

Immediate Physical Therapy Initiation in Patients With Acute Low Back Pain Is Associated With a Reduction in Downstream Health Care Utilization and Costs

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Background. Physical therapy is an important treatment option for patients with low back pain (LBP). However, whether to refer patients for physical therapy and the timing of initiation remain controversial.

Objective. The objective of this study was to evaluate the impact of receiving physical therapy and the timing of physical therapy initiation on downstream health care utilization and costs among patients with acute LBP.

Design. The design was a retrospective cohort study.

Methods. Patients who had a new onset of LBP between January 1, 2009, and December 31, 2013, in New York State were identified and grouped into different cohorts on the basis of whether they received physical therapy and the timing of physical therapy initiation. The probability of service use and LBP-related health care costs over a 1-year period were analyzed.

Results. Among 46,914 patients with acute LBP, 40,246 patients did not receive physical therapy and 6668 patients received physical therapy initiated at different times. After controlling for patient characteristics and adjusting for treatment selection bias, health care utilization and cost measures over the 1-year period were the lowest among patients not receiving physical therapy, followed by patients with immediate physical therapy initiation (within 3 days), with some exceptions. Among patients receiving physical therapy, those receiving physical therapy within 3 days were consistently associated with the lowest health care utilization and cost measures.

Limitations. This study was based on commercial insurance claims data from 1 state.

Conclusions. When referral for physical therapy is warranted for patients with acute LBP, immediate referral and initiation (within 3 days) may lead to lower health care utilization and LBP-related costs.



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Low back pain (LBP) is a common and costly medical condition associated with significant physical pain, disability, and loss of productivity. Recent reports ranked LBP as the leading cause of disability, as measured by years lived with disability in the United States and across the globe.^{1,2} In 2014, approximately 68.6 million (28.6%) adults in the United States reported having LBP that lasted a whole day or more in the past 3 months.³ The estimated total costs associated with LBP in the United States exceed \$100 billion per year; two-thirds of the costs are indirect (lost wages and reduced productivity).⁴

Evidence indicates that physical therapy is a cost-effective treatment option for a variety of medical conditions including LBP.^{5,6} As many patients with LBP are initially evaluated by physicians, decisions for referral to a physical therapist may have important implications for the health care system. Approximately 20% of patients with LBP are referred for physical therapy by a physician.⁷ Yet the timing of physical therapy initiation remains controversial. While it is generally agreed that patients with LBP should remain active physically in the acute and subacute phases,^{8–11} there is no consensus about when to refer patients for formal physical therapy. Several clinical practice guidelines^{12–14} recommend delaying physical therapy for several weeks because most individuals with an acute episode of LBP experience substantial improvement in the first month.^{15,16} However, some studies have expressed concerns with delayed referral to a physical therapist, suggesting that most patients with LBP experience subsequent recurrences without timely intervention, which may be associated with more health care utilization and higher costs over time.^{17–19}

In practice, many patients are referred for physical therapy without a delay of 2 to 4 weeks as recommended by clinical practice guidelines.^{12–14,20–23} One study observed the management patterns for Medicare beneficiaries with a new onset of LBP over a 1-year period and found that of those receiving physical therapy, 52.0% received physical therapy within 4 weeks, 18.1% between

4 weeks and 3 months, and 29.9% after 3 months.²¹ Another 2 studies found that receiving physical therapy within 14 days after the onset of LBP was associated with reduced health care utilization and lower LBP-related costs among patients with commercial insurance and those covered by the Military Health System, respectively.^{22,23}

Some delivery system innovations have targeted immediate physical therapy initiation (within 3 days after the onset of LBP). Virginia Mason Medical Center offered patients with uncomplicated LBP same-day access to a physical therapist–physician team that developed and implemented a treatment plan for the patients during the first visit.²⁴ Patients seen at the spine clinic had less absenteeism, fewer imaging tests, and fewer specialist visits while reporting higher levels of patient satisfaction than those receiving standard treatment.²⁵ Pinnington et al²⁶ studied 552 patients with acute LBP who received physical therapy within 3 or 4 days at some back pain clinics in the United Kingdom. They found that patients receiving physical therapy within 4 days had lower costs per LBP episode than those described in other studies of LBP in primary care.

Few population-based studies have examined the impact of immediate physical therapy initiation with 1 exception. Zigenfus et al²⁷ studied the health care utilization of workers with acute low back injuries using a database of a large occupational health care provider. They found that injured workers who received physical therapy within 1 day of being injured had fewer physician visits, fewer restricted workdays, fewer days away from work, and shorter case duration than those receiving physical therapy at later times. However, that study was limited because the results were based on 3-way analyses of variance, with controlling only for sex and age group. Additionally, health care cost measures were not examined. Further research on immediate physical therapy initiation is needed to explore its impact on health care utilization and costs.

Using a large health insurance claims database, we aimed to examine the impact of receiving physical therapy and

the timing of physical therapy initiation (receiving physical therapy within 3 days, between 4 and 14 days, between 15 and 28 days, or between 29 and 90 days after the onset of acute LBP) on health care utilization and costs over a 1-year follow-up period.

