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RESEARCH ARTICLE

Physical Therapy as the First Point of Care to Treat Low Back Pain: An Instrumental Variables Approach to Estimate Impact on Opioid Prescription, Health Care Utilization, and Costs

Bianca K. Frogner, Kenneth Harwood, C. Holly A. Andrilla, Malaika Schwartz, and Jesse M. Pines

Objective. To compare differences in opioid prescription, health care utilization, and costs among patients with low back pain (LBP) who saw a physical therapist (PT) at the first point of care, at any time during the episode or not at all.

Data Sources. Commercial health insurance claims data, 2009–2013.

Study Design. Retrospective analyses using two-stage residual inclusion instrumental variable models to estimate rates for opioid prescriptions, imaging services, emergency department visits, hospitalization, and health care costs.

Data Extraction. Patients aged 18–64 years with a new primary diagnosis of LBP, living in the northwest United States, were observed over a 1-year period.

Principal Findings. Compared to patients who saw a PT later or never, patients who saw a PT first had lower probability of having an opioid prescription (89.4 percent), any advanced imaging services (27.9 percent), and an Emergency Department visit (14.7 percent), yet 19.3 percent higher probability of hospitalization (all $p < .001$). These patients also had significantly lower out-of-pocket costs, and costs appeared to shift away from outpatient and pharmacy toward provider settings.

Conclusions. When LBP patients saw a PT first, there was lower utilization of high-cost medical services as well as lower opioid use, and cost shifts reflecting the change in utilization.

Key Words. Physical therapy, imaging, opioid, insurance claims, health care costs

Low back pain (LBP) is the most common type of pain experienced in the United States, with 25 percent of the U.S. population reporting at least one full day of LBP within the last 3 months (Deyo, Mirza, and Martin 2006). LBP is

also the number-one contributor to years lived with disability and the number three contributor to disability-adjusted life years (DALYs) in the United States (U.S. Burden of Disease Collaborators 2013). In 2008, it was estimated that back pain resulted in $34.2 million in direct costs, and about 75 percent were for medical treatment costs for pain (Gaskin and Richard 2011). Individuals with chronic LBP cost twice as much as individuals with acute LBP (Becker et al. 2010). LBP health care costs are growing faster than non-LBP expenditures (Martin et al. 2009).

Clinical practice guidelines (CPGs) for nonspecific LBP—that is, the absence of red flag symptoms for more serious causes for pain—recommend avoiding routine imaging and other diagnostic tests, prescribing acetaminophen or nonsteroidal anti-inflammatory drugs (NSAIDS) as first-line medications, and implementing nonpharmacological therapy for those who do not improve quickly. Nonpharmacologic therapies include spinal manipulation, exercise, interdisciplinary rehabilitation, and cognitive-behavioral therapy (Chou et al. 2007). Despite CPGs, there is overuse of pharmacological and underuse of nonpharmacological treatments for LBP. Half of LBP patients receive opioid prescriptions; by contrast, physical therapy, exercise therapy, and psychological therapy are recommended less (12, 19, and 8 percent, respectively) (Salt et al. 2016). In addition, imaging studies are commonly ordered for LBP, including x-ray and MRI. Studies suggest that specialist visits may lead to earlier, potentially unnecessary imaging services and greater health care costs without health benefit (Flynn, Smith, and Chou 2011; Srinivas, Deyo, and Berger 2012; Webster et al. 2013).

Engaging physical therapists (PTs) earlier in the care of LBP may reduce utilization of expensive health services and costs. Fritz, Brennan, and Hunter (2015) found that patients with LBP experienced less surgery, injections, specialist and Emergency Department (ED) visits, and lower health care charges if their primary care physician referred the patient to the PT before referring the patient to advanced imaging services. Gellhorn et al. (2012) found a

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reduction in health care services with early physical therapy for LBP, and Fritz et al. (2012) found that delaying initial PT increased health care utilization and costs. Conceptually, this may be because LBP is usually a self-limited condition that in most cases resolves without treatment; however, medications and other therapies can hasten recovery times. Because PTs initiate nonpharmacological services earlier in the LBP episode, it may alleviate symptoms and accelerate recovery without the need for other health care services. In addition, PTs cannot directly prescribe medication and commonly do not directly order advanced imaging studies.

