Improving Quality, Preventing Disability and Reducing Costs in Workers' Compensation Healthcare

A Population-based Intervention Study

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Background: Problems of poor quality and high costs are worse in the workers' compensation system than in the general medical care system, yet relatively little work has been done to improve performance in workers' compensation healthcare.

Objective: To evaluate the effect of a quality improvement intervention that provided financial incentives to providers to encourage adoption of best practices, coupled with organizational support and care management activities, aimed at reducing work disability for patients treated within the Washington State workers' compensation system.

Research Design: Prospective nonrandomized intervention study with nonequivalent comparison group using difference-in-difference models to estimate the effect of the intervention.

Participants: Two cross-sections of data representing 33,910 workers' compensation claims filed in the baseline (preintervention) period from July 2001 to June 2003 and 71,696 claims filed in the postintervention period from July 2004 to June 2007 were analyzed. 46,928 (44%) of these 105,606 claims represent patients treated by over 275 providers recruited through Centers of Occupational Health and Education (COHEs) at 2 pilot regional sites.

Measures: Outcomes, measured at 1-year follow-up, included work disability status, number of disability days, disability cost, and medical cost.

Results: COHE patients were less likely to be off work and on disability at 1 year postclaim receipt (OR = 0.79, $P = 0.003$). The average COHE patients experienced a reduction in disability days of 19.7% ($P = 0.005$) and a reduction in total disability and medical costs of $510 per claim ($P < 0.01$). For patients with back sprain, the reduction in disability days was 29.5% ($P = 0.003$). Patients treated by providers who more often adopted occupational health best practices had, on average, 57% fewer disability days ($P = 0.001$) compared with patients treated by providers who infrequently adopted best practices.

Conclusions: Financial incentives, coupled with care management support, can improve outcomes, prevent disability, and reduce costs for patients receiving occupational healthcare. Owing to important disability prevention capacity, workers' compensation healthcare may be especially fertile ground for continued quality improvement innovation.

Key Words: quality improvement, work disability, worker's compensation

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The empirical and conceptual literature on quality improvement has expanded over the past 10 years but has neglected the field of workers' compensation healthcare delivery. In fact, peer-reviewed published reports of quality improvement within workers' compensation are practically nonexistent. Yet, work-related disability represents a major, largely overlooked, public health problem. According to the Department of Labor, there were 965,000 work-related injuries in the US in 2009 resulting in at least 1 day of lost work time. Given this incidence figure, work-related injuries covered through workers' compensation would in the aggregate result in millions of days of lost work time annually. A measurable portion of this lost work time could potentially be reduced by improving the quality of care provided to injured workers through the workers' compensation system.

Since 2002, Washington State has been the site of a major, ongoing initiative that has sought to improve quality and outcomes in the state's workers' compensation system. In fiscal year 2007, the Department of Labor and Industries (DLI), which administers the workers' compensation system, accepted approximately 120,000 workers' compensation claims and paid over $1.5 billion in direct medical costs and disability payments for all prevalent claims. The intervention used financial incentives to encourage providers to adopt occupational health best practices, provided organizational support to improve care coordination and supported the

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development of enhanced health information technology to conduct patient tracking. The intervention was implemented at 2 pilot Centers of Occupational Health and Education (COHEs) located in eastern and western Washington State. The Western Washington COHE is located in Renton, a manufacturing area within the Seattle metropolitan area, and is operated by a large, tertiary care hospital. The Eastern Washington COHE, located in Spokane, is operated by a rehabilitation hospital and serves a large, more rural, geographic area in eastern Washington.

Our study was designed to compare disability and cost outcomes for patients treated by COHE providers versus patients treated in the usual manner by non-COHE providers, and was guided by 3 aims: (1) to evaluate the effect of the quality improvement intervention on disability measures and medical costs; (2) to analyze the effect of the intervention for patients with back sprain, the most prevalent disabling work-related injury; and (3) to examine whether COHE providers who more frequently adopted occupational health best practices exhibited better outcomes compared with COHE providers who did so less often. Throughout the paper we use the term "COHE provider." Although the vast majority of the COHE providers are physicians, both chiropractors and advanced registered nurse practitioners participate as "attending doctors" in the Washington compensation system, and are thus included in all analyses.

