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Workers' Compensation Medical Expenditures: Price vs. Quantity

David L. Durbin
Dan Corro
Nurhan Helvacian

ABSTRACT

This study compares the medical costs for treating workplace injuries covered by workers' compensation insurance to the costs of treating similar injuries not occurring at work that are covered by group health insurance. Dramatic differences in total medical costs are observed: Medical costs in workers' compensation are double those for similar injuries covered by group health. After controlling for demographic and claimant characteristics, the differences can be entirely explained by a greater utilization of services and a different mix of medical care providers. There is no evidence that health care providers price discriminate or charge workers' compensation claimants any differently for the same services.

INTRODUCTION

A widely-cited study produced for the Minnesota Department of Labor and Industry (1990) found that workers' compensation medical expenditures may be more than twice those for similar injuries treated outside the workers' compensation system. Additional research derived from the Minnesota study (Baker and Krueger, 1993) attributes the disparity in costs to price discrimination and the lack of cost controls in workers' compensation. Baker and Krueger conclude that there may be large potential savings for integrating workers' compensation into a universal health insurance or 24-hour coverage program. The Minnesota study was unique because it used detailed medical information and included a control group

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David L. Durbin is Vice President and Director of Research, Dan Corro is an Actuary, and Nurhan Helvacian is Director of Claims Research, all at the National Council on Compensation Insurance.

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of medical claims covered by group health insurance policies issued by Blue Cross and Blue Shield of Minnesota.[1]

This article re-examines the findings of the Minnesota study employing an equally rich and more comprehensive data set of medical bill–level information. A control group is also employed. This analysis is broader in scope in that data on multiple insurers and states are examined. A sample of workers' compensation claims from four states (Florida, Illinois, Oregon, and Pennsylvania) from 1988 through 1991 for the 15 largest workers' compensation insurers is paired with a control of group health claims for injuries likely to occur on the job. In particular, we examine whether medical expenditures are different for workers' compensation claimants and whether any such differences may be attributable to differences in the unit price per medical service, the quantity or utilization of services, or both.

The next section briefly discusses the data. A section on empirical analysis follows. The first part of the empirical analysis section presents descriptive statistics that decompose medical expenditures per claim into price and quantity measures. The second part analyzes unit prices per procedure, including comparisons between the workers' compensation sample and the control group. The third part of the empirical analysis section presents the results of multivariate regression analyses that examine the factors influencing the observed differences in medical expenditures between the workers' compensation and control groups. This analysis replicates and extends the analysis and findings from the Minnesota study. The descriptive and multivariate analyses imply that the putative differences in medical costs between the workers' compensation and control groups can be explained entirely by differences in treatment intensity and mix of medical care providers. Further, we find no evidence for price discrimination: prices per unit of service do not differ inside or outside the workers' compensation system.

DATA: WORKERS' COMPENSATION AND GROUP HEALTH SAMPLES

The study uses data on workers' compensation claims filed from 1988 through 1991 that resulted in time loss from work.[2] Four states are represented: Florida, Illinois, Oregon, and Pennsylvania.[3] The data consist of a subsample of claims from the National Council on Compensation Insurance (NCCI) Detailed Claim Information (DCI) data base. The DCI is primarily a longitudinal indemnity data base designed to track weekly benefit payments for samples of injured workers until claim resolution. Construction of the data base used in the study involved compiling every medical bill for each claim and reconciling with the reported medical re-

[1] The study used compilations of medical bills, including information on providers and procedures, in contrast to the more generally available total medical expenditures per case.

[2] The data for this study were collected as part of a National Council on Compensation Insurance research pilot project carried out for the National Association of Insurance Commissioners to evaluate the feasibility of a broad-based medical data reporting effort and determine the policy and research usefulness of a medical bill line-item detail data base.

[3] The states were selected based on geographic mix, diversity of statutory cost containment programs, and size to yield an appropriate sample. 5,500 claims were subsampled from the 15 largest insurers in each state with the sampling proportional to insurer market share. See the Appendix for more details.

serves insurers are required to post on their balance sheets. The medical bills include information on each service rendered, the diagnosis, the type of health care provider performing the service, where the service was performed, the amount billed, and the amount the insurer eventually paid. Thus, there is information on unit prices per service, the quantity or utilization of services, and the timing of treatments rendered. The same information is also available on a control sample of group health claims for the same states and years, matched by diagnosis code.[4] This data base is unique: The Minnesota study has some of the same information but for only one state and one insurer. A more detailed discussion of the data selection and descriptive statistics is contained in a working paper that is available from the authors upon request. Details on the data base construction and a list of participating insurers are contained in the Appendix.

In addition to the more comprehensive sample of insurers, states, and years, there is another important distinction between these data and the data used in the Minnesota study. The Minnesota study relied on billed medical amounts; we use data on both billed and paid amounts, and, as discussed below, we control for any out-of-pocket payments (co-pays and deductibles) made by claimants in the control group. Thus, we are able to test for price discrimination based on both billed amounts and actual payments.

ANALYTICS: COSTS, PRICES, AND UTILIZATION OF MEDICAL CARE

The past decade has witnessed a growing interest in research on the determinants of workers' compensation costs and especially the relationship between the level of indemnity (wage) benefits and the propensity to use the workers' compensation system (see Worrall, 1983; Worrall and Appel, 1985; Appel and Borba, 1988; Borba and Appel, 1990; Durbin and Borba, 1993; Thomason, 1993; and Butler, 1994). This literature presents convincing evidence that worker incentives dominate firm incentives in that as statutory benefits rise, total costs rise even more. This so-called "benefit utilization" effect has also been labeled claims reporting moral hazard (Butler and Worrall, 1991); higher benefits have no effect on actual injuries or risk per se but do induce more claim filing.

However, the only significant prior research that analyzes workers' compensation medical expenses in detail is the Minnesota study. A more limited analysis of the difference in hospital costs between workers' compensation and other payors has been conducted by the California Workers' Compensation Institute (CWCI). Otherwise, analysis of the determinants of workers' compensation medical expenses is relatively sparse. The academic research concentrates either on predicting aggregate medical costs and any cyclicality that may exist for pricing (ratemaking) purposes (Butler and Worrall, 1991; Fields and Venezian, 1991) or on evaluating the impact of medical cost containment strategies (Victor and Fleischman, 1990; Durbin and Appel, 1991; and Pozzebon, 1993).

