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Original Contributions

RADIOGRAPH USE IN LOW BACK PAIN: A UNITED STATES EMERGENCY DEPARTMENT DATABASE ANALYSIS

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□ **Abstract—We identified factors associated with radiograph evaluation for patients who presented to the Emergency Department (ED) with uncomplicated low back pain (LBP). Using 1998–2000 ED data from the National Hospital Ambulatory Medical Care Survey, a multivariate analysis was performed to assess utilization of radiographs for LBP. Based upon published guidelines, of the over 3 million patients who met our criteria of uncomplicated LBP, 17.8% received an unnecessary radiograph. Patients who arrive via ambulance with moderate pain, who need to be seen within 15 min, and who have 3 or more screening tests ordered are 100% likely to also get a radiograph. There is an increased probability of receiving a radiograph for those patients 40–70 years old, being seen at a metropolitan hospital, having private insurance, and being treated by a resident in training. Multiple factors are associated with the overuse of radiographs for patients presenting with uncomplicated LBP.** © 2004 Elsevier Inc.

□ **Keywords—low back pain; radiograph; Emergency Department; NHAMCS; utilization**

INTRODUCTION

The prevalence and health impact of low back pain (LBP) in the United States are enormous. Even though LBP rarely indicates a serious disorder, it is a major cause of pain, disability, and societal cost (1). The annual prevalence of low back pain in the United States is estimated at 15–20%, with lifetime prevalence over 60%. Low back pain is the fifth most common reason for all physician visits, and is the second most common symptomatic reason. In 1999, LBP accounted for nearly 1 million visits to Emergency Department (EDs) (2). In addition, LBP consistently ranks nationally among the top 20 complaints of patients who present to EDs.

The economic burden of LBP is staggering. In the workplace, LBP is the most costly ailment, with an average cost of $8000 per claim (1). Moreover, LBP accounts for one-third of worker's compensation costs. The approximate annual national bill for the care of low back problems is $38–50 billion.

Given the prevalence and costs associated with LBP, guidelines have been proposed to manage and treat those who present with this condition. In 2000, the American College of Radiology (ACR) published guidelines that included recommendations for diagnostic imaging for patients with acute low back pain (3). Before these, in December 1994, the Agency for Health Care Policy and Research (ACHPR) issued a set of guidelines to address this problem (4,5). According to the ACR guidelines, acute LBP is a benign, self-limited condition that does NOT warrant any imaging studies (3). This is because the majority of these patients are back at their usual activities within 30 days. However, patient conditions

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that point to a potentially more serious back problem, termed "red flags," include a history of recent trauma or mild trauma in persons over 50 years of age, with unexplained weight loss, unexplained fever, immunosuppression, history of cancer, intravenous drug use, prolonged corticosteroid use, osteoporosis, or anyone over 70 years of age. The guidelines recommend the use of plain radiographs in all the preceding "red flag" cases. Advanced radiographic studies, such as computed tomography (CT) scan or magnetic resonance imaging (MRI), should be obtained in patients with a history, examination, or prior tests that strongly suggest a serious cause for back pain, such as cauda equina syndrome, infection, or tumor (1,6).

The main purpose of radiographic evaluation of the lumbar spine is to exclude LBP caused by malignancies, infections, inflammatory spondyloarthropathies, and fractures (7). Even in these complicated cases there is little consensus regarding what constitutes appropriate diagnostic imaging in patients with complicated LBP (6).

Several studies have suggested that spinal radiograph imaging is not indicated for every patient who presents with LBP (8,9). The incidence of unexpected findings on lumbosacral radiographs is only 1 in every 2500 patients under the age of 50 years (10). Other disadvantages of the ordering of lumbosacral radiographs for uncomplicated LBP include poor correlation between patient findings and symptoms, and the increased health costs incurred without additional patient benefits.

Lumbar spine radiographs deliver a high dose of radiation to the patient (11,12). In fact, the radiation dose from lumbar radiographs in a given patient is 40 times the dose received during routine chest radiography. Of further concern is that the gonadal doses of radiation for women are equivalent to a chest radiograph performed daily for over 6 years (13,14).

