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We previously identified significant declines in work-related musculoskeletal back injury rates because of overexertion among a large cohort of union carpenters in Washington State between 1989 and 2003⁶ as well as increasing health care utilization for the same diagnoses through their health and welfare fund during

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the same time period.⁷ Their WC costs declined substantially; this was due in large part to declining rates of injury rather than substantive changes in costs per claim over time.⁸ We now further explore the medical costs for musculoskeletal back disorders paid by the carpenters' health and welfare fund during this time period.

Materials and Methods

Data Sources

By using data from the Carpenters Trusts of Western Washington (CTWW), we identified a cohort of union carpenters who worked in the State of Washington between 1989 and 2003, their dates of birth, gender, earliest date of union activity, and their hours of union work. The CTWW also provided the records of eligibility for health care coverage through the trust each month and all claims for medical care covered through the trust. The latter included the actual line items showing payments for care including provider-assigned International Classification of Diseases, 9th revision (ICD-9) diagnosis codes. We subsequently refer to care and payments through the health care trust as private insurance.

The Washington State Department of Labor and Industries (L&I) provided the WC claims for the cohort. The State of Washington operates a state-operated worker's compensation program that captures medical only claims as well as those that result in lost work time. Claims from companies that self-insure for compensation coverage are coded in the L&I data only if they result in paid lost time from work. The L&I data include the date of injury, American National Standards Institute (ANSI) codes describing the type of event causing the injury and the body part(s) injured. Data were extracted on August 26, 2004 allowing 8 months after the last claims were filed in 2003 for fuller development of the claims, proper claim identification, and capture of the self-

insured claims that resulted in paid lost time.

All records were provided with a blinded unique identifier; this allowed us to merge the data on an individual basis without the use of personal identifiers. These methods have been previously described in detail.^{9–11} No race or ethnicity information was available from these sources. Cohort membership was limited to individuals who worked at least 3 months of union hours during this 15-year period and were eligible for health insurance through CTWW.

Primary and Secondary Objectives

There were two primary objectives in these analyses. The first objective was to describe health insurance payment rates for treatment of musculoskeletal back disorders through the CTWW and to explore factors associated with those rates. The second, more exploratory, objective was to compare trends over time in WC injury rates and private health insurance payment rates, charges, and insurance deductibles. The latter objective supplements previously contrasted private utilization rates and work-related injury rates among this cohort⁶ with the goal of further exploration of possible cost shifting.

Definitions of Outcomes and Time at Risk

The primary outcome of interest in the first analysis was payments made by the CTWW for outpatient health care for musculoskeletal back diagnoses based on a primary ICD-9 code diagnosis assigned to the claim by the provider as a requirement for billing purposes. These codes have been described previously.⁷ More specifically, we were interested in assessing payment rates through the health care trust.

By using previously identified line items associated with outpatient health insurance claims⁶ for musculoskeletal back disorders through the trust, payments were identified, ad-

justed, and discounted to compare costs incurred during different years and express them in constant dollars. By using the Consumer Price Index medical component for the nation, we adjusted costs for inflation to the year 2006. Those adjusted costs were then discounted forward by 3% per year to account for changes in the time value of money during the study period. This procedure accounts for differences in the values of services received or payments made at different time periods, yielding comparable values of each cost stream.¹² These two adjustments resulted in all costs being expressed in constant 2006 dollars.

Time at risk was based on months in which each carpenter was eligible for private insurance coverage through the trust; this measure was used as the denominator for rate calculations. Discounted and inflation-adjusted payments, which were used as the rate numerator, were defined as dollars paid for outpatient care for musculoskeletal back disorders during months of insurance eligibility.

