

Length of Disability and Medical Costs in Low Back Pain

Do State Workers' Compensation Policies Make a Difference?

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Objective: The aim of the study was to examine the impact of state workers' compensation (WC) policies regarding wage replacement and medical benefits on medical costs and length of disability (LOD) in workers with low back pain (LBP). **Methods:** Retrospective cohort analysis of LBP claims from 49 states ($n = 59,360$) filed between 2002 and 2008, extracted from a large WC administrative database. **Results:** Longer retroactive periods and state WC laws allowing treating provider choice were associated with higher medical costs and longer LOD. Limiting the option to change providers and having a fee schedule were associated with longer LOD, except that allowing a one-time treating provider change was associated with lower medical costs and shorter LOD. **Conclusions:** WC policies about wage replacement and medical treatment appear to be associated with WC LBP outcomes, and might represent opportunities to improve LOD and reduce medical costs in occupational LBP.

Low back pain (LBP) remains an important public health problem, as it is the leading cause of years lived with disability in developed countries.¹ Occupational LBP represents a substantial economic and social burden. In the United States, the direct costs associated with work-related overexertion events (dominated by LBP) in 2011 were estimated to be \$14.2 billion.² In fact, LBP accounts for one third of all occupational musculoskeletal injuries and illnesses resulting in work disability.³ Although two thirds of LBP cases return to work (RTW) within 1 month, about 17% and 7% of cases experience work disability for 1 to 6 months and more than 6 months, respectively.⁴ In addition, increased length of disability (LOD) due to LBP is linked to increased likelihood of permanent disability.⁵

Over 90% of the private workforce in the United States is covered by workers' compensation (WC) insurance. Private employers are legally required to purchase coverage for their employees for

work-related injuries and illnesses. Claims are filed by an injured employee or their employer with a WC insurer. This insurance provides indemnity benefits that compensate a percentage of lost wages during injury-related work absence, and medical benefits that cover all related medical treatment and rehabilitation costs. There is also provision for vocational rehabilitation and other services. WC benefit policies are state-regulated and vary across states with respect to wage replacement percentage, duration of waiting period (number of days before an injured worker is eligible for indemnity benefits) and retroactive period (number of days before the injured worker is eligible for indemnity benefits covering the waiting period), employee's or employer's ability to choose initial treating provider or change treating provider, and medical fee schedules that set the maximum reimbursement amount for medical services from a provider. These policies are infrequently changed by new state regulations and require state legislative action or regulatory authority.⁶⁻⁸

Previous studies have shown that RTW outcomes, including LOD, in patients with LBP are influenced by diverse factors, such as patient characteristics, job and employer characteristics, and health-care-related factors.^{9,10} There is some evidence that RTW outcomes are also influenced by area-level factors, such as work disability compensation policies. Differences in these policies might influence LOD and amount of medical expenses through economic incentives (for workers, health care providers, employers, or insurers), and thus affect health care quality and patient satisfaction.^{11,12} One international study found that differences in sustainable RTW among patients with chronic occupational back pain from six developed countries were partially and independently explained by compensation policy factors, such as entitlement to long term (at least 3 months) disability benefits and level of work incapacity required to receive long-term disability benefits.¹³ In the United States, studies of WC policies have mainly examined effects of a specific policy variable(s) on medical costs and/or disability duration, such as WC policies governing initial treating provider choice,¹⁴⁻¹⁶ changes in treating provider,¹⁷ or medical fee schedules that affect the maximum reimbursement levels set by state.^{18,19} For example, one study examined state WC policies governing initial treating provider choice in 33 states and found that medical costs were 5% to 8% higher among workers from states that allow the employee to select the initial treating provider than workers from states allowing employers to select the initial treating provider.¹⁴ One study examined the combined effects of medical benefits and wage replacement policies on medical costs. In a sample of WC cases from 17 states, medical costs were higher in states with medical fee schedules, longer retroactive periods, and restriction of initial provider choice by the employee.²⁰ The primary limitation of these studies is the lack of controlling for important interstate differences in individual-level factors that are significant predictors of higher medical costs and longer disability duration in LBP. These include claim litigation status (whether the insurer assigned an attorney to the claim), and factors that affect medical care—such as early opioid prescribing (within the first 15 days of seeking medical treatment) or early magnetic resonance imaging (MRI) scanning (within the first 30 days of seeking medical treatment).²¹⁻²⁴ In addition, prior studies have used ordinary least squares linear

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regression analysis, and thus ignore the hierarchical structure of data (individuals nested within states), which might have led to biased standard error estimates.²⁵

The aim of this study was to examine associations between medical costs and LOD, and state WC policies about wage replacement and medical benefits, in workers with LBP, while controlling for potential state differences in individual-level factors using multi-variable multilevel regression analysis. This study design and a large national sample provided the opportunity to control for important sources of variation in outcomes at the state level and at the individual level (eg, individual characteristics and medical care risk factors), and thus focus on the separate impact of state policies.