Methods

Data Sources

The Truven Health MarketScan Commercial Claims and Encounters Databases for the state of New York from 2008 to 2014 were used in this study.²⁸ The claims records contained in these databases represent actual treatment patterns and payments of care received by patients with employer-sponsored health insurance.²⁸ The databases contain unique person-level identifiers that are consistent across an individual's enrollment, medical, and drug records.²⁸ As a result, health care services including outpatient care, inpatient care, and outpatient prescriptions received by a patient can be tracked longitudinally. Approximately 10% of residents in New York under the age of 65 years are captured in the databases.²⁹

Study Sample

Patients with a primary or secondary diagnosis of at least 1 of the LBP *International Classification of Diseases*, Ninth Revision, Clinical Modification, codes (Appendix), seen initially by a physician who might potentially refer patients for physical therapy in an outpatient setting (with specialties such as internal medicine, family practice, physical medicine and rehabilitation, and orthopedic surgery) from January 1, 2009, and December 31, 2013, were included. Podiatrists, nurse practitioners, and physician assistants could also be referring providers, but they were excluded from the study because of the small numbers of patients referred by these providers. Outpatient physician visits were identified using Current Procedural Terminology evaluation and management codes for office or other outpatient services (99201–99215). This initial physician visit associated with a LBP diagnosis was treated as the index visit, and the service date was treated as the index date. We required included patients to have continuous medical

and drug benefit coverage for at least 12 months before and after the index date. To ensure that only patients with acute LBP were selected in the study, we excluded patients with any LBP-related claims billed in the year preceding the index date. We further excluded patients aged 17 years or younger at the index date, those with any capitation or encounter claim or no LBP-related payments, any spine surgery prior to the index visit, or comorbid conditions diagnosed within 4 weeks of the index date indicating nonmusculoskeletal origins of LBP. These conditions included kidney stones, uterine fibroids, urinary tract infection, cauda equina syndrome, neoplasm, pregnancy or delivery, etc. In order to maintain consistency with the literature, we adapted relevant diagnosis and procedure codes used by previous studies and used a 90-day period after the index date to identify physical therapy utilization.^{22,23,30,31} Patients receiving both physical therapy and chiropractic care were not included in the analysis.

Independent Variables

The primary variable of interest was whether a patient received physical therapy and the timing of physical therapy initiation, with the latter measured as the number of days between the index date and the date for the first encounter with a physical therapy service in association with an LBP diagnosis code. For facility claims, physical therapy services were identified using the 042x series of revenue codes (0420-Physical therapy-general classification, 0421-Physical therapy-visit charge, 0422-Physical therapy-hourly charge, 0423-Physical therapy-group rate, 0424-Physical therapy-evaluation or re-evaluation, and 0429-Physical therapy-other). For professional claims, these services were identified using Current Procedural Terminology physical medicine and rehabilitation codes (97001, 97002, and 97010–97799).

Patients were divided into 5 groups on the basis of whether physical therapy was utilized and the timing of physical therapy initiation: no physical therapy, immediate physical therapy initiation (receiving physical therapy within 3

days after the index date), early physical therapy initiation (between 4 and 14 days), delayed physical therapy initiation (between 15 and 28 days), and late physical therapy initiation (between 29 and 90 days).

Outcome Measures

LBP-related health care utilization and costs over a 1-year period after the index date were recorded as outcome measures. The utilization measures (binary variables) including advanced imaging such as computed tomography and magnetic resonance imaging, opioid medication use, spinal injection, specialist visits, emergency department, and spine surgery reflected the annual probability of service use. An algorithm reported by a previous study was used to identify emergency department visits.³² Pain medication costs included payments for 3 types of medications: nonsteroidal anti-inflammatory drugs (NSAIDs), muscle relaxants, and opioids. LBP-related medical costs were measured as the sum of payments for all medical claims associated with a LBP diagnosis, while total LBP-related costs were the total of LBP-related medication and medical costs. Non-LBP-related costs were also calculated. All costs included both insurers' payments and enrollees' out-of-pocket cost sharing over the 1-year period after the index date and were presented in inflation-adjusted 2014 dollars using the medical care component of the Consumer Price Index.³³

Control Variables

Variables included as covariates in the multiple regression models were patient sex, age group, location (within the metropolitan statistical area [yes/no]), insurance plan type (exclusive provider organization, noncapitation point of service, preferred provider organization, or other [unknown]), physician specialty at the index visit (family practice, orthopedic surgery, physical medicine and rehabilitation, internal medicine, or other), copayment for the index visit, medical history 1 year prior to the index date (neck/thoracic pain, mental health condition, fibromyalgia, diabetes, hypertension, Charlson Comorbidity Index ≥ 1 , opioid

prescription 4 weeks prior to the index date, 5 or more unique diagnoses, 55 or more therapeutic classes of prescriptions filled), and year of the index visit (2009, 2010, 2011, 2012, or 2013). Comorbid conditions such as mental health conditions, neck/thoracic pain, and fibromyalgia were identified from diagnoses reported on claims within 11 year prior to the index date.^{22,23,30,31}

Data Analysis

Descriptive statistics including proportions and means with standard deviations by timing of physical therapy initiation were used to describe patient characteristics, health care utilization, and costs. Chi-square and Kruskal-Wallis tests were used to assess the statistical significance of differences across different cohorts.

To address potential selection bias caused by the nonrandom nature of physical therapy utilization and the timing of physical therapy initiation, the probability of each patient being included in a certain cohort was estimated using a logistic regression. Control variables mentioned above may influence physical therapy utilization and timing of physical therapy initiation were included in the regression model. The inverse of the estimated propensity scores, also known as the inverse probability of treatment weights, were used in regression models described below to control selection bias.³⁴ Considering that a large number of patients did not utilize physical therapy, the health care utilization and cost measures were further examined in the no-physical-therapy subgroups defined by total LBP-related cost quartiles. Separate regression models were also estimated to compare the cohorts receiving physical therapy initiated at different times.