This study will utilize data from the National Hospital Ambulatory Medical Care Survey (NHAMCS) from 1998–2000. Our objective was to determine what factors are associated with the ordering of lumbar spine radiographs in the ED in uncomplicated LBP patients, i.e., patients who do not have any of the guideline criteria (no "red flags") for radiographic evaluation of their LBP.

MATERIALS AND METHODS

Source of Data

This study is a retrospective analysis of data obtained from the National Hospital Ambulatory Medical Care Survey (NHAMCS) for the years 1998–2000. The protocol was reviewed by the University of Health Sciences IRB and was granted exempt status. The NHAMCS is a sample survey conducted annually in the contiguous United States by the National Center for Health Statistics (NCHS). The NHAMCS is designed to collect data on the utilization and provision of ambulatory care services in hospital emergency and outpatient departments. Findings are based on a national sample of visits to the emergency departments and outpatient departments of non-institutional general and short-stay hospitals, exclusive of Federal, military, and Veterans Administration hospitals, located in the 50 States and the District of Columbia. Annual data collection began in 1992.

Specially trained interviewers visit the hospitals before their participation in the survey to explain survey procedures, verify eligibility, develop a sampling plan, and train hospital staff in data collection procedures. The survey instrument is the Patient Record form, which is provided in two versions, one for use in outpatient departments and another for use in emergency departments (EDs). Hospital staff are instructed to complete Patient Record forms for a systematic random sample of patient visits during a randomly assigned 4-week reporting period. Data are obtained on demographic characteristics of patients, expected source(s) of payment, patients' complaints, physicians' diagnoses, diagnostic and screening services, procedures, medication therapy, disposition, types of health care professionals seen, causes of injury where applicable, and certain characteristics of the hospital, such as type of ownership (15). The statistics contained in the data file reflect data concerning only a sample of patient visits, not a complete count of all the visits that occurred in the United States. Each record on the data file represents one visit in the sample. To obtain national estimates from the sample, each record is assigned an inflation factor called the "patient visit weight" by NHAMCS. We used the "patient visit weight" in every statistical procedure to reflect the national estimates. A detailed description of survey design and methodology has been described elsewhere (16).

Measurement of Variables

All visits to the EDs for "back symptoms" in nonpregnant adults 18–70 years of age were identified according to the primary reason for visit classification (RVC) codes: V905–910. Those patients presenting with "red flags" were excluded from the analysis, as it was determined before the study that these patients potentially would not be representative of "uncomplicated" LBP. Specifically, patient visits for back symptoms with the following diagnoses identified by the International Classification of Disease Ninth Revision, Clinical Modification (ICD-9-CM) codes were excluded from the analysis: 962 = adrenal corticosteroids, 733 = osteopo-

rosis, V10 = history of neoplasm, 780.6 = fever, 042 = AIDS and HIV, V22 = pregnancy, and V42 = transplant patients who were considered immunocompromised (17). Also, those patients receiving medications identified via the Ambulatory Care Drug Database system codes 1032, 1181, 1183, 1479, and 1481 were excluded from the analysis (18).

Radiographic evaluation of the patient was determined using one of the following: Chest X-ray, Extremity X-ray, "Other" X-ray, MRI, and CT scan. For the purposes of the assessment of "back symptoms," the assumption was made that those who received an "Other" X-ray received a radiographic evaluation of the back or spine, neither of which was a CT scan or MRI. Examples of diagnostic or screening tests ordered by physicians during the visits for back symptoms include the following: Mental Status Examination, Blood Pressure, Pregnancy Test, HIV serology, and CBC. Examples of medical procedures evaluated include: i.v. fluids, lumbar puncture, endotracheal intubation, nasogastric tube placement, and bladder catheter insertion.

Statistical Analysis

All statistical analyses were performed with Statistical Analysis Software (SAS) Version 8.0 (SAS Institute, Cary, NC). We used descriptive statistics to compare the differences of study variables between the patient visits with back symptoms and the patient visits without back symptoms. Multiple logistic regression analysis was used to assess the independent contribution of patients' health-related factors to the probability of ordering lumbar spine radiographs in the ED for uncomplicated LBP visits. Stepwise selection procedure was used for entering the independent variable in the model while controlling for patients' age, gender, and ethnic status. Results are presented as adjusted odds ratios (OR) with 95% confidence intervals (CI).