Despite evidence that access to PTs early in care may benefit the patient, patients may not see a PT as the first line of care. Although all 50 states and the District of Columbia (DC) allowed for some form of direct access to PTs during our study period (APTA 2016), insurance plans may require individuals to obtain a referral prior to seeing a PT. Even if state law and their insurance plan allow for patients to see a PT first, patients may not be aware of their ability to see a PT first, and its benefits. Also, cost may be a deterrent if a PT visit requires a higher copay than a visit to a primary care provider, particularly if PTs are classified as specialty services by an insurance company.

Currently, there are no large-scale civilian studies that compare how seeing a PT as the first point of care versus another health care provider results in different health care utilization and costs for patients with LBP. Moore et al. (2005) found no adverse events among military health beneficiaries who saw a PT first versus through a physician referral. Our study focuses on a commercial insurance population, tracking health care use, and costs based on the first provider seen by the patient when diagnosed with LBP. We hypothesize that the first provider sets the course of treatment, which results in different health care utilization and subsequent costs. We examine whether seeing PTs first versus later in care or never seeing a PT has any differential effects on patient utilization and costs. We apply an instrumental variables approach to private health insurance claims data to evaluate differences in opioid prescription rates, health care utilization, and cost in patients with LBP who used PTs first as compared with other providers across multiple states.

METHODS

Data and Sample

This study used private health insurance administrative data from 2009 to 2013 housed at the Health Care Cost Institute (HCCI). HCCI represents over

50 million individuals per year with over 1 billion insurance claims from four insurance companies: Humana, UnitedHealth Group, Blue Cross/Blue Shield, and Kaiser Permanente. From this sample, we extracted data for patients aged 18–64 years old residing in a convenience sample of northwestern United States (i.e., Alaska, Idaho, Montana, Oregon, Washington, and Wyoming).

We further restricted the sample to patients with a new LBP diagnosis between July 2009 and December 2012. We tracked care for patients with a new LBP diagnosis from an "index date" that followed a 6-month clean period where there were no visits for LBP. LBP was identified using an all-inclusive list of IDC-9-CM codes derived from HEDIS Measures on using imaging studies for LBP and from the literature (Fritz et al. 2012; NCQA 2014). LBP was identified within the primary diagnosis field across the provider, outpatient, and inpatient insurance claims files. Patients with a prior history (within the 6-month clean period) of LBP, any prior back surgery, or any prior serious diagnoses such as cancer and nonmusculoskeletal reasons for back pain were excluded (see Table S1 for full list of included and excluded ICD-9-CM and CPT codes). The index date visit was restricted to the following place of services (POSs): offices, retail clinics, urgent care, outpatient hospitals, EDs, ambulatory surgical centers, independent clinics, federally qualified health centers, and rural health clinics. The final sample size was 148,866 patients.

Independent Variables

Patients were categorized into three groups defining PT access: (1) "PT First," where patients saw a PT as the first point where a LBP diagnosis was recorded, or on the index date; (2) "PT Later," where patients visited a PT at some point in time, but not the index date; and (3) "No PT," where patients never visited a PT. For some of our analyses, we group "PT First" and "PT Later" into a group that we refer to as "Had PT." Patients were identified as PT First based on (1) whether the provider type listed on the index date was a PT and the visit did not include CPT code 97002 (Physical Therapy Re-Evaluation), or (2) the index date visit included CPT code 97001 (Physical Therapy Evaluation) listed. Although CPT code 97001 is only billable for services provided by a PT, in situations where a PT is employed by a hospital and the hospital submits the bill to the insurance company, the provider type listed could refer to a facility such as a "general acute care hospital." Hence, we assumed that if CPT code 97001 appeared in the patient file, that the PT delivered the services regardless of the provider type listed. Patients who saw another provider on

the index date were then categorized into PT Later or No PT. Patients who were categorized as PT Later had, at some point after the index date and within the following year, CPT codes 97001 or 97002 (Physical Therapy Re-Evaluation) and/or had a provider type listed as a PT. If a patient saw multiple providers including a PT on the index date, then the patient was assumed to have seen the other provider first. Patients who were categorized as No PT did not have CPT codes 97001 or 97002 and did not have a provider type related to PT for 1 year following the index date. To identify which provider was seen other than a PT First, we developed a hierarchy of providers (e.g., physician followed by nurse, etc.) based on looking at the patterns and expert opinion.