We conducted multivariate logistic regression analyses to investigate the impact of the timing of physical therapy initiation on the risk for health service use over a 1-year period after the index date, controlling for patient characteristics. Because health care cost measures tend to be positively skewed, generalized linear regression models with gamma distribution and log link

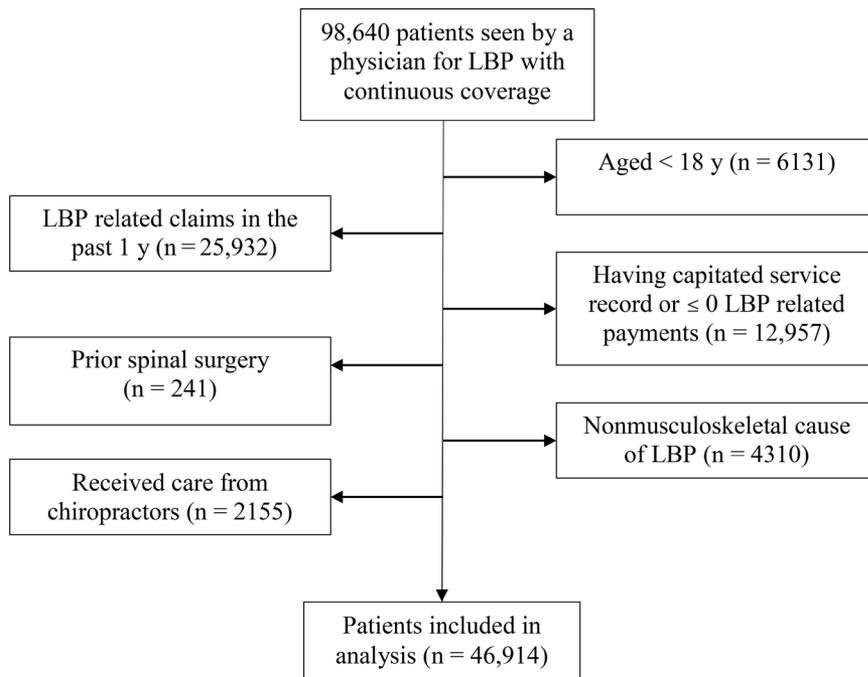


Figure 1. Flow diagram of study sample development. LBP = low back pain.

function were used.³⁵ When estimating the models for prescription medication and non-LBP-related costs, a minimal amount (\$0.01) was added before taking logs as some patients did not incur any related prescription or non-LBP-related costs. We reported adjusted utilization and cost measures based on logistic regression and generalized linear regression results by cohorts, which represent the estimated average probability of using certain health care services or average costs associated with the respective timing of physical therapy initiation while adjusting for patient characteristics.³⁶ All statistical tests were 2-sided, with a significance level of .05. Data management and statistical analyses were performed in SAS software, Version 9.4 for Windows (SAS Institute, Inc, Cary, North Carolina), and Stata (version 12.1) statistical software (StataCorp, College Station, Texas).

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Results
Patient Characteristics

A total of 46,914 unique patients were included in the analysis (Fig. 1). Among all patients, 53.8% were women, and 29.8% were between 45 and 54 years old. Almost all patients lived in a metropolitan area, and most had preferred provider organization plans. Baseline demographic characteristics are presented in Table 1.

Physical therapy services were utilized by 14.2% of patients within 90 days of the index date. Among 6668 patients who received physical therapy services, 2052 patients (30.8%) received physical therapy immediately (within 3 days after the index date) while 2219 patients (33.3%), 1044 patients (15.7%), and 1353 patients (20.3%) received physical therapy between 4 and 14 days, between 15 and 28 days, and

between 29 and 90 days, respectively (Tab. 1). More patients receiving physical therapy within 3 days were 18 to 44 years old (49.1%) than those receiving physical therapy between 4 and 14 days (43.1%), between 15 and 28 days (40.7%), or between 29 and 90 days (41.8%). Patients receiving physical therapy within 3 days were more likely to reside in metropolitan areas, have preferred provider organization plans, see a physical medicine and rehabilitation physician at the index visit, and suffer from neck pain, thoracic pain, or fibromyalgia in the prior year. But they were less likely to have comorbid hypertension or opioid prescription in the prior 4 weeks.

Health Care Utilization and Cost Measures

Unadjusted health care utilization measures and cost measures over the 1-year period after the onset of acute LBP were lower among patients who did not receive physical therapy than among those receiving physical therapy, with the exception of emergency department use (22.17% vs 21.12%) and pain medication costs (\$140.27 vs \$102.21) (Tab. 1). Among those receiving physical therapy, patients receiving physical therapy within 3 days had the lowest health care utilization and cost measures, with the exception of pain medication costs (\$86.56 vs \$84.00 for patients receiving physical therapy between 4 and 14 days).

Table 2 shows the adjusted health care utilization measures and cost measures for patients who had acute LBP and received or did not receive physical therapy after controlling for patient characteristics and adjusting for treatment selection bias. While many adjusted health care utilization and cost measures were the lowest among patients not receiving physical therapy, patients receiving physical therapy within 3 days were associated with the lowest opioid medication and emergency department use, pain medication, advanced imaging, and non-LBP-related costs. Among patients receiving physical therapy initiated at different times, patients receiving physical therapy within 3 days

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Immediate Physical Therapy for LBP: Health Care Utilization and Costs

Table 1.

