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Workers' Compensation Cost Containment and Health Care Provider Income Maintenance Strategies

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ABSTRACT

This article examines the effectiveness of health care cost containment measures. The basic hypothesis tested is that health care providers will attempt to circumvent any measures that may decrease their income. The data come from a single insurer in Michigan and include cases from before and after implementation of fee schedules and utilization review policies. The results suggest that, in response to fee schedules, health care providers tend to provide more complex procedures in a shorter period of time and tend to exploit ambiguities allowed under the fee schedule.

Introduction

Workers' compensation costs have increased from \$22.3 billion in 1980 to \$56 billion in 1990 (Thompson, 1992). During this period, average medical costs under workers' compensation increased at an annual rate of 14 percent, while the medical care component of the consumer price index increased at an annual rate of 8 percent. Nationwide, medical benefits accounted for 39.7 percent of total workers' compensation benefits paid during 1990, up from 28.9 percent in 1980 (U.S. Social Security Administration, 1992).[1] In the context of the growing contribution of workers' compensation to the cost of doing

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[1] A telephone conversation with the National Council on Compensation Insurance (NCCI) revealed the possibility that growth is accelerating: Although the percentages are not directly comparable, NCCI estimates that 1992 medical benefits accounted for 45 percent of total benefits paid.

business, containment of medical costs has become an increasingly important subject of concern for state policy-makers and employers.

In an effort to slow the growth of medical costs in workers' compensation, Michigan incorporated medical cost containment measures into its 1985 reform package. These measures, which include a fee schedule and utilization review process, were implemented in August 1989. The fee schedule, specifying the maximum fee payable for each procedure, is revised annually after public hearings. The 1989 fee schedule specified no payment limitation for 34.3 percent of the procedures listed. The fees for these procedures are determined on a case-by-case basis, or "by report" to use the Michigan Bureau of Worker's Disability Compensation (BWDC) terminology.[2]

Insurers are required to perform two types of utilization review: technical review to assure that the maximum fee schedule is observed for each procedure and professional review to evaluate the appropriateness of treatment. Insurers are required to review all cases where medical charges exceed $5,000 or when in-patient hospital treatment is provided, but they have discretion over the extent of their review of the remaining cases. Insurers also are required to send to the BWDC for review a sample of those cases that exceed $5,000 or where in-patient treatment was given.

The purpose of this study is to examine the effectiveness of health care cost containment measures in workers' compensation in Michigan. The perspective taken is that health care providers, like any other group threatened with wage loss or reduction, will attempt to circumvent measures that may decrease their income.[3] Prior studies that have used patient-level data to examine provider responses to cost containment have not been set in a workers' compensation context. Because workers' compensation medical costs are rising faster than costs for other types of medical care, examination of the dynamics of cost increases specific to workers' compensation is clearly important. Microlevel medical claims data from a large workers' compensation insurer in Michigan are used in this study, providing an opportunity to make several useful

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[2] The fee schedule is based on several existing price scales, including Blue Cross/Blue Shield preferred provider organization charges, fee schedules in other states, and other commercial health insurance rates. An initial fee schedule was developed by an ad hoc committee appointed by the Michigan State Office of Health and Medical Affairs that had representatives of state agencies, insurers, employers, and unions. The final fee schedule was the product of negotiation between that committee and representatives of health care providers. Most fees in the initial proposal were adopted from the Michigan Blue Cross/Blue Shield fee schedule. Fees for the most common procedures under workers' compensation were part of the revisions and negotiations. Estimates by experts in the state place the fee schedules on average at about 15 percent below Blue Cross/Blue Shield "usual and customary" rates and about 5 to 10 percent above Medicare rates. A comparison of the new resource-based relative value scale (RBRVS) developed for Medicare with the old "customary, prevailing and reasonable" (CPR) schedules indicates a redistributive effect across specialties (Levy et al., 1990). Assuming the CPR schedules under Medicare and workers' compensation are similar, provider payments will be above RBTVS-based payments for some procedures and below for others.

[3] See Christensen (1992) for a definition of practice income.

inferences about how health care providers can mitigate against measures that threaten their incomes.

