

Can Guidelines Impact the Ordering of Magnetic Resonance Imaging Studies by Primary Care Providers for Low Back Pain?

Jaya K. Rao, MD; Kurt Kroenke, MD; Kimberly A. Mihaliak, BS;
George J. Eckert, MAS; and Morris Weinberger, PhD

Objective: To compare primary care providers' (PCPs') use of lumbar spine magnetic resonance imaging (MRI) studies and surgical referrals for patients with low back pain (LBP) before and after dissemination of the 1994 Agency for Healthcare Policy and Research (AHCPR) LBP guidelines.

Design: Retrospective cohort study.

Patients and Methods: Computerized audits identified patients with LBP evaluated by PCPs in 1994 or 1996 at a university-affiliated Veterans Affairs medical center who had an MRI order and/or a surgical referral. Research assistants recorded patients' demographic characteristics, LBP-related symptoms, and whether the PCP ordered an MRI and/or a surgery consult. For patients referred to surgery without an MRI, subsequent MRI orders by surgeons were recorded. We compared patient characteristics and utilization patterns for 1994 and 1996 and identified independent predictors of MRI orders.

Results: PCPs saw 279 and 261 patients with LBP in 1994 and 1996, respectively. An almost identical number of MRIs were ordered in 1994 (99 by PCPs and 42 by surgeons) and 1996 (105 by PCPs and 32 by surgeons). Nearly 50% of patients meeting AHCPR guidelines underwent an MRI in 1994 or 1996. PCPs more frequently ordered a surgery consult in 1994 than in 1996. Providers were less likely to order an MRI for patients with a previous MRI and more likely to order an MRI for those seen in an urgent visit clinic. Neither year nor meeting AHCPR guidelines predicted MRI ordering.

Conclusions: Orders for MRI did not decrease after education on the guidelines. Limiting MRI orders to only "appropriate" patients would not have changed the observed results.

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gated to help providers select the most cost-effective strategies for the evaluation of patients.

Low back pain (LBP) is an ideal model for examining the impact of guidelines on utilization patterns of diagnostic tests and specialty referrals by PCPs. This common medical problem is associated with significant practice variation and enormous costs.¹⁻⁴ Clinician use of imaging studies and specialty referrals is an important contributor to these costs.^{3,5} Magnetic resonance imaging (MRI) is an expensive diagnostic strategy used to evaluate patients with LBP.^{3,6} This test is the most sensitive strategy for detecting anatomical abnormalities of the lumbar spine, but no gold standard exists to determine whether the imaging abnormalities are actually causing the patient's LBP symptoms.^{1,7-11} A significant number of asymptomatic individuals have abnormalities on these imaging studies,⁹⁻¹² whereas some patients with symptoms have no defects.¹ Thus, MRI might be associated with additional expense if clinically insignificant imaging abnormalities trigger further testing and specialty referrals.¹³⁻¹⁵

To provide evidence-based guidance to clinicians who see patients with acute LBP, the Agency for Healthcare Research and Quality, formerly known as

From the Center for Health Services Research, Roudebush Veterans Affairs Medical Center (JKR, KAM, MW); the Division of General Internal Medicine (JKR, KK, MW) and the Division of Biostatistics, Department of Medicine (GJE), Indiana University School of Medicine; and Regenstrief Institute for Health Care (KK, MW), Indianapolis, IN.

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Address correspondence to: Jaya K. Rao, MD, Health Care and Aging Studies Branch, Centers for Disease Control and Prevention, 4770 Buford Hwy NE, MS K-45, Atlanta, GA 30341-3724. E-mail: jgr6@cdc.gov.

When deciding to pursue a diagnostic evaluation for patients with persistent symptoms, primary care providers (PCPs) have several options: order diagnostic tests, refer to a specialist, or order tests and a consultation. The option selected might be influenced by a variety of considerations, including the clinical utility, risks, and costs of testing and lead time for appointments with a specialist. Clinical guidelines have been promul-

the Agency for Healthcare Policy and Research (AHCPR), disseminated in December 1994 guidelines that included diagnostic strategies for evaluating patients with this common medical condition. We examined patterns of MRI orders for the evaluation of primary care patients with LBP before and after dissemination of these guidelines. Our purpose was to determine whether MRI utilization by PCPs changed after they received education on these guidelines. We hypothesized that PCPs ordered MRIs more appropriately in 1996 vs 1994.