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[4] Data on early retirees, COBRA recipients, dependent care, and unemployed workers were excluded from the control group. The group health claimants were also restricted to be between 17 and 65 years of age. Note the control group is based on fee-for-service coverage and excludes managed care or capitated fee arrangements.

None of this literature, except the Minnesota and CWCI reports, seeks to explain the significantly higher observed levels of workers' compensation medical expenditures. Moreover, there is little in the way of descriptive information available on workers' compensation medical expenses, the nature and types of treatments, the time path of treatment, and how medical expenses are distributed among providers. Comparisons to treatments for similar injuries occurring off the job are likewise scant.

This section of the study comprises three parts: descriptive statistics on the nature, type, and costs of medical expenses between workers' compensation claims and the control group; information on the average prices per procedure for each sample; and multivariate regression analyses that explore the differences in costs (payments)—in particular, the differences between unit prices and utilization.

Descriptive Statistics

Table 1 summarizes the descriptive statistics. Of particular interest is the confirmation that workers' compensation costs and, in particular, the duration of service are much greater than the control group costs both overall and for selected injury types. For the full sample, workers' compensation claimants receive treatment on average for 206 days, compared to 52 days for the control group (a 397 percent difference). This translates into a total cost difference of 168 percent. These differences are strongly statistically significant.

The differences in treatment duration, payments, and number of distinct dates of outpatient service are present for virtually all types of injuries. The one exception is inguinal hernias. Under workers' compensation, hernias still receive treatment over a longer period, but the total payments are slightly lower (91 percent of

Table 1
Descriptive Statistics Summary: Percentage Differences
Between the Workers' Compensation and Control Groups

Type of Injury	Duration of Treatment (%)	Total Payments (%)	Outpatient Dates of Treatment (%)
All	397.8	168.1	216.1
Ankle	466.1	141.3	201.9
Back Strain	357.3	225.5	245.2
Burn	631.0	135.6	196.5
Dislocation	513.6	177.8	298.6
Eye Injury	179.7	144.9	122.2
Fracture	596.0	120.4	216.2
Hernia	295.0	91.3	99.9
Joint	1587.0	308.9	375.3
Knee	354.2	202.7	249.7
Laceration	794.8	285.5	242.0
Nerve	546.7	235.2	204.7
Other Strain	498.9	238.5	299.8
Other	311.1	143.0	183.3

the control). Interestingly, there is no difference in the number of distinct dates of service. In general, however, workers' compensation claims receive treatment for significantly longer periods and receive more services. Total payments also are much higher under workers' compensation: Fractures covered by workers' compensation are 20 percent more expensive, and joint injuries are 200 percent more expensive.

The numbers of dates of outpatient service, a measure of medical care utilization, are higher under workers' compensation. On average across all injuries, workers' compensation claimants see medical care providers more than twice as often as the control group. Excluding hernias, the range is from 122 percent more frequently for eye injuries to 375 percent more frequently for joint injuries.

The components of medical care vary significantly between the workers' compensation sample and the control group. For all injuries combined, workers' compensation claims have lower hospital (facility) payments but much higher payments for supplies (750 percent higher), diagnostic tests (220 percent higher), and professional services (226 percent higher). Although workers' compensation claimants receive more inpatient hospital care than the control group (61 percent of cases vs. 35 percent), the average payments are not statistically different ($1,856 vs. $1,889). This finding is consistent with the CWCI study, which found workers' compensation hospital costs to be no different than those observed for private payers (Blue Cross and Blue Shield and HMO).

However, there are important differences in the use of and average payments to selected health care providers. Workers' compensation claims are much more likely than the group health claims to include physical therapy procedures (35 percent vs. 4 percent) and have much higher average payments for such services ($1,177 vs. $597). Similar differences are observed for radiology services, chiropractic services, and use of orthopedic surgeons.

An examination of back injuries illustrates the general findings. Back injury cases in workers' compensation receive treatment on average over the course of 241 days compared to 68 days for the control group. Payments for back injury cases in workers' compensation are 2.25 times more than the control group ($2,629 vs. $1,166), and the number of distinct days of outpatient service is 2.45 times greater (17 days vs. 7 days). Again, workers' compensation back injury claims are more likely than control group claims to include inpatient hospital services (47 percent vs. 22 percent), but once hospitalized there are no statistically significant differences in average payments ($1,551 vs. $1,441). The difference in total payments per case is an outpatient phenomenon driven by high usage rates for physical therapy (56 percent vs. 6 percent), radiology (65 percent vs. 2 percent), and orthopedic surgeons (16 percent vs. 0.3 percent). Interestingly, the workers' compensation claimants' use of chiropractors is lower than the control group's for back injuries (18 percent vs. 29 percent), but, among those who receive chiropractic treatment, the average payments are much higher ($1,486 vs. $313). These findings are generally consistent with the Minnesota study, which found that the adjusted charges for workers' compensation back injury cases were 2.3 times higher than those covered by group health insurance.

In contrast to the Minnesota study, we observe significant differences for other "non–soft tissue" injuries. For example, fractures covered by workers' compensation received treatment over much longer periods, although the difference in average payment was much lower. Workers' compensation payments were 120 percent higher than the control group's. Workers' compensation–covered fractures received 2.2 times as many days of outpatient services (9.7 vs. 4.5). Again, the differences in payments are an outpatient phenomenon; there are small differences in inpatient usage and no differences in average payments. Workers' compensation claims also exhibit much higher usage of and average costs for physical therapy, radiology, chiropractic services, and orthopedic surgeons.

In general, based on the descriptive statistics, workers' compensation claims receive treatment over a much longer period, perhaps three or four times longer than non–workers' compensation claims. Costs for some injuries may be two to three times as much, with the differences mainly attributable to greater use of outpatient services—particularly physical therapy, radiology, chiropractic services, and orthopedic surgery.

Unit Prices

In an attempt to better differentiate price from quantity, the analyses below focus on information at the procedure level as opposed to the claim level. Significant differences are observed in payments, the length of treatment, and the mix and type of health care providers seen by the workers' compensation claimants and the control group. These differences principally relate to the use of services and not *per se* to the price per service.