We included a limited set of patient characteristics based on availability of data in claims files, including gender, 10-year age bands (due to HCCI data restrictions), and whether they were in an open-network insurance plan (i.e., Preferred Provider Organization or Point of Service Plans). We generated a comorbidities index using the Elixhauser method, which is one of the most common comorbidity indices identifying 30 comorbidities using ICD-9-CM codes (Elixhauser et al. 1998). To create this index, we used the Comorbidity Software, version 3.7 provided by the Healthcare Cost and Utilization Project (HCUP) downloadable from STATA/MP 14.0 (HCUP 2017). We used the ICD-9-CM codes from the secondary diagnosis across all claims on the initial date of LBP diagnosis.

Dependent Variables

Several outcome variables related to LBP were examined, including opioid prescriptions, health care utilization, and costs based on a 1-year period from the index date. For health care utilization, we defined a set of imaging outcomes including whether a patient received radiography, magnetic resonance imaging (MRI) scan, or computerized tomography (CT) scan of the spine using CPT codes (see Table S2). We defined ED visits using POS categories for EDs across the inpatient and outpatient insurance claims files. We defined a hospitalization based on whether the patient had greater than zero inpatient claims costs. Opioid prescriptions were defined by matching a list of National Drug Codes (NDC) for opioids developed by the Center for Disease Control and Prevention (CDC) National Center for Injury Prevention and Control with NDC codes in the patient's pharmacy insurance claims file (National Center for Injury Prevention and Control 2015).

Cost measures included patient and provider costs by the setting where services were delivered (i.e., provider office, outpatient settings, inpatient

departments, and pharmacy). In addition, patient out-of-pocket and total patient and provider costs were calculated across the four settings. For comparison across the study period, we deflated costs to 2009 dollars.

Instrumental Variables Approach

Potential endogeneity exists in the decision about the provider seen at the first point of care that may influence the various outcome measures. For example, patients who saw a PT First may do so because they live close to a PT, which may also be associated with living in an urban area and having more access to health care services. To reduce this bias, this study used the leading instrumental variables approach called two-stage residual inclusion (2SRI) to predict the provider seen at the first point of care (Tezra, Basu, and Rathouz 2008). The first stage of 2SRI estimates the endogenous variable (i.e., provider seen at the first point of care) as a function of the instrumental variable (IV) and patient characteristics. The residuals from the first stage are entered as regressors in the second stage estimating the outcome variables alongside the IV. Two sets of IV were run to estimate the (1) endogenous variable of seeing a PT First versus PT Later or No PT; and (2) endogenous variable of seeing a PT at any time (Had PT) versus No PT.

The IV was defined as the differential distance between (1) the patient and the provider seen at the index date, and (2) the patient and the "counterfactual" provider that could have been seen at the index date. This instrument has been often used in studies examining choice of providers given the intuition that distance influences a patient's choice in which provider to see (McClellan, McNeil, and Newhouse 1994; Brooks et al. 2006; Grabowski et al. 2013; Hirth et al. 2014). The counterfactual provider for patients in the PT Later and No PT groups was the closest PT within their insurance plan group ID, which is a proxy for providers "in network." The counterfactual provider for patients in the PT First group was any provider (excluding hospitals) closest to the patient within their insurance plan group ID. Straight-line distance between the patient and provider zip codes was defined using an algorithm developed by National Bureau of Economic Research (NBER 2016). We restricted zip code pairs to be within 100 miles, and between patients and providers living in any one of the six northwestern states. Cross border relationships between patient and provider may exist. For patients who saw multiple providers on the index date, the location of the providers was the same most of the time. We used the same hierarchy mentioned above, which is based on our examination of patterns and expert opinion, to identify the

provider to which the patient travelled. We used the method by McClellan, McNeil, and Newhouse (1994), allowing for an overage such that if the PT was a little further away (within 2 miles) than the counterfactual provider, we assumed the patient saw the PT even though the other provider was technically closer as we assumed 2 miles was a reasonable radius. We examined various versions of differential distance, Akaike's information criteria, and F-statistics to inform the choice of IV, and how confounders balanced across the IV compared to the variables being instrumented.

