

Innovations in Occupational Health Care Delivery Can Prevent Entry into Permanent Disability

8-Year Follow-up of the Washington State Centers for Occupational Health and Education

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Background: Long-term work disability is known to have an adverse effect on the nation's labor force participation rate. To reduce long-term work disability, the Washington State Department of Labor and Industries established a quality improvement initiative that created 2 pilot Centers of Occupational Health and Education (COHE).

Objectives: To document the level of work disability in a sample of injured workers with musculoskeletal injuries and to examine (8-y) work disability outcomes associated with the COHE health care model.

Research Design: Prospective nonrandomized intervention study with nonequivalent comparison group using difference-in-difference regression models.

Subjects: Intervention group represents 18,790 workers with musculoskeletal injuries treated by COHE providers. Comparison group represents 20,992 workers with similar injuries treated within the COHE catchment area by non-COHE providers.

Measures: Long-term disability outcomes include: (1) on disability 5 years after injury; (2) received a state pension for total permanent disability; (3) received total disability income support through the Social Security Disability Insurance program; or (4) a combined measure including any one of the 3 prior measures.

Results: COHE patients had a 30% reduction in the risk of experiencing long-term work disability (odds ratio = 0.70, $P = 0.02$). The disability rate (disability days per 1000 persons) over the 8-year

follow-up for the intervention and comparison groups, respectively, was 49,476 disability days and 75,832 disability days.

Conclusions: Preventing long-term work disability is possible by reorganizing the delivery of occupational health care to support effective secondary prevention in the first 3 months following injury. Such interventions may have promising beneficial effects on reversing the nation's progressively worsening labor force participation rate.

Key Words: coordinated care, quality improvement, disability, workers' compensation

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A major source of disability in the US population is injuries and illnesses occurring in the workplace. Injuries common to the workplace, in particular, low back pain, other musculoskeletal disorders, and neck pain account for almost two thirds of all years lived with disability, a metric representing the total burden of disability incurred by the US population.¹ In a national survey, 31% of Americans with a disability reported that a work-related injury was the cause.² In 2016, workers in the United States incurred 2.86 million recordable occupational injuries or illnesses, or 3.2 injuries/illnesses per 100 full time workers.³ Almost one third (31.2%) of these injuries resulted in lost work time.³ Social Security Disability Insurance (SSDI) is the largest disability insurance program in the United States, and provided income support and medical coverage for 10.2 million persons in 2016.⁴ Diseases of the musculoskeletal system and connective tissue, common causes of disability within workers' compensation, account for approximately one third of the SSDI beneficiary population.⁴

It is currently unknown how much of the work-related disability could be avoided if injured workers receiving health care through the workers' compensation system received timely and effective treatment focused on preventing the transition to long-term disability. One key may lie in organizing systems of care to provide early and effective secondary prevention to reduce the risk of long-term work disability.^{5,6} The timing of such care is critical in that the risk of long-term disability substantially rises after just 3 months of lost time from work.⁷ Thus, innovations reorganizing care to achieve meaningful prevention of disability must occur during the first 1–2 months following injury.

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To reduce work disability and improve health outcomes, the Washington State Department of Labor and Industries (L&I), which operates the state workers' compensation program, initiated a major pilot in 2001 to assess the effect of delivering occupational health care through a communitywide intervention designed to provide timely secondary prevention to reduce the risk of injured workers incurring long-term disability. The background, design, and implementation of the pilot have previously been described.^{5,6} In brief, the pilot established 2 Centers of Occupational Health and Education (COHE), located in Seattle and Spokane, Washington. The COHEs recruited on a voluntary basis community physicians for the pilot. Key features of the pilot, intended to enhance secondary prevention aimed at reducing work disability, included: (1) improved care coordination provided through health services coordinators; (2) enhanced physician payment for adoption of occupational health best practices, defined by a set of quality indicators linked to specific billing codes; (3) training designed to improve providers' ability to treat common workplace injuries such as low back pain and carpal tunnel syndrome; (4) financial support for the development of improved information systems to track patient progress; (5) support of institutional executive and medical leadership committed to the goal of reducing work disability and improving health outcomes for injured workers; and (6) full support and engagement of business and labor leaders.