The unit price analysis tests the price discrimination hypothesis by looking at differences in the unit price per specific service charged (billed) as identified by the current procedural terminology (CPT) codes used by physicians to categorize the types of services rendered.[5] If price discrimination is contributing to the observed differences in medical expenditures between workers' compensation and the control group, this would be observed by systematic differences in price per service between the workers' compensation and control groups.

Unfortunately, the concept of unit price is sometimes ill-defined in medical care. Data reporting contributes to this problem. For example, the control data include only dollars charged (or paid) per CPT with no indication of the number of services rendered. This is especially problematic for services such as x-rays where multiple services may be rendered at the same time and billed accordingly. In instances where the number of services is not available, the analysis is performed on

[5] CPT codes are used for medical services and procedures performed by physicians and other medical services and procedures performed by physicians and other medical providers (including physical therapists and chiropractors). The CPT codes are quite detailed and include codes for different types of office visits (limited versus comprehensive) and different services (x-rays, MRI, surgical procedures, and physical therapy procedures such as ultrasound, ice packs, and so on).

a price per diem basis. The amount billed or charged, rather than the actual payments, forms the basis for these analyses.[6]

In general, no convincing evidence of price discrimination is observed in our data. Although instances of statistically significant price differences are found in terms of both the price levels and in their trends, there is no pattern that suggests workers' compensation claims are charged more. This finding is based on t-tests of the differences in the average amount billed per CPT.

The top ten procedures observed in the data include chest x-rays, four types of office visits, and five physical therapy procedures. Quite interestingly, although there are statistically significant differences in average prices in nine of the top ten procedures, in only two of those cases (comprehensive office visit and consultation) are prices for workers' compensation claims higher (see Table 2, Panel A). Physical therapy costs for workers' compensation claims are roughly 75 percent of those for the control group. This might be explained in part by the fact that, because of data reporting, this analysis is on a per diem basis; as shown below in Table 3, workers' compensation claims involve many more physical therapy visits per claim than the control group.

Average price differences between workers' compensation claimants and the control group for high-cost procedures are shown in Panel B of Table 2. The high-cost procedures include knee arthroscopy, repair of inguinal hernia, laminectomy, surgery for carpal tunnel, and MRIs. For the most part, these procedures are performed once per case, which simplifies the definitional issues (per diem versus per procedure). For these 14 high-cost procedures, which significantly affect overall medical expenses, there are only three statistically significant differences between the two groups of claims. In each case, the price per procedure was somewhat lower in workers' compensation. In general, the average prices across the 14 procedures are quite similar; the ratio of prices charged workers' compensation claims to the prices charged the control group claims ranges from 0.84 to 1.13, certainly not suggestive of systematic price discrimination. Combined with the descriptive statistics discussed above, these findings suggest that unit price differences are not driving the observed differences in medical expenses; rather, workers' compensation claimants consume a greater volume of medical care.

To examine utilization of medical services, we compare the average number of procedures per case (when performed) between the workers' compensation and control groups. More precisely, we compiled information on the average number

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[6] The data reporting problems also might be affected by the use of medical fee schedules in workers' compensation which may use a slightly different version of the CPT codes, or the CPT codes may differ depending on where the service is actually performed (e.g., physicians office versus hospital). These problems may be particularly acute in Florida, which has had several fee schedule variations over the years. The data used for this analysis were taken as provided and processed by the insurers (both workers' compensation and group health). To the extent that workers' compensation claims are billed with a different set of CPT codes cannot be analyzed with these data. However, a fairly high proportion of CPT codes were matched, suggesting that this is not a significant problem. The analyses were also performed on a by-state basis and the major conclusions were unaffected. Also, as discussed below, the analyses were performed for both high-frequency procedures (where data reporting might be an issue) and for higher-cost procedures (where data reporting problems are less likely), and the results were unchanged.

of days each procedure is performed per case (see Table 3). For all ten high-frequency procedures, workers' compensation claims use more services. The differences are especially notable for the intermediate and extensive office visits (3.32 vs. 1.38 and 3.15 vs. 1.43, respectively) and for physical therapy procedures. Workers' compensation claims use physical therapy treatments more than three times as much on average as the control group.

Table 2
Analysis of Average Cost Differences for High-Frequency and High-Cost Procedures for Workers' Compensation Claimants and a Control Group

Procedure	Control Group Cost	Workers' Compensation Claimant Cost	Ratio
Panel A: High-Frequency Procedures			
Chest X-Ray	44.87	34.95	0.78*
Limited Office Visit	31.44	29.18	0.93*
Intermediate Office Visit	35.58	35.37	0.99
Extensive Office Visit	38.61	42.98	1.11*
Office Consult	148.23	154.81	1.04*
Hot/Cold Pack	32.33	22.70	0.70*
Therapeutic Ex	53.60	41.10	0.77*
Massage	31.33	21.06	0.67*
Ultrasound	31.36	22.45	0.72*
Manipulation	39.72	29.02	0.73*
Panel B: High-Cost Procedures			
Arthroscopy	1577.02	1502.23	0.95
Arthroscopy	1738.76	1735.56	1.00
Repair Hernia	1068.70	898.53	0.84*
Excision-Lumbar	3070.48	2895.93	0.94
Excision-Lumbar	3259.96	3696.48	1.13
Neuroplasty	903.96	919.92	1.02
Radiology-Brain	727.52	728.46	1.00
Radiology-Lumbar	304.61	329.03	1.08
Radiology-Spinal	795.98	758.36	0.95
Radiology	745.68	746.27	1.00
Radiology	797.56	740.47	0.93*
Radiology-Upper Extremity	876.10	793.41	0.91*
Radiology-Lower Extremity	772.88	715.03	0.93
Radiology-Lower Extremity	788.08	727.29	0.92

* Statistically significant at a 90 percent confidence level.