Analyses

Health Insurance Payment Rates. In addition to the overall financial burden related to musculoskeletal back disorders through the workers' trust-provided private health insurance plan, we were interested in factors associated with those costs including the history of a prior work-related back injury and the length of time that had elapsed since the date of the work injury. Work-related back injuries and the dates of injury were previously identified using WC records.⁶

Age and gender are associated with health care utilization in other populations^{13,14} as well as in this one,⁷ and both were covariates of interest in the analysis. We were also interested in length of union membership and predominant type of work which are both associated with health care utilization and the risk

of work-related back injury in this cohort.^{6,7}

Strata were constructed to assess risk in each of 4 years of apprenticeship training (which typically correspond to the first 4 years of time in the union) and at 2-year intervals afterward. The union local affiliation was the only surrogate available for characterizing the work done by cohort members. The locals represented by the cohort members were grouped into categories based on the predominant type of carpentry work done by the locals. Assignments of predominant type of work from earlier work with this cohort^{9–11} were updated through interviews with business agents for each union local. The categories included light commercial, heavy commercial, drywall installation, millwrighting, piledriving, residential carpentry, and a mixed category. We were unable to identify the type of work performed by carpenters affiliated with locals outside of the State of Washington; consequently, data for workers in these locals were combined for the analyses and simply labeled “Out of Washington.” These individuals did have private health insurance coverage through CTWW as well. Also of note, the variable constructed for time in the union reflects first union membership rather than first affiliation with a specific union local.

Time at risk and events of interest (health care costs for back disorders in CTWW) were stratified by time before and after a work-related injury as well as by gender, age category, time in the union, and type of work. Age, time in the union, prior work-related back injury status, and calendar time since work injury were all treated as time-dependent variables with time at risk accumulating in the appropriate strata during the 15-year study period. All time at risk for individuals who did not file a work-related claim was assigned to the time before injury category. Payment rates for musculoskeletal back disorders were calculated per 100 person-years (or 1200 months) of

insurance eligibility by year as were payment rates for all other diagnoses for comparison.

The distribution of medical cost data was highly skewed; costs among users were highly variable and a significant proportion of the population never sought care for back pain. Negative binomial models were used to calculate stratified rates and rate ratios.¹⁵ To account for multiple observations per person and the correlation of health care visits and associated costs within subjects, generalized estimating equations were used in the multivariate modeling of these longitudinal data.¹⁶ This general linear modeling did not require transforming the skewed cost data and retransforming back to dollars for interpretation thereby avoiding the associated potential bias.^{17–19}

The initial multivariate model explored health care payments based on categories of age, gender, time in the union, and predominant type of work. We evaluated the effect of having had a work-related back injury and the time that transpired since that injury, adjusting for the above factors. The latter models excluded individuals who had multiple work-related injuries because of interpretive difficulties in defining time before and after injuries. We did evaluate payments made through the health care trust based on the number of compensation injuries during the 15-year period and included a variable for calendar time in the model as well.

Private Insurance Payment Rates Contrasted to Work-Related Back Injury Claims. To meet our second objective, the private insurance payment rates for back disorders were compared with previously described work-related back injury rates based on hours of work in the same 15-year period.⁶ The WC injury rates were felt to be more useful in this comparison than WC payments because of the fact that the state determines the fee schedule for care under WC, a condition not present in private insurance. We also examined the pat-

terns of private health care charges and deductible payments, which are the responsibility of the worker, during this 15-year period.

Results

Private Health Insurance Payment Rates and Associated Factors

The predominantly male cohort of 18,768 carpenters who worked in the State of Washington between 1989 and 2003 has been previously described as have details of their patterns of health care use for back disorders⁷ and their work-related injury experiences and associated costs.^{6,7} The cohort was relatively young at first observation (range from 17 to 76 years, mean 35 years, median 34 years). Sixty percent ($n = 11,217$) of the cohort did not seek medical care for back disorders through either the WC system or through their private union-provided insurance; 10% ($n = 1819$) sought care in both systems.

In this cohort musculoskeletal back disorders accounted for \$6,439,909 in private outpatient health insurance payments in 2006 dollars in 1,117,250 months of insurance eligibility. The overall payment rate was \$6917 per 100 person-years of insurance eligibility (or \$69 for every year of insurance eligibility). This represented 8.2% of private outpatient payments for all conditions among cohort members older than 15 years. The proportion of payments for back disorders varied to some extent by year, ranging from a low of 6.5% in 2001 to a high of 10.8% in 1990, 1992, and 1993.