METHODS

Study Design and Population

The study used a large WC administrative database of a single private insurer that represents about 10% of the US private WC market.²⁶ The database has complete capture of individual medical and indemnity services provided to injured workers, and is comparable in terms of distribution of occupational injuries/disorders and overall medical costs to other occupational injury data sets, such as the Bureau of Labor Statistics and the National Council on Compensation Insurance.²⁷ The study was approved by the New England Institutional Review Board.

All workers aged 18 to 65 years at the reported date of injury, residing in 49 jurisdiction states including the District of Columbia, were included (cases from North Dakota and Wyoming were excluded due to an insufficient number of cases) in the initial sample. To identify cases treated primarily for uncomplicated LBP, diagnoses associated with bills for medical services received in the first 15 days of seeking medical treatment were evaluated. Prior studies found that the vast majority of diagnoses relevant to the initial injury are identified in the first 15 days, and are represented on these bills.²⁸ Each medical service bill can contain up to five physician-assigned diagnostic codes from the International Classification of Diseases, Ninth Edition (ICD-9), which are meant to fully describe the injury that occurred and any additional comorbidity. First, we selected all cases who had any of the diagnostic codes referring to a specific LBP musculoskeletal diagnosis, or nonspecific back pain (Appendix 1, <http://links.lww.com/JOM/A239>).²⁹ Next, we developed a process to ensure that LBP was the main diagnosis and focus for treatment in each case, not some other disorder or musculoskeletal problem. The total number of unique ICD-9 codes referring to diseases of the nervous system and sense organs (320–389), musculoskeletal system and connective tissue (710–739), and injury or poisoning (800–999) was quantified for each case. These codes were selected because they define general musculoskeletal issues and/or pain, and medical conditions that can cause LBP. The ratio of musculoskeletal back pain codes (listed in Appendix 1, <http://links.lww.com/JOM/A239>) compared with other general musculoskeletal and relevant medical issues and/or pain codes was calculated for each case to reflect the diagnostic intensity or primacy of back-related diagnoses. This ratio was obtained by dividing the number of unique ICD-9 codes referring to back pain (Appendix 1, <http://links.lww.com/JOM/A239>), by the number of unique ICD-9 codes referring to other diagnoses potentially relevant to a back condition (see equation below).

LBP diagnostic intensity score

$$= \frac{\text{of unique ICD-9 codes from the list in appendix 1}}{\text{of unique ICD-9 codes(list Y)}}$$

Y: ICD-9 codes chapters referring to diseases of the nervous system and sense organs (320–389), musculoskeletal system and connective tissue (710–739), and injury or poisoning (800–999).

For example, the LBP diagnostic intensity score for a case with a total of six ICD-9 codes in the first 15 days of seeking medical treatment, where four codes refer to back pain and two codes refer to other musculoskeletal system and connective tissue, will be 67% ($[4/6] \times 100$). Only cases with a ratio of at least two thirds (66%) of unique codes for back pain were included ($n = 59,360$). The majority of cases (89%) had 100% of their unique ICD-9 diagnoses codes representing back pain.

Measures

Outcome Variables

The outcome variables were total medical costs (summarized from paid medical bills) and LOD (calculated from paid indemnity services). LOD was obtained using continuous, consecutive payments for lost wage replacement (temporary total or temporary partial disability days) wherein each payment compensates a claimant for his/her lost-time at work due to disability. The final payment, or a time period of at least 14 days between continuous payments, was considered to represent the end of the disability period; gaps of at least 14 days between continuous disability payments typically represent disability recurrence, which was not the desired outcome.³⁰ Thus, LOD, measured in days, was calculated as the total number of days represented by continuous disability payments, and censored at 1 year after the date of injury, where applicable. We censored the data at 1 year from LBP onset as most cases return to work within a year, and we wanted to avoid the impact of highly variable state WC policies that dictate the closure of long-term claims with lump sum settlements, which could affect LOD after 1 year, but are unlikely to have an effect during the initial 1-year period.