... METHODS ...

The institutional review boards of Indiana University–Purdue University at Indianapolis and the Roudebush Veterans Affairs Medical Center (VAMC), Indianapolis, approved this study.

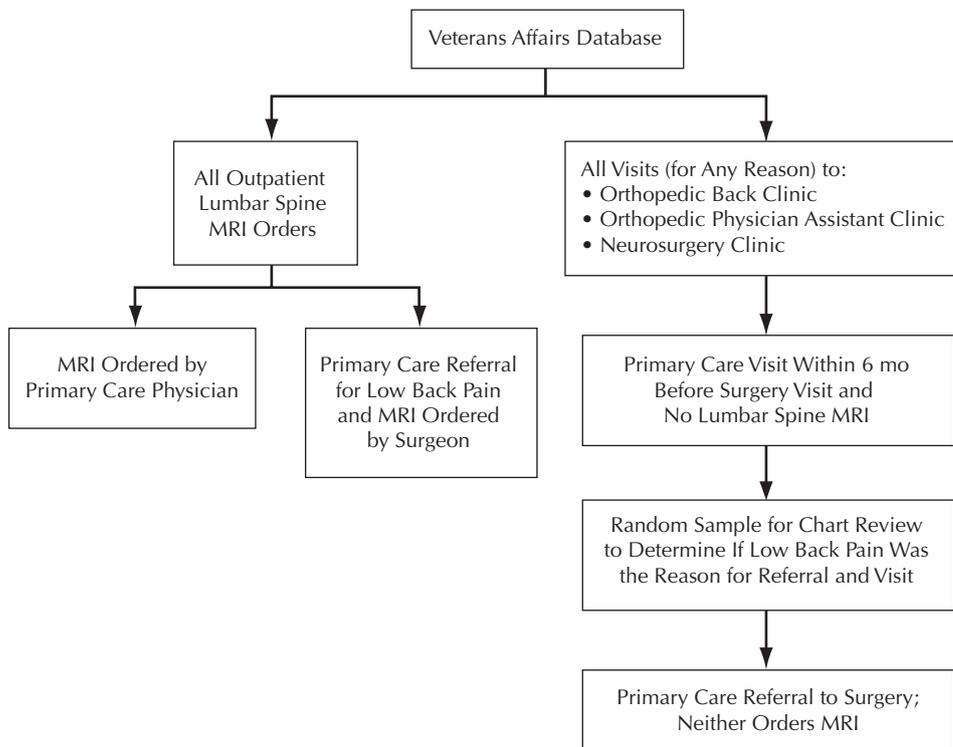
Setting

We studied primary care patients with LBP who were seen at a university-affiliated (Roudebush)

VAMC. Primary care providers practiced in 1 of 3 different settings: a general medicine clinic, an urgent visit center, or an emergency department. Patients with scheduled appointments were seen in the general medicine clinic by fellows, residents, nurse practitioners, and faculty internists. An urgent visit center staffed by faculty internists and nurse practitioners was created in late 1994 for patients with semi-urgent complaints during daytime hours. Patients with urgent complaints (eg, myocardial infarction or acute major trauma) were seen in the emergency department, which was staffed by faculty internists (until 6 PM) and board-certified internal medicine fellows (after 6 PM).

We chose the years 1994 and 1996 for several reasons. First, in late 1994, the AHCPR guidelines for LBP were disseminated. Second, in 1995, medical administrators and orthopedic surgeons at the VAMC expressed concerns that the PCPs were ordering too many MRI studies and surgery consults for patients with LBP. Therefore, educational efforts aimed at providers were undertaken in 1995.