Table 1. Characteristics of "Back Symptoms" Seen in Emergency Departments in the US During 1998–2000

Variables	Back symptoms (%)
All visits of back symptoms (3,074,500)	100.0
Screening X-ray ordered	
Yes	17.8
No	82.2
Extremity X-ray ordered	
Yes	2.8
No	97.2
CT scan ordered	
Yes	4.3
No	95.7
MRI ordered	
Yes	0.7
No	99.3
Age (years)	
18–39	47.0
40–54	37.8
55–70	15.2
Gender	
Male	41.3
Female	58.7
Ethnicity	
White	76.4
Non-white	23.6
HMO member	
Yes	18.3
No/Unknown	81.7
Source of payment	
Private insurance	44.7
Other	55.3
Admitted to hospital or ICU	
Yes	3.4
No	96.6
Treating physician	
Physicians	98.0
Residents	2.0
Urgency (need to be seen in minutes)	
<15	8.0
15–60	26.6
61–120	21.7
>120	13.3
Unknown	30.4
Pain level	
Moderate/severe	32.9
Mild/unknown	67.1
Hospital location	
Metropolitan areas	73.8
Non-metropolitan areas	26.2

RESULTS

During the period of 1998–2000, there were over 3 million emergency department patient visits with the principle complaint of "back symptoms" (Table 1). Overall, 17.8% of patients with a chief complaint of "back symptoms" and no "red flags" received a screening radiograph. Furthermore, 4.3% and less than 1% of patients had a CT scan or MRI ordered, respectively, during that visit.

Patient Characteristics

Nearly 60% of the patients were women and nearly half were between 18 and 39 years of age (Table 1). Those 40–70 years of age were over 1.3 times more likely to receive a spinal radiograph for their back symptoms than were younger patients.

Odds ratios for factors associated with radiograph screening for back pain are listed in Table 2. Neither race nor gender was found to be a significant factor for

Table 2. Factors Associated with Ordering Screening Radiographs for Back Symptoms in the ED in the US During 1998–2000

Predictors	Screening radiograph ordered		
	%	Odds Ratio*	95% CI**
Age (years)			
18–39	15.4	1.00	Reference
40–70	20.0	1.34	1.10–1.62
Gender			
Male	16.3	1.00	Reference
Female	18.9	1.19	0.97–1.44
Ethnicity			
Non-white	19.4	1.00	Reference
White	17.4	0.99	0.79–1.24
HMO member			
No	16.3	1.00	Reference
Yes	24.7	1.44	1.13–1.82
Source of payment			
Other types	15.7	1.00	Reference
Private insurance	20.5	1.26	1.04–1.55
Hospital location			
Non-metropolitan area	12.7	1.00	Reference
Metropolitan area	19.7	1.48	1.16–1.89
Treating physician			
Physicians	18.3	1.00	Reference
Residents	36.4	2.58	1.47–4.53
Total drugs prescribed			
One or fewer	15.2	1.00	Reference
Two or more	19.5	1.33	1.10–1.63
Screening tests ordered			
Two or fewer	10.8	1.00	Reference
Three or more	29.7	3.53	2.90–4.29
Procedure provided			
No	15.3	1.00	Reference
Yes	25.9	1.89	1.54–2.31
Admitted to hospital or ICU			
No	17.6	1.00	Reference
Yes	25.7	1.62	1.04–2.55
Urgency (need to be seen)			
≥15 min	18.6	1.00	Reference
<15 min	24.6	1.44	1.05–1.97
Arrival mode			
Other types	17.2	1.00	Reference
By ambulance	26.0	1.52	1.10–1.64
Pain level			
Mild/unknown	16.2	1.00	Reference
Moderate/severe	21.3	1.35	1.10–1.64

* Adjusted for patient's age, gender and race.
** 95% confidence intervals.

