CME credits available for this article — see page 112.

ORIGINAL RESEARCH & CONTRIBUTIONS

Low Back Imaging When Not Indicated: A Descriptive Cross-System Analysis

Rachel Gold, PhD, MPH; Elizabeth Esterberg, MS; Celine Hollombe, MPH; Jill Arkind, MPH; Patricia A Vakarcs; Huong Tran, MS; Tim Burdick, MD, MSc; Jennifer E DeVoe, MD, DPhil; Michael A Horberg, MD, MAS, FACP, FIDSA

Perm J 2016 Spring;20(2):25-33

http://dx.doi.org/10.7812/TPP/15-081

ABSTRACT

Context: Guideline-discordant imaging to evaluate incident low back pain is common.

Objective: We compared rates of guideline-discordant imaging in patients with low back pain in two care delivery systems with differing abilities to track care through an electronic health record (EHR), and in their patients' insurance status, to measure the association between these factors and rates of ordered low back imaging.

Design: We used data from two Kaiser Permanente (KP) Regions and from OCHIN, a community health center network. We extracted data on imaging performed after index visits for low back pain from June 1, 2011, to May 31, 2012, in these systems. Adjusted logistic regression measured associations between system-level factors and imaging rates.

Main Outcome Measures: Imaging rates for incident low back pain using 2 national quality metrics: Clinical Quality Measure 0052, a measure for assessing Meaningful Use of EHRs, and the Healthcare Effectiveness Data and Information Set measure "Use of Imaging Studies for Low Back Pain."

Results: Among 19,503 KP patients and 2694 OCHIN patients with incident low back pain, ordered imaging was higher among men and whites but did not differ across health care systems. OCHIN's publicly insured patients had higher rates of imaging compared with those with private or no insurance.

Conclusion: Rates of ordered imaging to evaluate incident low back pain among uninsured OCHIN patients were lower than in KP overall; among insured OCHIN patients, rates were higher than in KP overall. Research is needed to establish causality and develop interventions.

INTRODUCTION

Low back pain is a common reason for US primary care visits.[1-3] Patients seeking primary care for low back pain often receive x-rays and other imaging studies, but such imaging rarely improves care and can incur unnecessary radiation exposure and costs.[4-12]

Several national quality guidelines recommend that clinicians *not* order imaging tests for nonspecific low back pain. One Clinical Quality Measure (CQM) that is a metric of "Meaningful Use" of electronic health records (EHR), per the Centers for Medicare and Medicaid Services (CMS), is "Percentage of patients with a primary diagnosis of low back pain who did not have an imaging study ... within 28 days of diagnosis."[13,14] The National Committee for Quality Assurance's Healthcare Effectiveness Data and Information Set (HEDIS) includes a similar measure.[15] Nevertheless, clinical practice often diverges from these guidelines.[10] In data representing 440 million visits for spine-related care, 17% were associated with subsequent radiography.[11]

Research suggests possible reasons for this guideline-discordant care.[12] For example, physicians may be unaware of the guidelines, not trust them, or think they do not apply to the case at hand. They may order imaging for low back pain to appear to be "doing something," or from fear of litigation.[16-21] Health system-level factors that may influence these physician behaviors include local practice customs; incentives to follow guidelines (or, conversely, to provide care that patients request); time restraints; and access to automated reminders in the EHR, counseling materials, and radiology services.[19-21]

The purpose of these analyses was to generate hypotheses for further exploration and development of interventions. To that end, we explored several patient- and system-level factors potentially affecting guideline-discordant imaging for low back pain. We compared imaging rates in two care systems divergent in their ability to provide integrated care and track patient care with a unified EHR, and in their patients' insurance status. We hypothesized that the fully integrated managed care system with sophisticated EHR communication functions would have lower rates of imaging for incident low back pain, compared with a system without these resources.

This study was reviewed by the Kaiser Permanente (KP) Northwest institutional review board by expedited review on July 7, 2013, and verified to be exempt from institutional review board review.

Rachel Gold, PhD, MPH, is an Investigator in the Science Program at the Center for Health Research and an Investigator for the Practice-Based Research Network for OCHIN, Inc, in Portland, OR. E-mail: rachel.gold@kpchr.org. **Elizabeth Esterberg, MS,** is a former Research Analyst in the Science Program at the Center for Health Research in Portland, OR. E-mail: elizabeth.esterberg@kp.org. **Celine Hollombe, MPH,** is Project Manager in the Science Program at the Center for Health Research in Portland, OR. E-mail: celine.b.hollombe@kpchr.org. **Jill Arkind, MPH,** is a Research Associate for OCHIN, Inc, in Portland, OR. E-mail: arkindj@ochin.org. **Patricia A Vakarcs** is a Research Analyst for OCHIN, Inc, in Portland, OR. E-mail: vakarcst@ochin.org. **Huong Tran, MS,** is a Research Analyst for Utility of Care Data Analysis for the Kaiser Foundation Health Plan in Oakland, CA. E-mail: marie.h.tran@kp.org. **Tim Burdick MD, MSc,** is the Chief Research Officer for the Practice-Based Research Network for OCHIN, Inc, in Portland, OR. E-mail: burdickt@ochin.org. **Jennifer E DeVoe, MD, DPhil,** is the Chief Clinical Research Informatics Officer for OCHIN, Inc, and an Associate Professor of Family Medicine at Oregon Health and Science University in Portland, OR. E-mail: devoej@ohsu.edu. **Michael A Horberg, MD, MAS, FACP, FIDSA,** is the Executive Director of Research and Community Benefit for the Mid-Atlantic Permanente Research Institute in Rockville, MD. E-mail: michael.horberg@kp.org.