Figure 1. Identification of Potentially Eligible Study Patients



MRI = magnetic resonance imaging.

Provider Education

After national dissemination of the AHCPR guidelines, systematic efforts were implemented locally during 1995 to educate PCPs regarding the diagnostic evaluation and management of patients with LBP. These efforts included didactic seminars conducted by orthopedic surgeons and rehabilitation physicians and distribution of review articles on LBP and pamphlets containing the AHCPR guidelines. Data were not available at the individual provider level regarding uptake of these educational efforts (ie, the proportion who either attended the formal seminars or read and understood the guidelines). Because this study took place in a teaching hospital, there was turnover of one third of the housestaff each year. Of faculty practicing in 1995 (when education occurred), 92% were still practicing in 1996; of those practicing in 1994, 50% were still practicing in 1996.

Identification of the Study Cohort

The strategy for identifying the study cohort is illustrated in **Figure 1**. We included patients seen in 1994 or 1996 by a PCP for an episode of LBP that merited an order for a lumbar spine MRI and/or a consultation to the orthopedic or neurosurgery clinic. We defined a PCP as a faculty internist, medical housestaff, or nurse practitioner who practiced in the emergency department, general medicine clinic, or urgent visit center.

Because patients' principal reasons for their outpatient visits were not recorded in the VAMC database, we used 2 complementary strategies to identify potentially eligible patients with LBP. First, all patients who had a lumbar spine MRI order were identified by computerized searches of the VAMC database. We retrieved the medical charts of all patients for whom an MRI was ordered by a PCP, orthopedic surgeon, or neurosurgeon. For patients for whom an MRI was ordered by a surgeon, the medical record had to include documentation of a primary care referral for evaluation of LBP within 6 months of the MRI order.

Second, we identified all patients who (1) visited an

orthopedic or neurosurgery clinic in 1994 or 1996; (2) visited the general medicine clinic, urgent visit center, or emergency department within 6 months before the surgery visit; and (3) did not have a lumbar spine MRI ordered during these time intervals. These computerized searches were limited to 3 outpatient surgery clinics where patients with LBP were most likely to be seen: the orthopedic back, orthopedic physician assistant, and neurosurgery clinics. Patients with LBP as well as those with other clinical problems were seen in the orthopedic physician assistant and neurosurgery clinics, whereas only patients with LBP were seen in the orthopedic back clinic.

We identified 2081 patients (923 in 1994 and 1158 in 1996) (**Table 1**) who were referred by a PCP to 1 of the 3 outpatient surgery clinics (for any reason) and did not have an MRI performed during the study. We reviewed a random sample of medical charts from each clinic to determine the percentage of surgery visits for which the primary reason for the surgery visit (and PCP referral) was LBP. Thus, each patient in the total sample was assigned a random number. The lists were then sorted in ascending order and by clinic, and we selected the first 50 patients from each clinic (or 150 total per year) for medical chart review and to apply our eligibility criteria. If fewer than 50 patients were seen in a given clinic, we attempted to obtain all of those medical

Table 1. Sampling Strategy for Patients Who Were Referred by a Primary Care Physician to a Surgery Clinic (for Any Reason) and Did Not Undergo an MRI During the Study*

Clinic	Patients, No.		
	Total	Sampled	Eligible [†]
	1994		
Neurosurgery	218	50	11
Orthopedic physician assistant	545	50	0
Orthopedic back	160	50	28
Subtotal	923	150	39
	1996		
Neurosurgery	310	50	8
Orthopedic physician assistant	807	50	4
Orthopedic back	41	34	8
Subtotal	1158	134	20

*Neither surgeons nor primary care providers ordered a lumbar spine magnetic resonance imaging (MRI) study for these patients.

[†]Had low back pain and met study eligibility criteria.

charts. We chose to sample 50 medical charts per clinic based on a sample size calculation for a 95% confidence interval, which indicated that the percentage of eligible patients in each clinic could be estimated $\pm 15\%$.