Independent Variables

Individual-Level Variables

Individual-level variables previously associated with LOD were included: age, sex,⁹ employee average weekly wage,²⁴ job tenure,³¹ industry, and LBP severity.³¹ LBP injury severity was classified as “less severe” or “more severe” based on a grouping of the ICD-9 codes recorded during the first 15 days of seeking medical treatment²⁹ (Appendix 1, <http://links.lww.com/JOM/A239>). Cases with at least one ICD-9 code referring to a more severe diagnosis were classified as “more severe”. Industry type of the employer was classified into 10 division structures based on standard industry classification codes.³²

Early opioid prescribing and early MRI scanning for LBP have also been associated with prolonged disability duration.^{21–23} Prescriptions for opioids were identified from medical bills in the first 15 days of seeking medical treatment, and converted to total morphine equivalent amount.²¹ Early MRI scanning (within the first 30 days of seeking medical treatment) and any lumbar surgery (within the entire 1-year follow-up period) were similarly identified using Clinical Procedural Terminology codes.³³ WC claim litigation (whether the insurer assigned an attorney to the claim) has been reported as a significant predictor of disability duration and was included as a binary variable (yes, no).²⁴

State-Level WC Variables

State WC policies on wage replacement and medical benefits (2002 to 2008) were obtained from the US Chamber of Commerce Annual Analysis of Workers’ Compensation Laws⁶ and Inventory of Workers’ Compensation Laws reports published by the Workers Compensation Research Institute.^{7,8} Indicators were created for the following: (1) whether the state allowed the employee or the employer to select the initial treating provider; (2) whether change of treating provider was limited, allowed once, or not-limited; and (3) whether a state medical fee schedule set the maximum

reimbursement amount for specific medical services. State-level WC policy variables by jurisdiction state between 2002 and 2008 are presented in Appendix 2 (<http://links.lww.com/JOM/A240>). The wage replacement rate of each state can vary between 60% and 80% of the claimant's pre-injury salary.

The waiting period, which is the number of days before disabled workers start receiving indemnity benefits for lost work time, ranges between 3 and 7 days. The retroactive period, which is the number of days of disability before the disabled worker receives indemnity benefits that retroactively cover the waiting period, ranges between 0 and 42 days.

Cases were grouped by state of residence based on their home address. The majority of cases (94%) were residing and working in the same state; however, about 6% of cases were residing and working in two different states. As medical care and follow-up for the vast majority of these workers were delivered by healthcare providers in the workers' residential states, we controlled for this aspect with an additional binary individual-level variable indicating whether or not the worker was residing and working in the same state.

Statistical Analysis

Descriptive statistics were calculated for LBP case characteristics and related state WC policy variables. Because of the hierarchical structure of the data (LBP cases [level-1] nested within jurisdiction states [level-2]), multivariable multilevel regression was conducted using the PROC MIXED procedure in SAS 9.2 (SAS Institute, Cary, NC). This analysis was performed in three modeling steps for each outcome. Each model has two variance components, one representing between-group variance (differences between state means and the grand mean of the outcome variable) and the other representing within-group variance (differences between individual scores within states and the grand mean of the outcome variable). First, an "empty model" with no predictors (model 1) was conducted and the two variance components were used to estimate the Intra-class Correlation coefficient (ICC) that quantifies the percentage of total variance in medical costs/LOD explained by observed and unobserved state-level factors ($ICC = \text{between-state variance} / [\text{between-state variance} + \text{within-state variance}]$). In model 2, state-level WC policy variables were added and each outcome variable was modeled as a linear function of state-level WC policy variables, each weighted by a regression coefficient that quantifies variation in the outcome variable as a function of variation in the independent variable. To determine the proportional reduction in variance after including state-level WC policy variables, $(1 - [\text{between-state variance in model 2} / \text{between-state variance model 1}])$ was computed.²⁵ The resulting percentage is interpreted as the amount variance in the outcome variable attributed to WC policy variables. Model 3 included state-level WC policy variables and individual-level variables (as fixed effects only). Similarly, the proportional reduction in variance in model 3 was then computed to determine the amount of variance explained by state WC policy variables while controlling for interstate differences in individual-level variables. All continuous individual-level and state-level variables were centered at the grand mean by subtracting the sample grand mean for each continuous variable.

The distributions of the outcome variables were positively skewed, and thus were transformed using the natural log. To facilitate interpretation of findings, the Ln transformed conditional regression coefficients (with 95% confidence intervals [CI]) in model 3 were exponentiated to obtain the percentage difference (higher or lower) in the geometric mean of medical costs for each variable. These percentages represent a measure of association between each variable and the change (increase or decrease) in the geometric mean of medical costs. For example, a regression coefficient of 1.01 for age is interpreted as an increase in age by 1

year (for a worker with an average age in the sample) is associated with a 1% increase in the geometric mean of medical costs. Then the percentages of included variables were sequentially multiplied by the conditional intercept in model 3 (which represents the geometric mean of the outcome variable when the continuous predictors are at their grand means and the categorical predictors have the value of the reference category) to compute the amount and direction of change in medical costs in dollars associated with each variable.