METHODS

Study Setting and Quality Improvement Intervention

Washington State uses a state fund system for workers' compensation to provide first dollar coverage for medical care needed to treat occupational injuries or illnesses. The system also provides wage replacement payment for injured workers who miss 4 or more days of work as a result of a work-related injury. No restrictions are imposed on the worker's choice of provider. Employers who do not self-insure must purchase workers' compensation insurance through the DLI state fund. Approximately, 350 employers in Washington State, representing one third of the state's workforce, self-insure for workers' compensation. In effect, the DLI serves as a single payer for Washington State, insuring two-thirds of the state's nonfederal workforce.

The development of the quality improvement intervention we evaluated has previously been described.[1,2] In brief, 3 focus groups of community physicians and nationally recognized experts in conditions common to workers compensation settings (back pain, carpal tunnel syndrome, and extremity fractures) met in 1999 in Seattle to review the existing scientific and clinical literature and to establish quality indicators for occupational health best practices. Four generic occupational health performance indicators, reflective of best practices, were developed through a modified Delphi process: (1) submission by the provider of the initial report of accident within 2 business days, (2) 2-way telephone communication between the provider and the employer about the worker's return to work or work modification if the worker was expected to be off work, (3) completion of an activity prescription form at each evaluation to document activity restrictions and treatment/rehabilitation plans when the worker was expected to be off work, and (4) formal assessment (or referral for assessment) for impediments to returning to work if the worker was off work for 4 weeks.

The DLI modified its fee schedule to provide enhanced payments for COHE participating providers for the 4 quality indicators. Fees were increased by 50% for timely submission of the report of accident from approximately $30 to $45, and new fees were established for the other 3 services. All COHE providers were eligible for the enhanced payments. As a principal goal of the workers compensation system is to prevent chronic disability, the COHEs were designed to emphasize early best practices. Thus, participating providers could only bill for quality indicator services during the first 12 weeks of a workers' compensation claim. Some claims, such as carpal tunnel syndrome, are defined as an occupational illness. Often these claims require treatment beyond 12 weeks, but providers could only bill for the quality indicator services during the first 12 weeks the claim was open.

Table 1 shows the key quality improvement COHE components. In addition to financial incentives, the COHE included other components intended to improve quality and reduce work disability. Of particular importance was the role of health services coordinators, who typically had experience in vocational rehabilitation or occupational health nursing and familiarity with the local workers' compensation healthcare delivery system. Often in workers' compensation, long delays and extended disability occur because of communication problems between the provider, the employer, the injured worker and the claim manager (who has to approve referrals to specialists or authorize costly medical procedures). The longer an injured worker is off work and on disability, the less chance there is of him or her returning to work.[3] By providing lead communication from the healthcare system to other key parties within the workers' compensation system (employer, claims manager), the health services coordinators played a key function in getting workers back to work, thereby reducing disability. The development of health information systems, which enabled the COHEs to improve patient tracking and monitor the duration of disability, was also important. Finally, as noted in Table 1, the development of institutional support for the pilot was important to create an organizational culture supportive of quality improvement.

The COHE implementation at the Renton pilot site began in July 2002; the Spokane pilot site followed a year later (July 2003). Each pilot site had an initial start-up year that allowed for provider recruitment, identification of senior clinicians knowledgeable about occupational healthcare who could serve as mentors to assist participating providers, development of administrative systems, and hiring of health services coordinators to track patient status and coordinate care. During the initial start-up year (not evaluated), the COHEs recruited 294 providers who continued to practice in their established clinical setting (eg, office, clinic, or hospital emergency department). They continued to recruit providers after the start-up year. Thus, the number of active COHE providers varied from year to year.