METHODS

Care Delivery Systems

Kaiser Permanente

KP, one of the nation's largest managed care organizations, provides integrated care to its members. The organization's Epic EHR (Epic Systems Corp, Verona, WI) captures all aspects of patient care delivered at or billed to KP. Members of KP can subscribe to plans with different levels of coverage; these analyses include members with standard plans (in which all medical care is delivered at KP facilities), or with point-of-service plans. In both plans, KP is the insurer. Point-of-service plans allow members to obtain care at non-KP facilities, although attendance at KP facilities is encouraged. For KP standard members, most imaging procedures are performed at KP sites that share an EHR with the primary care physician. It is more common for KP point-of-service members to receive imaging at non-KP facilities, which do not share this EHR.

We used data from 2 KP Regions differing in degree of regional market saturation (indicating likelihood that members sought care at non-KP settings, if no KP facility was nearby). These Regions extend across 5 states and in 2012 served approximately 1 million unique patients (488,269 members in 1 Region; 480,386 in the other).

OCHIN, Inc

Originally called the Oregon Community Health Information Network but now serving many states, OCHIN is a nonprofit organization that provides health information technology support to safety-net community health centers (CHCs). OCHIN is not an integrated or managed care system, but rather a network of autonomous primary care ambulatory CHCs sharing a single, linked Epic EHR. At the time of analysis, OCHIN served more than 450 primary care CHCs in 17 states. Most OCHIN CHCs refer patients to external care providers for imaging. These analyses included data from 87 OCHIN member CHCs in 3 states (Oregon, Washington, and California), with 156,190 unique patients served in 2012; one-fourth of these CHCs offer on-site imaging.

Cross-System Comparison

We calculated rates of patients with low back pain who received orders and/or procedures for imaging as discordant with the CQM quality metric (described later, in the Outcome Measures section) in these two systems. We compared rates in KP's population (privately insured; EHR data available in an integrated managed care system) and OCHIN's population (mostly uninsured or publicly insured; EHR data available in a nonintegrated system) to assess whether integrated care, use of a systemwide EHR, and patients' insurance status were associated with system-level rates of guideline-discordant imaging for noncomplicated, incident low back pain.

Both systems use an Epic EHR; the same query was used to extract comparable data as possible. We extracted data on imaging subsequent to index visits occurring from June 1, 2011, to May 31, 2012. Data from June 1, 2010, to May 31, 2011, were used to identify persons meeting study exclusion criteria (described in the Outcome Measures section) and prior care utilization; data from June 1, 2012, to December 31, 2012, were used for follow-up. Extracted data included ordered imaging, referrals, received imaging, diagnoses, and demographic characteristics as available.

All KP data were extracted from KP's Epic EHR Clarity database and the Decision Support Services National Value Tracker datamart (which provides data about medical services provided to KP members, including external claims).

All OCHIN data were extracted from OCHIN's Epic EHR Clarity database, which contains data on care received, and patient demographics and insurance status. Few OCHIN CHCs offer on-site imaging; imaging procedures are often externally referred, and results are scanned or hand-entered into the EHR when and if the patient is returned to the referring site. To validate the OCHIN data on received imaging, we conducted a manual chart review of 50 randomly selected study patients to ensure that we collected all available relevant EHR data.

Outcome Measures

Our outcome measures were rates of imaging for incident low back pain based on 2 national quality metrics: CQM 0052, one of a set of measures for assessing care systems' Meaningful Use of EHRs, and the HEDIS measure "Use of Imaging Studies for Low Back Pain." Both metrics assess "Percentage of patients with a primary diagnosis of low back pain who did not have an imaging study (plain x-ray [film], MRI [magnetic resonance imaging], CT [computed tomography] scan) within 28 days of diagnosis."[13-15,22,23] The following parameters apply to both metrics except as noted:

- *Numerator:* Persons who did not receive imaging (plain x-ray, magnetic resonance imaging, or computed tomography imaging) within 28 days of an index visit. (Here, we present the *inverse* of this metric—the percentage of patients who *did* have an imaging study within 28 days of index low back pain visit—to explore guideline-discordant imaging.)
- *Denominator:* Persons aged 18 to 50 years who had an index visit, defined as the first primary care outpatient visit or Emergency Department (ED) encounter not resulting in hospitalization with a principal diagnosis of low back pain, according to International Classification of Diseases, Ninth Revision (ICD-9) codes (in the next paragraph), in the measurement year.
- *ICD-9 codes identifying a low back pain index visit:* Both metrics: 724.2 (Lumbago); 724.5 (Backache, unspecified); the HEDIS measure also includes 721.3 (Lumbosacral spondylosis without myelopathy); 722.10, 722.32, 722.52, and 722.93 (Disc disorder of the lumbar region); 724.02 and 724.03 (Spinal stenosis, lumbar region); 724.3 (Sciatica); 724.6 (Disorders of sacrum); 724.70 and 724.79 (Other or unspecified disorder of coccyx); 738.5 (Other acquired deformity of back or spine); 739.3 and 739.4 (Nonallopathic lesions of lumbar/sacral region); and 846.0, 846.1, 846.9, and 847.2 (Sprain of lumbar/sacral region).
- *Inclusion criteria:* In KP, persons continuously enrolled in the Health Plan 180 days before through 28 days after

