A REPORT TO THE INDUSTRY

Provider Experience and Volume-Based Outcomes in California Workers' Compensation

Does "Practice Make Perfect?"

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Foreword

A substantial body of evidence from the group health sector indicates that there is a strong relationship between physician experience, measured by the volume of care provided, and the outcome of that care. In several group health studies, higher levels of provider experience have been associated with lower mortality rates, fewer post-surgical complications, fewer unnecessary services and lower costs to purchasers. This study explores the association between the experience level of the providers who treat and manage California's injured workers and their outcomes as measured by claim costs (medical and indemnity) and other factors.

The study focuses on 39,248 providers who rendered treatment in 1.1 million workers' compensation claims for injuries and illnesses that occurred between 1993 and 2000. Aggregate workers' compensation benefit payments on these claims totaled $8.1 billion. The distribution of cases by the provider's experience in workers' compensation shows 97.8 percent of the providers had fewer than 200 claims over the eight-year span. This subset had an average of 1.3 claims per year, and accounted for 35.2 percent of the claims and 67 percent of the total benefits paid. Average claim costs ranged from $19,856 for providers with one claim in the study period to $8,707 for providers with 1000+ claims, a 56.1 percent relative cost difference after adjusting for differences in case mix. Claims treated by high-volume providers were associated with lower rates of attorney involvement, but even when attorney involvement did occur, these claims had lower claim costs.

About CWCI

The California Workers' Compensation Institute, incorporated in 1964, is a private, non-profit organization of insurers and self-insured employers conducting and communicating research and analyses to improve the California workers' compensation system.

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Provider Experience and Volume-Based Outcomes in California Workers' Compensation – Does "Practice Make Perfect?"

Introduction

California workers' compensation benefit costs total more than $17 billion a year, approximately one-half of which is for medical treatment. Over the last ten years, these medical expenses have increased at a significant rate. In that time, legislators, insurers, employers and researchers have searched for an explanation for a persistent paradox: despite studies showing that managed care programs (including fee schedules, utilization review and PPO network discounts) can generate significant savings for payors (Blay 2000, Swedlow 2000, Johnson 1999, Green-Mckenzie 1998, Bernacki 1998), the Workers' Compensation Insurance Rating Bureau, which tracks insurer premiums and losses, repeatedly has increased its estimates of medical cost development. Bureau data show the average medical cost per indemnity claim rose from $8,707 in 1992 to $24,235 in 2001, a cumulative increase of 178 percent over the 10-year period[1] (WCIRB 2002).

In workers' compensation, as in most healthcare systems, medical care is directed by the physicians[2] who treat the injured workers. These providers order diagnostic tests, admit patients to the hospital, refer to other doctors and physical medicine specialists, and prescribe pharmaceuticals and medical equipment. Recent studies have shown that even when unit prices are set by a fee schedule, physicians can drive higher overall medical costs through increased medical utilization (Gardner 2002, Johnson 2002). Examining a six-year period, Gardner documented a 96 percent increase in average monthly payments for physical medicine services, and a 114 percent increase in average monthly payments for surgery, without any material change in the mix of injuries. Other studies have suggested that where there is a lack of workers' compensation price controls (i.e., for outpatient surgery), there may be an incentive toward opportunistic billing practices by some providers (Kominsky 2001). Much of the recent focus has been on back surgeries, which currently account for more than one-third of all workers' compensation hospital admissions (OSHPD 2000), and the debate over both the volume and the efficacy of back surgery has crossed over from the domain of healthcare professionals to lay audiences (Groopman 2002).

Workers' compensation accounts for less than 5 percent of the overall healthcare economy (OSHPD 2000), yet because the system is administratively complex and burdensome for physicians compared to group health, some providers argue that higher fees for services such as evaluation and management office visits are merited in workers' compensation (Dobson 2002). In addition to managing the course of treatment, workers' compensation physicians must also manage the disability component of the injury, file required medical reports, and meet other administrative requirements. While a limited number of physicians and PPO networks focus exclusively on treating occupational injuries, the California Commission on Health and Safety and Workers' Compensation recently reported on the effect of inadequate physician experience and training within the California workers' compensation system, noting a deterioration in the quality of medical reports, as well as delays in claims administration and return to work (CHSWC 2000).

This study explores the association between the experience level of California's workers' compensation medical providers and their outcomes, as measured by the average medical and indemnity costs per claim as well as other factors.

1 The WCIRB recently estimated that continued increases in medical expenses would push total annual California workers' compensation costs to $20 billion in 2004.

2 Under Labor Code 3209.3, "physicians" include physicians and surgeons holding an M.D. or D.O. degree, psychologists, acupuncturists, optometrists, dentists, podiatrists, and chiropractic practitioners licensed by the state and providing services within the scope of their practice as defined by state law.

Background

The Relationship Between Volume and Outcome

A substantial body of evidence from the group health sector has indicated a strong relationship between physician experience, measured by the volume of care provided, and the outcome of that care (Hughes, Hunt and Luft, 1987). This research has demonstrated that hospitals with a high volume of patients with a specific diagnosis, or who undergo a specialty procedure, have lower mortality rates, adjusted for case mix; shorter average lengths of stay; and fewer patients with extremely long stays (Showstack et al., 1987). Luft, Bunker and Enthoven (1979) examined mortality rates in 1,498 hospitals for 12 surgical procedures of varying complexity. The procedures included open-heart surgery, vascular surgery, transurethral resection of the prostate, coronary bypass and total hip replacement. After adjusting for case mix, the study found that death rates in the hospitals with higher annual volumes of these procedures were 25 to 41 percent lower than in the hospitals with lower volumes.

The volume-outcome relationship has been found at the physician level as well. Research has shown that the greater the proportion of a hospital's patients operated on by low-volume or less experienced surgeons, the worse the patient outcomes. For example, Hughes, Hunt and Luft (1987) analyzed the influence of both hospital volume and the proportion of a hospital's patients operated on by low-volume surgeons on patient outcome across 10 procedures, controlling for other selected factors that may have influenced outcomes. Their results indicated that quality of care was related to both hospital and surgeon experience, with better patient outcomes associated with higher hospital and surgeon volumes.

