Patients	106	334	
Analgesics	97(92%)	297(89%)	NS
Diazepam	21(20%)	72(21%)	NS
Bedrest	65(59%)	177(53%)	NS
Heat	84(79%)	251(75%)	NS
Exercise	36(34%)	111(33%)	NS
Hospitalization	4(4%)	4(1%)	NS

discs by myelogram. Four patients had hip disease. Non-musculoskeletal causes of back pain were found in several patients, including renal stones in two patients, and hepatitis, prostatitis, and hepatomegaly with ascites in one patient each. However, the majority of patients could not be given a specific diagnosis. Eight patients (two percent) required hospitalization.

The clinical course of most patients was remarkably benign. On average, patients lost less than three days from their usual activities because of their illness. Most patients (85 percent) responded to simple therapeutic measures including analgesics, muscle relaxants, heat, and bedrest in the acute phase, and exercises during the recovery phase.

Utility of Back X-Ray Examination

This study was of a consecutive group of patients presenting with backache. Although not strictly comparable, the non-x-rayed group of patients was used as a naturally occurring control group to determine what effect, if any, the back x-ray examination had on diagnosis, therapy, outcome, or satisfaction in the group receiving x-rays. There were differences between the composition of the group selected and the one not selected for back x-rays; the x-rayed group was, on average, five years older, and tended to have more chronic symptoms at initial visit. Although one might suspect that the x-rayed group had more severe symptoms, this could not be demonstrated from an analysis of the frequency of symptoms and physical findings recorded on the standardized checklists.

Not surprisingly, back x-rays contributed more to the cost of patient care than any other diagnostic study. Furthermore, patients who received a back x-ray were also more likely to receive other x-rays or laboratory tests (Table 3). However, for most patients, back x-rays contributed minimally to diagnosis. Only nine patients, all over 50 years old, were found to have potentially serious, x-ray-dependent diagnoses, and in all nine, the diagnosis was clinically suspected prior to the x-ray examination. By comparing the therapy prescribed to the x-rayed and non-x-rayed groups, the authors found that back x-rays seemed to have little effect upon therapeutic decisions (Table 4). Therefore, in most patients, the contribution of the back x-ray to the diagnosis was to allow retrospective classification as "lumbago" or "degenerative joint disease," rather than "unable to diagnose;" but this increased diagnostic specificity resulted in no therapeutic differences. Furthermore, there were no differences between the x-rayed and the non-x-rayed groups in illness outcomes as measured by days patients lost from their usual activity or status of symptoms (Table 5). However, if along with stated dissatisfaction, visiting another physician is considered a proxy measure of dissatisfaction, then there were significantly more patients who were dissatisfied in the non-x-rayed group.

Several hypotheses could explain why the back x-ray may enhance patient satisfaction: (1) Many patients trust technology to a high degree and expect that a technology such as x-ray examinations will be used to evaluate their problem. (2) A normal back radiograph may reassure an anxious patient that no disease is present, and thus con-

Table 5. Relation of Patient Outcomes and Satisfaction to Spine X-Ray

	Spine X-Ray	No Spine X-Ray	P Value
Total Patients	106	334	
Number Followed-Up	92(87%)	308(92%)	NS
Mean Days Lost	2.8 ± 5.2	2.3 ± 4.5	NS
Symptom Status			
Gone or Better	78(85%)	262(85%)	NS
Same or Worse	14(15%)	46(15%)	NS
Symptoms Improved and ≤ 3 Days Lost	58(63%)	204(66%)	NS
Satisfied	87(95%)	275(89%)	NS
Dissatisfied	5(5%)	33(11%)	NS
Saw Another Physician	1(1%)	17(6%)	NS
Dissatisfied and/or Saw Another Physician	6(6.5%)	45(15%)	P<.05