Eligibility Criteria

We excluded patients for whom the MRI or surgery consult was ordered during an inpatient stay, by a non-PCP (ie, medicine subspecialist or anesthesiologist), for evaluation of acute trauma, by a provider from an outside VAMC, or more than 6 months before the surgery appointment. For the “PCP refers to surgery, neither orders MRI” group, we also excluded patients who were referred for clinical reasons other than LBP or for whom it was unclear where the referral had originated (ie, ongoing surgery clinic patients). Patients were not excluded on the basis of an ongoing relationship with surgery if the primary care clinic note documented that the patient was being seen for LBP and had an upcoming surgical clinic appointment for this problem.

Data Collection

Three trained research assistants reviewed potentially eligible patients’ medical records. For excluded patients, they recorded demographic characteristics and the reason for exclusion. For eligible patients, they recorded demographic characteristics, clinical symptoms at the time of primary care

evaluation, and PCP type (faculty, nurse practitioner, or housestaff). Each LBP symptom was recorded as present, absent, or uncertain (if not documented in the medical chart). We also documented whether the PCP ordered a lumbar spine MRI and, if so, whether he or she requested a surgery consult simultaneously with the MRI order or sequentially (ie, after reviewing the results). If the PCP referred the patient to a surgeon without ordering an MRI, we recorded the referral and whether the surgeon ordered an MRI after seeing the patient.

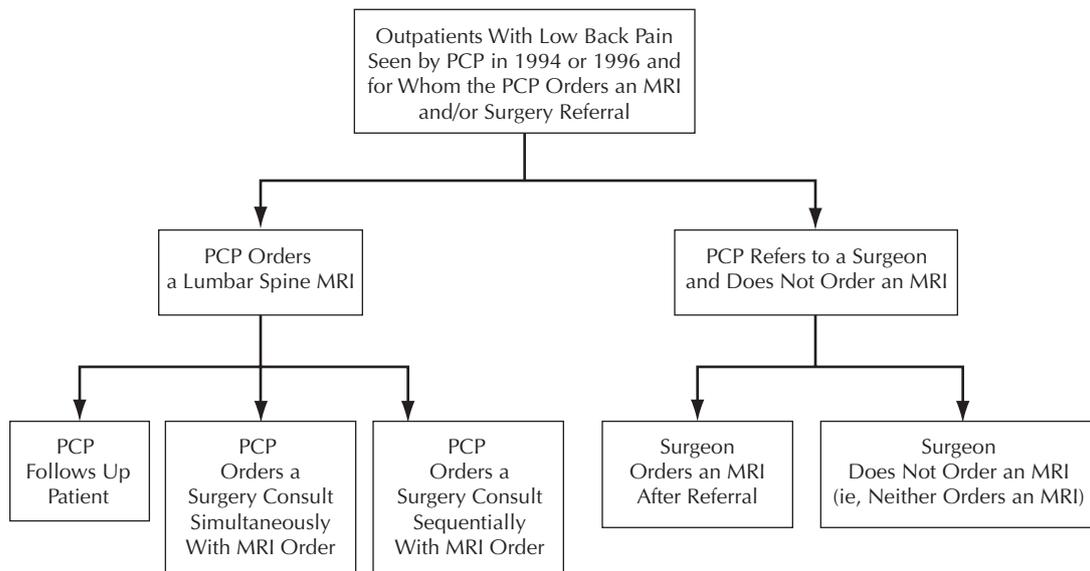
Statistical Analyses

All analyses were performed using statistical software (SAS for Windows, version 6.12; SAS Institute Inc, Cary, NC).

Patients were initially categorized as “PCP orders MRI” or “PCP orders surgery consult” (ie, no primary care MRI order) (Figure 2). For the “PCP orders MRI” group, patients were further subdivided into 3 groups: (1) PCP followed up the patient without referring to surgery; (2) PCP ordered MRI and surgery consult simultaneously; and (3) PCP ordered MRI and surgery consult sequentially. For the “PCP orders surgery consult” group, we subdivided patients based on whether the surgeon ordered an MRI after receiving the PCP’s consult.