Private payment rates for musculoskeletal back disorders for older individuals (older than 30) and women were higher than for other workers. Payment rates for back disorders were lower among carpenters affiliated with locals whose members worked predominantly in residential or light construction, drywall installation and millwrighting compared

TABLE 1

Months of Private Insurance Eligibility, Health Insurance Payments, Payment Rates and Adjusted Rate Ratios, Union Carpenters Washington State, 1989–2003

	Months of Insurance Eligibility	Payments	Univariate Payment Rate*† Models (95% CI)	Multivariate Adjusted Rate Ratios‡ (95% CI)
Age				
<20	5,107	9,294	1,971 (1,269–3,162)	0.47 (0.29–0.76)
20–<30	173,565	816,175	4,610 (4,290–4,954)	0.97 (0.82–1.17)
30–<40	356,530	2,327,793	6,512 (6,197–6,841)	1.21 (1.05–1.39)
40–<50	311,613	1,890,206	6,104 (5,788–6,436)	1.08 (0.94–1.23)
50+	216,410	1,341,323	5,741 (5,408–6,095)	1
Gender				
Female	19,594	180,449	9,096 (7,373–11,220)	1.62 (1.16–2.26)
Male	1,043,416	6,204,340	5,846 (5,681–6,017)	1
Time in the union				
<1 yr	74,168	267,751	4,034 (3,577–4,552)	0.65 (0.54–0.77)
1–<2 yrs	77,374	446,489	5,910 (5,297–6,595)	0.92 (0.78–1.09)
2–<3 yrs	63,253	360,222	5,497 (4,890–6,180)	0.85 (0.72–1.00)
3–<4 yrs	54,380	287,740	4,896 (4,323–5,547)	0.75 (0.65–0.88)
4–<6 yrs	88,948	475,988	5,112 (4,640–5,630)	0.79 (0.69–0.91)
6–<8 yrs	69,945	402,054	5,548 (4,974–6,188)	0.84 (0.71–1.00)
8–<10 yrs	64,755	362,243	5,464 (4,871–6,130)	0.82 (0.70–0.95)
10 yrs and over	573,177	3,784,083	6,449 (6,207–6,700)	1
Predominant work				
Residential	14,394	71,156	5,090 (3,973–6,520)	0.98 (0.68–1.41)
Light commercial	125,004	645,991	4,909 (4,521–5,331)	0.83 (0.70–0.98)
Drywall	188,316	1,087,227	5,627 (5,264–6,015)	0.87 (0.75–1.01)
Millwright	20,781	93,991	4,462 (3,647–5,460)	0.65 (0.49–0.88)
Pile driver	60,430	345,033	5,764 (5,116–6,494)	0.90 (0.71–1.14)
Mixed commercial	462,806	2,904,370	6,219 (5,959–6,490)	1.01 (0.88–1.14)
Out of Washington§	17,065	125,816	6,746 (5,449–8,354)	1.20 (0.88–1.63)
Heavy commercial	155,290	988,519	6,323 (5,878–6,803)	1

*Rates are per 100 person-years of insurance eligibility.

†Negative binomial regression model.

‡Negative binomial regression model with generalized estimating equations.

§Affiliated with union local outside the State of Washington; they did have health insurance coverage through CTWW.

TABLE 2

Private Health Insurance Outpatient Payment Rates and Adjusted Rate Ratios for Musculoskeletal Back Diagnoses by the Number of Work-Related Claims, Union Carpenters Washington State, 1989–2003

Number of WC Claims	Payment Rate* (95% CI)	Adjusted Rate Ratio† (95% CI)
None	5,158 (4,992–5,330)	1
One	7,296 (6,817–7,808)	1.40 (1.26–1.55)
Two	9,145 (8,052–10,386)	1.68 (1.41–2.00)
Three	10,362 (8,358–12,847)	1.92 (1.51–2.44)
Four or more	15,164 (11,210–20,514)	2.93 (2.06–4.17)

*Rates are dollars per 100 person-years of insurance eligibility; negative binomial regression.