Some analysts have interpreted the results of the volume-outcome studies to mean that physicians and hospital personnel with more patients develop greater skills, and that this results in better outcomes. This is referred to as the "practice-makes-perfect" hypothesis. Woods et al. (1992) conducted a study focusing on the relationship between volume and costs that provides a good example of the "practice-makes-perfect" effect. After examining a consecutive series of 71 heart transplant patients treated in the same institution, and controlling for various preoperative demographic and clinical risk factors and the specific experience of individual surgeons, the authors noted a marked decrease in operative and postoperative hospital costs over time. While most tests of the practice-makes-perfect hypothesis have used cross-sectional data, the longitudinal study design and the control variables used in this analysis greatly enhance the likelihood that the cost reduction was due to a learning effect. In another longitudinal study, researchers used data from a national sample of hospitals to explore reasons for improved in-hospital survival rates for coronary artery bypass graft (CABG) surgery over a 10-year period (Rosenfeld et al., 1987). The study associated much of the decline in the death rate among these patients to increases in the annual volume of CABG surgery.

An alternative explanation for the volume-outcome phenomenon is that physicians and hospitals with better outcomes attract more patients. This is known as the "selective-referral" hypothesis and was evaluated by Luft et al. (1990) in an exploration of choice of hospitals for patients with seven surgical procedures and five medical diagnoses in three geographic areas in California. For five of seven surgical procedures and two of five medical diagnoses, hospitals with poorer than expected outcomes attracted significantly fewer admissions. The reverse held for two surgical procedures and one medical diagnosis. The authors concluded that quality did play an important role in patient choice of hospital.

Studies of geographic variation in health care have shown regional differences in the practice of medicine are influenced by the training institutions and practice leaders in the region (Chassin, 1986; Wennberg, 1989; Brook, 1988). Wennberg compared the costs and outcomes of care in two areas surrounding academic medical centers (Cambridge, MA and New Haven, CT) and found large differences in Medicare costs, later associated with philosophical differences within the institutions. (For example, at Yale, the emphasis was on allowing elderly patients to die at home, while at Harvard, the emphasis was on procedures that attempted to prolong life.) Studies of the differences in the rates of procedures between regions also found significant differences in mortality associated with these procedures. Institutions and providers who had more experience with newer or more complex procedures had better outcomes than those with less experience. At the core of these differences is the concept that practice makes perfect (and that medical care with efficient and effective outcomes requires continuing practice.) This concept of developing technical expertise through practice is not new to medicine; remember, resi-

dencies are periods of practice for young physicians, where they develop core expertise under the supervision of more experienced practitioners.

A few studies have analyzed both the practice-makes-perfect and the selective-referral explanations at the same time (Luft, Hunt and Maerki, 1987; Hughes et al., 1988; Black and Johnston, 1990). The results suggested that both explanations are valid, and that the relative importance of the practice or referral explanations varied by diagnosis or procedure. However, the nearly unanimous conclusion of the volume-outcome literature was that better outcomes and lower costs could be realized by concentrating patient care in regional referral centers and selected provider networks (Luft, Bunker and Enthoven, 1979).

Some authors have explicitly suggested shutting down low-volume surgery units (Showstack et al., 1987). However, patient volume by itself is not an adequate indicator of quality. Volume is a relative measure, and there are no gold standards for the appropriate volume for a given procedure or diagnosis. The dilemma is that the changing healthcare environment has not only increased the need for quality indicators, it also has affected the use and validity of some of these measures (Phillips and Luft, 1997). Selective contracting with providers can potentially lower mortality, decrease duplication of services and reduce costs to purchasers. However, there are some disadvantages that would result from concentrating care in these ways, including decreased patient convenience, problems maintaining continuity of care and potential reductions in access to care. Selective contracting has traditionally been a process of negotiation based on discounted rates. Little is known about what the political fallout would be if there was an attempt to selectively contract based on criteria like provider volume.

Research Hypothesis

To date there have been no published studies and only anecdotal information concerning the relationship between provider experience in treating and managing workers' compensation claims and claim outcomes. A key goal of this study was to understand the association between the predominant provider's level of workers' compensation experience and the cost of treating an injured worker. The hypothesis of this study was that providers with more experience treating patients in the workers' compensation system achieved better outcomes, reflected in lower medical care and indemnity costs. The study examined provider experience and claim outcomes along several dimensions:

- Distribution of providers by level of workers' compensation experience;
- Claim volumes and characteristics by provider experience level;
- Rates of attorney involvement and percentage of indemnity claims by provider experience level;
- Average cost per claim for all claims, litigated claims and indemnity claims by provider experience level;
- Length of disability by provider experience level; and
- Differences in outcomes by provider experience level for two kinds of musculoskeletal claims (medical back conditions and fractures to the upper and lower extremities).

Data

The Claim Sample

This research utilized data on medical providers, injured workers and medical and other benefit payments compiled from the California Workers' Compensation Institute's Industry Claim Information System (ICIS).[3] Eight national or regional (West Coast) workers' compensation insurers, representing approximately 70 percent of the total insurance premium written in the California workers' compensation system contributed data. ICIS data are comprised of open and closed claims with dates of injury between January 1, 1993 and December 31, 2000. These claims are representative of the broad range of policies (industry type and premium/payroll size) and claim characteristics (injury type, demographics) found in the overall population of California workers' compensation claims.[4] The data include all benefit payments made through December 2000.

This study used 1.1 million claims with workers' compensation benefit payments totaling $8.1 billion. The insurers paid $3.8 billion in medical benefits on these claims (46 percent of total benefits) including outpatient and inpatient services, pharmacy, durable medical equipment and other medical services. They paid $4.3 billion in indemnity benefits (54 percent of total benefits) including temporary disability for lost work time, permanent disability awards and other indemnity payments. The research excluded any insurer data that did not include medical procedure detail.

The distribution of injured workers by gender, average age, employee tenure (the time between date of hire and injury date) and claim type (medical-only and indemnity) was consistent with other studies and observations published in the literature (CWCI, 2002). Exhibit 1 profiles various key characteristics of the claim sample:

Exhibit 1: Claim Sample Characteristics

Claims	**1,098,444**
Total Benefits ($000s)	**$8,147,584**
Medical	$3,806,348
Indemnity	$4,341,236
Gender	
Male	72.1%
Female	27.9%
Average Age at Injury	34.5
Average Tenure (Yrs.)	3.4

Exhibit 2 shows the top ten diagnostic categories based on benefit payments. Claims within the top ten diagnostic categories comprised 81.3 percent of all claims, 79.4 percent of medical payments, 84.5 percent of indemnity benefit payments and 82 percent of total benefits paid.