Patients in the “PCP refers to surgery, neither orders MRI” group were drawn from a random sam-

Figure 2. Classification of Study Patients With Low Back Pain



PCP = primary care physician; MRI = magnetic resonance imaging.

ple of patients seen in the orthopedic physician assistant, orthopedic back, or neurosurgery clinics during the study periods. The number of eligible patients from the random sample was used to estimate the total number who would be eligible had we reviewed the medical records of all patients seen in these 3 clinics in 1994 ($n = 923$) and 1996 ($n = 1158$). The total estimate of eligible patients was calculated by weighting the percentage of eligible patients from the random sample of medical charts reviewed for each clinic. We used weights in making these estimates because the total number of patients actually seen by the surgeons differed among the 3 clinics.

We compared patient characteristics for 1994 and 1996 using χ^2 tests for categorical variables (ie, sex, race, site of PCP evaluation, evaluating PCP, previous MRI, MRI order, MRI fulfills the AHCPR guidelines, history of back injury, history of back surgery, history of substance abuse, presence of neurological findings, and patient meets the AHCPR guidelines [with or without age included]) and t tests for continuous variables (ie, age and LBP duration). χ^2 Tests were used to compare utilization patterns for 1994 and 1996. Weighting factors were included in all analyses because each patient in the "PCP refers to surgery, neither orders MRI" group also represented patients whose medical charts were not reviewed. To examine the effect of sampling variability on our estimates, we also performed a simulation with 5000 iterations. Results of the simulation are not presented because the findings were similar to the standard analyses.

To determine whether there was an actual reduction in MRI orders for primary care patients with LBP in 1996, forced entry logistic regression models were fit, with an MRI order as the dependent variable. Independent predictors included history of previous MRI, previous back surgery, year, meeting the AHCPR guidelines, and encounter site (urgent visit center, general medicine clinic, or emergency department). To meet the AHCPR guidelines, the patient was required to meet ≥ 1 of the following criteria: age >50 years; history of injury; drug or alcohol abuse; lower extremity weakness; bowel or bladder impairment; saddle anesthesia; LBP worse with rest; or severe or progressive neurological deficits (LBP worse with extension, neurogenic claudication, lower extremity pain, lower extremity numbness, positive straight leg raise test, and asymmetric or absent reflexes). Because the VA population is typically older, thereby potentially increasing the likelihood that the age criterion would be satisfied, we also ran these logistic regression models

with (model 1) and without (model 2) including the age criterion of the AHCPR guidelines. Odds ratios and 95% confidence intervals were calculated for each independent predictor in the model.

... RESULTS ...

Of 960 potentially eligible patients seen in 1994 or 1996, 420 were excluded: 127 were referred to surgery by a non-PCP or non-VA physician; 77 were seen by a surgeon for reasons other than LBP; 37 had no evidence of where the surgery consult originated; 19 had a postoperative MRI; 8 had the MRI ordered by a non-VA physician; 6 had the MRI ordered as an inpatient; and 2 had major trauma. An additional 144 medical records could not be located, and this group was similar demographically to those included in the study.

Of the remaining eligible patients, 279 were seen in 1994 and 261 were seen in 1996 (Table 2). Compared with patients seen in 1996, those seen in 1994 were more frequently seen in the emergency department (55% vs 25%; $P = .05$) and by faculty internists (73% vs 46%; $P = .05$) and were more likely to have a history of previous back surgery (28% vs 17%; $P = .05$). Patients were more likely to meet AHCPR criteria for imaging studies in 1994 than in 1996 ($P = .05$) and to report worsened LBP with extension ($P = .05$), neurogenic claudication ($P = .05$), and lower extremity numbness ($P = .05$). A history of previous MRI was more common in patients seen in 1996 compared with those seen in 1994 (41% vs 29%; $P = .05$). Fewer patients were referred to surgeons in 1996 than in 1994 (84% vs 94%; $P = .0002$). The percentage of "appropriate" MRI orders by PCPs vs surgeons did not differ significantly for either 1994 ($P = .28$) or 1996 ($P = .22$). For comparisons between 1994 and 1996, results of post-hoc analyses indicated that for binary categorical variables, the study had 94% power to detect a difference between 50% and 65% and 90% power to detect a difference between 10% and 20%.