Descriptive Statistics for Patients With Acute LBP and Unadjusted Health Care Utilization and Cost Measures by Timing of Physical Therapy Initiation^a

Characteristic at Index Visit	All Patients (N = 46,914)	Patients Not Receiving Physical Therapy (n = 40,246)	Patients Receiving Physical Therapy (n = 6668)	Timing of Physical Therapy				P
				Immediate (Within 3 d) (n = 2052; 30.77%)	Early (4–14 d) (n = 2219; 33.28%)	Delayed (15–28 d) (n = 1044; 15.66%)	Late (29–90 d) (n = 1353; 20.29%)	
Women	53.77	53.63	54.60	51.75	57.41	50.29	57.65	<.0001
Age group (y)								<.0001
18–34	20.83	20.86	20.61	22.42	21.27	18.01	18.77	
35–44	23.11	23.02	23.70	26.66	21.81	22.70	23.06	
45–54	29.78	30.00	28.42	28.31	27.44	30.94	28.23	
55–64	26.28	26.12	27.28	22.61	29.47	28.35	29.93	
Within metropolitan statistical area	92.33	92.17	93.31	96.0	92.25	91.67	92.24	<.0001
Plan type								<.0001
Exclusive provider organization	12.22	12.62	9.79	9.55	10.14	9.29	9.98	
Noncapitation point of service	12.37	12.09	14.05	13.40	13.97	16.00	13.67	
Preferred provider organization	62.01	61.88	62.81	67.69	60.57	60.06	61.20	
Other/unknown	13.39	13.40	13.35	9.36	15.32	14.66	15.15	
Physician specialty								<.0001
Family practice	32.23	33.16	26.60	22.71	26.95	27.20	31.49	
Orthopedic surgery	9.38	8.50	14.68	9.45	18.43	17.34	14.41	
Physical medicine and rehabilitation	5.85	3.75	18.55	32.02	16.22	10.15	8.43	
Internal medicine	36.53	38.43	25.09	15.59	27.08	30.36	32.15	
Other	16.00	16.16	15.07	20.22	11.31	14.94	13.53	
Copay for index visit, \$, mean (SD)	20.63 (19.93)	20.68 (19.84)	20.33 (20.43)	19.72 (21.33)	20.93 (20.09)	19.96 (18.00)	20.56 (21.34)	.0253
Medical history 1 y prior to index date								
Neck/thoracic pain	14.53	14.26	16.15	23.05	13.61	11.97	13.08	<.0001
Mental health condition	16.00	16.01	15.97	15.59	16.54	15.33	16.11	.7785
Fibromyalgia	4.12	4.03	4.71	6.43	3.52	3.54	4.95	<.0001
Diabetes	9.79	9.97	8.68	8.92	7.84	9.39	9.16	.3656
Hypertension	22.21	22.58	19.99	16.96	21.05	21.17	21.95	.0006
Charlson Comorbidity Index ≥1	9.01	9.11	8.41	8.43	8.56	7.66	8.72	.8026
Opioid prescription 4 wk earlier	23.52	23.98	20.71	16.91	21.59	20.02	25.57	<.0001
Five or more unique diagnoses	82.04	81.91	82.83	81.34	84.27	80.56	84.48	.005
Five or more therapeutic classes of prescriptions filled	39.76	39.82	39.38	35.67	42.32	37.93	41.32	<.0001
Year of index visit								.0034
2009	15.39	15.40	15.33	16.33	14.78	13.03	16.48	
2010	21.49	21.38	22.20	25.05	21.32	21.46	19.88	

(Continued)

Table 1.

Continued

Characteristic at Index Visit	All Patients (N = 46,914)	Patients Not Receiving Physical Therapy (n = 40,246)	Patients Receiving Physical Therapy (n = 6668)	Timing of Physical Therapy				P
				Immediate (Within 3 d) (n = 2052; 30.77%)	Early (4–14 d) (n = 2219; 33.28%)	Delayed (15–28 d) (n = 1044; 15.66%)	Late (29–90 d) (n = 1353; 20.29%)	
2012	20.03	20.11	19.50	18.08	20.19	20.02	20.10	
2013	17.88	17.91	17.71	15.84	17.94	19.92	18.48	
Health service use over 1-y follow-up period, % of patients								
Advanced imaging	14.48	11.53	32.26	17.30	28.26	43.77	52.62	<.0001
Opioid medication	36.57	36.19	38.87	28.31	39.52	46.26	48.12	<.0001
Spinal injections	4.49	3.58	9.99	5.31	9.10	12.07	16.93	<.0001
Specialist visits	16.56	12.80	39.29	32.46	34.88	46.17	51.59	<.0001
Emergency department	22.02	22.17	21.12	17.54	21.18	22.41	25.42	<.0001
Spine surgery	1.22	0.79	3.87	1.32	3.02	5.56	7.83	<.0001
Health care costs over 1-y follow-up period, \$, mean (SD)								
Pain medication costs	134.86 (1027.47)	140.27 (1091.11)	102.21 (490.66)	86.56 (622.44)	84.00 (288.95)	106.19 (342.69)	152.77 (606.94)	<.0001
Advanced imaging costs	105.81 (362.18)	82.83 (318.98)	244.53 (535.13)	116.70 (342.05)	221.96 (558.06)	325.75 (535.00)	412.74 (666.25)	<.0001
LBP-related medical costs	1155.25 (7022.74)	771.90 (5837.61)	3469.05 (11,622.69)	2664.42 (11,215.26)	2795.22 (8966.24)	3734.26 (9011.23)	5589.85 (16,568.51)	<.0001
Total LBP-related costs	1290.11 (7120.26)	912.16 (5960.77)	3571.25 (11,670.30)	2750.97 (11,248.43)	2879.21 (8998.13)	3840.43 (9057.19)	5742.61 (16,642.56)	<.0001
Non-LBP-related costs	8029.53 (27,138.89)	7919.15 (28,070.73)	8695.80 (20,629.02)	8137.37 (19,364.61)	8673.45 (19,337.30)	9558.23 (27,735.28)	8913.92 (17,935.16)	.0028

*Data other than P values are reported as percentages of patients unless otherwise indicated. Cost estimates have been adjusted for inflation. LBP = low back pain.

were consistently associated with the lowest adjusted health care utilization measures and cost measures.