Exhibit 2: Top Ten Diagnostic Categories[5] (by Total Benefits Paid)

Diagnostic Category	Claims N	Claims PCNT	Total Benefits ($000s)	Total Benefits PCNT	Medical ($000s)	Medical PCNT	Indemnity ($000s)	Indemnity PCNT
Back W/O Spinal Cord Involvement	200,239	18.2%	1,913,809	23.5%	822,165	21.6%	1,091,644	25.1%
Other Injuries, Poisonings & Toxic Effects	145,721	13.3%	1,537,726	18.9%	734,915	19.3%	802,811	18.5%
Sprain Of Shoulder, Arm, Knee, Leg	110,312	10.0%	563,904	6.9%	261,954	6.9%	301,951	7.0%
Wound, Fx Of Shoulder, Arm, Knee, Leg	36,630	3.3%	513,108	6.3%	240,786	6.3%	272,321	6.3%
Back W/ Spinal Or Root Involvement	14,759	1.3%	496,196	6.1%	$207,660	5.5%	288,535	6.6%
Tendonitis, Myositis & Bursitis	46,883	4.3%	431,564	5.3%	190,042	5.0%	241,522	5.6%
Joint Disorders	24,375	2.2%	414,652	5.1%	181,220	4.8%	233,432	5.4%
Minor Wounds	219,775	20.0%	305,177	3.7%	175,190	4.6%	129,986	3.0%
Carpal Tunnel	12,210	1.1%	257,235	3.2%	97,581	2.6%	159,654	3.7%
Cranial & Peripheral Nerve Disorders	10,306	0.9%	248,806	3.1%	107,246	2.8%	141,560	3.3%

3 ICIS is a proprietary transactional database maintained by the California Workers' Compensation Institute that contains detailed information on over 2.5 million work injury claims, including employer and employee characteristics, medical service information and benefit and other administrative cost information.

4 Dobson (2002) analyzed the ICIS database for how well it represents the entire California workers' compensation industry.

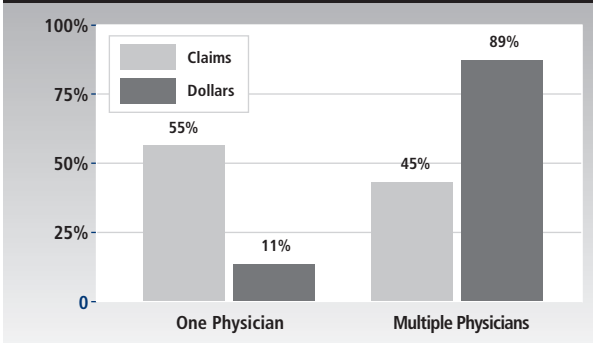
5 ICIS uses a proprietary algorithm to determine primary, secondary and tertiary diagnosis and to group the claims into one of 505 diagnosis categories. The algorithm and grouping system were developed for ICIS data by Swedlow and Gardner and have been previously described in several studies including Smithline et al (1990), Swedlow (1992), CWCI (2001) and Gardner (2001).

The Predominant Provider

This study identified providers and provider groups – clinics, group practices and solo practitioners – through their federal tax identification (tax ID) numbers. The tax ID is useful in that it functions like a Social Security number for the medical organization and is unique to each business entity. The main limitation of using tax ID numbers is that they do not discriminate between individual providers in solo practices and multi-site clinics that have more than one provider.[6]

Occupational injuries and illnesses range from mild (bruises, mild sprains and strains) to catastrophic. Routine, simple injuries typically require less medical intervention than more clinically severe conditions. Exhibit 3 shows that while more than half of the claims had a single medical provider per claim, these claims were associated with only 11 percent of the total medical benefits paid.

Exhibit 3: Claims and Medical Payments by Number of Unique Treating Providers per Claim



Gatekeepers and primary care physicians are terms used to describe the physician who has the most significant influence and responsibility over the course of treatment. However, administrative databases such as ICIS currently do not identify the gatekeeper or primary care physician for the claim. This study used a previously validated approach to identify the predominant treating provider for those claims that had more than one medical provider. Each unique medical treating provider was profiled as to the number of unique dates of service, who received the most payments, who had the longest span of care (days between first and last date of service), the provider's specialty and which provider initiated treatment. The algorithm weighted these various claim control dimensions and the provider with the highest score was "tagged" as the predominant provider for that claim.

The Predominant Provider's Level of Experience

Provider experience was defined as the total number of workers' compensation claims treated between 1993 and 2000. To classify the results, nine provider experience categories were developed:

1. 1 claim
2. 2-4 claims
3. 5-29 claims
4. 30-49 claims
5. 50-99 claims
6. 100-199 claims
7. 200-499 claims
8. 500-999 claims
9. ≥1000 claims

Analysts performed both descriptive and regression analyses to profile the data. The results of the descriptive analyses portray a factual account of the dimensions of workers' compensation experience and outcomes such as the number of claims and total dollars paid to each provider experience group. The regression models define the association between volume and outcomes after controlling for (or case-mix-adjusting) individual and combined effects of other claim characteristics. These factors, also known as independent or predictor variables, are listed in the technical appendix, Along with a more detailed description of the statistical methods.

6 For that reason we could only test our hypothesis at the provider or provider-group level. Physician license numbers, when provided with each medical bill and included in insurers' payment data, will facilitate profiling at the individual provider level.

Results—Unadjusted

Physician and Claim Count Experience

There were 39,248 distinct providers acting as predominant providers on 1.1 million claims. Overall, these providers treated an average of 3.5 workers' compensation claims per year over the eight-year study period. Exhibit 4 shows the distribution of claims and predominant providers across the nine provider experience categories.

Exhibit 4: Physician Claim Counts by Provider Experience (1993-2000)

Experience Category	Providers		Claims		
	TAXIDs	Pcnt	N	Pcnt	Claims/Yr
1	15,129	38.5%	15,129	1.4%	0.1
2–4	10,090	25.7%	27,078	2.5%	0.3
5–29	10,039	25.6%	115,704	10.5%	1.4
30–49	1,290	3.3%	49,599	4.5%	4.8
50–99	1,132	2.9%	79,371	7.2%	8.8
100–199	710	1.8%	99,682	9.1%	17.5
200–499	516	1.3%	161,164	14.7%	39.0
500–999	182	0.5%	126,889	11.6%	87.1
≥1,000	160	0.4%	423,829	38.6%	331.1
Grand Total	39,248	100.0%	1,098,455	100.0%	3.5

The distribution of the workers' compensation cases among these predominant providers was highly skewed. Nearly two-thirds (64.2 percent) of the providers in the sample fell into the two least experienced categories, with only 1-4 workers' compensation claims over the eight-year span. This is an average of less than one workers' compensation case per year. Providers in the two least experienced categories accounted for only 3.9 percent of all claims in the study. Conversely, 2.2 percent of the providers were in the top three experienced categories (200 or more claims), and they averaged more than 103 claims per year, and accounted for almost 65 percent of the claim volume.