Nearly identical numbers of MRIs were ordered in both years: 99 by PCPs and 42 by surgeons in 1994 and 105 by PCPs and 32 by surgeons in 1996 (Table 3). Of patients who met the AHCPR guidelines, 48% (102/212) had an MRI in 1994 compared with 49% (84/172) in 1996. Of patients who did *not* meet the guidelines, 58% (39/67) underwent an MRI in 1994 compared with 60% (53/89) in 1996. In 1994, PCPs more frequently ordered the MRI and surgery consult simultaneously ($P < .05$), whereas in 1996, they

Table 2. Demographic and Clinical Characteristics of Patients With Low Back Pain Seen by Primary Care Providers in 1994 and 1996 (Weighted Table)*

	1994 (n = 279)	1996 (n = 261)	P
Age, mean (SD), y	51 (18)	53 (15)	—
Male	267 (96)	250 (96)	—
White	241 (86)	184 (70)	.05
Evaluation site			.05
Urgent visit clinic	8 (3)	46 (18)	—
Emergency department	153 (55)	65 (25)	—
General medicine clinic	118 (42)	150 (57)	—
Evaluating primary care provider [†]			.05
Faculty	205 (73)	119 (46)	—
Housestaff (resident or fellow)	72 (26)	54 (21)	—
Nurse practitioner or physician assistant	2 (1)	86 (33)	—
Previous MRI	80 (29)	108 (41)	.05
Years since previous MRI			
0	5 (8)	17 (16)	—
1	37 (58)	66 (63)	—
2	8 (13)	9 (9)	—
3	14 (22)	3 (3)	—
4	0 (0)	9 (9)	—
Date not recorded in chart	16	4	—
MRI ordered	141 (51)	137 (52)	—
Meeting the AHCPR guidelines	102 (72)	84 (61)	—
Not meeting the AHCPR guidelines	39 (28)	53 (39)	—
Referred to surgeons	261 (94)	218 (84)	.0002
Duration of low back pain, mean (SD), wk	9.2 (6.5)	9.6 (6.2)	—
History of past back injury	95 (34)	90 (34)	—
History of previous back surgery	77 (28)	45 (17)	.05
History of substance abuse	6 (2)	3 (1)	—
Low back pain worse with extension	26 (9)	6 (2)	.05
Neurogenic claudication	50 (18)	20 (8)	.05
Lower extremity pain	155 (56)	161 (62)	—
Lower extremity numbness	75 (27)	46 (18)	.05
Lower extremity weakness	42 (15)	41 (16)	—
Positive or crossed straight leg raise test	67 (24)	63 (24)	—
Reflex abnormality	40 (14)	41 (16)	—
Bowel/bladder symptoms	7 (3)	6 (2)	—
Saddle anesthesia	0 (0)	2 (1)	—
Meets the AHCPR guidelines with age criteria	212 (76)	172 (66)	.05
MRI ordered	102 (48)	84 (49)	—
Primary care provider ordered MRI	69 (68)	62 (74)	—
Surgeon ordered MRI	33 (32)	22 (26)	—
No MRI ordered	110 (52)	88 (51)	—
Meets the AHCPR guidelines without age criteria	192 (69)	158 (61)	.05
MRI ordered	99 (52)	79 (50)	—
Primary care provider ordered MRI	67 (68)	58 (73)	—
Surgeon ordered MRI	32 (32)	21 (27)	—
No MRI ordered	93 (48)	79 (50)	—

*Data are given as number (percentage) of patients except where indicated otherwise.

[†]We were unable to determine provider type for 2 patients.

MRI = magnetic resonance imaging; AHCPR = Agency for Healthcare Policy and Research.

more frequently ordered an MRI without ordering a surgery consult ($P < .01$). The simulation showed that sampling variability had little effect on these results.