TABLE 1. Key Quality Improvement Components of Washington State Centers of Occupational Health and Education

Quality Improvement Components	Quality Improvement Objective
Organizational Support/Care Management	
Provider continuing medical education	Enhance provider knowledge and training in treating occupational injuries and diseases
Provider mentoring by senior clinicians	Provide consultation for complex cases
Health services coordinators	Improve coordination of care Improve communication with employers to foster timely return to work Reduce administrative burden for providers Reduce administrative delays in claims processing
Development of information technology	Improve patient tracking
Financial Incentive	
Enhanced payment for selected activities and services related to quality indicators	Promote occupational health best practices
Other components	
Development of institutional support for pilot	Create an organizational culture supportive of quality improvement

Data and Measures

In the Washington workers' compensation system, workers who incur an occupational injury (eg, back sprain) or an occupational illness (eg, carpal tunnel syndrome) file a claim through a health provider. Once a claim is accepted, it remains open until the injured worker achieves maximum medical improvement, and therefore not in need of further medical care. Fourteen percent of disabling low back claims remain open for at least 1 year.[4] The COHE intervention provided financial incentives for providers but sought to improve care coordination and disability management at the individual patient level. We defined the patient as the unit of analysis. Alternatively, we could have defined the provider as the unit of analysis, but that would have led to substantial loss of information because a sizeable portion of the providers treated too few patients to allow us to analyze the data at the provider level. For this reason and because the focus of attention in workers' compensation is the patient's claim, we chose to analyze the data at the claim level but adjust for clustering within provider.

Claims filed by patients who received medical care from a COHE participating provider during a 2-year period beginning in July 2004 for the Renton COHE and a year later for the Spokane COHE and who (1) had an injury date after January 2001 and (2) were not seeking medical care for a hearing loss claim, became intervention cases for this study (n = 31,520). This 2-year period corresponds to operational years 3 and 4 for the COHE pilots. We constructed a contemporaneous comparison group, using the same inclusion criteria, representing all claims (n = 40,176) filed by patients during the same time period treated by non-COHE providers practicing within the 2 COHE catchment areas. (Each COHE defined its catchment area for purposes of recruiting providers for the pilot.) Claims filed during the year before the implementation year, July 2001 to June 2002 for Renton and July 2002 to June 2003 for Spokane, were defined as baseline-year (preintervention) claims (COHE, n = 15,408; comparison group, n = 18,502). The 105,606 claims included in the intervention and comparison groups in the 2 time periods represent patients treated by 2809 providers. Of the 2,809 providers, 2297 (81.7%) providers were comparison-group providers, and 512 (18.3%) providers were COHE providers.

Using the DLI claims data, we constructed 4 outcome measures: (1) a binary variable indicating whether the injured worker was off work and receiving disability payments 1 year after filing a claim; (2) number of disability days per claim; (3) disability costs per claim; and (4) medical costs per claim. Disability and medical costs were measured in nominal dollars. The COHE medical costs included all enhanced payments related to the quality indicators described earlier. We tracked the 4 outcome measures for 1 year after claim filing. The DLI administrative database contained a limited set of variables we included in our analysis as covariates to control for differences in patient, employer, and provider factors. These included (1) worker age, sex, and type of injury; (2) size of employer (number of full time equivalent employees) and type of industry; and (3) provider specialty and patient volume (defined as the number of workers' compensation patients treated by providers). All covariates were measured in categorical form. Our study was approved by the University of Washington Institutional Review Board.

Statistical Techniques

To evaluate the intervention, we analyzed the change in outcomes for the intervention group compared with the corresponding change for the comparison group using 2 cross-sections of data representing the baseline and outcome years. Empirically, we estimated the following difference-in-difference model:

$$Y = b_0 + b_1\text{Group} + b_2\text{Time} + b_3\text{Group*Time} + b_4\text{Covariates}.$$

The estimated coefficient (b_3) on the interaction term provides information about the COHE effect. It measures the change in outcome associated with the COHE intervention after adjusting for the change in outcome for the comparison group and for the covariates.[5,6]

We used logistic regression to assess the impact of the intervention on the odds of being off work and on disability 1 year after claim filing and used generalized linear models, with a γ distribution and log link function, to assess the other 3 (continuous) outcome measures. We also adjusted the standard errors of our estimates to account for clustering of cases within provider. There was little meaningful difference in the intervention effects for the 2 pilot sites. As a result of this and to simplify the presentation of results, we pooled the data across the 2 pilot sites and report the combined effect of the intervention. In addition to this analysis, we conducted further analysis to examine the effect of the COHE for

patients with low back pain, a costly and prevalent condition within the workers' compensation system that accounts for significant long-term work disability.[7,8]