Distribution of Benefit Payments by Level of Provider's Workers' Compensation Experience

Exhibit 5 shows the distribution of total benefit payments made for claims treated within each experience category.

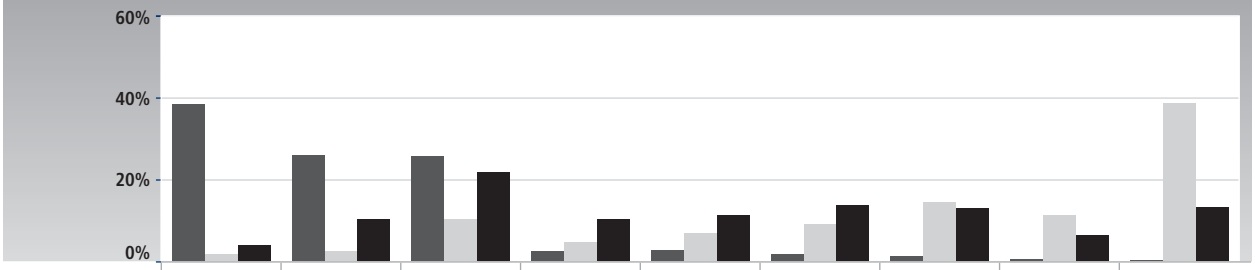
Exhibit 5: Total Benefit Payments ($000's) by Provider Experience (1993-2000)

Experience Category	Total Benefits		Medical		Indemnity	
	Paid ($)	Pcnt	Paid ($)	Pcnt	Paid ($)	Pcnt
1	323,393	4.0%	167,622	4.4%	155,771	3.6%
2-4	451,165	5.5%	220,413	5.8%	230,752	5.3%
5-29	1,788,521	22.0%	836,558	22.0%	951,963	21.9%
30-49	789,576	9.7%	360,158	9.5%	429,418	9.9%
50-99	946,439	11.6%	421,097	11.1%	525,343	12.1%
100-199	1,168,298	14.3%	513,262	13.5%	655,036	15.1%
200-499	1,052,381	12.9%	478,796	12.6%	573,586	13.2%
500-999	541,758	6.6%	273,541	7.2%	268,217	6.2%
≥1000	1,086,051	13.3%	534,901	14.1%	551,150	12.7%
Grand Total	8,147,583	100.0%	3,806,348	100.0%	4,341,236	100.0%

A comparison of the distribution of benefit payments to the distribution of claims, shows costs are disproportionately concentrated at lower experience levels. Exhibit 6 shows the direct comparison of the distribution of claim volume and total benefits paid by experience category.

The 97.8 percent of the predominant providers who treated fewer than 200 claims over the eight-year span accounted for just over one-third of the claims, but those claims accounted for two-thirds of the total benefits paid. In contrast, the 2.2 percent of the providers who had 200+ claims accounted for two-thirds of the claims, but only one-third of total benefit payments.

Exhibit 6: Provider, Claim and Paid Benefit Distributions by Provider Wokers' Compensation Experience



Exp. Category	1	2 – 4	5 – 29	30 – 49	50 – 99	100 – 199	200 – 499	500-999	≥1000
% Providers	38.5%	25.7%	25.6%	3.3%	2.9%	1.8%	1.3%	0.5%	0.4%
% Claims	1.4%	2.5%	10.5%	4.5%	7.2%	9.1%	14.7%	11.6%	38.6%
% Paid	4.0%	5.5%	22.0%	9.7%	11.6%	14.3%	12.9%	6.6%	13.3%

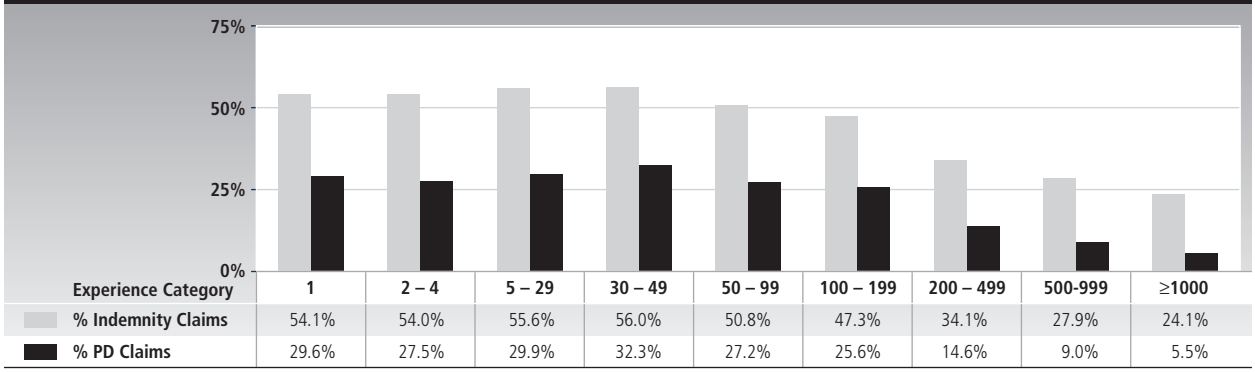
Percentage of Indemnity Claims by Level of Workers' Compensation Experience

In California workers' compensation, if an injured worker is off work less than 3 days or is not hospitalized as an inpatient, their claim is considered a medical-only case. If the injured worker is off work for more than three days or is hospitalized as an inpatient, the claim becomes an indemnity case. Both medical-only and indemnity claims are eligible for full medical coverage; indemnity claims are also eligible for temporary disability payments to help cover lost wages, permanent disability awards if appropriate and, where indicated, vocational rehabilitation or death benefits.

Medical-only cases comprised almost two-thirds of all claims in this study, while indemnity claims (including death cases) accounted for 36 percent of the claim volume, 90 percent of the medical payments and 95 percent of total benefits paid. Permanent disability claims, the most complex claims in workers' compensation, represented just 1 out of every 6 cases, but $6 out of every $7 in benefit payments, and $3 out of $4 in provider and hospital payments. The average benefit cost of a permanent disability claim ($40,454) was more than 10 times the average cost of a temporary disability claim ($3,980).