Table 1. Subjects' characteristics at index visit for low back pain, by study group			
Characteristic	**KP[a]**	**OCHIN[a]**	**p value (χ^2)**
Patients aged 18-50 years with LBP visit June 1, 2011 to May 31, 2012	36,735	6214	
Excluded			
Evidence of prior LBP	5651	2333	< 0.001
Evidence of cancer diagnosis	3259	274	< 0.001
Evidence of neurologic diagnosis	642	73	0.001
Evidence of recent trauma	2135	407	0.023
Evidence of IV drug use	262	238	< 0.001
Included in analyses			
Eligible patients with Clinical Quality Measure LBP index visit[b]	19,503	2694	
Sex			
Female	11,305 (58.0)	1510 (56.1)	0.059
Age, years			
18-30	5817 (29.8)	980 (36.4)	< 0.001
31-40	6090 (31.2)	859 (31.9)	
41-50	7596 (39.0)	855 (31.7)	
Race/ethnicity			
White	7807 (40.3)	1605 (59.6)	< 0.001
Black	4121 (21.1)	336 (12.5)	
Hispanic	2020 (10.4)	576 (21.4)	
Asian	997 (5.1)	55 (2.0)	
Other/unknown	4558 (23.4)	122 (4.5)	
Utilization in 6 months before index visit			
Mean number of visits	2.8 (4.0)	3.3 (5.1)	< 0.001
0 visits	6045 (31.0)	1101 (40.9)	< 0.001
1 visit	3859 (19.8)	359 (13.3)	
2+ visits	9599 (49.2)	1234 (45.8)	
LBP index diagnosis source, KP only			
Internal	19,345 (99.2)	NA	NA
External	158 (0.8)		
Payment source, OCHIN only			
Commercial	NA	325 (12.1)	NA
Medicare		116 (4.3)	
Medicaid		984 (36.5)	
Uninsured		1268 (47.1)	
Other/unknown		1 (0.04)	
Federal poverty level, OCHIN only			
100% or less	NA	1869 (69.4)	NA
101%-150%		244 (9.1)	
150%-200%		83 (3.1)	
200% or more		133 (4.9)	
Unknown		365 (13.4)	
Index CHC with onsite imaging, OCHIN only			
No	NA	1670 (62)	NA
Yes		1024 (38)	
Follow-up at KP sites			
All follow-up care at KP sites	17,590 (90.2)	NA	NA
Any follow-up care at non-KP sites	1913 (9.8)		

[a] Data are presented as no. (%) unless indicated otherwise.
[b] All subsequent data reflect this population.
CHC = community health center; IV = intravenous; LBP = low back pain; KP = Kaiser Permanente; NA = not applicable.

the index visit; in OCHIN, any person with a claim or encounter during the measurement year.

- *Exclusion criteria:* Patients with a diagnosis clinically indicating imaging (cancer, recent trauma, intravenous drug abuse, neurologic impairment) in the last 180 days. See CQM definitions for details.

Using these criteria, we assessed rates of persons confirmed to have *received* an imaging procedure. There were substantial cross-system differences in how we could identify received imaging. In KP's data, it was primarily identified in clinical results entered into the EHR at or after the radiology visit, and/or in billing data; in OCHIN's data, received imaging was identified primarily through the presence of scanned imaging results. Because of these differences and because we were interested in assessing physician behaviors (ie, imaging orders), we also looked at each system's rates of persons for whom imaging was *ordered*. There were minimal cross-system differences in how ordered imaging was identified. Ordered or received imaging occurring more than once on a given day was considered a single event.

Analysis

Our primary analyses included persons with an index low back pain visit from June 1, 2011, to May 31, 2012. We described the populations at the index visit, and persons excluded from analyses per the CQM/HEDIS criteria, comparing the included populations via χ^2 tests. We calculated rates of the outcome measures overall and stratified them by baseline factors: age; sex; care utilization in the last 6 months; ICD-9 code associated with the index visit; insurance status at index visit (OCHIN only); and whether the index or any follow-up visits were at non-KP facilities (KP only).

We conducted adjusted logistic regressions of the association between these factors and low back pain imaging rates in three models:

1. in both groups, including a variable for group, adjusted for baseline factors differing between study groups
2. in OCHIN only, adjusted for insurance status at index visit and for whether the index visit was at a CHC with on-site imaging

Table 2. Differences in unadjusted rates of imaging across study groups (percentage)[a]

	KP, no. with an index visit = 19,503			OCHIN, no. with an index visit = 2694		
Factors	Imaging ordered or received	Ordered only[b]	Received only[b]	Imaging ordered or received	Ordered only[b]	Received only[b]
Any imaging in 28 days after index visit	17.2	0.1	0.3	18.9	4.9	2.2
Any imaging in 28 days after index visit by:						
Age, years						
18-30	16.7	0.1	0.3	17.4	5.0	1.3
31-40	16.6	0.2	0.2	20.1	4.8	2.0
41-50	18.0	0.1	0.4	19.4	4.3	3.5
Sex						
Male	18.9	0.1	0.4	16.9	4.3	1.8
Female	15.9	0.1	0.3	20.5	5.4	2.6
No. of visits 6 months before index visit						
0	18.1	0.1	0.3	16.4	4.4	2.2
1	16.3	0.1	0.3	23.4	5.9	2.2
2+	16.9	0.1	0.3	19.8	5.2	2.3
Insurer at index visit						
Uninsured	NA			14.5	3.9	1.3
Medicaid/Medicare				25.8	6.7	3.5
Commercial				12.6	3.1	1.5
Index clinic has imaging						
Yes	Data not available for non-KP sites			16.3	2.7	1.2
No				20.5	6.3	2.9
Index visit at KP site						
Yes	17.2	0.1	0.3	NA		
No	12.7	0.6	3.8			
Follow-up all at KP						
Yes	16.4	0.1	0.1	NA		
No	24.5	0.1	2.6			

[a] Population as defined by Clinical Quality Measure #0052.
[b] Subsets of those ordered or received.
KP = Kaiser Permanente; NA = not applicable.