In the study sample, 40,246 (85.8%) patients did not receive physical therapy within 90 days after the onset of acute LBP. A further look at the no-physical-therapy subgroups defined by total LBP-related cost quartiles indicates that there is great variation among patients not receiving physical therapy (Tab. 3). A quarter of the patients not receiving physical therapy (10,062 patients) had higher unadjusted annual advanced imaging, opioid medication, spinal injections, and emergency department use as well as higher pain medication, advanced imaging, and non-LBP-related costs than patients receiving physical therapy.

Separate regression analyses were conducted to focus on patients receiving physical therapy initiated at different times. Table 4 presents the adjusted health care utilization and cost measures for patients receiving physical therapy by the timing of physical therapy initiation, whereas Figure 2 presents the adjusted odd ratios and corresponding 95% CIs for receiving particular services over the 1-year period after the index visit. Compared with those receiving physical therapy between 4 and 14 days, patients receiving physical therapy within 3 days were less likely to use advanced imaging, opioid medication, and specialist visits and incurred lower costs for pain medication and advanced imaging. Reduction in health care utilization and costs becomes more evident when

comparing patients receiving physical therapy within 3 days and those receiving physical therapy between 15 and 28 days or between 29 and 90 days. Particularly, the average total LBP-related health care costs for patients receiving physical therapy within 3 days was \$2901.78, which is significantly lower than that for patients receiving physical therapy between 15 and 28 days (\$4283.33) or between 29 and 90 days (\$6366.68).

Discussion

Nearly 1 of 55 patients with LBP are referred for physical therapy by physicians and decisions about referral for physical therapy may have important implications for the health care system.⁷ In the present study, we examined the impact of receiving physical therapy

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Table 2.

Adjusted Annual Probability of Service Use and Average Costs for All 46,914 Patients With Acute LBP^a

Parameter	No Physical Therapy	Immediate Physical Therapy (Within 3 d)	Early Physical Therapy (4–14 d)	Delayed Physical Therapy (15–28 d)	Late Physical Therapy (29–90 d)
Health service use 1 y after index visit, % of patients					
Advanced imaging	13.55	19.76	31.51	46.75	56.70
Opioid medication	47.71	43.85	53.99	61.29	60.37
Spinal injection	5.99	10.11	14.37	18.86	23.84
Specialist visit	19.14	29.92	41.41	56.14	64.08
Emergency department	32.58	27.37	31.85	34.23	37.96
Spine surgery	0.86	1.67	3.67	5.89	8.38
Health care costs incurred 1 y after index visit, \$, mean (SD)					
Pain medication costs	164.75	116.62	152.99	192.32	222.32
Advanced imaging costs	562.49	538.31	611.66	574.47	602.36
LBP-related medical costs	1022.58	3218.61	3800.09	5061.60	7301.25
Total LBP-related costs	1217.13	3434.43	4026.02	5392.48	7707.98
Non-LBP-related costs	10972.00	10336.00	11833.00	13452.00	11808.00

^aCovariates in the multivariable generalized linear models included age group and sex. LBP = low back pain.

Table 3.

Unadjusted Annual Probability of Service Use and Average Costs for Patients With No Physical Therapy by Total LBP-Related Cost Quartile^a

Variable	All Patients Not Receiving Physical Therapy	Total LBP-Related Cost Quartile			
		First	Second	Third	Fourth
No. (%) of patients	40,246	10,061 (25.00)	10,062 (25.00)	10,061 (25.00)	10,062 (25.00)
Health service use 1 y after index visit, % of patients					
Advanced imaging	11.53	0.01	0.04	1.84	44.24
Opioid medication	36.19	19.27	30.36	39.27	55.85
Spinal injections	3.58	0.09	0.14	0.77	13.31
Specialist visit	12.80	0.23	2.67	10.70	37.58
Emergency department	22.17	18.77	18.96	21.25	29.69
Spine surgery	0.79	0.00	0.00	0.00	3.14
Health care costs incurred 1 year after index visit, \$, mean (SD)					
Pain medication costs	140.27 (1091.11)	5.41 (8.45)	15.96 (23.22)	54.16 (82.69)	485.53 (2143.47)
Advanced Imaging costs	82.83 (318.98)	0.01 (0.96)	0.04 (2.01)	4.92 (40.25)	326.34 (571.23)
LBP-related medical costs	771.90 (5837.61)	69.91 (15.04)	123.32 (30.53)	243.83 (102.45)	2650.43 (11,470.88)
Total LBP-related costs	912.16 (5960.77)	75.30 (15.54)	139.27 (24.15)	297.98 (86.34)	3135.95 (11,640.35)
Non-LBP-related costs	7919.15 (28,070.73)	5171.63 (12,806.31)	6144.10 (15,262.38)	7503.90 (16,166.07)	12,856.64 (49,582.74)

^aCost estimates have been adjusted for inflation. All *P* values were <.0001. LBP = low back pain.

and the timing of physical therapy initiation on health care utilization and costs among patients with acute LBP. We found that compared with those receiving physical therapy, patients who did not receive physical therapy had lower health care utilization and cost

measures, with some exceptions. There was great variation in health care utilization and costs among patients who did not receive physical therapy with a quarter of them had higher health care utilization and cost measures than those receiving physical therapy.