†Negative binomial regression with generalized estimating equations. Estimates adjusted for age, gender, time in the union, and predominant type of work. Calendar time was not significant and removal did not change other parameter estimates.

with those in heavy commercial work (Table 1).

Private health insurance payments for back diagnoses increased among carpenters with each additional work-related back injury (Table 2). The private health insurance pay-

ment rates for workers with one work-related injury were 40% higher than for those with no history of work injury, while payment rates for those with four or more work-related injuries were nearly three times the payment rate for those with no prior

work injury. After the first work-related back injury claim, medical costs for back disorders covered by private health insurance increased 19% in the first year and 30% for each year thereafter (Table 3).

Patterns of Private Health Insurance Payment Rates and Work-Related Back Injury Claim Rates

The pattern of yearly private health insurance payments associated with musculoskeletal back disorders on behalf of cohort members is contrasted to their previous pattern of work-related back injuries of a musculoskeletal nature because of overexertion type activities (lifting, carrying, pushing, etc)⁶ in Fig. 1A. Work-related back injuries declined steadily over 15 years. Private med-

TABLE 3

Stratified Private Health Insurance Payment Rates and Adjusted Rate Ratios Based on Calendar Time Since Work-Related Back Injury, Union Carpenters Washington State, 1989–2003

Time Since Work Injury	Stratified Rate* of Utilization (95% CI)	Adjusted Rate Ratios† (95% CI)
No prior work injury	5,501 (5,338–5,670)	1
Less than 1 yr	8,030 (6,589–9,787)	1.19 (0.99–1.43)
1–<3 yrs	8,892 (7,592–10,414)	1.30 (1.08–1.58)
3–<5 yrs	9,365 (7,797–11,248)	1.33 (1.05–1.70)
5+ yrs	9,035 (7,877–10,363)	1.32 (1.04–1.68)

*Rates are per 100 person-years of insurance eligibility.

†Adjusted for age, gender, time in the union, predominant type of work, and calendar time; negative binomial regression with generalized estimating equations.

ical payment rates also declined until 1995 after which time they gradually increased; private payment rates for outpatient musculoskeletal back disorders were 16% lower in 2003 than in 1989. Overall outpatient payment rates for all conditions increased 9.7% during this 15-year period. The pattern of charges (the amounts charged by private health care providers, which can differ from actual payments made) (Fig. 1B) rose more steeply after 1995, ending as high as they had been in the early 1990s. (In both figures, the two y axes show different scales pertinent to the sets of rates. Work-related back injury rates are based on hours of work while trust payment rates are based on months of health insurance eligibility.) Mean deductible payments by workers rose nearly 2-fold over 15 years from a low of \$23.95 in 1989 to a high of \$45.51 in 2003. WC payment rates for overexertion back injuries, influenced by occasional very high costs cases, were less stable than injury rates, but they also declined during the 15-year period (not shown here).⁸

Discussion

Among this cohort of union carpenters with private health insurance coverage, medical care for musculoskeletal back disorders was responsible for \$69 in outpatient costs for every person-year of private insurance eligibility between 1989 and 2003. This burden should be viewed

in light of the fact that 60% of the cohort did not seek medical care for back disorders at all in either care system. Even though carpenters with less union experience were at greater risk of work-related injuries⁶ and used more private outpatient health care,⁷ their private payment rates for care in these analyses were not higher than those of workers with more union tenure. These findings suggest differences in severity of musculoskeletal back disorders among those with more union tenure or differences in their patterns of care-seeking for musculoskeletal back problems.

There was a steady increase in payment rates for back diagnoses through the health and welfare fund as the number of work-related back injuries a carpenter experienced increased. The private health insurance payment rates for outpatient care for musculoskeletal back disorders increased by 30% a year in their health and welfare fund a year after a work-related back injury. This increase may reflect formal closure of WC claims and, thus, coverage for care under WC benefits. These findings are all consistent with the chronic nature of some musculoskeletal problems even among working populations,^{1–4} and they provide evidence of the connection, or interplay, between WC and private insurance coverage for these workers.