We previously demonstrated that delivery of such care through reorganized occupational health delivery via the COHEs could reduce the likelihood of work disability at 1 year following injury by 21% for the average injured worker and by 30% for workers with low-back conditions.⁸ Using the original COHE cohort, we extend our prior study and examine long-term work disability outcomes over an 8-year follow-up period. We hypothesized that secondary prevention, if effective in preventing transition to 1 year disability in the original cohort, would also be effective in preventing transition to permanent disability status by 8 years of follow-up. To our knowledge, this is the first study of its kind to examine the effect of a quality improvement initiative on long-term, often permanent, disability outcomes. Improving understanding of how efforts to reorganize occupational health care delivery systems to promote improved secondary prevention aimed at reducing work disability is especially important given the historic low US labor force participation rates.⁹

METHODS

Study Setting

Except for the federal workers compensation program, workers' compensation systems are regulated at the state level. In addition to providing comprehensive coverage for medical care required to treat work-related injuries or illnesses, workers' compensation provides wage replacement for injured workers who have lost more than a specified number of work days—3 days in Washington State. By law in Washington State, all employers have to purchase workers' compensation insurance through L&I unless the employer chooses to self-insure for workers' compensation. L&I

provides workers' compensation insurance for approximately two thirds of the state's nonfederal workforce. State regulations prohibit any limitation from being imposed to restrict injured workers access to care, thus injured workers are free to select any provider of their choice once their claim for a work-related injury or illness is approved.

Data and Measures

L&I administrative (claims) information served as the data source for our study. Included in this data source is information pertaining to date of injury, patient demographic data, provider specialty and volume of workers' compensation cases treated, medical and wage replacement payments, duration of disability, and a flag variable indicating receipt of income support from the Social Security Administration (SSA). Our earlier COHE evaluation analyzed data on 105,606 injured workers with different injuries, including musculoskeletal injuries, lacerations and contusions, extremity fractures and unclassified injuries.⁸ For purposes of this study, we limited the study population to 39,782 of the 105,606 injured workers with a musculoskeletal injury because workers with these injuries face higher risk of long-term work disability and premature exit from the labor force. The current study population ($n = 39,782$) consisted of 15,426 injured workers with a diagnosis of "low back sprain" and 24,356 injured workers with a diagnosis of "other sprain," which included knee sprains, shoulder sprains, and neck sprains. These injured workers received treatment for their musculoskeletal conditions during years 3 and 4 of the COHE pilot, corresponding to the calendar period September 2004 to June 2007 (The Spokane pilot site became operational 1 year later than the Seattle site, hence the total case accumulation time of 3 y). More detailed information on the COHE pilot sites is reported elsewhere.⁶

Outcome Variables

As noted earlier, this study extended the follow-up period used to track disability outcomes from 1 year to 8 years and also supplemented the data base with information we used to create new disability outcome measures. The primary outcome variable was a composite measure of 3 work disability measures representing different dimensions of permanent disability: (1) off work and on disability at 5 years following date of injury; (2) receipt of a L&I workers' compensation pension for total permanent disability; and (3) presence of a flag variable in the L&I administrative data base indicating initiation of income support from the SSA through the SSDI program. The composite measure took on a value of 1 if an injured worker had any one of the 3 specific disability measures and 0 otherwise. In addition, we documented the aggregate number of days patients were off work and receiving disability wage replacement payments from L&I during the 8-year follow-up period.

Study Design and Statistical Techniques

We used a prospective cohort design to compare work disability outcomes for COHE patients ($n = 18,790$) and comparison-group patients ($n = 20,992$). Comparison group patients represented all patients receiving medical care from

non-COHE physicians practicing in a COHE pilot catchment area during the baseline year before COHE operation or during the 2-year COHE operational period. COHE providers participated in the pilot on a voluntary basis, and thus may differ from non-COHE providers on both known and unknown characteristics. But all providers treating injured workers in the 2 study groups practiced within the same COHE pilot medical community, which offers some reassurance of similarity in market factors and local standards of practice.

We used univariate analysis to describe worker and provider characteristics and the disability outcome measures for the 2 study groups. Only a small percentage (< 3%) of the injured workers incurred permanent disability as assessed by our 3 outcome measures. But many more injured workers experienced some level of disability during the 8-year follow-up period. As a further descriptive analysis to provide a more complete picture of work disability in our study population, we assessed the cumulative number of disability days injured workers were off work and receiving L&I disability wage replacement payments over the 8-year follow-up period. We limited the analysis to those injured workers treated during the COHE operational period (n=26,271), that is, we excluded injured workers treated in the baseline, pre-COHE period. We report the cumulative number of disability days and the disability rate (disability days per 1000 injured workers) for injured workers treated by COHE physicians and non-COHE (comparison-group) physicians.