The Hypotheses About Provider Behavior

The evidence on the effectiveness of fee schedules to contain medical costs is mixed. Within workers' compensation, anecdotal evidence suggests that fee schedules can slow the growth of medical costs (Johnson and Burton, 1989). Empirical evidence in a study within a single state found that fee schedules were not especially effective in controlling costs (Minnesota Department of Labor and Industry, 1990). One cross-state comparison of the effect of fee schedules on medical cost growth rates found that fee schedules slightly slowed growth (National Council on Compensation Insurance, 1989), while another found no effect (Boden and Fleischman, 1989).

Many reasons for the failure of fee schedules to control costs have been suggested, most referring to changes in provider behavior.[4] One simple explanation is that once fee schedules are published, health care providers who had been charging below-average rates realize what the market can bear and raise their rates (Christensen, 1992; Glaser, 1990). Another explanation is based on the assumption that health care providers are income maximizers seeking the appropriate level of services to provide given the prices they charge (Wedig, Mitchell, and Cromwell, 1989). According to this view, health care providers make up in quantity what they lose in price by increasing their caseload and/or the number of procedures per patient, producing what is referred to as a "volume-offset" (Barer, Evans, and Labelle, 1988; Bradford, 1993; Christensen, 1992; Grimaldi, 1990; Hughes, 1991; Iglehart, 1989; Rakich and Becker, 1992; Reinhardt, 1985). Consistent with this view is the notion that health care providers may be able to provide a greater volume of services by reducing quality (Bradford, 1993; Campbell et al., 1990; Morreim, 1987; Wedig, Mitchell, and Cromwell, 1989). In these studies, quality is measured in terms of the amount of time spent with each patient.

Other studies refer to health care providers as "gaming the system," which includes the provision of increasingly complex procedures as a way of raising revenues or simply the reporting of slightly more expensive procedures (Feldman and Sloan, 1988; Hughes, 1991; Pozzebon, 1990; Wedig, Mitchell, and Cromwell, 1989). A more sophisticated version of system manipulation is self-referral, where physicians refer patients to testing or treatment facilities that they, themselves, own (Mitchell and Scott, 1992; Swedlow et al., 1992). Finally, in workers' compensation claims that involve no lost work time, providers may cost-shift and bill the non-workers' compensation insurer (Glaser, 1990).

[4] Commonly cited reasons for rising medical costs in the face of fee schedules that do not rest specifically on provider behavior are exogenously-driven technological advances in treatment (Holahan, Dor, and Zuckerman, 1990) and insurance-driven price distortions that increase demand (National Council on Compensation Insurance, 1989; Wedig, Mitchell, and Cromwell, 1989).

The basic hypothesis advanced here is that, in the face of health care cost containment measures, health care providers will circumvent those cost containment measures wherever possible and adopt whatever strategies necessary to maintain their level of practice income. The data set used in this study permits the examination of a subset of the possible provider strategies discussed above.

First, consistent with the literature cited above, it is expected that health care providers will attempt to increase the revenues associated with any given type of injury or illness. Although revenue is not synonymous with practice income, it is likely that the two are positively correlated (Starr, 1982; Hemenway et al., 1990; Holahan, Dor, and Zuckerman, 1990). To determine if health care providers engage in this behavior to maintain practice incomes, three hypotheses are tested:

1A: To the extent possible, after the implementation of cost containment, health care providers will increase the volume of services provided by increasing the average number of procedures per claimant, holding the nature of the injury constant.

1B: To the extent possible, after the implementation of cost containment, in order to be able to increase the volume of services they provide, health care providers will reduce the quality of care as measured by duration of treatment, holding the nature of injury constant.[5]

1C: To the extent possible, after the implementation of cost containment, health care providers will increase their use of the most expensive procedures.

It is also argued here that health care providers will attempt to increase the share of cases requiring greater use of utilization review. The rationale for this proposition is that monitoring represents a cost to the monitoring agent, and it is likely that the monitoring resources that can be directed toward an individual case are limited. Utilization review presents an opportunity for the health care provider to negotiate with the monitoring agency over the costs of a case, in particular over the mix and quantity of procedures (Friedson, 1975; Droste, 1989). As the number of cases requiring monitoring increases, the ability of the monitoring agent to carefully review and negotiate over each case will diminish, increasing the likelihood that the health care provider will successfully negotiate higher fees. It is hypothesized here that, in the face of tightly controlled fee schedules but less well controlled utilization review, health care providers will adopt two strategies to avoid income loss:

[5] Average length of time shared by the physician and patient per visit is commonly used as a measure of quality of care (Bradford, 1993; Wedig, Mitchell, and Cromwell, 1989). However, that measure is unavailable in this data set, so duration of treatment period is used as a proxy for quality of care.