As noted above, the price per procedure comparisons are performed on billed or charged amounts. This may be affected by the use of medical fee schedules in workers' compensation (there is no strict analog in the control group since Medicare-eligible claims are excluded). It is conceivable that medical care providers reference the applicable workers' compensation medical fee schedule when billing. In that case, the presence of the fee schedule might bias downward the billed figures for workers' compensation claims. To examine this issue, we show, by state, average procedure charges for the high-frequency and high-cost procedures shown

above, where a statistically significant difference was observed (see Table 4). No clear pattern emerges indicating that the difference in average charges is any different between fee and non–fee schedule states either by procedure or across all procedures.

Table 3
Use of High-Frequency and High-Cost Procedures:
Average Number of Services Rendered per Case

Procedure	Control Group	Workers' Compensation Claimants
Panel A: High-Frequency Procedures		
Chest X-Ray	1.06	1.24
Limited Office Visit	1.38	2.95
Intermediate Office Visit	1.38	3.32
Extensive Office Visit	1.43	3.15
Office Consult	1.10	1.15
Hot/Cold Pack	3.21	9.51
Therapeutic Ex	3.46	8.14
Massage	3.16	9.14
Ultrasound	2.72	7.69
Manipulation	3.55	14.39
Panel B: High-Cost Procedures		
Arthroscopy	1.02	1.14
Arthroscopy	1.02	1.11
Repair Hernia	1.02	1.02
Excision-Lumbar	1.02	1.05
Excision-Lumbar	1.08	1.15
Neuroplasty	1.14	1.32
Radiology-Brain	1.03	1.06
Radiology-Lumbar	1.03	1.16
Radiology-Spinal	1.02	1.12
Radiology	1.02	1.11
Radiology-Spinal/Lumbar	1.01	1.09
Radiology-Upper Extremity	1.00	1.00
Radiology-Lower Extremity	1.01	1.16
Radiology-Lower Extremity	1.00	1.02

Interestingly, the average price in Oregon of $883.07 for repair of an inguinal hernia is close to the 1990 maximum reimbursement of $886.69. In contrast, in Florida the average price for the same procedure is $962.06, well in excess of the 1991 reimbursement level of $713.

Multivariate Regression Analysis

The analysis presented thus far has been fairly simple in that other factors that can influence the consumption of medical services—for example, demographic characteristics such as age and sex—have not been considered. The nature of the insurance coverage—in particular, the level of cost sharing through copayments and

deductibles—certainly affects the demand for medical care. An extensive health economics literature investigates this issue (Jacobs, 1991, provides a review and bibliography). Differences in the type and severity of injury and other characteristics related to the industry and occupation of the claimants also may affect the demand for medical services. Since our goal is to decompose costs into price and quantity and investigate their relative importance in determining the observed higher costs and growth rates for workers' compensation claims, regression models were estimated that consider a number of other factors. The regression analysis allows an indirect test of whether unit prices are statistically different between the workers' compensation and control groups after controlling for other important injury and demographic differences.

Table 4
Average Cost per Procedure by State

	Florida	Illinois	Oregon	Pennsylvania
Employer Choice	Yes	No	No	Yes
Fee Schedule	Yes	No	Yes	No
Chest X-Ray				
Control Group	43.55	47.09	42.90	46.07
Workers' Compensation	32.09	26.16	56.02	34.48
Limited Office Visit				
Control Group	32.39	32.45	23.77	31.02
Workers' Compensation	29.27	37.29	23.84	31.85
Intermediate Office Visit				
Control Group	35.70	33.66	32.92	36.40
Workers' Compensation	34.73	34.90	34.45	35.41
Extensive Office Visit				
Control Group	40.41	39.65	39.88	37.19
Workers' Compensation	37.35	44.31	47.70	44.11
Repair Hernia				
Control Group	979.16	1105.13	1015.56	1096.99
Workers' Compensation	962.06	951.90	883.07[a]	862.83
Radiology-Spinal/Lumbar				
Control Group	736.06	768.20[a]	688.25[a]	893.51
Workers' Compensation	739.38	473.55	827.29	819.47
Radiology-Upper Extremity				
Control Group	883.75[a]	463.00[a]	550.00[a]	879.93
Workers' Compensation	848.60[a]	622.89[a]	629.25[a]	862.86[a]

[a] Mean based on fewer than 20 observations.

The analysis involves estimating hedonic functions for medical costs. Cost per claim can be represented as

$$c = pq, \tag{1}$$

where c = cost,
p = price, and
q = quantity.

Although measures of prices are not always directly observed, proxy variables are available that measure utilization or the quantity of services. These variables include type of injury, duration of treatment, intensity and volume of treatments, days of hospital stay, and surgery. Specifying q as a function of this set of characteristics plus the demographic controls, and making the usual assumption that demand is a log-linear function of the characteristics gives

$$\ln(q) = \Sigma \beta_i \ln(x_i). \tag{2}$$

Substituting ln(q) into ln(c) gives

$$\ln(c) = \Sigma \beta_i \ln(x_i) + \ln(p), \tag{3}$$

where the constant term (ln(p)) plus the estimated residual in a cost regression implicitly measures the quality-adjusted price. In order to infer whether providers price discriminate against workers' compensation claims, an intercept dummy variable is introduced that takes the value of unity for workers' compensation claims and zero for the control group. The test of price discrimination involves testing the significance of the workers' compensation dummy variable, that is, testing whether there is any additional impact on the intercept (price). This is also the estimation strategy employed in the Minnesota study.[7]

In contrast to the Minnesota study, our regression models use actual payments or reimbursements to providers as the dependent variable of primary interest—a more relevant variable for public policy purposes. Tables 5 through 7 summarize the multiple regression analysis. Table 5 lists the control variables used in the analysis. Since panel data are used, controls for fixed effects (state and year dummy variables) are used; the fixed effects controls, in combination with the basic demographic controls, provide benchmark estimates. These roughly correspond to the descriptive statistics already presented but control for demographic factors not relating to injury type or treatment.

Thus, the final form of the estimating equation is

$$\ln(c_{ijt}) = \beta_i X_{ijt} + \theta_i WC_{ijt} + M_j + \Gamma_t + e_{jt}, \tag{4}$$

where c = total claim payment (costs) of claimant i, in state j, in year t,
β = vector of model parameters,
X = vector of variables influencing payments,
θ = workers' compensation parameter,
M = omitted state effects,
Γ = omitted effects that vary across time but not across states, and
e = independent and identically distributed random variable.