RESULTS

The cohort included 59,360 LBP cases from 49 states (see Appendix 3, <http://links.lww.com/JOM/A241>, for proportionate distribution by state). The demographic, health, and state-level WC policy characteristics for the cohort are shown in Table 1. About two thirds of cases were men (69.1%), with an average age and tenure of 39.4 and 5.8 years, respectively. The average waiting and retroactive periods were 5.3 days (range 3 to 7) and 15.7 days (range 0 to 42), respectively. About 62.1% of cases worked in jurisdiction states that limit initial treating provider choice and treating provider change, and 82.3% were from states employing medical fee schedules. The mean medical cost per case was \$8296, with a median of \$3786. The mean LOD per case was 98 days, with a median of 42 days. There was large (unadjusted) variability between states in the median medical costs per case; Texas had the highest median medical costs (\$8044), while Rhode Island had the lowest median medical costs (\$1554). Similarly, there was significant between state variability in LOD; the highest median LOD was in Louisiana (104 days), and the shortest median LOD was in Hawaii (22 days).

Principal Findings

Parameter estimates from the three multilevel regression models examining the associations of medical costs and LOD with individual-level and state-level WC policy variables are presented in Table 2. The empty models (without predictors) for both outcomes (models 1) showed significant variability between states in mean medical costs and LOD ($P < 0.001$). Using the estimated between-state and within-state variance components in model 1, the ICC indicated that 5% of the total variance in both medical costs (0.087/[0.087 + 1.840]) and LOD (0.072/[0.072 + 1.393]) can be explained by state-level factors. In the final models (models 3 shown in Table 2), the measured state-level WC policy variables explained 43% of the original between-state variance in medical costs after accounting for interstate differences in individual-level variables (1-[0.049/0.087]). Similarly, state-level WC policy variables explained 50% of the original between-state variance in LOD after accounting for individual-level variables (1-[0.036/0.072]).

Associations Between State-Level WC Policy Variables and Medical Costs and LOD

As expected, there were significant associations between all individual-level variables and both medical costs and LOD (Tables 2 and 3). After controlling for these individual-level variables, the between-state variability in mean medical costs per case remained significant, with the mean ranging from \$1211 in New York to \$4514 in Texas (Figure 1). Similarly, there was significant between state variability in mean LOD, ranging from 19 days in Missouri to 69 days in Texas, after adjusting for individual-level differences (Figure 2).

As shown in Table 3, after adjusting for interstate differences in individual-level variables, there were significant associations between some state-level WC policy variables and geometric means of medical costs and LOD. Increase in state wage replacement rate by 1% was associated with a \$16 increase in the geometric mean of medical costs per case (95% CI \$6, \$26). LBP cases working in states allowing employers to choose the initial treating provider had \$308

TABLE 1. Cohort Characteristics According to Individual and State-Level Workers' Compensation Policy Variables

Variable	Number	Percentage	Mean	SD
Sex				
Women	18,352	30.9		
Men	41,008	69.1		
Age (yrs)			39.4	10.8
Tenure (yrs)			5.8	7.7
Average weekly wage (\$)			403.0	187.5
Injury severity				
Less severe	47,805	80.5		
More severe	11,555	19.5		
Early opioid prescribing				
No	43,013	72.5		
Yes	16,347	27.5	3.9	3.8
Early lumbar MRI scan				
No	41,805	70.4		
Yes	17,555	29.6		
Lumbar spine surgery				
No	53,869	90.7		
Yes	5,491	9.3		
Industry type				
Mining	1,071	1.8		
Construction	2,087	3.5		
Transportation, communications, electric, gas, and sanitary services	16,305	27.5		
Agriculture, forestry, and fishing	588	1.0		
Manufacturing	10,887	18.3		
Wholesale trade	4,515	7.6		
Retail trade	6,626	11.2		
Services	14,782	24.9		
Public administration	1,990	3.4		
Finance, insurance, and real estate	509	0.9		
Litigation status				
Yes	19,182	32.3		
No	40,178	67.7		
Live-work in same state				
Yes	55,641	93.7		
No	3,719	6.3		
Wage replacement rate (%)			0.68	0.03
Waiting period (days)			5.3	1.9
Retroactive period (days)			15.7	7.0
State medical fee schedule				
No	10,498	17.7		
Yes	48,862	82.3		
Initial treating provider choice				
Allowed	22,516	37.9		
Not allowed	36,844	62.1		
Treating provider change				
Allowed	8,282	14.0		
Allowed once	14,241	24.0		
Not Allowed	36,837	62.1		

MRI, magnetic resonance imaging; SD, standard deviation.

(95% CI \$223, \$388) lower mean medical costs compared with cases from states allowing employees to make the choice of initial treating provider. Cases in states that limit treating provider change had \$271 (95% CI \$167, \$370) higher medical costs than cases in states that allowed one-time provider change; however, no significant difference in mean medical costs was found between cases working in states that limit initial treating provider change and those that do not limit provider change. Also, we found no significant associations between length of state waiting period or the presence of a medical fee schedule, and mean medical costs per case.