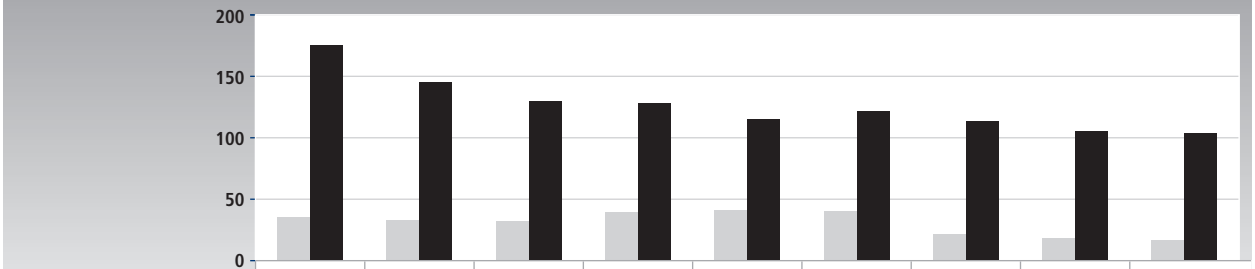
Exhibit 7 shows the proportion of indemnity claims varied significantly among the provider workers' compensation experience categories. As the provider's experience increased, the proportion of medical-only claims increased and the proportion of indemnity claims and permanent disability claims decreased. For example, only about one out of every 18 cases handled by a physician from the most experienced category (1,000 or more claims in the eight-year period) involved a permanent disability, compared to more than one out of four cases in which the provider had fewer than 200 claims. These results show that the workers' compensation case loads of less experienced providers involve a significantly higher percentage of clinically and administratively complex claims. In contrast, the workers' compensation case loads of the more experienced providers include a higher proportion of medical-only claims.

Exhibit 7: Percentage of Indemnity Claims By Provider Workers' Compensation Experience



Experience Category	1	2 – 4	5 – 29	30 – 49	50 – 99	100 – 199	200 – 499	500-999	≥1000
% Indemnity Claims	54.1%	54.0%	55.6%	56.0%	50.8%	47.3%	34.1%	27.9%	24.1%
% PD Claims	29.6%	27.5%	29.9%	32.3%	27.2%	25.6%	14.6%	9.0%	5.5%

Exhibit 8: Average Length of Disability (TD Paid Days) Temporary and Permanent Disability Claims



Experience Category	1	2 – 4	5 – 29	30 – 49	50 – 99	100 – 199	200 – 499	500-999	≥1000
Temporary Disability	35.9	32.8	32.2	33.9	31.6	31.1	21.9	19.2	17.2
Permanent Disability	175.4	145.4	130.6	127.0	114.6	121.7	113.1	104.3	103.7

Length of Disability

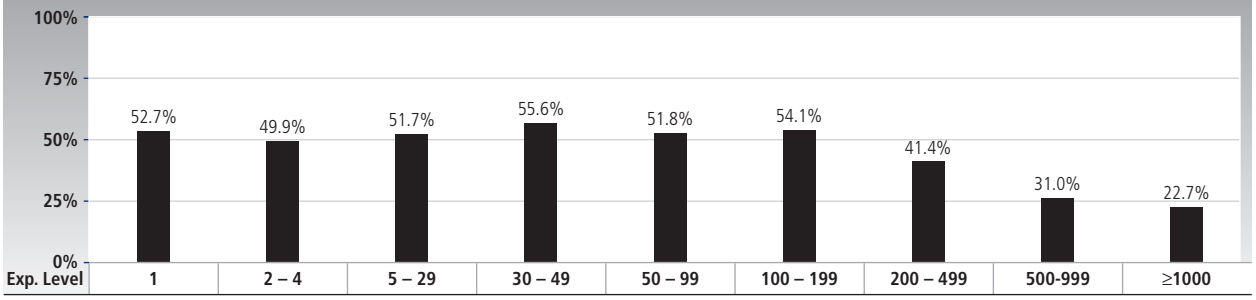
Exhibit 8 shows the average length of disability[7] among two types of indemnity claims (temporary and permanent disability) by experience category. For both types of indemnity claims there was an inverse relationship between a physician's workers' compensation experience and length of disability. For example, the average length of temporary disability on an indemnity claim when the provider had fewer than 200 claims was a little over a month, compared to 17 days for claims treated by providers in the most experienced category. The differences in length of disability were apparent among permanent disability cases as well, with an average disability duration ranging from 175 days among cases handled by the least experienced workers' compensation providers to 104 days when the provider had treated more than 1,000 injured workers.

Attorney Involvement Rates by Provider's Level of Workers' Compensation Experience

Claims with attorney involvement[8] are ultimately the most expensive claims in the system, entailing legal and administrative costs in addition to higher medical costs, lost-time and other indemnity benefits. Claims with attorney involvement are also the most administratively complex claims. Results from this research and other recent studies show attorney involvement is typically the single most important factor associated with high cliam costs in California workers' compensation.

Exhibit 9 shows that indemnity claims managed by providers with 1000 or more claims overall had an attorney involvement rate of 22.7 percent. In contrast, the attorney involvement rate for indemnity claims in which the provider treated only one workers' compensation claim was 52.7 percent, nearly 2.5 times the rate for claims in which the doctors had the most workers' compensation experience.

Exhibit 9: Attorney Involvement Rate (Indemnity Claims Only) By Provider's Workers' Comp. Experience



7 The authors are indebted to Frank Neuhauser for his suggestions and refinements to the authors' methodology for calculating length of paid temporary disability.

8 Attorney involvement claims are defined as a combination of both the presence of an attorney involvement flag (from the payor's claim administrative files) coupled with actual payments made to applicant or defense attorneys.

Results—Case-Mix-Adjusted

The preceding section profiled a number of factors that might explain the differences in costs that are associated with different levels of provider experience. In addition to different indemnity and attorney involvement rates, injured workers who go to a more experienced provider may have a different mix of injuries, occupations, or demographic characteristics than those treated by someone with less workers' compensation experience.

To assure a fair evaluation of the relationship between provider experience and outcome, a methodology was needed to control for those variables other than provider experience that may influence outcomes. This process is known as case-mix-adjustment. The analysts performed the case-mix-adjustment using regression analysis, which is described in greater detail in the technical appendix. The regression models allowed the researchers to determine the independent effect of physician experience by controlling for the impact of other measurable factors such as indemnity, litigation, diagnosis, demographics, etc. The regression results were then converted into dollar differences to determine case-mix-adjusted costs by level of provider experience with a workers' compensation population.