2A: To the extent possible, after the implementation of cost containment, health care providers will increase the proportion of cases with total costs exceeding $5,000, the threshold triggering required review by the insurer or monitoring agent.

2B: To the extent possible, after the implementation of cost containment, health care providers will increase the proportion of procedures that are not covered under the fee schedule and consequently require a case-by-case review.

The data used to test the above hypotheses were provided by a large insurer that writes workers' compensation policies in Michigan. This insurer accounts for approximately 17 percent of premium dollars in the voluntary workers' compensation insurance market. A slice-in-time sampling method was used to generate two samples, one before and one after implementation of the cost containment measures. The pre-implementation sample included all workers' compensation claims that involved medical treatment where treatment began between October 1, 1988, and March 31, 1989. The post-implementation sample included all cases with treatment start dates that fell in the same six-month period after cost containment went into effect (that is, October 1, 1989, to March 31, 1990). The variables in the data set include starting date of medical treatment, ending date of treatment, total charges, charges by procedure type,[6] total payments, number of treatments by procedure type, and injury type.[7] The sample sizes were 6,997 for the pre-implementation period and 9,620 for the post-implementation periods.[8]

Empirical Tests and Results

Before examining the hypotheses about health care provider behavior, medical charges before and after implementation of cost containment measures were compared to determine the overall effect of cost containment on charges. Given the above hypotheses about health care provider behavior, it was expected that overall payments per claim would not decrease because health care providers would adopt income maintenance strategies. Median total

[6] The procedure codes were based on those described in American Medical Association (1991). The procedure categories used in this study were generated by the insurer who supplied the data.

[7] See U.S. Department of Health and Human Services (1980) for a description of the injury codes.

[8] One drawback to this data set is that it included no demographic or employment information on claimants. Therefore, it is possible that there were differences between the two samples that contributed to differences in the outcomes examined in this article, such as severity of injury and claimant age, both of which are shown to affect utilization of medical services (Worrall, Appel, and Butler, 1987). Because the period of time between the mid-points of the two samples is one year, it is unlikely that the age of the sample changed significantly. However, it is possible that severity of injury, even after controlling for injury type, did change. One feature of this data set that should minimize unobservable differences between the two periods is that it comes from a single insurer, and one year is too short a period to make major changes in policyholder mix.

payments increased 25.7 percent, from $148 prior to cost containment to $186 after cost containment.[9] While this suggests that the cost control measures had not been effective in reducing total payments, it is possible that the injury mix changed over the two time periods, thus affecting payments. Table 1 shows the injury mix before and after cost containment measures were implemented.

Table 1
Injury Distributions Before and After Implementation of Cost-Containment Measures

	Before Cost Containment		*After Cost Containment*	
Injury Category	*Number of Cases*	*Percent*	*Number of Cases*	*Percent*
Nervous System	51	0.7	112	1.2
Musculoskeletal	697	10.0	1,063	11.0
Fractures	378	5.4	474	5.9
Dislocations, Sprains, Excluding Back	1,194	17.1	1,460	15.2
Dislocations, Sprains, Back	1,525	21.8	1,954	20.3
Open Wounds	1,168	16.7	1,634	17.0
Contusions	1,412	20.2	2,035	21.2
Other	572	8.2	888	9.2

There was a negligible difference in injury mix before and after cost containment, so it is unlikely that the injury mix could explain the absence of a reduction in costs. However, two-way analysis of variance was used to conduct a more formal test for this explanation. This method tests three null hypotheses: (1) the equality of mean payments before and after cost containment, (2) the equality of mean payments across injury categories, and (3) the absence of an interaction effect—that is, that the mean payment per case prior to cost containment equaled that after cost containment, controlling for injury mix. All three hypotheses can be rejected at the 0.0001 level or better ($F = 58.26$, $F = 83.31$, and $F = 7.45$, respectively). The third hypothesis is of specific interest, and rejection of it reinforces the notion that a shift in injury mix cannot explain the absence of reduction in payments.