tribute to symptom resolution. (3) By ordering the x-ray examination, the provider may communicate to the patient that he is sincerely concerned about the patient's health; in essence, he/she is saying, "Your pain is real and I want to find out what is causing it." This might enhance the therapeutic aspect of the patient-provider relationship. (4) The patient who is x-rayed may receive more attention during his visit. Not only is he seen by the primary provider, but also by an x-ray technician and then again in follow-up for x-ray results. The patient probably also knows that a radiologist will look at the x-rays. The patient may be reassured when more people are involved in his care. (5) The patient who gets an x-ray examination is also more likely to be assigned a diagnosis. Since a physician may be more comfortable with a diagnosed patient, the medical care he provides the patient may be more effective.[6] The process of obtaining the x-ray examination may play a validating function in confirming the patient's "sick role." (The x-rayed patients may have reported their symptoms to be gone less frequently, especially if an abnormality was found which reinforced their "sick role.")

On the other hand, there are reasons a medical provider might obtain a back radiograph, even if there was a low probability of finding anything serious. Medical care providers are highly concerned about missing a serious diagnosis. This attitude may result not nearly so much from fear of a malpractice suit, as from the basic decision making premise in medicine. Unlike the US criminal legal system where the defendant is "innocent until proven guilty," in the medical care system a patient is "sick until proven well."[22] Additionally, the patient may request an x-ray examination, a request difficult to refuse when the possibility of clinical error exists.

Unfortunately, the present study was not designed to determine why the back x-ray examinations were being obtained. Although the authors reviewed each x-ray report, including the portion completed by the clinician requesting the x-ray, it was often impossible to accurately determine the diagnoses considered likely or unlikely, and the role the provider felt the x-ray would play in making that diagnosis.

Relationship to Other Studies

This study confirms Greenfield's findings[14] that physician-supervised mid-level practitioners can provide safe and effective clinical algorithm-directed treatment for patients with back pain. Greenfield's study was performed in a prepaid group practice, and the present study was done in a high-volume Army clinic. Kaiser's nurse practitioners are more extensively trained than Amosists, and the physicians at Kaiser are staff physicians while those at Brooke Army Medical Center are first year residents. However, there are basic similarities between the two studies: the patients in both groups incur no direct expense for visits, laboratory, or medication; both groups have financial barriers to free choice of alternate ambu-

latory medical services; and both groups are entitled to comprehensive services. A low incidence of serious conditions presenting as backache was found in both studies. The rate of spine x-ray use by Kaiser's nurse practitioners (9.5 percent) was comparable to the Amosist's 11 percent rate of ordering x-rays on the first visit. Additionally, the back x-ray use by Kaiser physicians (18.2 percent) was similar to the total physician-approved, initial visit, x-ray acquisition rate at Brooke Army Medical Center (21.1 percent). Patient satisfaction and outcome were comparable in both studies, and a positive relationship between satisfaction and favorable outcome was found in both. However, this study shows that the back x-ray may independently contribute to satisfaction.

Several other studies have questioned the clinical usefulness of the back x-ray in evaluating patients with back pain.[4,19-21] Splithoff[19] in 1953 compared the x-ray findings of 100 patients with and 100 controls without backache, and found no significant difference in the incidence of vertebral abnormalities in the two groups. However, his study did not match the cases with the controls for significant variables such as age and sex, nor did it account for these variables in the analysis. LaRocca also compared a symptomatic to an asymptomatic group and found no differences in x-ray findings.[20]

Rowe followed 500 male employees with back pain for up to ten years and compared them with 100 asymptomatic men matched closely for age and activity level.[4] There was no statistically significant difference between the two groups for the x-ray findings of spondylolisthesis (five percent vs six percent), transitional lumbosacral vertebrae (11 percent vs 10 percent), sagittal or asymmetrical lumbosacral facet joints (22 percent vs 26 percent), or spina bifida occulta (11 percent vs 9 percent). However, in the men 30-to-50-years old, the incidence of degenerative disc changes detected by x-ray was 62 percent in the patient group and only 22 percent in the controls. This pointed to degeneration of the intervertebral disc as a common accompaniment, if not the cause, of a large percentage of chronic backache cases.