We used multivariable statistical analyses to examine the effect of reorganizing care delivery via the COHE on long-term disability outcomes. To conduct the multivariable statistical analysis, we estimated a generalized linear model using a difference-in-differences (DiD) specification, with robust SE. The (binary) outcome variable, described earlier, took on a value of 1 if an injured worker incurred any one of the 3 disability outcomes during the 8-year follow-up period, and 0 otherwise. The model included a treatment dummy variable (COHE = 1, comparison group = 0), a time dummy variable (follow up = 1, baseline = 0), and an interaction term (time × treatment). The estimated coefficient on the interaction term provides information regarding the change over time in the outcome variable for the COHE cohort, accounting for the corresponding change in the non-COHE comparison group.¹⁰ We report results as adjusted odds ratios (OR) using 2-sided tests.

The L&I administrative data base contained several variables we included in the model to control for worker-related and provider-related factors. These were worker age at time of injury, sex, employer size and industry, and provider specialty and case volume (number of injured workers treated during the baseline period). The case volume variable was intended to adjust for provider self-selection. We considered using propensity score techniques to ensure balance among the covariates between the COHE and comparison groups.¹¹ However, given the number of cases analyzed (> 35,000) and the limited number of relevant variables available in the L&I data base, using propensity score techniques offered little advantage over entering the covariates directly in the model. The University of Washington Institutional Review Board

approved the study protocol. We used SPSS version 24 to perform all analyses.

RESULTS

The COHE treatment group and comparison group differed on both worker characteristics and provider characteristics (Table 1). Two thirds of the study population was male, with an average age at injury of ~37. Back sprains occurred somewhat less frequently among COHE injured workers than comparison-group injured workers (37.1% vs. 40.2%), but the opposite was true for other sprains (COHE, 62.9%; comparison-group, 59.8%). A greater proportion of COHE injured workers were treated by primary care physicians or occupational medicine physicians compared with comparison-group injured workers (47.0% vs. 36.1% and 13.0% vs. 6.8%, respectively). In contrast, more comparison-group injured workers than COHE injured workers were treated by chiropractors (17.0% vs. 5.3%). Finally, large differences were observed in provider case volume. A greater proportion of comparison-group injured workers than COHE injured workers were treated by low

TABLE 1. Descriptive Information on Study Population

	n (%)		P
	COHE Cohort (N = 18,790)	Comparison Group (N = 20,992)	
Injured worker characteristics			
Sex			< 0.001
Male	12,811 (68.2)	13,967 (66.5)	
Female	5979 (31.8)	7025 (33.5)	
Age [mean (SD)]	36.3 (11.9)	37.9 (12.2)	< 0.01
Type of injury			< 0.001
Back sprain	6977 (37.1)	8449 (40.2)	
Other sprain	11,813 (62.9)	12,543 (59.8)	
Employer size (FTE)			< 0.001
< 50	6999 (37.8)	7923 (40.5)	
50–100	3253 (17.6)	3295 (16.9)	
100–250	4204 (22.7)	3811 (19.5)	
> 250	4071 (22.0)	4524 (23.1)	
Employer industry			< 0.01
Construction	2613 (13.9)	3547 (16.9)	
Manufacturing	2055 (10.9)	2093 (10.0)	
Transportation	1661 (8.8)	1660 (7.9)	
Wholesale/retail	5101 (27.1)	5352 (25.5)	
Finance/public administration	971 (5.2)	1445 (6.9)	
Service	5425 (28.9)	6103 (29.1)	
Other	964 (5.1)	792 (3.8)	
Provider characteristics			
Provider specialty			< 0.001
Primary care	8828 (47.0)	7577 (36.1)	
Occupational medicine	2448 (13.0)	1425 (6.8)	
Chiropractor	997 (5.3)	3569 (17.0)	
Emergency room	4221 (22.5)	4239 (20.2)	
Surgeon	332 (1.8)	807 (3.8)	
Other specialty	1964 (10.5)	3375 (16.1)	
Provider case volume			< 0.001
Low volume	4311 (22.9)	11,742 (55.9)	
Medium volume	7805 (41.5)	5482 (26.1)	
High volume	6674 (35.5)	3768 (17.9)	

COHE indicates Centers of Occupational Health and Education; FTE, full time equivalent.