An important assumption of the intervention was that COHE providers who adopted occupational health best practices more frequently would be more successful in reducing worker disability. To examine this assumption, we constructed a second dataset for a subgroup of COHE providers and used the same difference-in-difference approach and statistical models to analyze the measures described earlier. First, we determined the percent of patients for whom each COHE provider used an occupational health best practice, based on 3 of the 4 quality indicators described earlier (the indicator pertaining to 4-week return-to-work impediment assessments was excluded because it was infrequently used). Second, we summed the percentage values, measured in decimal form, across the 3 quality indicators. A provider who never adopted a best practice would receive a score of 0.0, whereas a provider who always adopted best practices would receive a score of 3.0 (1.0×3). Third, we divided the distribution of best practice scores into 2 groups representing the bottom one-third of the distribution (low adopters) and the top one-third (high adopters). The low-adopter group (n = 181 providers) had a mean best practice score of 0.26; the high-adopter (n = 175 providers) group's score was 1.82. All primary and secondary analyses were conducted using STATA version 11.0.

RESULTS

Table 2 describes the characteristics of patients in the intervention and comparison groups for the baseline year. Approximately 15% of the patients had injuries involving back sprain and 22% other sprains (knee, shoulder, neck). A smaller percentage (< 10%) of patients had either carpal tunnel syndrome or some type of fracture. A large percentage (approximately 55%) of cases was classified as other injuries, representing minor conditions involving cuts, scratches, and contusions, or ill-defined and unclassified injuries. Primary care providers, and to a lesser extent hospital emergency department physicians, provided most of the initial care for injured workers. Although statistically significant due to the large sample size, most of the differences shown in Table 2 are of small magnitude. However, there were substantial differences in the measure of provider volume (volume of workers' compensation patients treated per year). High-volume providers (>200 workers' compensation patients per year) were more likely to participate in the pilot and treat intervention group cases, whereas low-volume providers (< 80 workers' compensation patients per year) were less likely to do so.

Table 3 presents descriptive information on outcomes for all cases (n = 105,606) and for back sprain cases (n = 15,322). The 2 groups of cases present a different profile. Observed baseline differences (for all cases) in outcomes reflect, in part, case mix differences and differences in provider type shown in Table 2 (greater proportion of surgeons and low-volume providers treating comparison-group patients). Disability measures for COHE patients remained essentially unchanged ($P > 0.10$), and medical costs increased ($P < 0.001$). Incidence of long-term disability (off work and on disability at 1 year), disability duration (days), and disability costs increased ($P < 0.001$) for comparison-group patients, and medical costs also increased ($P < 0.001$). In contrast, for back sprain cases one observes almost no difference between COHE patients and comparison group patients at baseline in disability measures. However, the COHE group exhibits a favorable change in disability measures over time ($P < 0.05$ for disability days and costs), whereas the comparison group shows the opposite, with the 3 disability measures increasing ($P < 0.05$) over time. Medical

TABLE 2. Selected Characteristics of COHE Pilot Groups, Baseline Year (N = 33,910)

Characteristic*	COHE Claims (N = 15,408)	Comparison (Non-COHE) Claims (N = 18,502)	*P*
Age (mean)	35.4	36.8	< 0.001
Male (%)	73.4	70.1	< 0.001
Type of injury (%)			< 0.01
Back sprain	13.7	15.2	
Carpal tunnel syndrome	0.8	2.0	
Fracture	3.9	3.5	
Other sprains	23.2	22.8	
Other injuries†	58.3	56.4	
Provider specialty (%)			< 0.001
Occupational medicine physician	10.9	7.0	
Primary care physician	42.1	33.7	
Hospital ED physician	31.3	29.0	
Chiropractor	2.3	7.5	
Surgeon	1.9	5.1	
Other provider	11.5	17.8	
Provider claim volume (%)			< 0.001
Low (< 80 claims per year)	18.4	46.3	
Medium (80 to 200 claims per year)	40.3	28.7	
High (> 200 claims per year)	41.3	25.0	

*Categories may not sum to 100% due to rounding.
†The category other injuries includes (1) cuts, scratches and lacerations (60%); and (2) ill-defined and unclassified injuries (40%).
COHE indicates Center of Occupational Health and Education; ED, emergency department.