We found significant associations between all state WC policy variables, except state wage replacement rate, and differences in the geometric mean of LOD per case. An increase in the waiting

period by 1 day was associated with a 1.9 day (95% CI 1.5, 2.3) increase in mean LOD. Also, an increase in the retroactive period by 1 day was associated with a 0.2 day (95% CI 0.1, 0.2) increase in mean of LOD. LBP cases working in states with limited initial treating provider choice had 6.1 days (95% CI 5.0, 7.2) lower mean LOD compared with cases from states that do not limit initial treating provider choice. Similarly, LBP cases working in states with limited treating provider change had 3.2 days (95% CI 1.4, 5.1) lower mean LOD than cases from states that did not limit ability to change provider; however, cases in states that limit treating provider change had 2.5 days (95% CI 0.9, 4.0) higher LOD than cases in states that allowed one-time provider change. In states with medical fee schedules, mean LOD was higher by 2.5 days (95% CI 1.4, 3.6).

TABLE 2. Parameter Estimates From the Three Multilevel Regression Models Examining the Associations of Medical Costs and LOD With Individual-Level and State-Level WC Policy Variables

Parameter	Medical Costs			Length of Disability		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	8.162***	8.215***	7.465***	3.835***	3.848***	3.253***
Sex						
Women			0.107***			0.077***
Men ^a						
Age (yrs)			0.007***			0.005***
Tenure (yrs)			-0.002**			-0.004***
AWW/\$100			0.035***			0.015***
Industry type						
Mining			0.242***			0.454***
Construction			0.185***			0.194***
Transportation			0.264***			0.258***
Agriculture			0.176**			0.091
Manufacturing			0.171***			0.127**
Wholesale trade			0.131**			0.083
Retail trade			0.153**			0.126**
Services			0.119*			0.101*
Public administration			0.168**			0.078
Finance ^a						
Injury severity						
More severe			0.142***			0.085***
Less severe ^a						
Early opioid/100 mg MEA			0.031***			0.013***
Early MRI scan						
Yes			0.709***			0.426***
No ^a						
Lumbar spine surgery						
Yes			1.330***			0.719***
No ^a						
Litigation status						
Yes			1.232***			1.145***
No ^a						
Live-work in same state						
Yes			0.027			-0.129***
No ^a						
Wage replacement rate		0.008	0.009**		0.002	0.004
Waiting period		-0.001	0.014		0.054***	0.070***
Retroactive period		0.011***	0.012***		0.006**	0.006***
Treating provider change						
Allowed		0.103***	-0.001		0.226***	0.117***
Allowed once		-0.063	-0.169***		0.018	-0.102**
Not allowed ^a						
Treating provider choice						
Allowed		0.093*	0.194***		0.163***	0.271***
Not-allowed ^a						
State medical fee schedules						
Yes		0.005	0.030		0.056*	0.092***
No ^a						
Variance components						
Within-state variance	1.840***	1.839***	1.001***	1.393***	1.390***	0.915***
Between-state variance	0.087***	0.078***	0.049***	0.072***	0.058***	0.036***
Proportional reduction in between-state variance ^b		10%	43%		19%	50%
Model fit statistic						
-2LL	204,745	204,729***	168,768***	188,306	188,206***	163,487***
BIC	204,749	204,733***	168,772***	188,310	188,210***	163,491***

-2LL, -2 log likelihood ratio; BIC, Bayesian Information Criterion; MRI, magnetic resonance imaging.

^aReference group.

^bIntra-class correlation (percentage of total variance in medical costs or length of disability that is explained by between-state variance).

**P* < 0.05.

***P* < 0.01.

****P* < 0.001.

TABLE 3. Adjusted Associations Between Individual-Level and State-Level Workers' Compensation Policy Variables With Medical Costs and Length of Disability Estimated by Multivariable Multilevel Regression (Model No. 3)