Among those receiving physical therapy, patients receiving physical therapy within 3 days were consistently associated with the lowest health care utilization and cost measures compared with those receiving physical therapy later. This suggests that immediate referral

Table 4.

Adjusted Annual Probability of Service Use and Average Costs for 6668 Patients With Acute LBP by Timing of Physical Therapy Initiation^a

Variable	Immediate (Within 3 d)	Early (4–14 d)	Difference (Early Cohort – Immediate Cohort)	Delayed (15–28 d)	Difference (Delayed Cohort – Immediate Cohort)	Late (29–90 d)	Difference (Late Cohort – Immediate Cohort)
Health service use over 1-y follow-up period, % of patients							
Advanced imaging	19.5	30.2	10.6 ^b	45.3	25.8 ^b	55.9	36.4 ^b
Opioid medication	43.4	52.2	8.7 ^c	59.5	16.1 ^b	60.6	17.1 ^b
Spinal injection	8.8	12.9	4.1	16.4	7.6 ^c	24.6	15.8 ^b
Specialist visits	30.5	38.4	7.9 ^c	52.3	21.8 ^b	59.5	29.0 ^b
Emergency department	27.7	32.1	4.5	34.3	6.6	36.3	8.7 ^d
Spine surgery	1.8	3.7	1.9	5.9	4.2 ^c	8.7	6.9 ^b
Health care costs incurred over 1-y follow-up period, \$, mean (SD)							
Pain medication costs	115.70	143.80	28.10 ^c	186.00	70.30 ^b	223.60	107.90 ^b
Advanced imaging costs	550.20	618.90	68.70 ^d	601.20	51.00	634.20	84.00 ^c
LBP-related medical costs	2746.80	2973.30	226.50	4068.30	1321.50 ^b	6067.00	3320.20 ^b
Total LBP-related costs	2901.80	3135.70	233.90	4283.30	1615.50 ^b	6366.70	3464.90 ^b
Non-LBP-related costs	10,066.00	10,566.00	500.00	12,709.00	2643.00 ^b	10,891.00	825.00

^aCovariates in the multivariable generalized linear models included age group and sex. LBP = low back pain.

^b*P* < .001.

^c*P* < .01.

^d*P* < .05.

for physical therapy and initiation may lead to lower health care utilization and LBP-related costs among patients who are going to be referred for physical therapy.

The present study contributes to the literature in 2 ways. First, we found that 14.2% of patients with acute LBP utilized physical therapy services within 90 days of the index date. This percentage is similar to those reported by Gellhorn et al (8.9%),²¹ Fritz et al (7.0%),²² Childs et al (16.3%),²³ and Fritz et al (20.0%).³⁷ While previous studies tend to exclude patients not receiving physical therapy,^{21–23} the present study examined patients who did not receive physical therapy and compared them with those receiving physical therapy at different times. Our findings show that patients who did not receive physical therapy had lower health care utilization and cost measures than those receiving physical therapy with some exceptions. This is the case even after controlling for

patient characteristics and adjusting for treatment selection bias using Inverse Probability of Treatment Weights. However, we should not jump to the conclusion that receiving no physical therapy is more desirable than receiving physical therapy because patients not receiving physical therapy represent a vast and heterogeneous group. A further examination indicates that a quarter of those who did not receive physical therapy had higher health care utilization and cost measures than those receiving physical therapy. Future research is warranted to investigate the causes of variation in physical therapy utilization among patients with acute LBP and identify subgroups that may potentially benefit from physical therapy.

Second, to our knowledge, the present study is the first population-based study to demonstrate the benefits of immediate physical therapy initiation (within 3 days) for patients with acute LBP. Although Zigenfus et al²⁷ studied 3867

workers with acute low back injuries, the study sample included only lumbar sprain cases treated by 1 occupational health care provider. Two clinical trials also studied the relationship between immediate physical therapy initiation and health care utilization. Nordeman et al³⁸ studied patients with LBP that lasted 3–12 weeks and did not find a meaningful difference in the number of physician visits between those receiving physical therapy within 2 days and those receiving physical therapy after 4 weeks. Fritz et al³⁹ compared patients with acute LBP who were randomized to receive physical therapy within 3 days with those receiving usual care (no physical therapy) and found no statistically significant differences between groups for health care utilization outcomes after 4 weeks, 3 months, and 1 year. Both clinical trials were based on relatively small samples (220 patients and 60 patients, respectively) and patient self-reported data.^{38,39} Fritz et al³⁹ reported that approximately 3%