TABLE 3. Descriptive Information on Study Outcome Measures

Outcome Measure	COHE Group			Comparison Group		
	Baseline Year	Outcome Years	*P**	Baseline Year	Outcome Years	*P**
All cases, N = 105,606						
All cases	(n = 15,408)	(n = 31,520)		(n = 18,502)	(n = 40,176)	
On disability and off work 1 year after injury (%)	2.0	2.2	0.14	2.7	3.5	< 0.001
Disability days per claim	14.4 (54.0)	14.3 (54.5)	0.87	19.5 (62.2)	23.1 (69.2)	< 0.001
Disability costs per claim ($)	758 (3328)	748 (3289)	0.76	1038 (3734)	1344 (4594)	< 0.001
Medical costs per claim ($)	1636 (3818)	2076 (5026)	< 0.001	1979 (4230)	2646 (5923)	< 0.001
Back sprain cases, N = 15,322						
Back sprain cases	(n = 2231)	(n = 4178)		(n = 3068)	(n = 5845)	
On disability and off work 1 year after injury (%)	3.9	3.4	0.24	3.7	4.8	0.014
Disability days per claim	24.7 (74.1)	20.1 (65.9)	0.01	25 (70.7)	29.3 (81.0)	0.006
Disability costs per claim ($)	1370 (5069)	1060 (4059)	0.008	1342 (4335)	1722 (5446)	0.001
Medical costs per claim ($)	3259 (8947)	3559 (9094)	0.21	3564 (10,504)	4347 (10,095)	0.001

Standard deviations in parentheses.
Comparisons for *P* values are within group, baseline versus outcome year.
COHE indicates Center of Occupational Health and Education.

costs increased significantly ($P < 0.001$) for comparison-group patients, whereas COHE patients had a nonsignificant ($P = 0.21$) increase in medical costs.

The results of our multivariable analysis indicate that the COHE was associated with decreased incidence in long-term disability, disability duration and disability costs, and the magnitude of the estimated decrease was larger for back sprain cases. The adjusted odds ratios for the measure of long-term disability (off work and on disability at 1 year after injury) for all cases and back sprain cases, respectively, was 0.79 (95% CI, 0.67-0.92, $P < 0.01$) and 0.63 (95% CI, 0.46-0.88, $P < 0.01$). In other words, compared with comparison-group patients, the relative risk of being off work and on disability at 1 year was 21% lower for all COHE patients and 37% lower for back sprain COHE patients.

Table 4 shows the results of the multivariable generalized linear models analysis for the 2 continuous disability measures and for medical costs. The difference-in-difference estimates represent approximate (adjusted) percentage changes (see footnote in Table 4) from baseline to follow-up for the COHE group. The table also shows marginal estimates of the change in nominal costs from baseline to follow-up for the COHE group. The estimates for the 2 disability measures (days and costs per claim) are negative and statistically significant ($P < 01$) indicating the COHE was associated with decreased work disability. Again, one observes estimates that are larger in magnitude for back sprain cases. Reflecting both the lower incidence of long-term disability and lower disability duration, the COHE was associated with a substantial reduction in disability costs. For all cases, disability cost decreased from $1147 per claim in the baseline period to $880 in the follow-up period. The corresponding decrease in disability cost for back sprain cases was larger, from $1576 to $1034. COHE medical cost per claim decreased by approximately 7%, but this decrease was not statistically significant ($P = 0.13$). However, the postintervention COHE medical costs included added provider incentive payments (approximately $57 per claim). Had these added payments not been included, the decrease in medical costs would have been larger.

We combined medical and disability costs to derive an estimate of total costs and then examined the change in total costs associated with the COHE. Total costs for all cases (n = 105,606) decreased by approximately $510 per claim ($P < 0.01$).