Exhibit 10 shows average case-mix-adjusted medical and indemnity costs for all claims in the study by experience category. In addition, the table lists the proportion of medical to indemnity costs and the differences in payments between claims involving the least experienced providers (those with only a single workers' compensation claim in eight years) and claims from each of the other provider experience categories.

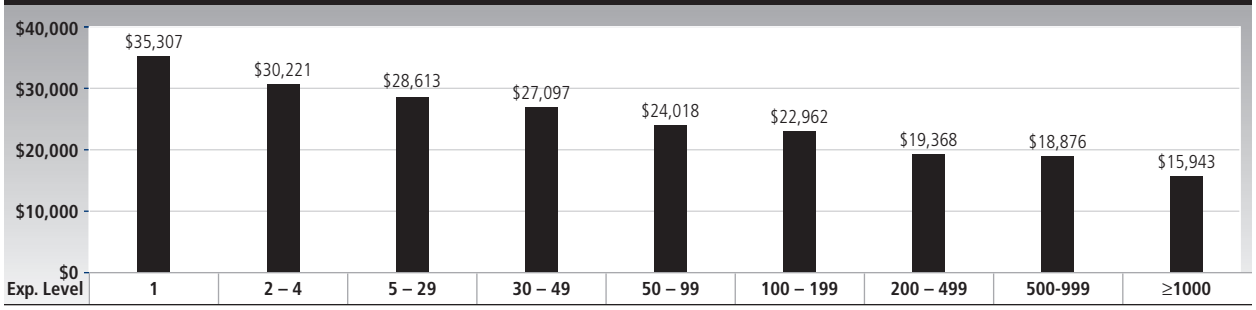
Average case-mix-adjusted claim costs ranged from a high of $19,856 for providers with one claim in the study period to a low of $8,707 for providers with 1000+ claims, a 56.4 percent relative cost difference. Some have suggested that any medical savings generated through the use of more experienced workers' compensation providers may be offset by delays in the injured worker's return to work. However, Exhibit 10 shows the proportion of medical to indemnity costs was relatively stable across the provider experience categories, suggesting there is no substitution of indemnity or time-off costs for lower medical costs.

The data also suggest that even at high levels of provider experience, there is room for greater efficiencies. A comparison of case-mix-adjusted average costs for the two most experienced provider categories (500-999 and 1000+) shows a $1,576 difference. That translates to an additional 8.5 percent reduction in average cost per claim (compared to the baseline average cost) for claims handled by the most experienced providers.

Exhibit 10: Case-Mix-Adjusted Average Cost per Claim by Provider's Workers' Comp Experience – All Claims

	Provider Experience Category								
	1	2 – 4	5 – 29	30 – 49	50 – 99	100 – 199	200 – 499	500 – 999	1000+
Average Paid									
Medical	$9,560	$8,029	$7,591	$7,063	$6,243	$5,960	$5,046	$4,977	$4,167
Indemnity	$10,296	$8,998	$8,680	$8,545	$7,807	$7,523	$6,085	$5,305	$4,540
Total	$19,856	$17,027	$16,271	$15,607	$14,049	$13,482	$11,131	$10,283	$8,707
Benefit Percentages									
Medical	48.1%	47.2%	46.7%	45.3%	44.4%	44.2%	45.3%	48.4%	47.9%
Indemnity	51.9%	52.8%	53.3%	54.7%	55.6%	55.8%	54.7%	51.6%	52.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Payment Difference with Additional Experience									
Total Benefit Paid	—	**-16.0%**	**-20.6%**	**-26.1%**	**-34.7%**	**-37.7%**	**-47.2%**	**-47.9%**	**-56.4%**

Exhibit 11: Case-Mix-Adjusted Avg. Cost by Provider's Workers' Comp Experience (Indemnity Claims Only)



Case-Mix-Adjusted Average Cost per Indemnity Claim

Exhibit 11 displays average case-mix-adjusted benefit costs for indemnity claims, which represented over 95 percent of the paid benefits in the study sample. Again, there was an inverse relationship between cost and physician experience. Claims treated by the least experienced providers had the highest average cost ($35,307) while those handled by the most experienced providers averaged less than half that amount ($15,943).

Exhibit 12 shows the average cost for claims in which an attorney was involved. After adjusting for case mix, average benefit payments on a litigated claim managed by a provider with 1000+ claims was $23,926, compared to $52,986 for a litigated claim managed by a provider with one claim, a relative difference of 54.8 percent.

The combined findings of Exhibit 9 (attorney involvement rate) and Exhibit 12 (average cost when there was attorney involvement) indicate that claims treated by high-volume providers were associated with less attorney involvement, but even when attorney involvement did occur, these claims had lower benefit costs.

Results for Two Specific Diagnostic Categories

Musculosketal injuries are more prevalent in workers' compensation than in other health care sectors. Previous studies have shown that 34 percent of all workers' compensation hospital admissions are for back surgery (DRG 496 – 500) compared to 4.5 percent in group health (CWCI 2001). As was shown in Exhibit 2, medical back conditions without spinal cord involvement were the single most costly diagnostic category among the claims analyzed for this study, accounting for nearly one out of every four dollars in benefit payments and one out of every six injuries.

Exhibit 13 displays the case-mix-adjusted cost outcomes for two leading types of musculoskeletal-related claims: medical back conditions without spinal cord involvement, and fractures to the upper and lower extremities (arms, legs, etc.)

The case-mix-adjusted average cost for a medical back condition without spinal cord involvement for claims managed by providers with one claim was $13,184, versus $8,621 for claims managed by providers with 1000+ claims, a 34.6 percent relative difference. The case-mix-adjusted average cost per claim for treating an upper or lower extremity fracture was $17,789 for claims managed by providers with one claim compared to $13,226 for claims managed by providers with 1000+ claims, a 25.7 percent difference.