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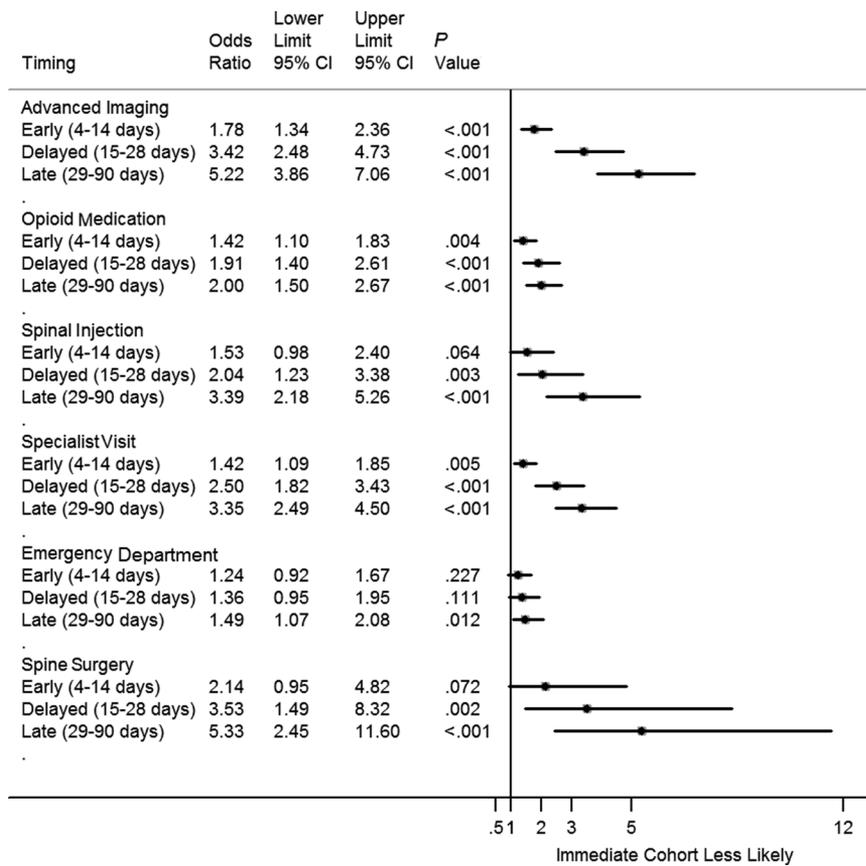


Figure 2.

Likelihood of service use over the 1-y follow-up period by timing of physical therapy initiation, with the cohort receiving immediate physical therapy (within 3 d) as the reference group. Covariates in the multivariable generalized linear models included age group and sex. The *P* values were adjusted for multiplicity.

of patients used advanced imaging and spinal injection and 1% had spine surgery, which are much lower than the numbers reported in previous studies and the present study.^{21-23,39} These data indicate that population-based studies are more advantageous for studying health care utilization and cost measures.

The findings of the present study are consistent with those of previous studies.^{21-23,40} We found that the adjusted average 1-year total LBP-related health care costs for patients receiving physical therapy within 3 days, between 4 and 14 days, between 15 and 28 days, or between 29 and 90 days after the onset of acute LBP were \$2901.78, \$3135.69, \$4283.33, and \$6366.68, respectively (in 2014 dollars). In comparison, Fritz

et al²² reported that the adjusted average total LBP-related health care costs over the 18-month follow-up period were \$3148.49 for patients receiving physical therapy within 14 days and \$5884.71 for those receiving physical therapy between 15 and 90 days (in 2004 dollars). Additionally, Gellhorn et al²¹ reported a dose-response relationship between the timing of physical therapy initiation and probability of service use. In the present study, we observed a similar dose-response relationship between both utilization and cost measures and timing of physical therapy. That is, with a few exceptions, immediate physical therapy initiation (within 3 days after the onset of LBP) was associated with the lowest probability of service use and related costs over a 1-year follow-up, followed by early physical therapy initiation

(between 4 and 14 days) and delayed physical therapy initiation (between 15 days and 28 days). Late physical therapy initiation (between 29 and 90 days) was associated with highest probability of service use and related costs.

Our findings suggest that reduction in LBP-related health care costs could be substantive if immediate or early physical therapy initiation are achieved among patients who are going to be referred for physical therapy. A recent report by the Centers for Disease Control and Prevention estimated that 68.6 million adults (18 years old and older) in the United States had LBP in 2014.³ On the basis of the data from the current study, approximately 72% of patients reporting LBP have acute onset and 14% of those with acute LBP will be referred for physical therapy. Multiplying the net cost difference between immediate physical therapy initiation and later initiation cohorts by the numbers of potentially affected patients, we estimate that a cost savings of \$7.2 billion per year nationwide would be achieved if all patients with acute LBP receive physical therapy within 3 days. In more conservative scenarios, a cost saving of \$5.8 billion and \$3.0 billion per year would be achieved if all patients with acute LBP receive physical therapy within 14 days and within 28 days, respectively. For New York State, the potential cost savings associated with shifting to earlier physical therapy initiation range from \$183.7 million to \$449.3 million, depending on how early physical therapy can be initiated after the onset of LBP. Results of this quick calculation should be viewed with caution because it assumes widespread policy changes and adoption of more timely access to physical therapy. It also assumes that the effects of the timing of physical therapy initiation calculated based on the commercially insured nonelderly adults in New York can be generalized to the general adult population. Future work should examine the effects in other geographic regions and among patients with a variety of health coverages.

A recent study found that guideline discordant care such as advanced imaging

and opioids has been on the rise in the management of LBP.⁷ Opioid medication use per physician visit increased from 19.3% in 1999 to 2000 to 29.1% in 2009 to 2010 and the use of computed tomography or magnetic resonance imaging per visit increased from 7.2% to 11.3% during the same period. In the present study, patients receiving physical therapy within 3 days had significantly lower probability of using opioids and incurred significantly lower pain medication and advanced imaging costs, comparing with those who did not receive physical therapy as well as those receiving physical therapy at later times. Specifically, after controlling for confounding variables and selection bias, the percent of patients using opioids in the no-physical-therapy, immediate (within 3 days), early (between 4 and 14 days), delayed (between 15 and 28 days), and late (between 29 and 90 days) cohorts were 47.71%, 43.85%, 53.99%, 61.29%, and 60.37%, respectively. Our analysis suggested that immediate physical therapy initiation might reduce the use of these guideline-discordant treatment options.