ordering a spine radiograph. HMO members, who represented 18% of the population, were 1.44 times more likely to receive a screening radiograph. Those paying with private insurance were 1.26 times more likely to receive a radiograph compared to those with other forms of insurance, such as Medicaid. Fewer than 4% of patients with back symptoms were admitted to the hospital (Table 1). In contrast, patients admitted to the hospital were over one and a half times more likely to be given a spinal radiograph (Table 2). Similarly, those with an urgency to be seen in less than 15 min comprised only 8% of all patients, but they were 1.44 times more likely to have a spinal radiograph ordered. Approximately 26% of patients who arrived by ambulance received a radiograph, which was over 1.5 times more frequent than those arriving to the ED by other modes of transportation. Those who had a medical procedure (e.g., CPR, i.v.) performed on them were nearly twice as likely to get a spinal radiograph compared to those who received no procedure. Those patients having three or more screening or diagnostic tests ordered were more than 3.5 times more likely to have a radiograph ordered.

Residents treated only 2% of all patients who entered the ED with a chief complaint of low back pain. However, residents were 2.5 times to 4.5 times more likely to order a spinal radiograph than ED staff physicians. Also, 19.5% of patients who were prescribed two or more drugs for their "back symptoms" had a 1.33-fold higher likelihood for radiologic study than those whose physicians prescribed them only one or two medications. Finally, the practice site seemed to play a role in the prescribing patterns of the physicians. Physicians working in metropolitan EDs treated nearly three-fourths of all patients with back symptoms. Physicians in metropolitan areas ordered radiographs on 19.7% of all LBP patients, which is higher than the 12.7% utilization rate in rural areas.

Factor analyses of several patient and physician factors were performed and are presented in Figure 1. More than one out of four patients who arrived by ambulance alone were likely to receive a spine radiograph. However, when combining patients who arrived via ambulance with moderate pain, who needed to be seen within 15 min, and who had 3 or more screening tests ordered, a predictive value of 100% to get a radiograph was found.

DISCUSSION

Over 4 million visits to the ED were recorded using the NHAMCS survey for "back symptoms" during 1998–2000, with over 3 million visits included in this analysis. We found that 17.8% of patients who present to the ED with back symptoms receive an unnecessary spine radiograph. Excluding the patients in whom a complicated (i.e., "red flag") back condition may exist, we found that approximately one out of every six patients is being prescribed an unnecessary radiographic evaluation. Our utilization rate is similar to that in a report by Weiner and colleagues in which 19% of their LBP patients who presented to the ED had a radiograph (19). However, in that smaller series, patients with "red flags" were not excluded from analysis.

There are two unique features of our study. First is the national perspective the database provides, the second is

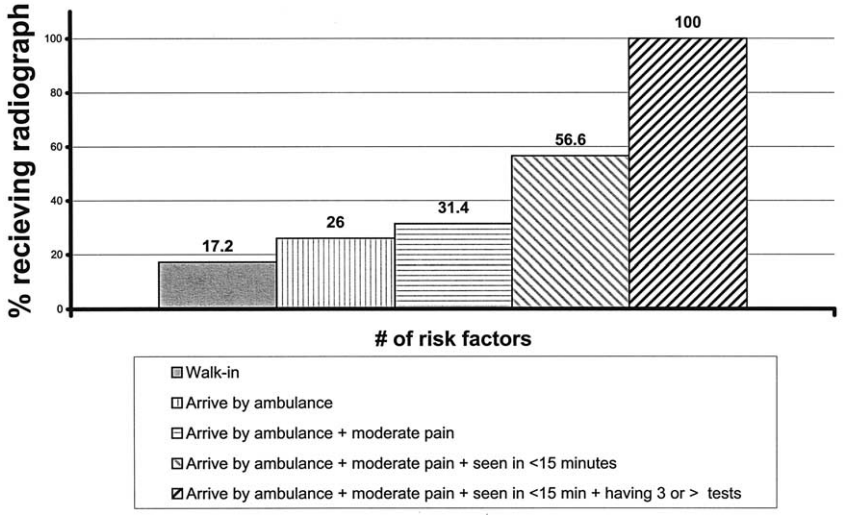

Figure 1. Cumulative effect of variables on likelihood of receiving radiograph in ED for LBP.

the ability to access acuity factors (e.g., patient severity of pain, immediacy with which the patient should be evaluated) associated with the utilization of radiographic evaluation of LBP patients in the United States. Based upon our findings, over-prescribing of some 500,000 radiographs occurred throughout the United States during that period of time. The economic impact of the over-utilization of this test is difficult to estimate, but would undoubtedly range in the millions of dollars (20).