A more recent study by Torgerson and Dotter[23] compared the x-ray findings of 217 asymptomatic and 387 symptomatic patients between 40 and 70 years of age. There was no difference between the rate of spondylosis (osteophyte formation). However, confirming Rowe's finding, evidence of disc degeneration was more frequent in the symptomatic group, 218/387 (56 percent) vs 48/217 (22 percent). There was also an increased incidence of radiographic evidence of spondylolysis (pars interarticularis defect) and spondylolisthesis (slippage of the vertebral body) in the symptomatic group, 18/387, (4.9 percent) vs 3/217 (1.5 percent). However, this study compared two different patient populations; the symptomatic group was a consecutive group of patients reporting to the Department of Orthopedics at Lahey Clinic in 1973, whereas the control group was undergoing intravenous pyelography (IVP) in 1967. Assuming usual referral patterns to orthopedists, a selection bias for back pain patients with radiographic abnormalities may have occurred. Interestingly, only 217 (27 percent) of the 800 IVP patients could be used as controls because the other 583 (73 percent) reported previous back symptoms. However, no comparison of the lumbosacral spine x-ray findings of the IVP patients with a history of back pain to those without was reported.

Brolin[21] reviewed 68,000 consecutive lower spine x-ray examinations done over a ten-year period at Sahlgren Hospital, Gottenburg, Sweden. Clinically unsuspected, positive radiographic findings in patients 20-to-50-years old were obtained only once in 2,500 examinations.

In a recent review article, Nachemson[1] makes the following statement: "In the majority of patients between 30 and 50 years of age, x-ray investigations [of the back] reveal little that is not seen or at least suspected on clinical examination, and since lumbar spine x-rays are connected with a very high gonadal irradiation risk, we must challenge our patients' many requests for immediate radiographic examination. Radiation is not a treatment for low back pain."

If this advice had been followed in the 440 patients in this study, significant savings would have occurred. Specifically, if otherwise healthy patients under 50 years of age with back pain had not been x-rayed on the initial visit, only 41 percent (38/93) of the initial x-ray examinations would have been obtained. Alternatively, if x-rays were obtained only in those patients who, despite therapy, lost four days or more from their usual activity or whose symptoms did not improve in four weeks, the overall x-ray rate would have been

36 percent of its observed level. Either strategy would have been clinically safe in that no serious x-ray-dependent diagnoses would have been overlooked.

As the Acute Minor Illness Clinic at Brooke Army Medical Center cares for about 4,000 patients with acute back pain per year, a reduction in the back x-ray rate to 40 percent of its present level would result in a savings, at this clinical site alone, of more than $75 thousand per year. Nationally, a reduction in the back x-ray use to one half its present level would save 1½ million x-ray examinations, or about $75 million per year.

Conclusion

From these data and a review of the literature, the authors conclude that back x-ray examinations have negligible diagnostic value in otherwise healthy patients under 50 years of age with nontraumatic backache. We also suggest that back x-ray use can be safely decreased without decreasing the quality of medical care. However, we recognize that any clinical strategy which reduces the use of the back x-ray examination may require concomitant patient education to maintain patient satisfaction.

Acknowledgements

The authors wish to thank John D. Wasson, MD and Harold C. Sox, Jr., MD for their development of the Back Pain clinical algorithm; Andre Ognibene, MD for chart reviews; and Margaret Ognibene, Helaine McNitt, Kathy Chatham, and Gordon Rain for their technical assistance.

This study was supported by contract DADA11-77-C-0008, Health Services Command, US Army, Department of Defense. Dr. Rockey was supported as a Robert Wood Johnson Clinical Scholar by training funds from the US Public Health Service, Health Services Administration, Division of Hospitals and Clinics.

Presented in preliminary form at the Annual Meeting of the American Federation for Clinical Research, Washington, DC, May 2, 1977. The opinions and conclusions presented herein are those of the authors and may not represent the views of the US Army, the US Public Health Service, or the Robert Wood Johnson Foundation.

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