Variable	Medical Costs (\$)					LOD (Days)				
	Parameter Estimate of Association	SE*	Difference in the Geometric Mean of Medical Costs	95% CI	P Value	Parameter Estimate of Association	SE*	Difference in the Geometric Mean of LOD	95% CI	P Value
Intercept	7.465	0.061	1747	1546, 1973	<0.001	3.253	0.059	25.9	23.0, 29.1	<0.001
Sex										
Women	0.107	0.010	178	146, 209	<0.001	0.077	0.010	1.9	1.4, 2.4	<0.001
Men [†]										
Age	0.007	<0.001	12	10, 13	<0.001	0.005	<0.001	0.1	0.1, 0.2	<0.001
Tenure	-0.002	0.001	-3	-5, -1	0.007	-0.004	0.001	-0.1	-0.1, -0.1	<0.001
AWW/\$100	0.035	0.003	62	52, 72	<0.001	0.015	0.003	0.4	0.3, 0.5	<0.001
Industry										
Mining	0.242	0.055	478	250, 731	<0.001	0.454	0.053	14.9	10.9, 19.3	<0.001
Construction	0.185	0.050	356	158, 574	<0.001	0.194	0.048	5.5	2.7, 8.7	<0.001
Transportation	0.264	0.046	528	332, 742	<0.001	0.258	0.044	7.6	4.8, 10.6	<0.001
Agriculture	0.176	0.061	335	99, 603	0.004	0.091	0.059	2.5	-0.6, 5.9	0.124
Manufacturing	0.171	0.046	326	147, 522	<0.001	0.127	0.044	3.5	1.1, 6.2	0.004
Wholesale trade	0.131	0.048	245	67, 440	0.006	0.083	0.045	2.2	-0.2, 4.9	0.067
Retail trade	0.153	0.047	289	110, 486	0.001	0.126	0.045	3.5	1.0, 6.2	0.005
Services	0.119	0.046	220	51, 406	0.010	0.101	0.044	2.7	0.4, 5.3	0.022
Public administration	0.168	0.051	319	124, 535	0.001	0.078	0.048	2.1	-0.4, 4.9	0.108
Finance [†]										
Injury severity										
More severe	0.142	0.011	267	225, 310	<0.001	0.085	0.010	2.3	1.7, 2.9	<0.001
Less severe [†]										
Early Opioid/100 mg MEA	0.031	0.002	56	50, 61	<0.001	0.013	0.002	0.4	0.3, 0.4	<0.001
Early MRI scan										
Yes	0.709	0.010	1803	1736, 1872	<0.001	0.426	0.009	13.7	13.0, 14.5	<0.001
No [†]										
Lumbar spine surgery										
Yes	1.330	0.015	4856	4665, 5057	<0.001	0.719	0.014	27.2	25.8, 28.8	<0.001
No [†]										
Litigation status										
Yes	1.232	0.010	4238	4126, 4353	<0.001	1.145	0.009	55.4	54.0, 57.0	<0.001
No [†]										
Live-work in same state										
Yes	0.027	0.018	49	-13, 113	0.125	-0.129	0.017	-3.6	-4.6, -2.6	<0.001
No [†]										
Wage replacement rate	0.009	0.003	16	6, 26	0.002	0.004	0.003	0.1	-0.1, 0.20	0.113
Waiting period	0.014	0.008	25	-2, 52	0.065	0.070	0.007	1.9	1.5, 2.3	<0.001
Retroactive period	0.012	0.002	21	16, 27	<0.001	0.006	0.002	0.2	0.1, 0.2	<0.001
Treating provider choice										
Allowed	0.194	0.029	308	223, 388	<0.001	0.271	0.029	6.1	5.0, 7.2	<0.001
Not allowed [†]										
Treating provider change										
Allowed	-0.001	0.032	-1	-110, 116	0.987	0.117	0.032	3.2	1.4, 5.1	<0.001
Allowed once	-0.169	0.035	-271	-370, -167	<0.001	-0.102	0.033	-2.5	-4.0, -0.9	0.003
Not allowed [†]										
State medical fee schedule										
Yes	0.030	0.021	52	-20, 128	0.160	0.092	0.020	2.5	1.4, 3.6	<0.001
No [†]										

AWW, average weekly wage rate; CI, confidence interval; LOD, length of disability; MEA, morphine equivalent amount; MRI, magnetic resonance imaging; SE, standard error.

[†]Standard error of parameter estimate of association.[†]Reference group.

DISCUSSION

Significant variations among states in mean medical costs and LOD were observed, after controlling for state differences in individual-level variables. State WC policy variables explained 43% and 50% of the originally observed 5% between-state variance in medical costs and LOD, respectively. Increased state wage

replacement rate, increased retroactive period, and allowing employees to select the initial treating provider were associated with significantly higher mean medical costs, but allowing a one-time provider change was associated with lower mean medical costs. State WC policy variables were also associated with significant differences in mean LOD. Longer waiting periods, longer

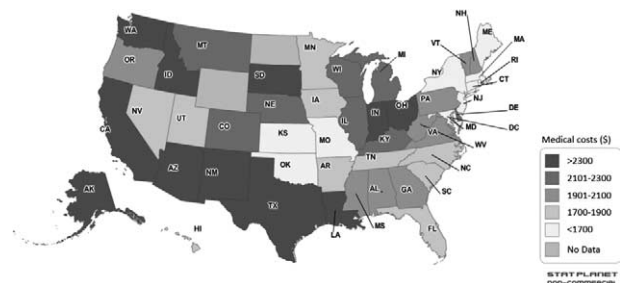


FIGURE 1. Adjusted* mean medical costs, censored at 1-year, for workers with low back pain 2002-2008 (n = 59,360). *Mean medical costs are adjusted for age, sex, tenure, average weekly wage, industry type, injury severity, early opioid prescribing, early lumbar spine magnetic resonance imaging, lumbar spine surgery, claim litigation status, and whether or not the employee works and resides in the same state.

retroactive periods, limiting treating provider change and the presence of medical fee schedules were all significantly associated with higher mean LOD, but allowing employers to select initial treating provider was associated with significantly lower mean LOD.