TABLE 2. Disability Outcomes for Study Population

Measure	Cases Treated in Pre-COHE Baseline Year [n (%)]			Cases Treated in Years 3 and 4 of COHE Operation [n (%)]		
	COHE Cohort	Comparison Group	P	COHE Cohort	Comparison Group	P
On L&I work disability 5 y after injury	61 (1.0)	97 (1.3)	0.221	125 (1.0)	218 (1.6)	<0.001
Received L&I pension for total permanent disability	50 (0.9)	73 (1.0)	0.535	57 (0.4)	82 (0.6)	0.053
Received income support from SSDI	30 (0.5)	64 (0.8)	0.024	65 (0.5)	115 (0.9)	<0.000
Combined disability measure*	102 (1.7)	156 (2.0)	0.205	197 (1.5)	332 (2.5)	<0.001

*Disability measures are not mutually exclusive. The combined measure includes the 3 separate outcome measures. COHE indicates Centers of Occupational Health and Education; L&I, Washington State Department of Labor and Industries; SSDI, Social Security Disability Insurance.

volume providers (55.9% vs. 22.9%), but the opposite was found for high volume providers (COHE, 35.5%; comparison group, 17.9%).

Table 2 presents descriptive information on the disability outcome measures. As shown, permanent work disability occurred among only a small percentage (<3%) of injured workers. In general, a greater proportion of comparison-group patients compared with COHE patients experienced one of the work-disability outcomes. For example, 1.5% of the injured workers treated by a COHE provider during operational years 3 or 4 experienced some form of permanent work disability compared with 2.5% of the comparison-group injured workers. Even though only a small percentage of injured workers experienced permanent work disability, as assessed by our 3 disability measures, the 26,271 injured workers treated during the COHE operational period incurred a large cumulative number of work disability days over the 8-year follow-up period.

Table 3 presents descriptive data on the aggregate number of disability days incurred by injured workers in the COHE intervention group and the comparison group, along with the rate of disability days per 1000 injured workers and disability years per 1000 injured workers. Injured workers treated through COHE, on average, were off work and on L&I disability for 49.5 days during the 8-year follow-up period compared with 75.8 days for injured workers in the comparison-group. But 70% of the patients did not incur any disability days because they returned to work shortly after

TABLE 3. Cumulative Disability Days and Disability Rates Over the 8-Year Follow-up Period

	Mean Disability Days (SD)	Cumulative Disability Days	Disability Days Per 1000	Disability Years Per 1000
Comparison group (n = 13,346)*	75.8 (299.9)	1,012,054	75,832	207.8
COHE cohort (n = 12,925)	49.5 (228.2)	639,489	49,476	135.6
Difference	26.3	372,565	26,356	72.2

*Cases include injured workers treated during the COHE operational period (n = 26,271). Injured workers during the preoperational (baseline) period are excluded. COHE indicates Centers of Occupational Health and Education.

injury. The large standard deviations for the mean values shown in Table 3 reflect the fact that a small percentage of injured workers were on disability for multiple years. The cumulative numbers of disability days for the COHE intervention group and the comparison group, respectively, were 639,489 and 1,012,054, a difference of 372,565 disability days. The disability rate (disability days per 1000 persons) was 49,476 for the COHE cohort and 75,832 for the comparison-group cohort, which translates into a rate of years of work disability per 1000 persons of 135.6 and 207.8, or a difference of 72.2 years per 1000 persons.

Finally, Table 4 presents abridged results of our multivariable analysis examining the relationship between the combined disability outcome measure and COHE treatment. The statistical model tested provides an estimate of the change over time in the odds of incurring permanent disability for the average COHE injured worker, adjusting for the similar change among comparison-group injured workers and for other factors, for example, worker age, sex, and provider type. Information about this estimate is provided by the coefficient on the interaction term in Table 4. The value of the coefficient, 0.70, implies a 30% reduction in the risk of experiencing one or more of the 3 work disability outcomes (OR = 0.70; 95% confidence interval = 0.51–0.96; P = 0.02).

TABLE 4. Abridged Results for Odds of Incurring Permanent Work Disability

Measure*	Unadjusted OR (95% CI)	Adjusted OR (95% CI) [†]
Time		
Baseline	—	1.00
Follow-up	—	1.16 (0.96–1.42)
Intervention category		
Comparison group	—	1.00
COHE cohort	—	1.07 (0.82–1.39)
Time × treatment interaction	0.71 (0.52–0.97)	0.70 (0.51–0.96)

*The model adjusted for the following variables: sex, age at injury, employer size, industry, physician specialty, and volume of workers' compensation patients treated by physicians.