Taking this simple analysis of total payments before and after implementation of cost containment measures as initial support for the basic argument that health care providers will seek to maintain practice income levels, how is health care provider income maintained? Hypothesis 1A states that health care providers will increase the number of procedures to treat patients. The raw mean number of procedures was 23.85 before and 21.89 after cost containment implementation. The hypothesis that the mean number of procedures before and after cost containment were equal could not be rejected at the 0.134 level (F

[9] It should be noted that the medical consumer price index for U.S. cities increased by 12.4 percent from 141.2 in October 1988, the start of this study, to 158.7 for March 1990, the end of the study.

= 2.25, df [degree of freedom] = $1,\infty$). The hypothesis that the mean number of procedures performed for each injury type did not change between the two time periods also could not be rejected ($F = 0.77$, df = $7,\infty$). This result provides counter-evidence for Hypothesis 1A and suggests that health care providers did not perform more procedures as a strategy to maintain revenues.

Hypothesis 1B, that the duration of treatment would decrease after the implementation of cost containment measures, was tested using a hazard model approach.[10] The dependent variable is the probability that an event—leaving medical care in this study—will occur between time t and t+1, given that it has not occurred by time t. This instantaneous transition, or hazard, rate, h(t) can be expressed using a proportional hazards specification as

$$h(t|x) = h_b(t)e^{x\beta},$$

where h_b = a baseline hazard function, and
x = a vector of observable covariates that will shift this function (Fenn, 1981).

Two models are estimated, one assuming a constant hazard over time (the exponential model) and the second assuming a monotonically increasing or decreasing hazard (the Weibull model).[11] The results are presented in Columns 2 and 4 of Table 2.

Literature on duration models has shown that failure to control for unobserved heterogeneity across individuals may bias the parameter estimates of the covariates, including the parameter of interest here, the dummy variable

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[10] As described, the data set used here was constructed from the insurer's management information system. Cases that had not closed by the time this data set was created were administratively terminated; however, no clear indicator of whether a case had been administratively ended was in the data. In order to be certain that no administratively generated end dates were incorrectly interpreted as true end dates, as well as to eliminate any bias that would occur as a result of having a longer period over which to observe pre-cost containment cases (i.e., from start date to point when data set was created), two adjustments were made to the data.

First, an assumption was made that all claims with an end date beyond the sampling window (March 31, 1989 and 1990 for the pre- and post-containment samples, respectively) had administratively generated end dates, and these cases were designated as censored observations. Although this method of censoring right-truncates those cases with end dates at or beyond the end of the sampling period, this can be viewed as random censoring because the cases begin at different times (Allison, 1984, p. 29).

Second, a subset of cases was then selected from each sample that included only those cases where the date of first treatment occurred in the first three months of each sampling period. This was done to minimize the number of cases where the true end of treatment was unobservable but still to have enough cases from which to infer durations. The implicit assumption was that there was no difference in the distribution of true treatment durations in those cases that started in the first three months of each sample period and in those that started in the second three months.

[11] The hazard function $\lambda(t)$ is λ and $\lambda p(\lambda t)^{p-1}$, for the exponential and Weibull distributions, respectively. When $p > 1$, the hazard is increasing in time, or has positive duration dependence; when $0 < p < 1$, the hazard has negative duration dependence; and, if $p = 1$, there is no duration dependence, (that is, the exponential distribution).