Regression Approach

The outcome measures were estimated as a function of the IV, residuals from the 2SRI approach, and patient characteristics. Opioid prescriptions, health care utilization, and health/quality of care outcomes were estimated using a probit model to predict the probability of an opioid prescription, advanced imaging (i.e., MRI or CT scan), radiography, ED visit, hospitalization, any surgery, or any serious diagnosis such as cancer and nonmusculoskeletal reasons for back pain (see Table S1). Costs were estimated using a generalized linear model (GLM) assuming a gamma distribution and log link to control for skewness of the data in estimating health care costs (Manning and Mullahy 2001). Where costs had a large proportion of zero values, costs were estimated using a two-part model where the first part estimates the probability of having any health care costs, and the second part estimates the expected health care costs among non-negative cost values (Belotti et al. 2015). No clear cutoff exists for defining a large proportion of zero values, so we test differences in outcomes using two-part models versus GLM to estimate cost (Deb and Trivedi 2002). Health care costs were examined in totality and by setting (i.e., provider office, outpatient, inpatient, and pharmacy). Robust standard errors were used for all models. State dummies were included to capture any state-level effects such as differences in policy environments. Year dummies for the index date of diagnosis were included in each model.

FINDINGS

Sample and Patient Demographics

Within the study sample, the incidence rate of LBP was 82.7 new primary LBP diagnosis per 1,000 patients. About 80 percent of patients in the sample had No PT, while the remaining 8.7 percent saw a PT First and 11.5 percent

saw a PT Later. Most patients (76.6 percent) saw only one provider on the index date; a little over 1 percent of the sample saw a PT and another provider on the index date. Among those who saw a PT Later, the average time between the index date to when a patient saw a PT was 38.3 days. Across quartiles of days to PT among this group, clear patterns did not exist in age distribution or number of comorbidities, although females appeared to be slightly more likely to see a PT later than males. The most common provider types seen at the first point of care were chiropractors (49.6 percent), orthopedists (9.4 percent), and acupuncturists (7.8 percent); a mix of other providers made up 15.0 percent of the sample. For those who had No PT, the provider types seen at the first point of care were chiropractors (66.5 percent), acupuncturists (8.7 percent), and radiographers (4.8 percent); 10.9 percent were a mix of other providers.

Patients that saw a PT First were significantly ($p < .001$ using Pearson's chi square for proportions and two-sample t-tests assuming unequal variances for continuous variables) more likely to be female, younger, in an open-network insurance plan, and had fewer comorbidities (Table 1). Nearly everyone in the sample was in an open insurance network such as a Preferred Provider Organization rather than a closed insurance network such as a Health Maintenance Organization, which is reflective of the broader HCCI sample.

Instrumental Variable

The 2-mile radius definition of differential distance produced the lowest Akaike's information criterion (AIC) value, an indicator of a best fit model. Examining the distribution across our limited set of patient characteristics, we saw a balanced distribution when we categorized differential distance into a binary variable (patient living within 2 miles of a PT vs. more than 2 miles) as well as across deciles of differential distance, which supports the assumption that the IV was not associated with confounders related to the outcomes of interest (data available upon request). We focused our results using a binary differential distance measure given that the literature does not state any preferred number of categories, studies show that findings are robust regardless of number of categories (Brooks et al. 2006; Hirth et al. 2014), and there is a trade-off to consider in the number of patients within each category. The probability of seeing a PT, first or at any time, was significant and positively associated with the patient living closer to the PT (Table S4), satisfying the IV assumption that the instrument has an association with the choice of provider. In our first-stage estimates for our IV, the F-statistics were well above the value

Table 1: Baseline Descriptive Characteristics of Study Sample of Patients with Low Back Pain by Point of Care by Physical Therapist, 2009–2013

	PT FIRST: Physical Therapist as First Point of Care (N = 12,906)	*PT LATER: Physical Therapist at Later Point of Care (N = 17,135)*	*NO PT: No Physical Therapist during Care (N = 118,825)*
Sex (female)	64.0	55.2	53.0
Age category (%)†			
18–24	7.6	7.2	8.4
25–34	21.9	17.9	19.8
35–44	26.7	24.9	24.1
45–54	22.5	23.8	23.9
55–64	21.2	26.3	23.8
Open-network insurance plan (i.e., PPO, POS)	96.2	94.9	94.5
Comorbidity index‡ (0 = low to 2 = high)	0.006	0.035	0.037
Year of index visit (%)			
2009	19.7	19.9	18.8
2010	32.7	32.9	32.0
2011	24.4	24.7	25.7
2012	23.1	22.5	23.5
State of residence (%)			
Alaska	2.3	3.3	5.5
Idaho	5.8	7.3	8.8
Montana	1.9	2.0	3.4
Oregon	15.5	20.6	24.6
Washington	73.7	65.1	54.9
Wyoming	0.8	1.7	2.9