For most patients with acute LBP, the etiology is thought to be mechanical, involving the spine and adjacent structures (21). Unfortunately, in most cases, physical examination or diagnostic testing cannot reliably confirm a precise etiology. One study points out that up to 85% of patients cannot be given a definitive diagnosis (1). The prevalence of serious diseases in patients with low back pain is low (8–11,22,23). Most patients with low back pain have normal lumbar radiographs or age-related degenerative changes that do not correlate with the presence or severity of pain (23,24–28). Dillane et al. pointed out that most of the spontaneous episodes of lower back pain are self-limiting and that in more than 80% of cases a cause is never found (29). Likewise, a recent study by Elam et al. concluded that because lower back pain resolves with minimal intervention, emergency physicians should refrain from obtaining not only diagnostic imaging studies, but specialist consultation as well (30).

We were able to identify, via factor analysis, four key groups of conditions that were associated with the utilization of radiographs in the ED. Those associated areas were: patient, prescriber, source of payment for medical services, and location of the ED.

Patient-associated Factors

Neither gender nor ethnicity played a role in the frequency with which radiographs were ordered. In a small series, it was found that non-white patients with LBP received more radiographs than white during a 12-month study (13 observed cases), however, due to the small number of cases, no statistical evaluation was possible (31). Our finding seems to contradict previous studies that have consistently demonstrated racial differences in global health services utilization, most notably with regard to diagnostic procedures (32–34). Other published work cites that Whites are more likely to undergo a broad variety of diagnostic and therapeutic procedures than Blacks and Hispanics, even after controlling for severity of illness and other indicators of physical condition (35–37).

From the 1999–2000 data, women represent about 60% of the patients who come into the ED with a chief complaint of "back symptoms." Similarly, in general, women are more likely than men to come to the ED for any reason (2). It is unclear as to why more women come to the ED for back symptoms. However, the likelihood of a woman receiving a radiograph for her complaint did not prove to be greater than that for her male counterpart.

Forty-seven percent of the patients seen in the ED for back symptoms are adults aged 18–39 years. In contrast, individuals over age 40 years were more likely to get radiographs. Our finding of age-associated use of radiographs is in contrast with Selim and colleagues, who found no association between the patterns of radiograph use and age, income, education, history of cancer, history of alcohol or drug use, and the number of medical and mental conditions (31). We speculate that age of the

individual may influence the utilization of radiograph evaluation for LBP. With increased age, there may be an increase in patient comorbidities, an increased chance of having developed a persistent low back problem, or an overall heightened concern in the patient. Thus, as one ages, the likelihood increases of developing more pathologies, such as "red flags" previously described.

Only about 3% of those patients with "back symptoms" were admitted to the hospital. However, those admitted were 1.6 times more likely than those not admitted to have a radiographic evaluation. Similarly, those with moderate to severe pain were 1.3 times more likely to receive a spine radiograph. Patients arriving by ambulance were over 1.5 times more likely to be given a spine radiograph. Likewise, those who were triaged to be seen by a physician within 15 min were nearly 1.5 times more likely to have a spine radiograph ordered. Several possible explanations may exist for these findings. Perhaps the patient entering the ED with severe back pain is more likely to demand a radiograph and place pressure on the prescribing physician. The perception of the medical team may be that patients who arrive by ambulance or patients who get triaged to immediate care are "sicker," and therefore these factors may justify a more extensive evaluation.

Other patient factors were associated with an increased likelihood of getting a radiograph. These included those patients who were prescribed two or more drugs and those receiving more diagnostic or screening tests or procedures. Specifically, patients prescribed two or more medications were 33% more likely to have a radiograph ordered. The most predictive factor associated with radiographs for LBP was receiving 3 or more screening tests (e.g., BP, Pulse Oxygen, Urinalysis). These patients had a 3.5 times greater chance of being screened with a spine radiograph. Therefore, it seems plausible that those patients presenting with multiple pathologies and requiring a more complete diagnostic workup have an overall greater chance of receiving plain radiograph spinal imaging.