The results of the present study indicated that more patients receiving physical therapy were referred by primary care physicians (with family practice and internal medicine as the specialty), followed by physical medicine and rehabilitation physicians, orthopedic surgeons, and physicians with other specialties. However, more patients receiving physical therapy within 3 days were seen by physical medicine and rehabilitation physicians, followed by family practitioners, physicians with other specialties, internists, and orthopedic surgeons. This suggests that physician specialty greatly influence referral for physical therapy and initiation. This is not surprising because it is well documented in the literature that management of LBP is highly variable with treatment strategies often determined by preferences of the clinical care practitioner.^{41–44} More research should be conducted among patients with LBP to document and reduce the variation in practice patterns among physicians with different specialties.

The present study had several limitations. First, although the claims database used in the present study included approximately 10% of residents in New York under the age of 65 years, it was not a random sample of the population in general or those with commercial health insurance. The impact of receiving physical therapy and the timing of physical therapy initiation on health care utilization and costs may be different at the national level due to geographic variation in care seeking behavior, practice patterns, and payment levels.^{45–47} In particular, future studies should investigate the timing of physical therapy initiation among patients with acute LBP in the workers' compensation system and its impact on downstream health care utilization and costs. Second, the analyses were limited to the accuracy of submitted claims. Coding in the large administrative databases may be incomplete, inaccurate, or biased.⁴⁸ Third, benefit design (eg, patient cost sharing), fee schedule, and billing guidelines vary greatly across different payers and plans, which may affect health care utilization and costs. For example, health insurance copayment/deductible may greatly influence patients' decision to use physical therapy and the timing of physical therapy initiation after the onset of LBP. Future research should examine the impact of patient cost sharing on physical therapy utilization and timing and related health care costs. Finally, patient functional outcomes such as the Oswestry Disability Index, pain severity, disability, fear avoidance, and quality of life were not included in the data source and were not controlled for in the current analysis. A prospective cohort study examining older adults (65 years old and older) with acute LBP found that patients receiving physical therapy within 28 days were more likely to experience improvement in function at 12 months but had no or minimal differences in pain, function, or health-related quality at 3, 6, or 12 months compared with a matched group that did not receive early physical therapy.⁴⁹ Therefore, immediate or early physical therapy initiation is favorable overall considering that it results in reduction in health care utilization and

costs without compromising patient outcomes.⁵⁰

As the United States health care system transforms into a system that rewards quality and value as opposed to volume, value-based payment policies are proliferating in both public and private sectors. The results of previous research and the present study lend support to delivery system innovations that feature immediate (within 3 days) or early (within 14 days) physical therapy initiation after the onset of acute LBP. Organizations seeking to implement immediate or early physical therapy need to have sufficient resources (including but not limited to money, space, and manpower), a sufficiently long-term view, insulation from operational demands, and senior leadership support.⁵¹ The fact that an integrated delivery system (Virginia Mason Medical Center) adopted a same-day physical therapy program suggests that immediate or early physical therapy initiation is feasible in practice.

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Ethics Approval

This study was approved by the University of Central Florida Institutional Review Board.

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Disclosures

The authors completed the ICJME Form for Disclosure of Potential Conflicts of Interest and reported no conflicts of interest.

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Appendix.

Low Back Pain–Related ICD-9-CM Codes^a

Diagnostic Category	ICD-9-CM Code	Description
Miscellaneous	719.55	Stiffness of joint not elsewhere classified involving pelvic region and thigh
Degenerative disk disease	721.3	Lumbosacral spondylosis without myelopathy
Degenerative disk disease	722.10	Displacement of lumbar disk without myelopathy
Degenerative disk disease	722.52	Degeneration of lumbar or lumbosacral disk
Degenerative disk disease	722.73	Intervertebral disk disorder with myelopathy (lumbar region)
Degenerative disk disease	722.93	Other and unspecified lumbar disk disorder
Spinal stenosis	724.02	Lumbar stenosis, without neurogenic claudication
Spinal stenosis	724.03	Lumbar stenosis, with neurogenic claudication
Nonspecific backache	724.2	Lumbago
Sciatica/radiculitis	724.3	Sciatica
Nonspecific backache	724.5	Backache, unspecified
Possible instability	724.6	Disorders of sacrum (including lumbosacral joint instability)
Miscellaneous	724.7	Unspecified disorder of coccyx
Possible instability	756.11	Spondylolysis, lumbosacral region
Possible instability	756.12	Spondylolisthesis
Sprains and strains	846.0	Lumbosacral (joint) (ligament) sprain
Sprains and strains	846.1	Sacroiliac (ligament) sprain
Sprains and strains	846.2	Sacrospinatus (ligament) sprain
Sprains and strains	846.3	Sacrobuterosus (ligament) sprain
Sprains and strains	846.8	Other specified sites of sacroiliac region sprain
Sprains and strains	846.9	Unspecified site of sacroiliac region sprain
Sprains and strains	847.2	Sprains and strains, lumbar
Sprains and strains	847.3	Sprains and strains, sacral

^aThe International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), codes were adapted from previous studies.^{22,30}