Notes. All pairwise comparisons are significantly different at $p < .001$ except where noted. Proportions are significantly different at $p < .001$ using Pearson's chi square, and continuous values are significantly different at $p < .001$ using two-sample t-tests assuming unequal variances.
†To protect privacy and confidentiality, age data from HCCI were restricted to age categories.
‡No statistically significant difference in comparison of means between PT Later and No PT for comorbidity index.

of 10 (Tables 3 and 4), which is a threshold value for a strong instrument (Stock, Wright, and Yogo 2002).

Opioid Prescriptions and Health Care Utilization

Comparing descriptive statistics by access to PTs, patients who saw a PT First had significantly ($p < .001$) lower opioid prescription rates, advanced imaging services, radiography, and ED visits, compared to the PT Later and No PT

Table 2: Descriptive Outcome Measures of Study Sample of Patients with Low Back Pain by Point of Care by Physical Therapist, 2009–2013

	PT FIRST: Physical Therapist as First Point of Care (N = 12,906)	*PT LATER: Physical Therapist at Later Point of Care (N = 17,135)*	*NO PT: No Physical Therapist during Care (N = 118,825)*
Any opioid prescription (%)	20.4	31.5	25.3
Any advanced imaging services (%)[†]	9.4	35.0	13.1
Any radiography (%)	11.0	37.0	23.3
Any emergency department visit (%)	14.7	21.3	23.8
Any hospitalization (%)	11.5	9.0	6.6
Any total costs (%)	100[§]	100	100
Total costs (non-zero mean)	$6,562[‡]	$9,883	$6,399
Any provider costs (%)	99.8[‡]	100	99.6
Provider costs (non-zero mean)	$3,433	$4,639	$2,739
Any outpatient costs (%)	52.4	63.9	54.7
Outpatient costs (non-zero mean)	$3,055	$4,224	$3,812
Any inpatient costs (%)	11.5	9.0	6.6
Inpatient costs (non-zero mean)	$13,357	$28,409	$23,862
Any pharmacy costs (%)	54.2[§]	53.9	48.8
Pharmacy costs (non-zero mean)	$1,102[‡,§]	$1,122[¶]	$1,154
Any out-of-pocket costs (%)	95.5[‡,§]	95.8[¶]	95.7
Out-of-pocket costs (non-zero mean)	$188	$232	$198

Notes. All pairwise comparisons have statistically significant differences at $p < .001$ unless otherwise noted.

[†]Advanced imaging includes magnetic resonance imaging and computerized tomography scan.

[‡]Not statistically significant at $p < .001$ between PT First and No PT using two-sample t-test assuming unequal variances.

[§]Not statistically significant at $p < .001$ between PT First and PT Later using two-sample t-test assuming unequal variances.

[¶]Not statistically significant at $p < .001$ between PT Later and No PT using two-sample t-test assuming unequal variances.

groups (Table 2). However, the rate of being admitted to a hospital was higher in the PT First group as compared to other groups.

Tables 3 and 4 report the marginal effects at the means on the regressions (see coefficients on the key independent variables in Table S4), which control for unobserved selection bias for seeing a PT, patient characteristics, state of residence, and year of diagnosis. For instance, patients with LBP who saw a PT First versus the PT Later or No PT groups had 89.4 percent lower probability ($p < .001$) of receiving an opioid prescription and 27.9 percent lower probability ($p < .001$) of having any advanced imaging services (Table 3). Patients who saw a PT First also had lower probability of having any radiography and ED visits, but 19.3 percent higher probability of being

Table 3: Effects of Care by Physical Therapist on Opioid Prescription and Health Care Utilization (N = 148,866)

Outcome Variable	*PT FIRST: Physical Therapist as First Point of Care Marginal Effect (Standard Error)*	*HAD PT: Physical Therapist at Either First or Later Point of Care Marginal Effect (Standard Error)*
Any opioid prescription	−0.894***	−0.876***
	(0.053)	(0.041)
Any advanced imaging services†	−0.279***	−0.260***
	(0.045)	(0.032)
Any radiography	−0.166**	−0.172***
	(0.056)	(0.041)
Any emergency department visit	−0.383***	−0.322***
	(0.052)	(0.040)
Any hospitalization	0.193***	0.006
	(0.03)	(0.024)
F-Statistic of first-stage instrumental variable estimation	3,255***	3,527***