Physician Factors

An interesting finding of our research is that physician experience seems to play a large role in the ordering of spine radiographs in the ED. Although our data show that residents see only 2% of all patients with back symptoms, they are over 2.5 times (95% CI: 1.47–4.53) more likely to order a screening radiograph compared to physicians who have completed training. There are several possible explanations for this finding.

As previously stated, in December 1994, the Agency for Health Care Policy and Research (AHCPR) of the U.S. Department of Health and Human Services developed practice guidelines for the assessment and treatment of acute low back problems in adults. The first publication is the document outlining the report and recommendations of the panel (4). The second publication is the Quick Reference Guide for Clinicians (5). This document is normally distributed to physicians as a clinical guide (13). There may be a lack of awareness on the part of physicians in training and their residency directors about treatment guidelines. Also, and perhaps as important, the guidelines were developed for primary care physicians, and not for physicians who practice in emergency departments.

An additional explanation may be traced back to medical school training. A study from researchers at the University of Pennsylvania found that residents are generally poorly trained in musculoskeletal knowledge (38). It is unknown whether additional training in musculoskeletal disease pathophysiology would be of value in curbing the over-utilization of spine radiographs in the ED.

Additionally, it has been hypothesized that practitioners who are more comfortable and confident in their clinical abilities with LBP and who recognize the possible therapeutic value of non-technological aspects of the clinical encounter may be more effective in diagnosing and treating patients (39–41). Cherkin et al. found that 42% of physicians felt "poorly prepared" to manage LBP when they first entered practice, compared with only 15% of chiropractors, whose training concentrates on back problems (42). Our study was unable to assess the physician confidence in diagnosing and managing LBP patients, however, it seems logical that the resident would likely feel less prepared to manage LBP than emergency physicians who have been in practice for some time.

The ED environment may in itself play a major role in the high utilization of radiographs. Specifically, patient follow-up with primary care providers cannot be guaranteed, nor do many practitioners have access to complete medical histories on the patients they treat in the ED. Thus, it is difficult for the ED physician to determine or verify from patient history if any prior work-up has been done for the patient's LBP (19). As a result, perhaps ED clinicians choose a more aggressive diagnostic evaluation of lower back-related complaints than a physician in the primary care arena.

Other potential reasons for the overuse of spine radiographs by all physicians, not only those in the ED, may include medicolegal issues, malpractice concerns, or for insurance purposes. However, the literature does not support the use of radiographs for these express purposes. In one series, the investigators questioned the ordering physician for the reason why the radiograph test

was ordered. In cases where the lumbosacral examination was requested for "medicolegal reasons," pertaining to possible malpractice action, the radiographs showed either normal findings or spondylosis in 38 (93%) of 41 patients (19). When insurance documentation was the indication for the lumbosacral series, 80 (95%) of 84 showed either normal findings or spondylosis (19). Moreover, because of the poor association between symptoms and findings noted previously, the ordering of imaging studies for "medicolegal reasons" is not recommended. Rather, in the event that the clinical evaluation does not support such radiographic testing, the prescriber should document the medical reasoning in the patient's chart (1).

Additionally, the same study found that when patient reassurance was the only motivating factor for a lumbar spine series, there was a low yield of radiographic diagnosis. Evidence shows that neither physical examination nor diagnostic testing can reliably confirm a precise etiology of LBP in up to 85% of the cases (1). Physicians may want to convey this information to the patient who is requesting a radiograph. Liang and Komaroff reported that the probability of encountering disease requiring specific therapy in patients with low back pain using radiographs was less than 0.2 in 100, and the probability of neoplasia or infection was less than 1 in 1000 (11). For all physicians, simply informing the patient that the test is not indicated, and will most likely be uninformative, may be sufficient to quell any concerns.