[†]Dependent measure is the combined outcome measure described in Table 2.

CI indicates confidence interval; COHE, Centers of Occupational Health and Education; OR, odds ratio.

There was little difference between the unadjusted and adjusted ORs.

DISCUSSION

We have shown in this large, prospective community-wide study that reorganizing care delivery early during treatment for injured workers with routine musculoskeletal conditions in a large state workers' compensation system can reduce subsequent entry into permanent work disability status, including entry into the SSDI system, by 30%. The type of secondary prevention effort via an integrated care approach fostered by the COHE is one of the only known interventions that has been reported to reduce entry to the SSDI system. Recognizing the potential of the COHE model to reduce long-term work disability and to improve labor force participation rates, the US Department of Labor and the Social Security Administration are supporting funding (FOA-ODEP-18-01) for cooperative agreements with states to develop and evaluate new care delivery models, based in part on the COHE model. This approach would be prudent in light of the dramatic increase in the proportion of new entrants into SSDI that are musculoskeletal disorders, nearly double that of just 2 decades ago.¹²

Washington State has a number of characteristics that has made this approach possible. First, the workers' compensation system is public, with direct purchasing power for two thirds of the covered workers in the state. As such, L&I acts as a single payer, which reduces fragmentation making it easier to develop incentives for health system delivery innovation. Regardless of one's view regarding the benefits of a single payer system to finance health care, such a system has important advantages for testing innovations in health care delivery and for evaluating those innovations using population-based data. Second, there are strong statutory relationships with critical business, labor, and provider stakeholders, and with University of Washington health services researchers. In fact, this collaboration was responsible for the original design of the COHEs, including maintenance of worker choice of provider,^{5,6} which was critical for labor stakeholder support. Third, the COHE design included targeted development of a health services coordination function reporting to the health system and to providers, not to the insurer. Fourth, under the COHE expansion the legislature provided funding for an information management system to improve patient tracking and screening for disability risk and for enhanced care coordination functions. Fifth, the credibility of the COHE system and its demonstrated benefit led the WA legislature in 2011 to make the COHEs permanent and to mandate that 100% of workers insured through L&I in the state have access to occupational health care provided through the COHEs.¹³

Large scale demonstrations, such as the COHEs, will be critical to interrupt the several-decade decline of labor force participation in the United States. Other key contributors to this decline, such as overprescribing of opioids, must also be addressed¹² and integrated into new, innovative models of health care delivery.

The most important limitation of this study is that it was not a randomized controlled study. We could not assume equivalence of the 2 study groups, except for exposure to the

COHE treatment model. The DiD statistical model, estimating net change in outcomes over time among treatment cases, is generally viewed as a desirable model for analyzing data generated from nonrandom assignment. Nonetheless, replication of the COHE model in another system, using the same general evaluation methods, will be important to validate these findings. A stepped care management approach with greater care integration on a population basis, such as the COHE intervention, is a promising approach in the treatment of chronic pain. Similar approaches are being implemented in the Veteran's Administration and other health systems.¹⁴

CONCLUSIONS

The ability to work and earn income from that work is viewed as a critical core element of quality of life,¹⁵ offering important advantages for both physical health and mental health.^{16–19} The findings reported here suggest that well designed health care delivery innovations that provide effective secondary prevention services early in the treatment cycle to injured workers with common musculoskeletal injuries can alter the long-term disability trajectory, thereby reducing the disability burden on a population basis.

The experience of Washington State demonstrates the potential of health services research, with important stakeholder support, to have a major impact on health policy. By working closely and collaboratively with a state agency (L&I) and with key stakeholder groups, University of Washington researchers were able to help design and then rigorously test a new model for delivering occupational health services to injured workers. Results from the pilot evaluation had an important influence on health reform via the passage of a state law¹³ expanding the COHE model on a permanent statewide basis. Today over 4000 physicians are providing COHE care to 60% of injured workers insured through L&I throughout the state. On the basis of the findings reported here, there is strong reason to believe the long-term, permanent work disability suffered by these workers is substantially less than it otherwise would be in the absence of occupational health care organized through the COHE model.

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