Table 2
Hazard Results

	Weibull Estimates	*Weibull with Heterogeneity*	*Exponential Estimates*	*Exponential with Heterogeneity*
Constant	2.613	1.192	3.211	0.992
	(0.091)	(0.138)	(0.031)	(0.139)
Post	-0.220	-0.211	-0.170	-0.209
	(0.053)	(0.061)	(0.018)	(0.059)
Surgery	1.371	1.631	0.927	1.663
	(0.070)	(0.078)	(0.024)	(0.075)
Nervous System	-1.664	-0.722	-1.615	-0.566
	(0.365)	(0.861)	(0.077)	(0.889)
Musculoskeletal	2.001	2.239	1.363	2.104
	(0.125)	(0.148)	(0.050)	(0.147)
Dislocations, Strains, and	1.454	1.676	1.012	1.558
Sprains, Excluding Back	(0.108)	(0.141)	(0.041)	(0.144)
Back and Spinal	2.133	2.400	1.462	2.259
	(0.108)	(0.139)	(0.042)	(0.140)
Open Wound	-1.063	-0.882	-0.855	-0.856
	(0.100)	(0.156)	(0.034)	(0.160)
Contusion	-0.884	-0.630	-0.757	-0.566
	(0.095)	(0.155)	(0.032)	(0.161)
Other Injuries	1.375	1.556	0.965	1.451
	(0.148)	(0.168)	(0.060)	(0.167)
p	0.540	0.878	1	1
	(0.010)	(0.033)		
Θ	1.341	1.831		
	(0.117)	(0.058)		
Lambda	0.024	0.075	0.020	0.096
	(0.001)	(0.005)	(0.000)	(0.003)
Log-Likelihood	-10,147.85	-9,919.34	-11,814.66	-9,927.16

Note: Standard errors are in parentheses.

indicating that a treatment was initiated after cost containment implementation (Butler and Worrall, 1991; Keifer, 1988; Trussell and Richards, 1985).[12] One method to control for heterogeneity is to treat it as being randomly distributed across individuals and to model that distribution directly (Trussell and Richards, 1985). This unobserved heterogeneity is explicitly incorporated into the denominator of the hazard (the survival function) and is assumed to have a gamma distribution, a frequently assumed distribution (Butler and Worrall, 1985; Greene, 1993). This gamma distribution has a mean equal to 1 and variance θ. The resulting survival function is

[12] The intuition behind this problem is that if the model omits controls for heterogeneity, the estimated hazard may fall more quickly or rise more slowly than would be the case if the population were homogeneous, because those with a high probability of experiencing an event (leaving medical treatment) will experience the event at an early point, leaving only those with lower probabilities in the sample.

$$S(t) = [1 + \theta(\lambda t)^{P}]^{-1/\theta}.$$

The closer θ is to 0, the less unobserved heterogeneity is present.

The results of this estimation controlling for unobserved heterogeneity are presented in Columns 3 and 5 of Table 2. The covariates included to control for observable heterogeneity include seven categorical variables for injury type plus a dummy variable if the case involved surgery.[13] All of the coefficients in all of the models are significant at the 0.0001 level or better except the coefficient for the variable signifying a nervous system injury in the two models that control for unobserved heterogeneity. In both models with controls for unobserved heterogeneity, θ is significantly different from zero, indicating the presence of heterogeneity. However, the effect of controlling for heterogeneity on the parameter of interest, the coefficient on the dummy variable signifying that treatment was initiated after the implementation of cost containment measures, is small. In all four models, the coefficient for this dummy variable is negative as hypothesized. In both Weibull models, $p < 1$, suggesting negative duration dependence; that is, the longer one is in treatment, the lower the probability that treatment will end soon.

Empirically, Hypotheses 1C, 2A, and 2B each states that health care providers will increase their use of specific procedures in order to maintain income. The first is a revenue maintenance strategy, and the last two argue that health care providers will use strategies designed to initiate utilization review, which gives them opportunities for negotiation of payment and increased income. Because parallel arguments are made in these three hypotheses, a general log-linear modeling framework was used to test each of them. For each test, the data were collapsed into a 2 x 8 x 2 matrix—two categories of time (before and after implementation of cost containment measures), eight injury categories, and a dichotomous procedure category indicating whether the change in procedure mix specified in each of the three hypotheses had been used. The following hierarchical log-linear models were fitted to the data:

$$\text{Model 1: } T_{ijk} = I + I^{P}_{i} + I^{I}_{j} + I^{T}_{k},$$

where T_{ijk} = the log of the expected cell frequency,

I = the grand mean (the geometric mean of the observed cell frequencies),

I^{P}_{i} = the logged value of the effects of procedure mix,

I^{I}_{j} = the logged value of the effects of injury, and

I^{T}_{k} = the logged value of the effects of time period.

[13] The dummy variable indicating whether the injury is a fracture is omitted because it is likely to be the easiest type of injury to diagnose and the least ambiguous to treat (see Dionne and St.-Michel, 1991).