This fixed effect specification allows the model to be estimated using ordinary least squares and provides unbiased parameter estimates.

Four sets of controls examine the impact of injury type, nature of treatment (provider controls), intensity of treatment (volume controls), and nature of work-

[7] The Minnesota study estimates separate workers' compensation and control cost equations and performs a decomposition analysis that allows estimation of a "discrimination coefficient."

ers' compensation cost containment programs (see Table 5). With the exception of hospital length of stay and number of dates of service, the remaining injury type, nature of treatment, and volume controls are all dummy variables with one indicating the presence or use of the treatment or provider type. The research plan involves first estimating simple models with only a core group of demographic controls without the additional control variables to provide benchmark estimates of the differences in payments (estimates of θ) between the workers' compensation and control groups. The additional sets of controls are then incrementally added to observe the effect on the workers' compensation variable. Some of the factors that have been found to affect workers' compensation medical expenditures—for example, the benefit replacement rate (Butler and Worrall, 1991) and attorney involvement (Fields and Venezian, 1991)—are not relevant for the control group. As a result, these effects are subsumed within θ, the workers' compensation coefficient.

Table 5
Control Variables Used in the Multivariate Analysis

Demographic Factors	State and Year Dummy Variables	Cost Containment Dummy Variables	Diagnosis Code	Nature of Treatment	Intensity of Treatment
Sex	Florida	Fee Schedule	Burns	Hospital	Outpatient Dates of Service
Age	Illinois	Employer Choice	Nerve Injury	Physical Medicine	Inpatient Length of Stays
Age Squared	Oregon	Limited Provider Change	Eye Injury	Radiology/ Orthopedic	Inpatient Care
Employment Status	Pennsylvania	Hospital Charge Regulation	Hearing Loss	Surgeon/ Anesthesia	Surgery
	1988	Utilization Review	Hernia	Chiropractor	
	1989	Bill Review	Spinal Cord Injury		
	1990		Joint Injury		
	1991		Fracture; Other Strains and Sprains; Knee, Ankle, and Back Strains and Sprains; Dislocations, Lacerations; Other		

Note: With the exception of hospital length of stay and number of dates of service, the remaining injury type, nature of treatment, and volume controls are all dummy variables with one indicating the presence or use of the treatment or provider type.

In total, seven sets of regressions are estimated, with model 1 the benchmark and model 5 the comprehensive specification; models 6 and 7 isolate the effects of the provider and volume controls (see Table 6). The data used in the regressions are consistent with those used in the descriptive statistics in that a valid diagnosis code is required, and one-day service treatments (the medical-only analogs) have been deleted from the control data.[8]

Table 6
Multivariate Analysis Summary: Impact of Workers' Compensation (WC) on Total Payments (N = 44,670)

Control Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
WC	0.789*	0.736*	0.785*	0.028	-0.037	0.080*	-0.302*
Demographic State and Year	Yes*[a]	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*
WC Cost Containment Program	No	No	Yes*	Yes*	Yes*	Yes*	No
Diagnosis Code	No	No	Yes*	Yes*	Yes*	Yes*	No
Nature of Treatment	No	No	No	Yes*	Yes*	No	Yes*
Intensity of Treatment	No	No	No	No	Yes*	Yes*	Yes*
R^2	0.035	0.037	0.092	0.524	0.673	0.629	0.599
F	162.63*	134.20*	168.88*	1,445.31*	2,456.80*	2,710.18*	4,798.96*

[a] Only state and year variables included.
* Statistically significant at 0.01.

The estimated workers' compensation coefficient in the basic models 1 and 2 is quite large, positive, and strongly statistically significant. This confirms the results from the descriptive statistics; the interpretation of the workers' compensation coefficient of 0.7 to 0.8 is that, even after controlling for state, year, and demographic characteristics, workers' compensation payments are 101 percent to 122 percent higher than payments in the control group.[9]

This finding changes dramatically when the additional sets of control variables are added, in particular the health care provider and treatment intensity (volume) controls. The workers' compensation coefficient diminishes in absolute value until it is not statistically different from zero. Stated differently, differences in total payments per claim between the workers' compensation and control group can be explained primarily by the mix and volume of services. The notion of price discrimination is not supported. The major contributor to this finding seems to be

[8] As discussed in the Appendix, regressions also were run including the one-day service treatments and excluding claims in the control data that had service durations less than the waiting period required before workers' compensation indemnity benefits may be collected. Both the magnitude and statistical significance of the results on the workers' compensation coefficient were unaffected.

[9] Since the models are in semi-log form, the coefficient may be transformed into an elasticity by $e^{\beta} - 1$ (see Halversen and Palmquist, 1981).

the inclusion of the provider controls (model 4); the workers' compensation coefficient becomes insignificant in that specification as well.

Models 6 and 7 explore the effect of various combinations of the control variables. For example, controlling for the volume of services and injury type but not medical care provider yields a positive and significant workers' compensation coefficient (model 6). Adding the health care provider controls but dropping injury type, cost containment, and demographic controls yields a negative and significant workers' compensation coefficient. Differences in medical care provider mix substantially affect medical costs; thus, it is important to control for provider mix when contemplating price versus quantity issues.[10]

Although not shown, the rest of the control variables in the model perform as expected. Inpatient care and surgery increase costs, older workers have higher medical costs, increased intensity or volume of services increases costs, and costs increase monotonically over the time period studied.[11]

The results on the cost containment control variables are also worth noting: Fee schedules and employer choice of physician are associated with lower medical payments. Hospital charge regulations are positively related to payments. The fee schedule and employer choice findings are consistent with earlier work by Durbin and Appel (1991) but different from recent work by Pozzebon (1993). This is the first time the findings with respect to the cost containment controls have been corroborated with microlevel data; previous studies examined state-level information. The provider controls are also all strongly significant. The presence of surgeons, orthopedists, radiologists, and physical therapists all lead to significantly higher payments for medical care.[12]

There are a number of reasons why workers' compensation costs may be higher. Among the most important is the presence of moral. Since medical care is essentially a zero cost good for injured workers, their incentives to consume are strong. Butler and Worrall (1991) find evidence that this "risk bearing" moral hazard is significant in workers' compensation and affects aggregate medical costs.[13]

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[10] Results for the remaining variables in the models are available from the authors upon request. Individual models were also estimated for the 14 previously-examined individual injury types; estimating separate models controls for any heterogeneity in injury mix between the two samples of data. Results are consistent with the combined runs and the descriptive statistics. Of the 14 injury categories, the workers' compensation coefficient is insignificant ten times and negative and significant three times.