3. in KP only, including a variable for whether the index and/or all follow-up visits took place at KP facilities or external sites, and adjusted for KP Region.

Because OCHIN's data do not include information on ED visits, our cross-system analyses included only persons whose index visit was an in-person primary care encounter. Then, in KP patients only, we conducted secondary analyses of ordered and received imaging rates among patients whose index visit was in an ED vs a primary care setting, further stratified into KP primary care sites, non-KP primary care sites, KP-run EDs, and EDs *not* in the KP system. All analyses were performed in SAS Version 9.3 (SAS Institute Inc, Cary, NC).[24]

RESULTS

Sensitivity analyses showed little difference in outcomes when we used the CQM vs HEDIS measure definitions, so all presented results are based on the CQM measure, for brevity. Using this definition, 19,503 KP patients and 2694 OCHIN patients were identified.

Table 1 shows how the study groups differed in terms of baseline age, race-ethnicity, and number of recent visits. Table 2 shows unadjusted rates of imaging ordered or received.

Cross-System Analysis

Ordered Imaging

Table 3 shows the odds of a patient with incident low back pain having any imaging ordered in the 28 days after the index visit, according to adjusted logistic regression. There was no significant difference between KP and OCHIN. Men were significantly more likely than women, and white patients were significantly more likely than black or Hispanic patients, to have imaging ordered.

Table 3. Ordered imaging: multivariate logistic regression results[a]

	Both groups (N = 22,197)		KP[b] only (n = 19,503)		OCHIN only (n = 2694)	
Parameter	Ordered, %	Odds ratio, adjusted (95% CI)	Ordered, %	Odds ratio, adjusted (95% CI)	Ordered, %	Odds ratio, adjusted (95% CI)
Group						
KP	16.9	Reference	NA		NA	
OCHIN	16.7	0.97 (0.87-1.08)				
Sex						
Male	18.1	Reference	18.5	Reference	15.1	Reference
Female	15.9	**0.87 (0.81-0.94)**	15.7	**0.82 (0.76-0.89)**	17.9	1.12 (0.90-1.39)
Age, years						
18-30	16.4	Reference	16.4	Reference	16.0	Reference
31-40	16.6	1.02 (0.93-1.12)	16.4	0.99 (0.90-1.10)	18.2	1.19 (0.92-1.52)
41-50	17.4	1.09 (1.00-1.19)	17.6	1.09 (0.99-1.19)	15.9	1.02 (0.79-1.31)
Race/Ethnicity						
White	18.6	Reference	18.2	Reference	20.5	Reference
Black	14.2	**0.73 (0.66-0.80)**	14.7	**0.70 (0.62-0.78)**	8.0	**0.37 (0.24-0.57)**
Hispanic	14.3	**0.74 (0.65-0.83)**	15.6	**0.79 (0.69-0.91)**	9.6	**0.44 (0.32-0.60)**
Asian	18.4	0.99 (0.84-1.17)	18.3	0.96 (0.80-1.14)	21.8	1.02 (0.53-1.99)
Other/unknown	16.9	**0.89 (0.81-0.97)**	16.8	**0.82 (0.73-0.91)**	21.3	1.01 (0.64-1.59)
Utilization 6 months before index visit						
0 visits	17.2	Reference	17.8	Reference	14.3	Reference
1 visit	16.5	0.96 (0.87-1.06)	16.0	0.90 (0.80-1.00)	21.2	1.36 (0.99-1.86)
2+ visits	16.7	1.01 (0.93-1.10)	16.6	0.94 (0.86-1.03)	17.5	1.00 (0.79-1.27)
Follow-up at KP						
Internal only	NA		16.3	Reference	NA	
Any external			21.9	**1.44 (1.29-1.62)**		
Payment source at index visit						
Uninsured	NA		NA		13.2	Reference
Medicare/Medicaid					22.4	**1.53 (1.21-1.94)**
Commercial					11.1	**0.64 (0.43-0.95)**
Index CHC has imaging						
No	Data not available for non-KP sites		Data not available for non-KP sites		17.6	Reference
Yes					15.1	1.05 (0.84-1.32)

[a] Population as defined by Clinical Quality Measure #0052. Boldface on odds ratios and confidence intervals indicates significant difference.
[b] Also adjusted for KP Region.
Boldface on odds ratios and confidence intervals indicates significant difference.
CHC = community health center; CI = confidence interval; KP = Kaiser Permanente; NA = not applicable.

Received Imaging

Rates of received imaging were significantly lower at OCHIN than at KP (Table 4). Older patients were significantly more likely than younger patients, men more likely than women, and white patients more likely than black or Hispanic patients, to receive imaging. There was no significant difference in prior utilization patterns.

In both systems, approximately half of patients had no care utilization in the 28 days after the index visit (Table 5), and 76% to 80% had no visit associated with low back pain in that time; 16% were issued only 1 imaging order during the 28-day follow-up, and very few had more than 1 order.