Despite the fact that state WC policy variables account for about half of the originally observed 5% between-state variance in medical costs and LOD, which might seem small, the predictions afforded by this multi-state study revealed the significant impact of state WC policies on medical costs and LOD, which might represent opportunities for considerable improvements in medical costs and disability outcomes. For example, based on model 3 (Table 3), a typical worker with LBP in Louisiana would have 19 more disability days than a worker with LBP in Indiana, and this difference could primarily be attributed to differences in WC policies between these two states after controlling for individual-level differences (eg, injury severity, age, etc).

We are not aware of any prior studies with information on the relationship between both medical costs and duration of disability and state WC policies regarding waiting period or retroactive period. It has been argued that a longer waiting period and retroactive period could create financial incentives for workers with WC claims to stay out of work longer to receive full benefits,¹² which might subsequently increase medical costs. Consistent with this, one study found a positive association between longer retroactive periods and medical costs²⁰; but this study did not examine the relationship between retroactive period and disability duration.

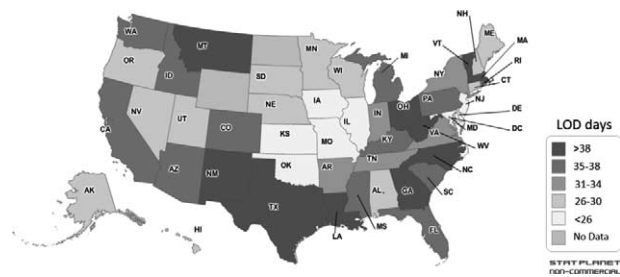


FIGURE 2. Adjusted* mean disability days, censored at 1-year, of workers with low back pain 2002-2008 (n = 59,360). *Mean disability days are adjusted for age, sex, tenure, average weekly wage, industry type, injury severity, early opioid prescribing, early lumbar spine magnetic resonance imaging, lumbar spine surgery, claim litigation status, and whether or not the employee works and resides in the same state.

Our finding of an association between limited initial treating provider choice and a decrease in mean medical costs and LOD in LBP cases agrees with the findings of previous studies.^{14,15} For example, Durbin and Appel¹⁴ found that medical costs were lower by 5% to 8% when employers were allowed to select initial treating provider. One plausible interpretation for this is that employers are incentivized to select medical provider networks that are familiar with the workplace and provide medical care that is more oriented to achieving timely and sustained RTW, thus reducing incentives for excessive or inappropriate medical care.^{35,36} Consistent with this, a few studies found that workers managed by medical provider networks, which were selected by employers, had lower medical costs and shorter disability duration than those workers who choose their treating provider.^{16,37} There is some evidence that workers managed by network providers have a higher level of dissatisfaction with medical care than workers managed by non-network providers^{37,38}; however, this does not necessarily mean that employees' dissatisfaction with overall medical care was due to poor healthcare or health outcomes. For instance, one study showed that employees had greater satisfaction with medical care when they were able to select their treating provider despite having longer disability duration and higher medical costs with no difference in physical recovery, compared with employees where treating provider selection was governed by employers.³⁷ In addition, our finding with respect to the potential positive effect of limited initial treating provider choice on medical costs agrees with the literature suggesting that managed care plans (eg, Health Maintenance Organizations) have been generally successful in controlling medical costs without compromising health care quality.³⁹

Our study showed that LOD was lower in states restricting the employee's ability to change treating provider than in states without such restriction, but this association was not statistically significant for medical costs. The scarce research evidence on the impact of limiting provider change on medical costs is mixed. One study used a sample from nine states between 1997 and 1999 and found that restricting provider change was associated with increased medical costs.²⁰ Another study, using a sample from 17 states between 1979 and 1987, reported that restricting provider change was associated with lower medical costs.¹⁷ A potential explanation for the differences in findings between these two studies^{17,20} and our study is that these studies included all cause claims from a smaller number of states and defined provider change as allowed or restricted. The majority of states that limit or allow one-time provider change also limit initial treating provider choice. So, the potential beneficial effect of medical network providers on disability duration is a potential explanation for our finding; however, our study found that LBP cases in states that allow one-time medical provider change had lower medical costs and shorter LOD compared with LBP cases from states that restrict provider change. A potential explanation for this is that some employees might feel dissatisfied with certain providers, but if they cannot change their treating physician, this might lead to mistrust and dispute of medical provider decisions, consequently affecting medical costs and disability duration.^{39,40}