[11] Although the state dummy variables are jointly significant ($F = 82.14$), models were run for each state in the sample. The workers' compensation coefficient is negative for two states, not significant in one, and positive in the other. Again, no consistent pattern is observed.

[12] The results using the full sample of control data (i.e., excluding one-day care) are consistent with those reported above. As might be expected, however, the inclusion of the lower-cost control claims increases the magnitude of the workers' compensation coefficient, at least in the benchmark models. The coefficient in model 1 is 1.186; workers' compensation payments are 2.3 times the control. Again, the inclusion of the provider and volume controls in models 4 and 5 causes the workers' compensation coefficient to be not statistically different than zero. All other findings are maintained.

[13] Medical care provider incentives also can play a role. Roberts and Zonia (1994) find evidence that imposing a medical fee schedule for workers' compensation may result in providers upcoding services or otherwise rendering or billing for additional services. To the extent that this hap-

To estimate the impact of moral hazard, regression models are estimated that include a cost sharing variable. For the control group, this variable represents the proportional effect of cost sharing and is equal to the sum of any deductibles, copayments, and coordination of benefits divided by the total payment received by the medical care provider or facility. The results from this model plus other refinements to the regression models are shown in Table 7.

Table 7
Multivariate Analysis Summary: Refined Approaches
Impact of Workers' Compensation (WC) on Total Payments (N = 44,670)

Control Variables	Full Model	Full Model	Full Model	Full Model	Full Model	Surgery Cases[b]	Censored Regressions
WC	—	-0.344*	0.675	0.921	0.027	-0.108**	-0.051
Cost Sharing[a]	-0.774*	-0.803*	—	—	-0.782*	—	—
WC* Demographic Interactions	Yes*	Yes*	Yes	Yes	Yes	—	—
WC* Provider Interactions	—	—	—	Yes*	Yes*	—	—
Demographic State and Year	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*
Cost Containment	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*
ICD-9	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*
Provider	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*
Volume	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*
R^2	0.691	0.691	0.673	0.676	0.694	0.633	—
F	2,695.71*	2,634.25*	2,298.48*	2,073.3*	2,152.5*	722.7*	—
Log-Likelihood	—	—	—				-50,884.7*

[a] Cost Sharing = (deductible + copy + cob)/total.
[b] N = 14,635.
[c] Censored regressions fit using lifereg procedure in SAS.
* Statistically significant at 0.01. ** Statistically significant at 0.05.

The cost share variable is negative and significant. In models without the workers' compensation control, the coefficient is -0.774 and is consistent with expectations on a price variable in a demand equation. The addition of the cost sharing variable has a significant impact on the workers' compensation coefficient. For example, in model 2, the workers' compensation control becomes negative and significant: Controlling for moral hazard and the volume and mix of medical services, the quality-adjusted price is lower in workers' compensation.

It may be the case that price discrimination is more subtle, with individual medical care providers or demographic characteristics playing a role rather than

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pens, the workers' compensation coefficient may be affected. However, the individual by-state regressions (see footnote 10) confirm the basic findings even for non–fee schedule states.

representing a more general tendency. In order to test this hypothesis, we introduce slope shift interactions into the regression models (see Table 7). All the models have the full set of controls plus the listed interaction terms.

Model 3 contains the workers' compensation control plus demographic interactions. None of the interaction coefficients are significantly different from zero. Models 4 and 5 contain workers' compensation/provider interactions with and without the cost sharing variable. Again, the workers' compensation variable and the demographic controls are not different from zero, and, although four of the five provider interactions are significant, only one is positive—the workers' compensation/chiropractor variable. Including the provider interactions, the partial derivative (evaluated at the means of the control variables) of the natural logarithm of payments with respect to workers' compensation is negative; again the price discrimination hypothesis is not supported.

Two other concerns are investigated: possible heterogeneity in injury severity between the workers' compensation and control groups and potential bias from open cases with unknown final costs. Model 6 of Table 7 contains the results from the full model specification (without the cost sharing variable) where the sample has been limited to surgical cases. Although the basic regression models contain controls for injury type and whether there is surgery and inpatient care, it is possible that, even within injury types, the severity of the injuries may not be homogeneous across the two samples.[14] To test this possibility, the samples were restricted to surgical cases which are presumably the more serious injuries and hence more homogeneous. The basic results are maintained: the workers' compensation coefficient is not statistically significant.

Another econometric concern that arises in analyses of workers' compensation claims is the potential bias from open cases where the final costs are not yet known. All models reported thus far include both closed cases (with final payments known) and open cases (with payments as of December 1992). Butler and Worrall (1991), and others, have shown that, to the extent that workers' compensation cases may have long durations, right censoring may affect benefit utilization elasticity estimates. In the present context, the issue is more subtle since the concern is a comparison of costs (payments) between two samples of data, both of which have some censoring. Censored regressions were run to test for any bias (see Maddala, 1983); Model 7 contains the result of maximum likelihood estimates using the full model specification. The workers' compensation coefficient is not significant ($p > 0.12$), and the basic finding of no support for price discrimination is maintained.

Taken together, the regression estimates suggest that the observed differences in workers' compensation payments may be explained by longer service durations driven by the mix of providers rendering medical care. Workers' compensation claimants tend to see more specialists and use physical therapy and chiropractic

[14] It is not obvious which direction any heterogeneity may go: On the one hand, it may be the case that workplace injuries are more serious, especially for lacerations, contusions, and soft tissue injuries. On the other hand, given incentives to file for indemnity benefits, workplace injuries may be less severe.

services more than the control group, thus generating higher costs. In short, utilization and intensity of services appear to be the major cost drivers.