During a period of time when work-related musculoskeletal back

injuries among this cohort decreased steadily and dramatically,⁶ private health insurance payment rates followed a different pattern. Private payment rates for back disorders dropped 38% between 1989 and 1995, but they have increased since that time. The increase in private payment rates after 1995 is not as dramatic as the increase in outpatient health care utilization rates for musculoskeletal back disorders which, in 2003, were over twice as high as they were in 1989.⁷ Nevertheless, while payments did not mirror our findings regarding utilization as closely as expected, the pattern of charges and deductible payments over time provide additional insight. The private charges closely followed the pattern of utilization through the trust-provided insurance plan that we have previously reported.⁷ When coupled with decreasing compensation injury and cost rates, we believe these observations are consistent with cost-shifting from WC to private insurance coverage. In light of the increasing deductibles, the shift appears to be not only from compensation to private insurance but also to the working individual.

We do not mean to imply that there has not been progress in workplace safety over time, and in fact the pattern of decreasing work-related injury rates and decreasing private costs up until 1995 would seem to suggest that the health status of these workers with regard to back disorders was improving. The same cannot be inferred after 1995 when the contrasting patterns in the two payment and delivery systems are dramatic.

Cost shifting is difficult to clearly evaluate. Concerns have been raised over shifts to worker's compensation caused by the rapid growth of Health Maintenance Organization's in the 1980s,^{20,21} while others have found no evidence of such in particular groups.²² There is a growing documentation of under reporting of work-related conditions for a variety of reasons,^{23–27} including pressure