Notes. Marginal effect (dy/dx) at the means reported from probit using two-stage residual inclusion instrumental variable approach. Models control for sex, age categories, comorbidity index, state, and year dummies with robust standard errors.
*$p < .01$, **$p < .005$, ***$p < .001$.
†Advanced imaging includes magnetic resonance imaging and computerized tomography scan.

admitted to an inpatient hospital stay. These trends are consistent with the unadjusted comparisons. When patients who saw a PT First are combined with those who saw a PT Later (i.e., Had PT), the probabilities of an opioid prescription, advanced imaging, and ED visits were slightly lower yet still significant.

Health Care Costs

Most patients in the sample had provider, out-of-pocket, and total costs data; only about half of patients had outpatient and pharmacy costs, and about 10 percent or less had inpatient costs. Given the high percentage of zeros among outpatient, pharmacy, and inpatient costs, we used a two-part regression model to estimate these costs. Unadjusted health care costs were significantly lower across all settings (i.e., provider office, outpatient, inpatient, and pharmacy) for patients who saw a PT First, although the differences were not significantly different between the PT First and No PT groups for pharmacy and total costs (Table 2). Provider costs were higher for PT First versus No PT, but

Table 4: Effects of Care by Physical Therapist on Health Care Costs ($N = 148,866$)

Outcome Variable	*PT FIRST: Physical Therapist as First Point of Care Marginal Effect (Standard Error)*	*HAD PT: Physical Therapist at Either First or Later Point of Care Marginal Effect (Standard Error)*
Out-of-pocket costs	−496.67***	−428.12***
	(36.83)	(29.32)
Provider costs	5925.51***	3369.01***
	(585.41)	(495.01)
Outpatient costs	−3447.89***	−3235.86***
	(790.81)	(627.76)
Inpatient costs	−695.54	−2940.01**
	(1357.34)	(1181.83)
Pharmacy costs	−807.24**	−754.42**
	(276.64)	(227.04)
Total costs	2613.41	−2837.96
	(2177.52)	(1820.17)
F-Statistic of first-stage instrumental variable estimation	3,255***	3,527***

Notes. Marginal effect (dy/dx) at the means reported from generalized linear model using gamma distribution and log link using two-stage residual inclusion instrumental variable approach; two-part models used to estimate outpatient, inpatient, and pharmacy costs given large percentage of zeros. Models control for sex, age categories, comorbidity index, state, and year dummies with robust standard errors.
*$p < .01$, **$p < .005$, ***$p < .001$.

lower than those who had PT Later. Generally, patients who had PT Later had the highest rates and average costs across all categories.

The regression results on cost data show that for patients with LBP that saw a PT First, health care costs were significantly lower for outpatient, pharmacy, and out-of-pocket costs versus the PT Later or No PT groups (Table 4). Provider costs were higher for those who saw a PT First. There were no significant differences in inpatient costs or in total costs. The trends were generally consistent for the combined Had PT sample with the exception that inpatient costs were significantly lower for those who were in the Had PT group versus No PT group (Table S3),

Study Limitations

There are a few limitations of this study. First, LBP is a condition that may recur over one's lifespan so determining the exact onset of LBP is not feasible.

We attempted to mitigate any preexisting back pain on utilization and outcomes by defining a "clean" period and excluding patients with high-risk health conditions that cause LBP symptoms within this period. While we did not specifically exclude any opioid prescription during the clean period, 12.3 percent of the sample had at least one opioid prescription during the clean period, although there were no meaningful differences in the rate of opioid prescription across the three groups (PT First, PT Later, and No PT) in the clean period. Second, claims data do not provide information on insurance benefit designs and coverage. Thus, we did not consider the variability in payment benefits for different health care providers or insurance policies. Third, given the limitations of claims data, we are not able to test all potential confounders such as patient education, income, and race that researchers have identified as missing in many instrumental variable studies (Garabedian et al. 2014; Soumerai and Koppel 2017). In addition to the robustness checks of our instrument, the use of 2SRI is intended to reduce the bias from unmeasured confounders. Another limitation of claims data is that we were restricted in our ability to examine health outcomes, such as functional recovery or the presence of diagnoses of serious conditions that might have been missed or delayed based on how people access health services. We limited the study to only cost and utilization outcomes.