Model 1 is the model of independence which hypothesizes that procedure mix, injury mix, and time period are independent.

$$\text{Model 2: } T_{ijk} = I + I^P_i + I^I_j + I^T_k + I^{IT}_{jk},$$

where I^{IT}_{jk} = the interaction between injury category and time.
Model 2 hypothesizes that cell frequency can be explained by the change in injury distribution between the two periods.

$$\text{Model 3: } T_{ijk} = I + I^P_i + I^I_j + I^T_k + I^{PI}_{ij},$$

where I^{PI}_{ij} = the interaction effect between procedure and injury mix.
Model 3 hypothesizes that cell frequency can be explained by the change in procedure mix by injury.

$$\text{Model 4: } T_{ijk} = I + I^P_i + I^I_j + I^T_k + I^{PT}_{ik},$$

where I^{PT}_{ik} = the interaction effect between procedure and time.
Model 4 hypothesizes that the procedure distribution changed between the two periods and that this change was not affected by a change in injury categories.

$$\text{Model 5: } T_{ijk} = I + I^P_i + I^I_j + I^T_k + I^{PT}_{ik} + I^{PI}_{ij}$$

hypothesizes that the interaction between injury category and procedures distribution and that between procedure distribution and time independently explain cell frequencies.

$$\text{Model 6: } T_{ijk} = I + I^P_i + I^I_j + I^T_k + I^{IT}_{jk} + I^{PI}_{ij}$$

hypothesizes that the interaction between injury category and procedure distribution and that between injury category and time independently explain cell frequencies.

$$\text{Model 7: } T_{ijk} = I + I^P_i + I^I_j + I^T_k + I^{IT}_{jk} + I^{PT}_{ik}$$

hypothesizes that the interaction between injury category and time period and that between procedure mix and time independently explain cell frequencies.

$$\text{Model 8: } T_{ijk} = I + I^P_i + I^I_j + I^T_k + I^{IT}_{jk} + I^{PT}_{ik} + I^{PI}_{ij}$$

hypothesizes the injury mix and time, time and procedure mix, and procedure and injury mix combinations explain cell frequencies.

$$\text{Model 9: } T_{ijk} = I + I^P_i + I^I_j + I^T_k + I^{IT}_{jk} + I^{PT}_{ik} + I^{PI}_{ij} + I^{PIT}_{ijk}$$

is the saturated model that includes all possible effects.

In order to test Hypotheses 1C, 2A, and 2B, the change in the log-likelihood ratio statistic is examined with the addition of each new variable interaction. By starting with the model of independence (Model 1) and comparing successive changes in how well the model fits the data, the structure of the interrelationship between the variables can be easily identified. To determine the procedure categories needed to test Hypothesis 1C—that health care providers will use the most expensive procedures—the mean charge for each procedure prior to the implementation of cost containment measures was examined. Surgical procedures were the most expensive.[14] To test this hypothesis, we defined a procedure variable that equaled 1 if the claimant received a surgical procedure and equaled 0 otherwise.

Comparable dichotomous variables were also constructed for each of the remaining hypotheses. To test Hypothesis 2A—that, holding injury mix constant, health care providers would increase the share of cases where total charges exceeded $5,000—a variable was defined that equaled 1 if total charges for the case exceeded $5,000 and equaled 0 otherwise. Finally, to test Hypothesis 2B—that health care providers would use more procedures for which no maximum charge was set under the fee schedule—a variable was created that equaled 1 if such procedures were among those provided to the claimant.

Table 3 shows the log-likelihood ratio statistic and degrees of freedom for each of the log-linear models estimated for each of the hypotheses. In each panel of Table 3, the comparisons between log-likelihood ratio statistics that need to be made are between the model of independence and Model 4. The results shown in Table 3 lend support to all three hypotheses. However, it should be noted that the change in the log-likelihood ratio varies considerably across the three hypotheses. Specifically, although there is support for Hypotheses 1C and 2A (ΔLL [change in the likelihood ratio] = 36.83, df = 1,∞; ΔLL = 39.27, df = 1,∞, respectively), the support is much stronger for Hypothesis 2B (ΔLL = 2039.48, df = 1,∞,). In other words, while there was an increase in the use of surgery and in the number of cases with total charges that exceeded $5,000, more dramatic change was observed in the use of procedures for which there was no specific maximum fee in the fee schedule.