Kaiser Permanente-Only Analysis

Ordered Imaging

Differences by sex and race-ethnicity seen in the KP data were similar to those in the cross-system analyses. Patients receiving any follow-up care in the 28 days after the index visit at a non-KP facility were significantly more likely to have imaging ordered.

Received Imaging

Differences in demographic characteristics were similar to those in the cross-system analyses of received imaging. Patients who had any follow-up care at a non-KP facility were significantly more likely to receive imaging than those who did not.

Site of Care

Eight percent of persons with index visits at a KP-run ED (n = 591) had subsequent ordered or received imaging; 23% of those at a non-KP ED (n = 1210); 17% of those at a KP-run primary care setting (n = 19,345); and 13% of those at a non-KP primary care setting (n = 158). Adjusted results were similar. Compared with patients with index visits at KP-run primary care sites, those seen at non-KP primary care sites, KP-run EDs, or non-KP EDs had significantly lower adjusted

Table 4. Received imaging: multivariate logistic regression results[a]

	All groups (N = 22,197)		KP[b] only (n = 19,503)		OCHIN only (n = 2694)	
Parameter	Received, %	Odds ratio, adjusted (95% CI)	Received, %	Odds ratio, adjusted (95% CI)	Received, %	Odds ratio, adjusted (95% CI)
Group						
KP	17.1	Reference	NA		NA	
OCHIN	14.0	**0.78 (0.69-0.87)**				
Sex						
Male	18.0	Reference	18.8	Reference	12.6	Reference
Female	15.7	**0.86 (0.80-0.93)**	15.8	**0.81 (0.75-0.88)**	15.0	1.16 (0.92-1.47)
Age, years						
18-30	15.9	Reference	16.6	Reference	11.7	Reference
31-40	16.3	1.03 (0.94-1.13)	16.4	0.99 (0.89-1.09)	15.4	**1.40 (1.07-1.85)**
41-50	17.6	**1.13 (1.04-1.24)**	17.9	**1.10 (1.01-1.21)**	15.1	**1.40 (1.06-1.85)**
Race/Ethnicity						
White	18.2	Reference	18.5	Reference	16.8	Reference
Black	14.2	**0.73 (0.66-0.80)**	14.8	**0.69 (0.61-0.77)**	7.1	**0.41 (0.26-0.64)**
Hispanic	14.1	**0.75 (0.66-0.85)**	15.7	**0.79 (0.69-0.91)**	8.2	**0.48 (0.34-0.67)**
Asian	18.5	0.99 (0.84-1.17)	18.3	0.94 (0.79-1.12)	23.6	1.50 (0.78-2.87)
Other/unknown	17.0	**0.88 (0.80-0.97)**	16.9	**0.81 (0.72-0.90)**	18.0	1.03 (0.63-1.67)
Utilization 6 months before index visit						
0 visits	17.1	Reference	18.0	Reference	12.1	Reference
1 visit	16.3	0.95 (0.85-1.05)	16.2	0.89 (0.0-1.00)	17.6	1.30 (0.93-1.83)
2+ visits	16.6	1.00 (0.92-1.09)	16.8	0.93 (0.85-1.02)	14.6	0.95 (0.73-1.23)
Follow-up at KP						
Internal only	NA		16.4	Reference	NA	
Any external			24.5	**1.68 (1.50-1.88)**		
Payment source at index visit						
Uninsured	NA		NA		10.7	Reference
Medicare/Medicaid					19.1	**1.72 (1.33-2.21)**
Commercial					9.5	0.73 (0.48-1.10)
Index CHC has imaging						
No	NA		NA		14.2	Reference
Yes					13.6	1.24 (0.98-1.58)

[a] Population as defined by Clinical Quality Measure #0052.

[b] Also adjusted for KP Region.

Boldface on odds ratios and confidence intervals indicates significant difference.

CHC = community health center; CI = confidence interval; KP = Kaiser Permanente; NA = not applicable.

odds ratio (OR) of having *ordered* imaging (OR = 0.38, 95% confidence interval [CI] = 0.22-0.67; OR 0.22, 95% CI = 0.14-0.33; and OR = 0.20, 95% CI = 0.15-0.28, respectively). (Non-KP physicians cannot place orders in the KP EHR, so imaging at non-KP sites was identified via billing records and could only be counted as received.) Compared with patients with index visits at a KP primary care site, those with visits at a non-KP primary care site or at a KP ED had lower odds of receiving imaging (OR = 0.51, 95% CI = 0.31-0.83 and OR = 0.42, 95% CI = 0.31-0.57, respectively); results not shown. Those with index visits at non-KP EDs had higher odds of receiving imaging (OR = 1.51, 95% CI = 1.29-1.76).

OCHIN-Only Analysis

Ordered Imaging

Only 15% of uninsured and 13% of privately insured patients received imaging orders, compared with 26% of those with public insurance; the regression results were similar. White OCHIN patients had significantly higher adjusted odds of having imaging ordered than did black or Hispanic patients. Patients with public insurance coverage at the index visit had significantly higher odds of having imaging ordered than uninsured patients did; persons with private coverage had lower odds than did uninsured patients.

Received Imaging

Older OCHIN patients had higher odds than did younger patients of receiving imaging. Race-ethnicity and insurance-based differences in the odds of receiving imaging were similar to the odds of having imaging ordered, except the difference between privately insured and uninsured patients in odds of receiving imaging was not significant.