Source of Payment

In our evaluation of the database, private insurance was the most common source of payment in the ED for LBP 47.8%, followed by self-pay (17.4%), Medicare (14.6%), and Medicaid (10.7%). Perhaps surprisingly, worker's compensation was very rarely ($< 1\%$) stated as the source of payment for visits to the ED for LBP in this series. Similar to our findings, another study that identified payment for back-related visits to offices found that commercial insurance (Blue Cross and others) was the most common source of payment, involved in about 31% of visits (43). We found that having private insurance increased the likelihood of receiving a screening spine radiograph. Specifically, if a patient belonged to a HMO, that patient was nearly 1.5 times more likely to receive a radiograph. Moreover, the 44.7% of patients who had private insurance (not HMO) were only slightly more likely to receive a spine radiograph. Reasons for the increased probability of a radiograph for patients having private insurance or belonging to an HMO remain unclear and need further investigation.

The AHCPR guidelines refer to the ability of the patient to pay for the medical care in the selection of testing for LBP patients. Specifically, the guidelines state that when selecting an imaging test, the physician should consider the economic burden to the patient (4,6). Prospective studies have demonstrated a link between patient income and diagnostic testing ordered. Ackerman and colleagues' analysis reported that increased annual household income was associated with the increased likelihood of MRI being performed in addition to radiograph or CT-myelography (6). This suggests that the ability to pay (out of pocket or via insurance) may have influenced the physician's decision to order imaging studies. Alternatively, annual household income may be indicative of an individual's socioeconomic status, suggesting that higher socioeconomic status may be associated with greater knowledge of, and demand for imaging modalities (6). We were unable to assess the socioeconomic status of the patients using the database and whether this variable played any role in the utilization of radiographs in the ED for LBP.

ED Location

Emergency department location was the final factor associated with the increased prevalence of spinal radiographs in the ED. Our data found that three-fourths of patients with back pain were evaluated in metropolitan hospitals. This is in contrast to Hart and colleagues, who found a greater number of office-based back pain visits in rural areas compared to urban areas (43). Those seen in the metropolitan hospital ED were 1.5 times more likely to get a radiographic evaluation than those seen in a rural area. Reasons for the greater utilization are speculative, but may be related to the lack of availability of radiographic equipment and personnel in the rural as opposed to the metropolitan areas.

Limitations

There were several limitations in this study that should be noted. First, we assumed that those who came into the ED with a chief complaint of "back symptoms" had low back pain. It is possible that those with the chief complaint of "back symptoms" did not have lumbosacral back pain. A second limitation is that the survey utilized by the NHAMCS does not contain a specific query for lumbosacral radiograph, only for Chest, Extremity, or "Other" X-ray. However, we were able to obtain accurate numbers of CT scans or MRI tests ordered in our series. Our assumption, therefore, is that patients with "back symptoms" who received a radiograph other than those cited above, received an evaluation of their back or

spine. This assumption may have resulted in an overestimate of the frequency with which spinal X-rays were ordered. In addition, due to database construct limitations, we were unable to assess the results or findings of any of the radiographs ordered. Thus, we cannot estimate how frequently pathology was identified in "back symptoms" patients with or without "red flags."

The major strength of the study is in the database itself. The data represent over 3 million patient visits to the ED and are representative of the entire United States. Unlike any previous study, we were able to focus on multiple factors associated with the utilization patterns of radiographs for patients who presented with uncomplicated low back pain.

In conclusion, per national guidelines, radiographic imaging is not indicated in the vast majority of patients who present with a complaint of uncomplicated LBP. Our study shows that approximately one out of every six patients who present to the ED with "uncomplicated" LBP is receiving an unnecessary radiographic evaluation. The two most compelling reasons against the routine use of radiographs are: 1) imaging findings are poorly associated with symptoms (i.e., not specific), and 2) important causes cannot be identified with plain radiographs (i.e., not sensitive) (1). Other disadvantages of routine ordering of lumbar spine radiographs include the high gonadal dose of radiation, and the high cost:benefit ratio (11,12). Our findings demonstrate that patients who are older, those who have private insurance, who arrive by ambulance, are in moderate to severe pain, and those assessed to need medical treatment within 15 min are more likely to receive radiographs. Residents are more likely than attending physicians to order radiographs. Physicians who order more diagnostic and screening tests, medications, or procedures for these patients, and those who practice in metropolitan areas are also more likely to order radiographs on LBP patients. The results of this study may prove useful for future educational efforts directed toward physicians and patients regarding utility of, and risks associated with, lumbosacral radiographs for uncomplicated LBP in the ED.

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