TABLE 4. Estimated Effects of COHE Intervention

Outcome Measure	Difference-in-Difference Estimates of COHE Effect† (95% CI)	*P*	Marginal Estimates of COHE Effect*	
			Baseline Year	Outcome Years
		All cases, N = 105,606		
Disability days per claim	−0.18 (−0.30 to −0.05)	0.005	20.2	16.9
Disability cost per claim	−0.27 (−0.41 to −0.12)	< 0.001	$1,147	$880
Medical cost per claim	−0.07 (−0.15 to 0.02)	0.130	$2,262	$2,117
		Back sprain cases, N = 15,322		
Disability days per claim	−0.35 (−0.57 to −0.12)	0.003	27.8	19.7
Disability cost per claim	−0.42 (−0.66 to −0.18)	0.001	$1,576	$1,034
Medical cost per claim	−0.07 (−0.22 to 0.08)	0.37	$2,869	$2,678

*Marginal estimates show the change in outcome measures from baseline to follow-up for the COHE group, with the covariates held at their mean values.
†The COHE effect estimates were generated by a generalized linear model (GLM), with a log link function. The estimates represent approximate (adjusted) percentage change values from preintervention to postintervention. Precise percentage change values can be obtained as follows: %Δ = exp (GLM estimate) − 1.00. The GLM model included the following covariates: patient age and sex, type of injury, size of employee firm, industry, provider type, and provider volume.
COHE indicates Center of Occupational Health and Education.

TABLE 5. Outcomes Associated with Adoption of Occupational Health Best Practices (N = 33,787)

Outcome Measure	Difference-in-Difference Estimate of Best Practice Adoption Effect (95% CI)	*P*	Marginal Estimates of Best Practice Effect	
			Baseline Year	Outcome Years
Disability days per claim	−0.45 (−0.80 to −0.11)	0.011	19.2	12.3
Disability costs per claim	−0.47 (−0.85 to −0.08)	0.018	$1,030	$646
Medical costs per claim	−0.18 (−0.48 to 0.11)	0.23	$2,218	$1846

The Center of Occupational Health and Education effect estimates for disability days, disability costs and medical costs were generated by the generalized linear model (GLM). A log link function was used for the GLM, thus the estimates represent approximate percentage change values from preintervention to postintervention, adjusted for covariates and for the change in outcomes for the comparison group. Precise percentage change values can be obtained as follows: %Δ = exp (GLM estimate) − 1.00. The GLM was adjusted for the following covariates: patient age and sex, type of injury, size of employee firm, industry, provider type, and provider volume.

As a further analysis, we stratified the COHE by provider volume and repeated the analysis using the same difference-in-difference model. The estimated COHE effects for the 3 disability measures were largest ($P < 0.01$) for low-volume providers and smallest for high-volume providers. It is plausible that low-volume providers with less experience in workers' compensation healthcare benefited more from the COHE intervention than high-volume providers who had more experience at the outset of the pilot in treating workers' compensation patients.

Adoption of Occupational Health Best Practices

An important goal of the quality improvement intervention was to foster adoption of occupational health best practices among COHE providers. The financial incentives offered to COHE providers were effective in promoting best practices. By July 2007, the target benchmark of 80% compliance had been achieved for submission of the report of accident and almost achieved (72%) for use of the Activity Prescription Form. Compliance with regard to the third best practice, provider phone consultations with employers, was less (approximately 38%). This lower compliance rate was due in part to the fact that Spokane COHE providers and health service coordinators tended to rely on e-mail rather than phone communication to contact employers. The fourth best practice, assessment of impediments to return to work, was adopted relatively infrequently.

We expected COHE providers who more frequently adopted the occupational health best practices to have better outcomes relative to COHE providers who adopted them less frequently. This expectation was supported by the analysis. The adjusted odds ratio for the measure of incidence of long-term disability was 0.63 (95% CI: 0.44-0.92, $P = 0.016$), implying that workers treated by high-adopter COHE providers were 37% less likely to be off work and on disability 1 year after injury compared with workers treated by low-adopter COHE providers. Consistent with this finding, workers treated by high-adopter COHE providers had 36% fewer disability days per claim ($P = 0.011$) and 37% lower disability costs per claim ($P = 0.018$) compared with workers treated by COHE providers who adopted best practices less often (Table 5). Although medical costs decreased by approximately 16.5% for workers treated by high-adopter providers, this decrease was not statistically significant ($P = 0.23$). However, the high-adopter provider group had substantial incentive payments related to their use of best practices, and these added incentive payments would have increased that group's medical costs, thereby reducing the estimated difference in costs for the 2 groups.

