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RESEARCH LETTER

Integrating Epidemiological Information into MRI Reports Reduces Ensuing Radiologic Testing Costs Among Patients with Low Back Pain: A Controlled Study

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TO THE EDITOR

In the United States, spine pain treatment is expensive and increasingly uses guideline discordant evaluation and treatment modalities, including magnetic resonance imaging (MRI),[1] up to 60% of which are considered inappropriate.[2] Inappropriate lumbar MRIs are associated with a short-term cascade of related care costs,[3] potentially causing patient harm.[4]

Including epidemiological data on MRI reports has been shown to reduce primary care clinicians' spine specialist referral and repeat imaging ordering rates.[5] We sought to determine whether including epidemiological data with spine pain patients' lumbar MRI reports might also reduce per-member-per-month (PMPM) care costs within an insurance plan.

METHODS

We conducted a retrospective, controlled, before-after analysis of 6,904 patients who were enrolled in Excellus BlueCross BlueShield (headquartered in Rochester, New York) between January 1, 2015, and December 31, 2018; had ICD-9 or ICD-10 (International Classification of Diseases, Ninth [Tenth] Revision) defined spine pain; had received a lumbar spine MRI for the first time in at least two years; and had not had spine surgery in the past two years. Beginning July 1, 2017, a quality improvement intervention including epidemiologic data (Table 1) within lumbar MRI reports was applied to patients obtaining care in 6 counties surrounding Rochester, New York. Controls obtained care in 25 other upstate New York counties and were not exposed to the intervention.

For periods before and after the intervention started, we calculated intervention and control demographic-adjusted per capita utilization rates and PMPM expenditures for four clinician visit types (primary care, chiropractic, physical therapy, and specialty care), three testing modalities (nerve conduction testing, MRI, and non-MRI), and five treatment types (spinal facet injections, opioid and muscle relaxant prescriptions, fusion spine surgery, and non-fusion spine surgery). We used zero-inflated negative binomial modeling to compare utilization rates and Tweedie modeling to compare PMPM expenditures using a difference-in-difference approach that controlled for age, gender, line of business, deductible, and forecasted risk score (at the time of first MRI). All adjusted utilization rates and PMPM expenditures were normalized by the number of months individual patients were enrolled in each period. Finally, we calculated relative rate of after/before change (RRC) of per capita utilization and PMPM expenditure data for the intervention group, compared to the control group.

RESULTS

Compared to controls, intervention patients were more likely to be enrolled in a safety net insurer, were more likely to have no deductible, and had slightly lower health care cost risks at their initial MRI (Table 2).

In the intervention group, the relative use of chiropractic care increased in the after period ($p = 0.045$, RRC = 1.37), but that of non-MRI radiographic testing ($p = 0.044$, RRC = 0.73) and spinal facet injection ($p = 0.018$, RRC = 0.71) fell (Table 3). On a relative basis, PMPM expenditures on MRI ($p = 0.023$, RRC = 0.57) and non-MRI radiographic testing ($p = 0.036$, RRC = 0.69) fell, while those on muscle relaxants ($p = 0.004$, RRC = 1.74) increased.

Relative to the control group, total spine-related PMPM expenditures in the intervention group fell (RRC = 0.85) by approximately $332 per member per year.

DISCUSSION

Using a before-after, controlled design, after controlling for important variables, we found that including epidemiologic data with lumbar spine MRI scan reports was associated with statistically significant relative increases in per capita chiropractic care use and spending on muscle relaxants but

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Table 1. Epidemiologic Data Included in MRI Reports in the Intervention Region

Among patients in the following age groups who are asymptomatic, a lumbar spine MRI will find							
Finding*	Age Group						
	20–29	30–39	40–49	50–59	60–69	70–79	80+
Disc degeneration (%)	37	52	68	80	88	93	96
Disc signal loss (%)	17	33	54	73	86	94	97
Disc height loss (%)	24	34	45	56	67	76	76
Disc bulge (%)	30	40	50	60	69	77	84
Disc protrusion (%)	29	31	33	36	38	40	43
Annular fissure (%)	19	20	22	23	25	27	29
Facet degeneration (%)	4	9	18	32	50	69	83
Spondylolisthesis (%)	3	5	8	14	23	35	50

Source: Adapted from Brinjikji W, et al. Systematic literature review of imaging features of spinal degeneration in asymptomatic populations. AJNR Am J Neuroradiol. 2015;36:811–816.

* Changes seen in an MRI report are often normal findings for a healthy, aging spine. These findings in symptom-free patients are so common that they must be interpreted with caution and in the appropriate clinical context.