In logistic regression analyses, providers were less likely to order an MRI for patients who already had an MRI in the past ($P = .0001$) and more likely to order an MRI for those seen in the urgent visit center ($P = .0001$) (Table 4). Neither the year (1996 or 1994) nor meeting the AHCPR imaging guidelines was predictive of an MRI order. When we performed logistic regression without including the age criterion (model 2), we obtained similar results.

... DISCUSSION ...

The 1994 AHCPR guidelines were developed by a multidisciplinary panel of expert clinicians and policy makers to provide clinicians with tools for evaluating and managing patients with LBP.^{1,16} Because studies indicate that 80% to 90% of patients with acute LBP recover within weeks, the panel recommended limiting imaging studies to patients for whom red flag symptoms are present, surgical intervention is being considered, or symptoms persist after 1 month of conservative treatment.¹

We found no decrease in MRI orders after dissemination of the AHCPR guidelines despite concerted efforts at this particular VAMC to educate PCPs on the diagnostic evaluation of LBP according to these guidelines. Half of the patients who would be considered appropriate candidates according to the AHCPR guidelines received an imaging study in both 1994 and 1996. Neither the year nor meeting the AHCPR guidelines was predictive of an MRI order. However, clinicians were less likely to order an MRI for patients who had had a previous MRI and were more likely to order the test for those seen in a semi-urgent setting. Although we did not find an overall decrease in orders, PCPs more frequently ordered the MRI simultaneously with a surgery consult in 1994 than in 1996.

Our results have several potential interpretations. Because we found no differences in the percentage of MRI orders, one might conclude that modest educational efforts failed to have an impact on ordering behavior. Simple educational programs (including dissemination of guidelines) are relatively weak interventions that are unlikely to change behavior. This may be especially true in settings that attempt to disseminate multiple clinical guidelines. Indeed, even more intensive strategies, such as computerized feedback systems,^{17,18} mandatory consultation,¹⁹ and practice pattern feedback,^{20,21} have had only varying degrees of success. Multidimensional approaches, particularly those that combine educational efforts with structural interventions (ie, blocking improper test orders or defaulting to the standard practice), may be more successful in improving physicians' use of diagnostic tests.²²

A second interpretation is that healthcare providers

ordered MRI studies for patients for whom they believed the test was *clinically appropriate*, regardless of the AHCPR guidelines. This may explain why clinicians ordered MRIs for only 50% of appropriate patients and for 60% of those not meeting the guidelines. Although it has been assumed that test ordering guidelines would decrease unnecessary use of imaging studies, several studies indicate the opposite effect. In 1986, Deyo and colleagues^{23,24} proposed selective ordering criteria for lumbar spine radiographs that include criteria that are similar to the AHCPR guidelines. Three clinical studies^{23,25,26}

Table 3. Comparison of the Actions of Primary Care Providers Who Saw Patients With Moderate-to-Severe Low Back Pain in 1994 and 1996

Action	Patients, No. (%)	
	1994 (n = 279)	1996 (n = 261)
Orders MRI only (no surgery consult)*	18 (6)	43 (16)
Orders MRI then surgery consult (sequentially)	31 (11)	36 (14)
Orders MRI and surgery consult simultaneously [†]	50 (18)	26 (10)
Obtains surgery consult (surgeon orders MRI)	42 (15)	32 (12)
Obtains surgery consult (no MRI ordered) [‡]	138 (49)	124 (48)

*Significant at $P < .01$ (comparison between 1994 and 1996).

[†]Significant at $P < .05$ (comparison between 1994 and 1996).

[‡]Estimated.

MRI = magnetic resonance imaging.