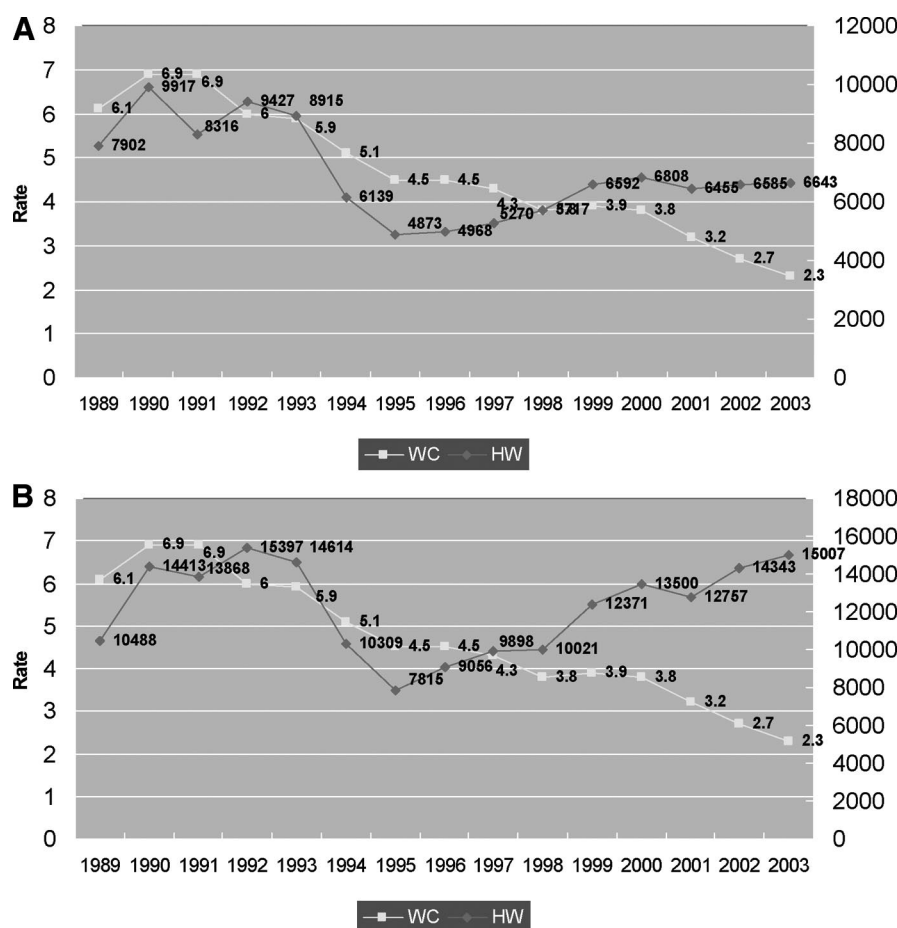


Fig. 1. A, Outpatient private health insurance payment rates for musculoskeletal back diagnoses paid through the CTWW compared with WC injury rates for overexertion back disorders, 1989–2003. B, Outpatient private health insurance charge rates for musculoskeletal back diagnoses, CTWW compared with WC injury rates for overexertion back disorders, 1989–2003. WC, overexertion injury rates per 100 person years (200,000 hours worked); HW, user rates for back care of MS nature per 100 person years of insurance eligibility; limited to one visit per day per person.

from employers, in the form of safety incentive programs.²⁸ Workers sometimes make decisions as to whether they will file a work-related injury claim or not, particularly for less severe events. Jointly trusted health and welfare funds, such as the one we studied, have traditionally had close alliances with the populations they serve. Some of these carpenters report that seeking care through their private union-provided insurance is less difficult than dealing with WC. Others relay concerns about filing WC claims against an employer for fear of being “black listed” in later hiring; this concern can be a serious one for workers such as these who continually work them-

selves out of a job as projects are completed. Some feared difficulty maintaining employment over the long term if they had a history of filing work-related claims for minor injuries such as sprains or strains.

The access to health care data through both the WC system and their union-provided health insurance allowed us to look comprehensively at the medical care for musculoskeletal back disorders and their associated costs for this large cohort over a considerable period of time. Without such access, contrasting the patterns of care over time would not have been possible. An advantage in using payments to measure resource use, particularly for medical care, is that no adjust-

ments for different charge structures among providers must be made. Typically, insurance plans pay for medical care according to a negotiated fee structure (employing a conversion factor and Current Procedural Terminology (CPT) units (for clinic or physician care) or Diagnosis Related Group (DRG) weights (for inpatient care); this obviates adjusting charges submitted by different clinics, hospitals or providers to an estimate of cost, which is a more accurate measure of resource use than are charges. Although we intentionally focused our analyses on payments, in this case, the assessment of charges and deductibles provided information that seems to reflect a shift of financial responsibility to the worker that would not have been evident through examination of payments alone.

The contrasting of patterns of private health care payments and charges with work-related injury rates over time might be described as ecologic in nature. Nevertheless, we know of no better way to assess potential cost-shifting among a population of workers. It is important to recognize that these population-based comparisons provide markers of the overall health of this population (in regard to back disorders) that are likely superior to existing work-related surveillance sources. However, they do not provide information that allows determination of attribution of work-relatedness for non-traumatic back disorders on an individual basis.

Because workers in the construction industry are less likely than workers in other industries to have private health insurance, and because lack of coverage is more prevalent among non-union workers,⁵ our findings are not necessarily generalizable to a workforce without health insurance coverage. Nevertheless, the report of Dong et al,²⁹ documented that less than half of total medical expenses for work-related injuries were paid by WC. These costs were borne not only by private insurance but also by public programs, such as

Medicaid, as well as by workers and their families. We also know that there was some misclassification in the identification of incident injuries based on lack of knowledge of work-related claims that occurred among cohort members prior to 1989, the point at which we were first able to gain data access. If present, misclassification would likely have attenuated the differences in payment rates we observed before and after injury.

Conclusions

In the United States, health care delivery for working individuals is covered by two insurance systems that are designed to operate independently—private health insurance and WC. Among union carpenters in Washington State with private health insurance coverage provided through union membership, medical costs for musculoskeletal back disorders do not appear to be independent of their work-related injury experiences. Private health insurance payment rates for musculoskeletal back pain were lower in 2003 than in 1989 when we first observed this cohort, but they have been steadily increasing since 1995; in addition, charge rates now exceed those observed in 1989. The more recent growth in these rates bears monitoring, particularly in light of indications that medical treatment of back disorders may be shifting from WC to private health insurance among these construction workers. The findings also provide an important warning message about our reliance solely, or even largely, on reported work-related injury statistics for the surveillance of work-related disorders and disease.

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