Site of Care

Sixteen percent of patients seen at CHCs with on-site imaging (n = 22 clinics, 1024 patients), and 21% of those seen at CHCs without on-site imaging (n = 65 clinics, 1670 patients) had any ordered or received imaging. "Ordered-only" imaging rates were higher in CHCs without (6%) than in those with (3%) on-site imaging. On-site imaging at the index visit at the CHC did not significantly affect the adjusted odds of ordered imaging, but the odds of receiving imaging were greater. Payment source may drive this difference: roughly half of uninsured and commercially insured patients were seen at clinics with onsite imaging, but only 14% of publicly insured patients were.

Table 5. Ordered imaging during a 28-day follow-up period[a]

Parameter	KP, no. (SD)	OCHIN, no. (SD)	p value
Denominator	19,503	2694	
Visits in follow-up period			
Mean no. of visits	1.0 (1.4)	1.1 (1.5)	< 0.001
0 visits	9687 (49.7)	1283 (47.6)	< 0.001
1 visit	4887 (25.1)	622 (23.1)	
2+ visits	4929 (25.3)	789 (29.3)	
LBP-coded visits in follow-up period			
Mean no. of LBP-related visits	0.6 (2.2)	0.2 (0.6)	< 0.001
0 visits	14,731 (75.5)	2178 (80.9)	< 0.001
1 visit	2845 (14.6)	413 (15.3)	
2+ visits	1927 (9.9)	103 (3.8)	
Ordered imaging			
Total	3288 (16.9)	449 (16.7)	
1 ordered image	3077 (15.8)	431 (16.0)	0.046
2+ ordered images	211 (1.1)	18 (0.7)	

[a] Population as defined by Clinical Quality Measure #0052.
KP = Kaiser Permanente; LBP = low back pain; SD = standard deviation.

DISCUSSION

The overall rates of guideline-discordant imaging for incident low back pain reported here align with those reported previously.[11] System-level and individual-level factors appear to influence these rates. We expected ordered imaging rates to be lower in KP, hypothesizing that KP's managed care organizational structure could support centralized communication about care guidelines and about any needed follow-up, and provide financial incentives for guideline compliance, more feasibly than in OCHIN's CHCs, which are not centrally managed. However, we found that these cross-system differences were not seen until we considered patients' insurance status. OCHIN's uninsured and privately insured patients—47% and 12% of the study population, respectively—appear to drive OCHIN's overall imaging order rates; KP's imaging order rate is 53% lower (17% vs 26%) than that in OCHIN's publicly insured population. Uninsured patients may not be able to afford recommended care and thus may decline certain services; similarly, OCHIN's privately insured patients may face unaffordable copayments. Imaging order rates are highest among OCHIN's publicly insured patients, possibly because of fewer cost barriers. Thus, although in some situations unaffordable copayments may yield guideline-discordant care, in terms of ordering imaging for evaluation of low back pain, they may lead to more guideline-concordant care by providing a disincentive to getting imaging.

Rates of received imaging were significantly lower at OCHIN (14%) than KP (17%). Insurance coverage distribution has a role here as well, perhaps because patients do not follow-up on ordered imaging to avoid payments. Care integration is involved. In KP's managed care system, most patients receive imaging at the facility where the index visit occurs, but for many OCHIN patients, filling imaging orders requires travel, probably affecting rates of received imaging. Furthermore, in OCHIN CHCs, imaging results may be mailed back to the primary care physician, then scanned into the EHR, weeks after the imaging is performed, if ever. Thus, our findings may underestimate imaging procedures actually received in the OCHIN population, but the differences in availability of imaging results reflect the EHR information available to physicians.

Rates of ordered or received imaging were almost 50% higher among KP patients who had any follow-up care at a non-KP facility, and they remained significantly higher in

adjusted analyses. This may reflect the lack of a single EHR system shared by KP and non-KP sites, resulting in non-KP physicians lacking access to certain medical history data or to information on imaging guidelines.

In both KP and OCHIN, white patients had significantly higher rates of ordered and received imaging, compared with black and Hispanic patients.

In both KP and OCHIN, white patients had significantly higher rates of ordered and received imaging, compared with black and Hispanic patients. This may be explained by socioeconomic or cultural differences in patients' demand for imaging for evaluation of low back pain. Some previous research found differences between white and nonwhite patients in ordered or received imaging related to low back pain,[25-27] whereas some did not.[11]

Although these analyses were exploratory, several strategies for improving implementation of care quality guidelines are implied. Managed care systems may choose to charge higher copayments for guideline-discordant care. Administrators may consider implementing strategies to facilitate physicians following imaging guidelines; for example, EHR reminders and decision-support tools can be effective at changing physicians behaviors.[28-31] Another option might involve continuing medical education related to guidelines, or coaching physicians in how to dissuade patients who demand guideline-discordant care.[32] Administrators could also support improved data sharing with external care providers. Health educators could inform patients about imaging guidelines.[33]

Our ability to collect data on received imaging differed across the two care systems; we were less able to identify received imaging in OCHIN, reflecting cross-system differences in the data available to providers in the EHR. However, rates of ordered imaging may more accurately indicate how physician actions align with care guidelines. Finally, these exploratory analyses cannot establish causation.

CONCLUSION

Rates of guideline-discordant imaging for evaluation of incident noncomplicated low back pain may be affected by the following criteria: 1) patient's ability to afford copayments, 2) whether the imaging service is performed at the same location as a primary care visit, 3) whether data on ordered or received imaging are available in real time, and 4) where follow-up care occurs. Research is needed to establish the causal relationships between patient-level and system-level factors and adherence to treatment guidelines, and to develop system-level interventions that can decrease rates of guideline-discordant imaging for low back pain. ❖

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

Acknowledgments

We wish to thank Craig Mosbaek for suggesting higher copayments for guideline-discordant care. We also wish to thank Michael S Johnson, PhD, at the Kaiser Foundation Health Plan, Portland, OR, for his help in developing this article.