Table 4. Predictors of Primary Care Patient Receiving an MRI

	Odds Ratio (95% CI)	
	Model 1*	Model 2 [†]
History of previous MRI (yes/no)	0.2 (0.1-0.3)	0.2 (0.1-0.3)
History of surgery (yes/no)	1.0 (0.6-1.6)	1.0 (0.6-1.6)
Year (1996/1994)	1.0 (0.6-1.4)	1.0 (0.6-1.5)
Meets the AHCPR guidelines (yes/no)	0.7 (0.5-1.2)	1.0 (0.7-1.6)
Evaluation site		
Urgent visit clinic/general medicine clinic	9.5 (3.5-26.4)	8.4 (3.0-23.1)
Urgent visit clinic/emergency department	12.2 (4.4-33.3)	12.2 (4.4-33.3)
Emergency department/general medicine clinic	1.3 (0.8-2.0)	1.5 (0.9-2.3)

*Age was included as part of the AHCPR guidelines.

[†]Age was not included as part of the AHCPR guidelines.

MRI = magnetic resonance imaging; CI = confidence interval; AHCPR = Agency for Healthcare Policy and Research.

indicate that implementation of these selective ordering criteria would result in increased utilization of lumbar spine radiographs. Similarly, one study²⁷ found that implementation of the AHCPR guidelines would actually increase utilization of imaging studies 3-fold.

A final potential factor is the guidelines themselves. As proposed, a patient needs to satisfy only one AHCPR criterion to be deemed appropriate for an imaging study. Some investigators²⁷ have proposed that the guidelines be modified, particularly the age criterion. When we omitted the age criterion, the number of patients satisfying the guidelines decreased from 76% to 69% in 1994 and from 66% to 61% in 1996, but there were no significant differences in MRI orders. We performed other exploratory analyses to examine whether patients with radicular symptoms or patients with 4 weeks of symptoms and one other AHCPR criterion were more likely to have an MRI order. We found no association between MRI orders and the presence of radicular symptoms. Patients with 4 weeks of symptoms plus one other AHCPR criterion were more likely to have an MRI order in 1994 ($P = .01$) and in 1996 ($P = .02$). In logistic regression models, however, neither meeting this modified criterion nor year was important in predicting MRI orders after controlling for other factors (clinical site, previous MRI, and previous surgery). Perhaps a prediction rule containing components from the history, symptom list, and physical examination might help clinicians better discriminate between patients with high, medium, and low likelihood of having positive findings on an imaging study.

Our study has several limitations. First, it was conducted at a single academically affiliated VAMC. Thus, our results should be verified in other clinical venues, such as managed care settings. Second, we lacked access to data on patients with LBP whose PCP followed up medically. As a consequence, we were unable to examine the impact of patient factors (ie, symptom severity and patient's requests for testing) on clinicians' decisions to pursue a diagnostic evaluation. Our results are most applicable to patients with LBP who have a clinical presentation severe enough to merit more than medical management by PCPs. Third, we lacked access to PCPs' rationale for ordering an MRI or a surgery consult. Whether failure to follow the guidelines was due to lack of provider knowledge about the guidelines or disagreement with their applicability in individual patients is not known. Furthermore, if the patient's symptoms or physical findings were not documented as present or absent in

the medical record, they were recorded as uncertain. A prospective study with standardized data collection would also address these concerns. Fourth, although patients were demographically similar, system differences occurred during the study, particularly implementation of the urgent visit center, more general medicine clinic sessions, increased use of physician extenders in primary care, and the provider turnover intrinsic to a teaching hospital. However, such system changes are not unique and are occurring at other VAMCs and managed care systems.

Our study demonstrates the importance of evaluating proposed diagnostic guidelines in actual clinical settings. In our study, the percentage of PCPs' MRI orders did not change after education on the AHCPR guidelines, and there was no shift in ordering from PCPs to surgeons. Although more intensive interventions might have resulted in fewer MRI orders for patients who are "inappropriate candidates," our results, like others, indicate that utilization would increase if all appropriate patients received an MRI. A prediction rule might be a logical extension of the AHCPR guidelines and might help clinicians discriminate between high, moderate, and low probabilities of having lumbar imaging abnormalities. Prospective studies should be performed to validate this prediction rule (or any proposed changes to the AHCPR guidelines) in a variety of clinical settings and patient populations and to evaluate its impact on utilization and patient outcomes.

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