Conclusion

Based on the results presented above, several conclusions can be drawn. First, there is no evidence to support the idea that the implementation of cost containment measures has decreased total costs per claim for medical care for workers' compensation claimants in Michigan. The absence of this reduction cannot be explained by some change in injury composition such that there were more cases requiring expensive treatment after cost containment.[15] We hypothesized that health care providers would engage in several types of behavior to maintain their practice income. The results from our tests of these hypotheses point to a conclusion that health care providers tend to provide more complex procedures in a shorter period of time. The moderate increase in the use of surgery suggests some inclination to use more expensive

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[14] The average charge for surgical procedures before cost containment was $317.47. Even after allowing for an interval of two standard deviations from their means, none of the pre-cost containment charges for the other procedures approached the level of surgical charges.

[15] This conclusion must be qualified because, as mentioned earlier, the injury categories used here are fairly broad, and there is no good measure of severity of injury in the data set.

Table 3
Results of the Log-linear Models

	Log-Likelihood Ratio Statistic	Degrees of Freedom	P
Test of Hypothesis 1C (Increased Use of the Most Expensive Procedures)			
1. Model of Independence	2719.67	22	0.0000
2. {S}{I}{T}{IT}	2684.78	15	0.0000
3. {S}{I}{T}{SI}	99.49	15	0.0000
4. {S}{I}{T}{ST}	2682.84	21	0.0000
5. {S}{I}{T}{SI}{ST}	64.66	14	0.0000
6. {S}{I}{T}{SI}{IT}	2647.96	14	0.0000
7. {S}{I}{T}{ST}{IT}	2647.96	14	0.0000
8. {S}{I}{T}{ST}{IT}{SI}	14.39	7	0.0447
9. Saturated Model	0	---	---
Test of Hypothesis 2A (Increased Share of Cases Exceeding $5,000)			
1. Model of Independence	804.10	21	0.0000
2. {F}{I}{T}{IT}	766.98	14	0.0000
3. {F}{I}{T}{FI}	88.57	14	0.0000
4. {F}{I}{T}{FT}	764.83	20	0.0000
5. {F}{I}{T}{FI}{FT}	49.86	13	0.0000
6. {F}{I}{T}{FI}{IT}	726.49	13	0.0000
7. {F}{I}{T}{FT}{IT}	726.49	3	0.0000
8. {F}{I}{T}{FT}{IT}{FI}	7.54	6	0.2735
9. Saturated Model	0	---	---
Test of Hypothesis 2B (Increased Share of Cases Using Non-Fee Schedule Procedures)			
1. Model of Independence	2409.10	22	0.0000
2. {P}{I}{T}{IT}	2374.22	15	0.0000
3. {P}{I}{T}{PI}	2201.03	15	0.0000
4. {P}{I}{T}{PT}	369.62	21	0.0000
5. {P}{I}{T}{PI}{PT}	334.74	14	0.0000
6. {P}{I}{T}{PI}{IT}	2166.14	8	0.0000
7. {P}{I}{T}{PT}{IT}	151.55	14	0.0000
8. {P}{I}{T}{PT}{IT}{PI}	105.46	7	0.0000
9. Saturated Model	0	---	---

Note: I = injury category, and T = time category (before or after implementation of cost containment measures). S, F, and P = dichotomous variables indicating whether surgery was used, the case exceeded $5,000, and non-fee schedules were required, respectively.

procedures. The decline in the length of treatment indicates a decline in quality of treatment; however, that question deserves further investigation with better measures of quality of care. The results also suggest that health care providers seek to exploit whatever ambiguity is allowed under the fee schedule. Holding injury mix constant, there was a dramatic increase in the proportion of cases where unregulated procedures were used. There was also a statistically significant increase in the number of cases where total charges exceeded $5,000.

The results of this study provide some insight into the role that health care providers play in the growth of workers' compensation medical costs. First, these results suggest that the number of procedures with unspecified fees should be minimized because they provide ambiguity that health care providers will exploit. Second, these results indicate that health care providers will respond to fee schedules by shifting the mix of procedures they provide toward the more expensive and complex. Health care providers also treat for a shorter period of time. This suggests that for a fee schedule to be an effective cost containment tool, it should be coupled with significant resources for utilization review to deter health care providers from overwhelming the system with cases requiring individual review and providing unnecessarily complex, expensive, and possibly lower quality care.

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