Discussion and Conclusions

Our sample had an incidence of LBP that aligns with known LBP incidence ranges (Hoy et al. 2010) suggesting concurrence between this U.S. region and national trends. The findings from this study suggest that seeing a PT First for a LBP episode significantly lowered the probability of having an opioid prescription, advanced imaging service, and ED visits compared to patients that did not. Similar findings were seen in studies investigating early, LBP guideline-adherent PT care (Childs et al. 2015; Fritz, Brennan, and Hunter 2015). Zheng et al. (2017) also found that individuals with LBP referred to PTs were less likely to be associated with an opioid prescription in a large Medicare and Medicaid population. These outcomes are consistent with practice recommendations from a nationally recognized CPG for LBP (Chou et al. 2007).

Our study found higher probability of hospitalization among those who saw a PT First. Having an inpatient hospitalization is not necessarily a bad outcome for a patient. PTs provide care that aims to resolve LBP by addressing musculoskeletal causes first, but if the problem does not get resolved, PTs may

refer patients appropriately for more specialized care. The reasons for the higher hospitalization rates warrant further investigation, although our results show that there were no significant differences in hospitalization costs for those who saw a PT First, suggesting that seeing a PT first did not necessarily result in additional costly complications.

Looking at other areas of cost, patients who saw a PT First experienced significantly lower out-of-pocket, pharmacy, and outpatient costs, but higher provider costs. The lower outpatient costs are consistent with the lower utilization of imaging services and ED visits, which often are billed through outpatient settings. While the lower opioid prescriptions may contribute to lower pharmacy costs, additional analyses are needed to understand whether concurrent prescriptions to opioids (e.g., NSAIDs, muscle relaxants) may be contributing to this effect. We postulate that higher provider costs may be indicative of a higher frequency of visits that are common for physical therapy care. In addition, there appears to be a shift from outpatient and pharmacy costs to provider costs that resulted in a zero net effect on total costs.

For patients with LBP that were in the Had PT (first or later) group, there was a significantly lower probability of having an opioid prescription, advanced imaging service, and ED visit compared to patients that were in the No PT group, however the likelihood was slightly less than patients that saw a PT First. For patients that Had PT, there were significantly lower costs for all cost outcomes except provider costs. Based on earlier literature and descriptive statistics, one is left with the impression that having a PT involved in care results in higher cost outcomes across most measures. However, when selection of provider and timing to seeing a PT (first versus later) are considered, cost outcomes are significantly improved.

Of particular interest was the significantly lower use of opioids in those patients who saw a PT First or PT Later. The potential reduction in opioid prescriptions is notable given the increasing awareness on the over-prescription of opioids and the high risk of substance abuse, and the importance of the role of the provider (Jones, Paulozzi, and Mack 2014). Opioid overdoses have reached epidemic proportions, and opioids have not been found to significantly improve health outcomes (Deyo et al. 2009; Bohnert et al. 2011; Friedman et al. 2015). First-line, nonpharmacological methods to treat LBP have been recommended in the literature (National Center for Injury Prevention and Control 2014); this study suggests that PT may be a positive alternative.

Some patients who may benefit from seeing a PT early, however, do not have access, sometimes because of regulatory and health insurance restrictions, and often, patient awareness. Although the study sample included two

states that had provisions on direct access, these provisions do not completely restrict a patient from accessing a PT. In addition, reimbursement for PT services may be hampered by the lack of a physician referral even when states allow direct access to care. Given the findings of this study, states should consider reviewing their laws that restrict direct access to physical therapy services and insurers should assess their policies. In addition, a national sample of claims data may further elucidate the effect of restrictions on health care cost and utilization. This study suggests that having direct access to physical therapy services may lead to decreases in health care utilization and certain costs, especially in opioid prescription, ED visits, and imaging.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix SA1: Author Matrix.

Table S1. ICD-9-CM and CPT Codes Included and Excluded to Define Low Back Pain.

Table S2. CPT Codes Defining Imaging.

Table S3. Descriptive Outcome Measures of Study Sample of Patients with Low Back Pain by Point of Care by Physical Therapist, 2009–2013: HAD PT vs. NO PT.

Table S4. Instrumental Variable Coefficients on Key Predictor Variable ($N =$ 148,866).