Results of both the multivariate and descriptive analyses are consistent in that neither supports the price discrimination hypothesis. Not only are no differences observed in average prices per service (the CPT analysis), but controlling for the utilization and volume of services explains the differences in total payments between the workers' compensation and control group. This is the major finding of our study: utilization of more, high-cost medical services causes workers' compensation costs to be greater than observed generally. Although the first-dollar nature of the insurance coverage may create incentives for physicians to prescribe, and injured workers to consume, more medical services, including the use of higher-cost providers and services, there is no evidence that on a per-service or per-claim basis workers' compensation claimants are charged any differently than individuals with the same injuries occurring off the job.

Afterthought: Review of State Statutes

Although it is clear from the analysis that there is no support for the price discrimination hypothesis, it is notable that seven states (Alabama, Arkansas, Missouri, Oklahoma, South Dakota, Texas, and Virginia) have explicit statutory language that prohibits such practices. And in recent years, states have addressed this issue indirectly by linking the fee schedules applicable for workers' compensation procedures to (some percentile of) usual and customary charges, or some multiple of an existing schedule (e.g., RBRVS or Blue Cross).

CONCLUSION

The results of our study suggest that utilization of medical services is the major factor driving workers' compensation medical expenses. The analysis further suggests that, although increases in unit prices have certainly impacted the observed growth in workers' compensation medical costs, the prices charged workers' compensation claims are not systematically different from prices observed generally. Thus, we find no support for the price discrimination hypothesis.

The data and analysis suggest that the greater utilization of services is due to several factors. First, the amount or volume of medical services consumed by workers' compensation claimants is greater than for similar injuries occurring off the job. Second, the treatments are extended over a much longer period. Finally, the mix of medical care providers and treatments differ; workers' compensation claimants are much more likely to use inpatient services, orthopedic surgeons, radiology services, physical therapy, and chiropractors. In total, workers' compensation costs are 1.7 times those for the control group, with differences for individual injury types ranging as high as three times as much. These differences on an average cost basis are an outpatient phenomenon. No systematic difference is observed in average hospital costs between the workers' compensation claimants and the control group (although workers' compensation claims are more likely to use hospital services).

The finding that utilization of services is the major element driving the differences in per-claim inflation of workers' compensation medical expenses has important policy implications. A number of states are following Oregon's lead in limiting treatments provided by chiropractors. Other states are considering similar restrictions on physical therapy treatments or are considering specific treatment protocols. These cost containment programs are often part of more general managed care programs which specify treatment standards combined with reviews of treatment plans for efficacy and appropriateness.

The data compiled for this study will be useful for more specific investigations of treatment patterns and potential savings. Future research plans include modeling the time patterns of treatments and costs, investigating the impact of attorney involvement on workers' compensation medical costs, and—since the data are a subsample of DCI (which includes indemnity information)—investigating the link between medical treatment and indemnity costs at the claim level. The link between medical and indemnity cases also addresses important quality-of-care issues, which, in the present context, are not addressed given the lack of meaningful quality information for the non–workers' compensation claims.

APPENDIX

The four sample states were selected based on their geographic mix and the diversity of their cost containment programs. The diversity of administrative rules to contain costs in the four states is summarized in Table 8. Florida and Pennsylvania limit the employees' choice in selecting service providers. Oregon restricts employees from switching providers in the middle of treatment; Florida and Oregon administer fee schedules for services and review bills for utilization rates and fees. Illinois essentially has none of the major cost containment features.

Table 8
Workers' Compensation Cost Containment Rules in Four States

State	Medical Trend	Limited Initial Provider Choices	Limited Provider Change	Fee Schedule	Hospital Charge Regulation	Utilization Review	Bill Review
Florida	11.1%	Yes	Yes	Yes ($)	Yes	Yes	Yes
Illinois	7.4%	No	No	No	No	No	No
Oregon	4.7%	No	Yes	Yes (RVS)	Yes	Yes	Yes
Pennsylvania	13.1%	Yes	Yes	No	Yes	No	No

The study design called for detailed medical cost information on 1,000 closed and 300 open claims to be captured for each state. The closed claims were selected from DCI claims with accident dates after 1987, which closed between 1988 and 1992. Open claims of October 1992 were selected from DCI with accident dates after 1987 that had incurred claim costs exceeding $20,000.

The sampling was refined by identifying the ten workers' compensation insurers in each state with the largest number of eligible claims. Since many of the insurers were the same across the four states, the list was further refined so that 15 insurers in all were selected and participated in the study. For each of the participating insurers, DCI claims were sampled in proportion to their market share in each state to yield the desired 1,300 total claims per state. The 15 participating insurers are

Aetna	Fireman's Fund	PMA
Allstate	Ohio Casualty	SAFECO
CIGNA	Hartford	SAIF
Continental	Liberty Mutual	Wausau
CNA	Lumbermens Mutual	Zurich

The group health or control data were provided by MEDSTAT, Inc., a division of Systemetrics. These data were drawn from the group health experience of Fortune 200 companies collected from over 100 different insurers. The data contain the medical experience of insured active employees, early retirees, COBRA participants, and their dependents and reflects the health care experiences of over six million people.

Data were provided on the employee group health medical costs for the same four states and time periods as the workers' compensation data. In order to focus on injuries similar to those likely to occur on the job, 150 diagnoses were selected to provide a basis for the sample (i.e., excluding such things as obstetrics/gynecology, pediatrics, and geriatric care). Based on other available data sources, the 150 codes chosen represent more than 95 percent of all workers' compensation claims and costs coded by diagnosis.

The MEDSTAT data contain information on providers rendering care, location of service, date of service, diagnosis code, procedure code, amount billed for service and amount paid, amount of any claimant copay or deductible, and demographic information. Using both the insurer and claimant paid amounts, the total amount of provider reimbursements may be calculated. Thus, our analyses focus on payments providers actually receive rather than the amount charged or billed, thereby taking into account any price discounting which may have occurred (unlike the Minnesota study, which looked at the charged amounts).

The ability to compare medical expenditures for similar injuries treated inside and outside workers' compensation systems is conditional on creating an analogous "injury episode" in the group health data. Unlike workers' compensation, where there is a well-defined injury with the actual date of the injury known because of claim filing requirements, there is no real analogous notion in group health.