Table 2. Patient Demographics and Mean Health Care Risk Scores in the Before and After Periods for the Intervention and Control Groups

Patient Demographics	Intervention		Control		*P* Value
	Before	After	Before	After	
N	2,091	924	2,737	1,152	
Mean age (SD)	55 (14)	57 (14)	56 (14)	57 (15)	< 0.001
Men (%)	46.2	46.4	46.1	46.1	NS
Line of business (%)					< 0.001
Commercial (%)	67.7	64.7	77.4	81.2	
Medicare (%)	21.9	26.7	19.2	16.5	
Safety Net (%)	10.5	8.5	3.4	2.3	
Deductible group (%)					< 0.001
$0 (%)	82.6	78.7	55.1	45.6	
> $0–$1,000 (%)	6.7	6.2	31.1	38.0	
> $1,000 (%)	10.6	15.2	13.8	16.4	
Mean risk score at initial MRI (SD)	2.0 (4.0)	2.2 (4.8)	2.1 (3.9)	2.3 (4.3)	0.001

SD, standard deviation; NS, not statistically significant.

relative decreases in per capita non-MRI radiographic testing, spinal facet injection use, and spending on both MRI and non-MRI radiographic testing. Relative changes in utilization and expenditures on other types of visits, testing, and treatments generally decreased within the intervention group.

Although our study is limited by its before-after design and retrospective nature, it confirms Fried et al.'s findings that epidemiologic data can reduce repeat ordering of images[5] and newly suggests that those reductions can generate meaningful imaging cost savings. Seemingly, a very low cost addition to standard lumbar MRI reports that can inform patients and reduce wasteful retesting, thereby potentially avoiding patient harm,[4] should become a standard of care.

Table 3. Adjusted Utilization Values for Specified Spine-Related Care Services and Per-Member-Per-Month (PMPM) Expenditures for Specified and All Spine-Related Care Services*

	Adjusted Utilization per 1,000 Patients						Adjusted PMPM Expenditures					
	Intervention		Control		Diff-in-Diff *p* Value	Relative Change	Intervention		Control		Diff-in-Diff p Value	Relative Change
	Before	After	Before	After			Before	After	Before	After		
Clinician visits												
Primary care visits	49.26	62.45	49.39	73.17	NS	0.86	$4.44	$6.07	$4.17	$6.63	NS	0.86
Chiropractic care visits	152.69	255.38	237.67	289.78	0.045	1.37	$7.88	$12.10	$9.94	$11.80	NS	1.29
Physical therapy visits	356.41	559.67	438.1	648.91	NS	1.19	$26.33	$42.87	$31.03	$45.13	NS	1.38
Specialty care visits	120.19	188.33	106.57	175.27	NS	0.95	$15.65	$28.70	$11.14	$20.68	NS	0.99
Radiographic and other testing												
Nerve conduction tests	4.15	5.65	4.00	9.58	0.053	0.57	$1.43	$2.67	$1.74	$3.64	NS	0.89
MRI testing	10.06	7.86	11.39	9.99	NS	0.89	$5.31	$3.11	$6.34	$6.53	0.023	0.57
Non-MRI radiographic tests	24.97	32.87	29.81	54.08	0.044	0.73	$1.89	$2.54	$2.95	$5.75	0.036	0.69
Treatments												
Had a spinal facet injection	73.00	91.10	58.99	103.27	0.018	0.71	$55.50	$79.69	$38.82	$60.89	NS	0.92
On an opioid	133.79	115.24	111.22	97.84	NS	0.98	$5.01	$3.81	$4.50	$4.63	0.07	0.74
On a muscle relaxant	76.73	70.69	61.95	69.75	NS	0.82	$1.25	$1.68	$2.02	$1.56	0.004	1.74
Obtained non-fusion spine surgery	7.13	14.15	3.65	10.22	NS	0.71	$38.44	$110.30	$35.76	$93.61	NS	1.10
Obtained fusion spine surgery	0.48	0.80	0.39	0.85	NS	0.76	$25.32	$32.99	$19.95	$40.45	NS	0.64
Total spine-related PMPM expenditures						$299.81	$456.95	$230.49	$415.25	0.054	0.85	

NS, not statistically significant.

* *P* values < 0.10 are shown for difference-in-difference analysis of changes in per capita utilization and PMPM expenditures. The relative after/before changes in per capita utilization and PMPM expenditures of the intervention group, compared to the control group are shown.

Potential Conflicts of Interest. Dr. Pike, Dr. Justice, and Mr. Donath are employees of Excellus BlueCross BlueShield in Rochester, New York.

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