A significant association between the presence of state WC fee schedules and longer LOD, but not medical costs, was identified. One possible explanation is that health care providers respond to medical fee schedules by increasing the volume or complexity of services as an income maintenance strategy.^{18,19,42} Such income maintenance strategies could negatively affect the quality of health care provided to WC cases leading to worse health and disability outcomes, as the added number of visits and prolonged episode of care could delay release of the worker to RTW. Another plausible explanation is that some states implemented medical fee schedules in response to excessive health care utilization and increasing health

care costs, but these fee schedules programs only partially achieved their anticipated outcomes.²⁰

Strengths and Limitations

A primary strength of this study is that the results are highly generalizable as the analysis used a large longitudinal sample of LBP cases, identified using standardized and precise medical diagnosis codes (ICD-9 codes), from 49 states over a period of 7 years. In addition, the data set has complete coverage of medical services provided to injured workers within the period of observation, and is comparable in terms of number of occupational injuries/disorders and overall medical costs to other occupational health data sets.²⁷ Furthermore, the associations between state WC policy variables and LOD were estimated after accounting for important individual-level predictors of work disability, including medical risk factors for prolonged LBP disability such as early opioid prescribing and MRI scanning, which differentiates this study from other similar studies. A multilevel approach provides balanced and generalizable information about the impacts of WC policies that have a significant and widespread impact on medical practice affecting medical expenses (a surrogate for intensity of medical care) and RTW outcomes.

This study also has some limitations. One limitation is that our administrative data set had no clinical information on injury severity or functional limitations; however, using ICD-9 codes to define injury severity, we found a significant relationship between “more severe” LBP and LOD. This result is consistent with the findings of a prior study that obtained more precise clinical information about injury severity using medical reports, and found that the ICD-9 severity designation correlated well with those found in medical reports in a similar data set.²⁸ In addition, there was no information on several important predictors of disability duration, such as occupation, job physical demand levels, social support at work, worker’s recovery expectations and employer/supervisor-employee relationship^{10,42}; however, these factors would not have a significant impact on the magnitude and direction of the associations between state WC policy variables and mean LOD, unless there were significant differences among states in these variables. Another limitation is that the measure of LOD was based on paid indemnity services, yet termination of indemnity benefits does not necessarily imply that workers had a sustained RTW. Under-reporting of occupational injuries in the WC system has been well documented, and it is possible that differential reporting of less-severe cases across states could account for some of the observed variation in outcomes that appear to be related to specific state policies.⁴³ State-based differences in under-reporting have not been documented, but are possible. And, under-reporting could be related to state policies, that is, under-reporting might be directly related to workers not being able to choose their health care provider if they file for WC. If the employer-chosen provider is felt to be undesirable there might be more people who seek medical treatment covered by their own health insurance so they can choose their preferred provider. If this is the case, reporting behavior in the states where the employer chooses the provider will be biased towards including more severe cases—those who file WC claims to cover long absences from work. However, as we controlled for severity, this should at least partially reduce the impact of potential under-reporting of less-severe cases. Our findings on the associations between state WC policies regarding treating provider choice/change and medical costs and LOD were based on state WC laws. We had no information about whether employees or employers have actually exercised their rights relating to provider selection or change as mandated in WC laws. Therefore, our findings should be interpreted in light of this fact. In addition, during our study period, some states (MI, ME, PA, OR, NM, and WA) restricted provider selection or change only for a certain

number of days (see Appendix 2, (<http://links.lww.com/JOM/A240>), after that period employees were free to select or change their treating providers. Other states (KY, MN, MT, NV, NH, NY, OH, OK, OR, and SD) did not restrict employee initial treating provider choice unless a managed care program was available. We examined the potential impact of this on our estimates by conducting sensitivity analyses excluding those states, but our original findings remained consistent in terms of magnitude and direction of associations.

CONCLUSIONS

This study showed that a significant portion of between-state variance in medical costs and LOD due to occupational LBP is explained by state-level WC policies regarding wage replacement and medical benefits. Despite the correlational nature of the study, the findings of this large study suggest that a shorter retroactive period and early referral of injured workers to health care providers familiar with occupational health issues might reduce medical costs and duration of work disability due to LBP. Providing injured workers who are not satisfied with their treating provider with an alternative treating provider choice might also result in better health care outcomes and lower medical costs. This study also suggests that fee schedules might have no impact on medical costs, but the presence of a fee schedule is associated with longer disability duration; whether this is a cause or effect of prior problems cannot be determined, although the effect is consistent across the time period of the study. More research is needed to examine whether these findings are generalizable to other health conditions leading to considerable work disability and medical costs.

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