We dealt with two issues in order to find group health cases that could be compared to the workers' compensation cases. First, like the strategy employed by the Minnesota researchers, we identify "clean" periods before and after which there is no related care. The idea is to search through medical records for a diagnosis that might occur within workers' compensation. Selected codes were used to

"trigger" the inception of a claim.[15] Once one of the trigger codes is first observed (i.e., after a period of no treatment), all related medical expenses within the time period of care are grouped to form an episode that is analogous to a workers' compensation claim. For the analysis presented in this study, two-month "clean" periods were selected.[16]

A second issue concerns the grouping of related medical expenses once a trigger diagnosis has been identified. Because there are 103 triggers, some of which involve completely different injuries, "continuation" diagnosis codes must be specified for each trigger code. Although the diagnosis codes are fairly extensive and well-defined, within a single case there may be multiple diagnosis codes from different medical providers. Some codes may relate to the specific injury, some may relate to care for unrelated treatments. For example, code 846 is for sprains and strains of the sacroiliac region; code 847 is for sprains and strains of other and unspecified parts of the back. Clearly, it makes sense to combine these two diagnoses to form an episode. In contrast, code 824 (ankle fracture) may or may not be related to a back injury. More than likely, back and ankle injuries are not related in a workers' compensation case, although serious accidents may involve multiple related injuries.

For the analysis in this study, we specify "continuation codes" in the episode creation to restrict the analysis to homogeneous injury types. Codes for similar injuries are combined to form the continuation list.[17] Thus, in comparisons of back injuries between the workers' compensation and control groups, only medical care related to the back is considered. This assumption, while simplifying from the possibility of multiple injuries, provides a cleaner basis for appraising how workers' compensation expenditures may differ. In total, data on 104,167 group health injury episodes are available for analysis.

One adjustment has been made to the data. Since the workers' compensation sample has been drawn from the DCI data base, only claims that resulted in time-loss from work and the receipt of indemnity benefits are included. There are no claims for which there is only medical treatment. Because of the nature of the episode creation for the control group, it is impossible to differentiate between indemnity and medical-only claims. Much of the analysis excludes control claims that have only one day of medical service.[18] The one-day claims have median payments of $73, with 95 percent of the claims having payments less than $478; these would appear to be likely candidates for medical-only status. A review of the injuries affected by this exclusion shows that most of them are coded as other

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[15] Among the 150 codes, many are nonspecific or otherwise not appropriate to signal a treatment episode. Their elimination left 103 codes that were used as formal triggers.

[16] In previous analyses prepared for the NAIC, we relaxed the two-month clean period assumption. Qualitatively, the results were maintained with one-, two-, or three-month clean periods (see National Council on Compensation Insurance, 1993).

[17] As part of our report to the NAIC, physician consultants were retained for some data interpretation. These physicians assisted in constructing the continuation codes. The CWCI is performing some similar research and made available to us their episode creation criteria.

[18] The multivariate analysis explores the implications for this assumption. It does not meaningfully affect the conclusions.

(i.e., the diagnostic code is general and not body-part specific) or the claims are of low-frequency injury types.

REFERENCES

Appel, David and Philip S. Borba, Eds., 1988, *Workers' Compensation Insurance Pricing* (Boston: Kluwer Academic Publishers).

Baker, Laurence C. and A. B. Krueger, 1993, Twenty-Four-Hour Coverage and Workers' Compensation Insurance, *Health Affairs,* 12 (Supplement): 271–281.

Borba, Philip S. and David Appel, Eds., 1990, *Benefits, Costs, and Cycles in Workers' Compensation* (Boston: Kluwer Academic Publishers).

Butler, Richard J., 1994, Economic Determinants of Workers' Compensation Trends, *Journal of Risk and Insurance,* 61: 383–401.

Butler, Richard J. and John D. Worrall, 1991, Claims Reporting and Risk Bearing Moral Hazard in Workers Compensation, *Journal of Risk and Insurance,* 58: 191–204.

Durbin, David L. and David Appel, 1991, The Impact of Fee Schedules and Employer Choice of Physician, *NCCI Digest,* 6(3).

Durbin, David L. and Philip S. Borba, Eds., *Workers' Compensation Insurance: Claim Costs, Prices, and Regulation* (Boston: Kluwer Academic Publishers).

Fields, Joseph and Emilio Venezian, 1991, Medical Cost Development in Workers' Compensation, *Journal of Risk and Insurance,* 58: 457–504.

Halversen, Robert and Raymond Palmquist, 1981, The Interpretation of Dummy Variables in Semilogarithmic Equations, *American Economic Review,* 70(3): 474–475.

Hospital Utilization in Workers' Compensation, *CWCI Research Update,* 1992.

Jacobs, Philip, 1991, *The Economics of Health and Medical Care* (Gaithersburg, Md.: Aspen).

Maddala, G. S., 1983, *Limited Dependent and Qualitative Variables in Econometrics* (New York: Cambridge University Press).

National Council on Compensation Insurance, 1993, *Workers' Compensation Medical Expenditures: A Final Report to the NAIC Workers' Compensation D Task Force and Advisory Committee* (Kansas City, Mo.: NCCI).

Pozzebon, Silvanna, 1993, Do Traditional Health Care Cost Containment Practices Really Work? *John Burton's Workers' Compensation Monitor,* 6(3): 17–22.

Report to the Legislature on Health Care Costs and Cost Containment in Minnesota Workers' Compensation, Minnesota Department of Labor and Industry, 1990.

Roberts, Karen and Susan Zonia, 1994, Workers' Compensation Cost Containment and Health Care Provider Income Maintenance Strategies, *Journal of Risk and Insurance,* 61: 117–131.

Thomason, Terry, 1993, Permanent Partial Disability in Workers' Compensation: Probability and Costs, *Journal of Risk and Insurance,* 60: 570–590.

Victor, Richard and Charles Fleischman, 1990, How Choice of Provider and Recessions Affect Medical Costs in Workers' Compensation, Workers' Compensation Research Institute, Cambridge, Massachusetts.

Worrall, John D., Ed., 1983, *Safety and the Work Force: Incentives and Disincentives in Workers' Compensation* (Ithaca, N.Y.: ICR Press, Cornell University).

Worrall, John D. and David Appel, Eds., 1985, *Workers' Compensation Benefits: Adequacy, Equity and Efficiency* (Ithaca, N.Y.: ICR Press, Cornell University).