Kathleen Louden, ELS, of Louden Health Communications provided editorial assistance.

References

1. Deyo RA, Mirza SK, Martin BI. Back pain prevalence and visit rates: estimates from U.S. national surveys, 2002. Spine (Phila Pa 1976) 2006 Nov 1;31(23):2724-7. DOI: http://dx.doi.org/10.1097/01.brs.0000244618.06877.cd.
2. Hart LG, Deyo RA, Cherkin DC. Physician office visits for low back pain. Frequency, clinical evaluation, and treatment patterns from a US national survey. Spine (Phila Pa 1976) 1995 Jan 1;20(1):11-9.
3. Dagenais S, Caro J, Haldeman S. A systematic review of low back pain cost of illness studies in the United States and internationally. Spine J 2008 Jan-Feb;8(1):8-20. DOI: http://dx.doi.org/10.1016/j.spinee.2007.10.005.
4. Srinivas SV, Deyo RA, Berger ZD. Application of "less is more" to low back pain. Arch Intern Med 2012 Jul 9;172(13):1016-20. DOI: http://dx.doi.org/10.1001/archinternmed.2012.1838.
5. Mathias JS, Feinglass J, Baker DW. Variations in US hospital performance on imaging-use measures. Med Care 2012 Sep;50(9):808-14. DOI: http://dx.doi.org/10.1097/MLR.0b013e31825a8c48.
6. Hendee WR, Becker GJ, Borgstede JP, et al. Addressing overutilization in medical imaging. Radiology 2010 Oct;257(1):240-5. DOI: http://dx.doi.org/10.1148/radiol.10100063.
7. Flynn TW, Smith B, Chou R. Appropriate use of diagnostic imaging in low back pain: a reminder that unnecessary imaging may do as much harm as good. J Orthop Sports Phys Ther 2011 Nov;41(11):838-46. DOI: http://dx.doi.org/10.2519/jospt.2011.3618.
8. Jarvik JG, Gold LS, Comstock BA, et al. Association of early imaging for back pain with clinical outcomes in older adults. JAMA 2015 Mar 17;313(11):1143-53. DOI: http://dx.doi.org/10.1001/jama.2015.1871.
9. American Academy of Family Physicians. Choosing wisely. Imaging tests for back pain: you probably do not need an X-ray, CT scan, or MRI [Internet]. Philadelphia, PA: ABIM Foundation; 2012 Apr [cited 2014 Jul 7]. Available from: www.choosingwisely.org/doctor-patient-lists/imaging-tests-for-lower-back-pain/.
10. Ivanova JI, Birnbaum HG, Schiller M, Kantor E, Johnstone BM, Swindle RW. Real-world practice patterns, health-care utilization, and costs in patients with low back pain: the long road to guideline-concordant care. Spine J 2011 Jul;11(7):622-32. DOI: http://dx.doi.org/10.1016/j.spinee.2011.03.017.
11. Mafi JN, McCarthy EP, Davis RB, Landon BE. Worsening trends in the management and treatment of back pain. JAMA Intern Med 2013 Sep 23;173(17):1573-81. DOI: http://dx.doi.org/10.1001/jamainternmed.2013.8992.
12. Keyhani S, Falk R, Howell EA, Bishop T, Korenstein D. Overuse and systems of care: a systematic review. Med Care 2013 Jun;51(6):503-8. DOI: http://dx.doi.org/10.1097/MLR.0b013e31828dbafe.
13. Centers for Medicare & Medicaid. EHR Incentive Program [Internet]. Washington, DC: US Department of Health & Human Services 2013 May [cited 2015 Jun 23]. Available from: www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/downloads/MU_Stage1_ReqOverview.pdf.
14. Centers for Medicare & Medicaid Services. EHR Incentive Programs: 2014 Clinical Quality Measures (CQMs) Adult Recommended Core Measures [Internet]. Washington, DC: U.S. Department of Health & Human Services; 2014 [cited 2015 Aug 26] Available from: www.cms.gov/regulations-and-guidance/legislation/ehrincentiveprograms/downloads/2014_cqm_adultrecommend_coresettable.pdf.
15. National Quality Measures Clearinghouse (NQMC). Use of imaging studies for low back pain: percentage of members with a primary diagnosis of low back pain who did not have an imaging study (plain x-ray, MRI, CT scan) within 28 days of the diagnosis [Internet]. Agency for Healthcare Research and Quality; [cited 2015 Aug 30] Rockville, MD. Available from: www.qualitymeasures.ahrq.gov/content.aspx?id=48635.
16. Shye D, Freeborn DK, Romeo J, Eraker S. Understanding physicians' imaging test use in low back pain care: the role of focus groups. Int J Qual Health Care 1998 Apr;10(2):83-91. DOI: http://dx.doi.org/10.1093/intqhc/10.2.83.
17. Schers H, Wensing M, Huijsmans Z, van Tulder M, Grol R. Implementation barriers for general practice guidelines on low back pain: a qualitative study. Spine (Phila Pa 1976) 2001 Aug 1;26(15):E348-53. DOI: http://dx.doi.org/10.1097/00007632-200108010-00013.
18. Parsons S, Harding G, Breen A, et al. The influence of patients' and primary care practitioners' beliefs and expectations about chronic musculoskeletal pain on the process of care: a systematic review of qualitative studies. Clin J Pain 2007 Jan;23(1):91-8. DOI: http://dx.doi.org/10.1097/01.ajp.0000210947.34676.34.
19. Espeland A, Baerheim A. Factors affecting general practitioners' decisions about plain radiography for back pain: implications for classification of guideline barriers—a qualitative study. BMC Health Serv Res 2003 Mar 24;3(1):8. DOI: http://dx.doi.org/10.1186/1472-6963-3-8.
20. Bussières AE, Patey AM, Francis JJ, et al. Identifying factors likely to influence compliance with diagnostic imaging guideline recommendations for spine disorders among chiropractors in North America: a focus group study using the Theoretical Domains Framework. Implement Sci 2012 Aug 31;7:82. DOI: http://dx.doi.org/10.1186/1748-5908-7-82.

21. Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. JAMA 1999 Oct 20;282(15):1458-65. DOI: http://dx.doi.org/10.1203/00006450-199904020-00719.
22. Driving down the cost of care [Internet]. Washington, DC: National Quality Forum; c2015 [cited 2014 Jul 7]. Available from: www.qualityforum.org/Story/Driving_Down_the_Cost_of_Care.aspx.
23. National Committee for Quality Assurance (NCQA). HEDIS 2013: technical specifications for physician measurement [Internet]. Washington, DC: National Committee for Quality Assurance; 2012 [cited 2014 Jul 31]. Available from: www.ncqa.org/Portals/0/HEDISQM/HEDIS2013/HEDIS_2013_PHYSICIAN_SUMMARY_TABLE_OF_CHANGES.pdf.
24. What's new in SAS 9.3 [Internet]. Cary, NC: SAS Institute Inc; 2012 [cited 2014 Jul 31]. Available from: http://support.sas.com/documentation/cdl/en/whatsnew/64209/PDF/default/whatsnew.pdf.
25. Carey TS, Garrett J. Patterns of ordering diagnostic tests for patients with acute low back pain. The North Carolina Back Pain Project. Ann Intern Med 1996 Nov 15;125(10):807-14. DOI: http://dx.doi.org/10.7326/0003-4819-125-10-199611150-00004.
26. Carey TS, Garrett JM. The relation of race to outcomes and the use of health care services for acute low back pain. Spine (Phila Pa 1976) 2003 Feb 15;28(4):390-4. DOI: http://dx.doi.org/10.1097/01.BRS.0000048499.25275.51.
27. Selim AJ, Fincke G, Ren XS, et al. Racial differences in the use of lumbar spine radiographs: results from the Veterans Health Study. Spine (Phila Pa 1976) 2001 Jun 15;26(12):1364-9. DOI: http://dx.doi.org/10.1097/00007632-200106150-00021.
28. Steele AW, Eisert S, Witter J, et al. The effect of automated alerts on provider ordering behavior in an outpatient setting. PLoS Med 2005 Sep;2(9):e255. DOI: http://dx.doi.org/10.1371/journal.pmed.0020255.
29. Schedlbauer A, Schroeder K, Fahey T. How can adherence to lipid-lowering medication be improved? A systematic review of randomized controlled trials. Fam Pract 2007 Sep;24(4):380-7. DOI: http://dx.doi.org/10.1093/fampra/cmm030.
30. Jaspers MW, Smeulers M, Vermeulen H, Peute LW. Effects of clinical decision-support systems on practitioner performance and patient outcomes: a synthesis of high-quality systematic review findings. J Am Med Inform Assoc 2011 May 1;18(3):327-34. DOI: http://dx.doi.org/10.1136/amiajnl-2011-000094.
31. Main C, Moxham T, Wyatt JC, Kay J, Anderson R, Stein K. Computerised decision support systems in order communication for diagnostic, screening or monitoring test ordering: systematic reviews of the effects and cost-effectiveness of systems. Health Technol Assess 2010 Oct;14(48):1-227. DOI: http://dx.doi.org/10.3310/hta14480.
32. Paterniti DA, Fancher TL, Cipri CS, Timmermans S, Heritage J, Kravitz RL. Getting to "no": strategies primary care physicians use to deny patient requests. Arch Intern Med 2010 Feb 22;170(4):381-8. DOI: http://dx.doi.org/10.1001/archinternmed.2009.533.
33. Interventions to improve health care quality and reduce harm: consolidated items relevant to primary care from the Choosing Wisely campaign [Internet]. Leawood, KS: American Academy of Family Physicians; c2014 [updated 2015 Jun 30; cited 2014 Jul 7]. Available from: www.aafp.org/dam/AAFP/documents/journals/afp/choosing-wisely-table.pdf.

We Want to Know

If the Roentgen rays, that are way ahead,
Will show us in the simple note,
How, when we ask our best girl to wed,
That lump will look in our throat.
If the cathode rays, that we hear all about,
When the burglar threatens to shoot,
Will they show us the picture without any doubt,
Of the heart that we feel in our boot.
If the new x-rays, that the paper do laud,
When the ghosts do walk at night,
Will show 'neath our hat to the world abroad
How our hair stands on end in our fright.
If the wonderful, new, electric rays,
Will do all the people have said,
And show us quite plainly, before many days,
Those wheels that we have in our head.
If the Roentgen, cathode, electric, x-light,
Invisible! This of that!
Can ever be turned on the Congressman bright
And show him just where he is at.
Oh, if these rays should strike you and me,
Going through us without any pain,
Oh, what a fright they would give us to see
The mess which our stomachs contain!

— Homer C Bennett, *American X-ray Journal,* 1987