DISCUSSION

Workers' compensation healthcare, such as general medical care, is highly fragmented and uncoordinated. The lack of effective financial incentives and organizational support for quality improvement is a major impediment to progress. The intervention described in this study sought to address these factors. In general medical care, a small (5%) percentage of patients account for the great majority (65%) of expenditures.[9] In our dataset, the same pattern prevails. Preventing long-term disability is a major public health goal of the workers' compensation system. Our analysis showed the intervention was associated with favorable reductions in the odds of having a disability claim involving extended loss of work time (1 y) and in the average number of disability days per claim. These effects translated into substantial savings in disability costs. The beneficial impact of the COHEs on reducing long-term disability was heightened for injured workers with low back injuries.

An important component of the COHE intervention was the incentive payments offered to providers who adopted occupational health best practices. Patients treated by providers who more often adopted best practices were less likely to experience extended work disability. Unlike pay-for-performance (P4P) programs that typically award bonus payments at the end of a defined cycle (calendar quarter or year), the COHEs paid providers each time they used a best practice. Findings of our study suggest this incentive payment method fostered adoption of best practices and promoted improved outcomes.

Two other aspects of the COHE merit brief mention. The COHE was successful in reducing disability, in part, because the intervention was able to track patients' time on disability and, when needed, have a health services coordinator intervene in a case to promote the patient's return to work. The reduction in administrative burden and paperwork achieved by the COHE was also important. Providers in the US labor under a mountain of paperwork, much of which has little value and tenuous justification. The Activity Prescription Form developed for the COHE, whose use was incentivized as a best practice, replaced 3 older forms providers had to routinely complete. This reduction in paperwork represented an important nonfinancial incentive for providers and aided provider recruitment.

Our study was not designed to assess the return on investment for the DLI, and we do not provide a return on investment estimate here. The COHE had 2 types of intervention-related costs: provider-enhanced payments and pilot administrative/operational costs. These costs, respectively, were $57 per claim and $66 per claim and represent a modest fraction of the estimated cost savings associated with the COHE.

The most important limitation of our study concerns the use of a nonrandomized study design. Our use of a difference-in-difference estimation approach does control for time invariant factors and secular trends. As Table 3 shows, disability measures and medical costs were lower at baseline for COHE providers compared with comparison group (non-COHE) providers. In part, this can be explained by differences in the mix of injuries and in provider volume (the comparison group had more low-volume providers with less experience in treating workers' compensation patients). We controlled for these factors in the analysis, however. The COHE effect we estimated (for all cases) was driven largely by the fact that disability measures over time worsened for comparison-group providers but remained largely unchanged for COHE providers. The increase in disability measures for comparison-group providers reflects larger secular trends observed for workers' compensation providers statewide at that time.

Our analysis of back sprain cases, a costly and common disabling condition in workers' compensation, coupled with our analysis of adoption of occupational health best practices, provides more compelling evidence that reinforces the study's validity. As shown in Table 3, for back sprain cases COHE providers and comparison-group providers had an almost identical profile of outcome measures at baseline. Outcomes improved for COHE providers but worsened for comparison group providers. Owing to the greater likelihood of long-term disability associated with back sprain, one might expect the COHE to have a more pronounced effect on work disability for this condition than for workers' compensation cases in general. Our analysis showed this expected effect. Furthermore, as one might expect, our analysis of adoption of occupational health best practices showed that COHE providers who adopted best practices more frequently, as compared with less frequently, had better outcomes.

The findings of our evaluation of the COHE intervention gained wide attention in Washington State and led to the introduction of legislation (SB 5801, An Act Relating to Establishing Medical Provider Networks and Expanding COHEs in the Industrial Insurance System) to expand the COHEs on a statewide basis. On March 14, 2011, Governor Christine Gregoire signed the bill into law. As of this writing, over 1000 primary care community providers are delivering healthcare to injured workers through the COHEs and active work is ongoing to expand the set of quality indicators. By 2015, all injured workers in Washington State must have access to occupational healthcare through COHEs. It is anticipated that the expansion of the COHEs will have an important effect for Washington State in reducing the serious public health problem of long-term work disability resulting from occupational injuries and illnesses.

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