Exhibit 12: Attorney Involvement Claims: Avg. Benefit Payments by Provider's Workers' Comp Experience

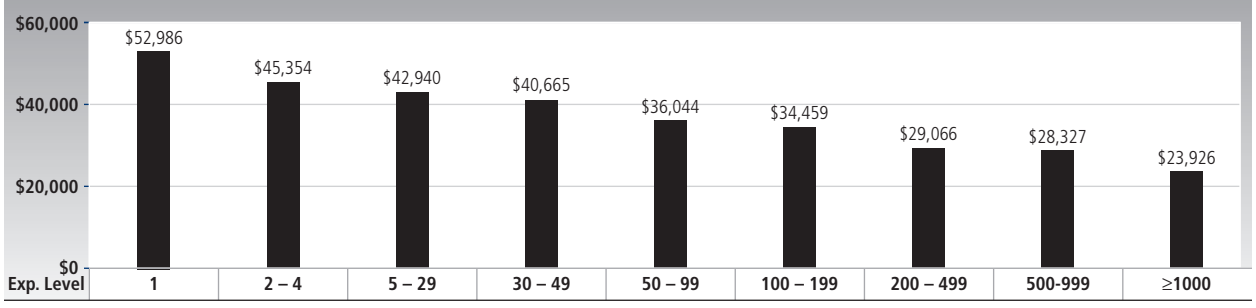
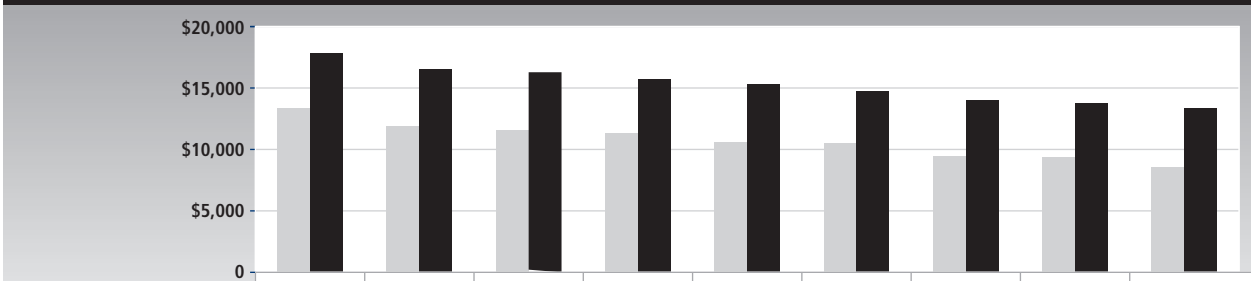


Exhibit 13: Avg. Cost per Claim by Provider's Workers' Comp Experience
Medical Back Conditions (w/o Spinal Cord Involvement) vs. Upper and Lower Extremity Fractures



Experience Levels	1	2 – 4	5 – 29	30 – 49	50 – 99	100 – 199	200 – 499	500-999	≥1000
Medical Back Conditions	$13,184	$11,986	$11,607	$11,250	$10,524	$10,524	$9,428	$9,312	$8,621
Fractures	$17,789	$16,590	$16,211	$15,854	$15,129	$14,880	$14,033	$13,917	$13,226

Isolating two leading (but fundamentally different) types of musculoskeletal claims produces the same inverse relationship between the average adjusted cost per case and the provider's workers' compensation experience, but the relationship does vary between the two conditions. One reason provider experience may have less of a cost impact in fracture cases than in medical back conditions may be that the treatment path for fractures is better defined. Most fracture injuries involve standard radiological tests, procedures to set and immobilize the impaired bones, and other fairly well-defined procedures. On the other hand, medical back conditions, particularly in workers' compensation, have much more utilization and cost variability, signifying greater provider discretion in the volume and mix of services provided, including surgery, physical medicine and chiropractic treatment (CWCI 2002).

Discussion

The hypothesis of this study was that claims handled by providers with greater workers' compensation experience would demonstrate lower claim costs. The descriptive and case-mix-adjusted regression analyses showed that claims in which the medical provider had more workers' compensation experience were associated with lower treatment costs, lower indemnity costs on lost-time claims, and lower rates of attorney involvement. There are two central factors to take into account in interpreting these results. First, the nature of the providers differs at different levels of claim volume. The lower end of the volume spectrum is dominated by providers who only sporadically render treatment in workers' compensation claims. Many had only handled one claim in the eight-year period. At the other end of the spectrum, the providers with the higher levels of claim volume may represent a different type of provider entity, such as clinics, large physician groups, or solo practitioners who specialize in workers' compensation injuries.

The relationship between provider claim volumes as measured by this study and the experience of individual physicians is not entirely clear because the study had to bundle provider experience by tax ID. It may be that those entities with large volumes of patients in this data set were large physician groups or clinics with administrative systems to support explicit treatment protocols, disability management, data collection and internal clinical review. However, it is equally possible that those providers or provider groups with only a single patient in the eight years were also large groups. Further research is needed to dissect out the patterns of individual providers.

This study shows that providers and provider groups with the least amount of exposure in workers' compensation had a higher proportion of claims that ended up being the most complex claims in our system – those that were litigated and had permanent disability benefits. Such claims have special reporting requirements to assess the level of disability and impairment and to project future medical requirements. The question that cannot be answered with the available data is whether less experienced providers are somehow saddled with more complex patients from the beginning (or the converse, that providers treating large numbers of workers' compensation cases somehow attract a higher proportion of simpler cases), or if lack of experience causes the higher medical and disability costs that we observed, possibly because of ineffective medical decision-making and/or inexperienced case management.

Applied Research: Experience in Group Health

Research and demonstration projects in the group health sector are expanding our understanding of the relationship between provider experience and the costs and outcomes of care. Currently a range of collaborative public and private initiatives have been developed to improve consumer understanding of quality of care and to improve provider and institutional performance. These initiatives assess the organization, delivery and financing of health care services, and measure the impact on the physical, mental and social functioning of individual patients. The goal of these initiatives is to identify a set of reliable performance measures and to develop methods and incentives to promote their achievement.

The issue of physician performance has been a major focus of group health since the inception of preferred provider networks and managed care. Recognizing that wide variations in the costs and outcome of care reflect a lack of consensus regarding the underlying problem and how to manage treatment (Chassin 1986; Brook 1988; Winslow 1988), these organizations have used a variety of tools to change provider behavior, including closed provider panels, fee schedules and capitation. Underlying many of these approaches is an increasing level of expertise among payers and provider groups with respect to data collection and analysis, as well as physician and ancillary provider credentialing. Current projects reflect the state of the art in the health care industry:

- Physician Group Oversight Improvement[9] is a partnership of the National Committee on Quality Assurance (NCQA), the California HealthCare Foundation (CHCF), and the Pacific Business Group on Health (PBGH) to develop a uniform tool to assess physician credentials and to share results among health plans. Physician credentialing has been a core element of health plan contracting, assuring adequate training of the network physicians and providing a method for tracking complaints, patient satisfaction and utilization. The credentialing program is a collaborative effort of the three oversight agencies, six medical groups, and six HMOs to develop a uniform tool that will assist the health plans in their credentialing process, minimize duplicative and time-consuming data production by providers and provider groups, and provide a mechanism for sharing results of these credentialing activities among health plans.
- The California Cooperative Healthcare Reporting Initiative[10] (CCHRI) is an initiative made up of health care purchasers, health plans and providers, managed by PBGH, to promote collaboration in health plan and provider level data collection and reporting. It has been instrumental in creating quality measurement and performance improvement and allowing consumers and purchasers to make "apples-to-apples" comparisons of health plan performance reports. In 2001 this group facilitated the development of standardized treatment guidelines for the care of diabetic patients and participated in the dissemination of these guidelines to the major medical groups and, with the help of the California Medical Association, to another 10,000 physicians in the state.
- The State of California Office of the Patient Advocate has directed PBGH to develop health plan and physician group report cards to provide consumers with information to make better health plan and provider choices. Based on a standardized survey (the Consumer Assessment Survey, CAS[11]), which asks questions about doctor-patient communication, access to primary and specialist care, overall ratings of medical group and health plan performance and preventive care counseling, PBGH, in collaboration with CCHRI, seven health plans and 81 medical groups, produces report cards on an annual basis.

These initiatives, while broadly focused on a wide-range of issues, have four common traits:

1. They are collaborations between payors, purchasers and health care providers that benefit healthcare consumers.
2. The primary focus of each is to better understand the mechanisms of quality care.
3. They rely on effective data collection and utilization of current scientific evidence.
4. They each have a reporting and information distribution mechanism that provides comparisons across health plans, provider groups and providers.

9 Information on PGO is available on www.ncqa.org/programs/pgo/pgoip.htm
10 Information on the CCHRI is available on www.pbgh.org/programs/cchri.asp.
11 Information on the CAS is available at www.pbgh.org/programs/cas/default.asp.

Considerations for the California Workers' Compensation System

The question for the workers' compensation industry is how the momentum of these group health initiatives can help efforts to measure and use performance data.

The current judicial and regulatory interpretation of the California Labor Code, which ensures coverage for all medical services to "cure or relieve" workplace injury, restricts payors from using the standard battery of demand controls that are common place in group health, such as deductibles, co-payments and closed panels; although supplier controls such as utilization review, utilization management, network incentives and fee schedules are not prohibited. Such constraints necessitate original program design and a coordinated approach between injured workers, payors (insurers and employers), providers and regulators.

Recommendations

Injured Workers

Injured workers can become more proactive about acquiring and applying available information to become better consumers of health services. While the process has been shown to be intimidating, overly technical and too emotional for many patients (Epstein 2000, Marshall 2000 Jencks, 2000), the use of such information to improve consumer decision-making is slowly growing (Henry J. Kaiser Family Foundation, 2000). Recommended strategies include:

- *Ask questions:* The most important question any injured worker or their representative can ask their primary treating provider concerns that provider's level of experience (and the outcomes achieved) in treating that particular condition, as well as in working with the administrative requirements of the workers' compensation system.
- *Become a more informed consumer:* Internet-based healthcare content providers[12] offer information on hospitals, providers, health plans, as well as medical information on occupational and non-occupational injury and disease.

Payors and Providers

Large employers and purchasers of group health care services have become more involved in finding solutions to healthcare delivery inefficiencies and sub-optimal quality of care (Galvin & Milstein, 2002). Workers' compensation insurers (who act as the healthcare purchasing agent for insured employers and their work force), as well as large self-insured employers, can modify their policies regarding services purchased from their managed care providers:

- *Re-evaluate PPO networks and channeling:* Rather than a "bigger is better" approach, payors can focus on smaller networks using subsets of providers who demonstrate experience and better outcomes in treating occupational injury, disability management (return-to-work), as well as in handling the administrative reporting requirements of the workers' compensation system.
- *Support data collection and analysis:* The majority of managed care providers in workers' compensation are capable of providing data and detailed reports on outcomes (individual provider performance, network and medical services utilization). Some providers, payors and employers integrate medical data with other claims information to provide a complete portrait of medical care and disability (Rosenstein 1997), as such measures of claim experience have proven helpful to both claims adjusters and medical providers[13] for ongoing case management. (Unfortunately, however, not all payors have sufficient market share, data and analytical resources to profile network and provider performance.) One partial solution is available from public policy researcher organizations such as WCIRB,[14] WCRI,[15] NCCI[16] and CWCI[17] that routinely publish medical utilization benchmarks and loss development trends. These data can be used to construct benchmark comparisons between an individual insurer's experience and industry results.

12 The two popular examples of such websites include HealthGrades (www.healthgrades.com) and WebMD (www.webmd.com).

13 Interestingly, the California Department of Industrial Relations, Division of Workers' Compensation recently amended the rules and regulations governing Health Care Organizations to restrict dialogue on medical treatment issues between payors and providers. (DWC Newsline, Bulletin 02-02, Sept. 2002.

14 Workers' Compensation Insurance Rating Bureau, San Francisco, CA. www.wcirbonline.org.

15 Workers' Compensation Research Institute, Cambridge, MA. www.wcrinet.org.

16 National Council on Compensation Insurance, Boca Raton FL. www.ncci.com.

17 California Workers' Compensation Institute, Oakland, CA. www.cwci.org.

Regulators

Given the large number of providers with such thin experience in treating injured workers and the corresponding variability in outcomes, there is a clear need to:

- Improve providers' access to information about the workers' compensation system, standards of care and administrative requirements.
- Encourage utilization management and cost control measures through the use of objective, scientifically based credentialing processes and utilization protocols.[18]

This study presents a limited but important first view into the relationship between volume and outcomes in the California workers' compensation system. The findings support the hypothesis that higher volumes of experience are associated with lower costs per claim and shorter lengths of disability. Future research will focus on additional characteristics of high- and low-volume providers (provider specialty, utilization of specific services, timing of involvement) and examine the effect of these characteristics on claim outcomes.

About The Authors

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18 URAC, aka the American Accreditation HealthCare Commission, publishes an inventory of organizations that have passed an accreditation process in workers' compensation.

Technical Appendix 1

Regression Modeling Methods and Approach

The authors employed a set of regression analyses using maximum likelihood estimation methods to regress total claim costs, medical costs and indemnity costs on a set of claim and claimant characteristics. Maximum likelihood estimation was necessary because the data contained both closed and open claims. Maximum likelihood estimation is an accepted statistical method for quantifying the relationship between a continuous dependent variable, such as costs, and one or more predictor variables, in the presence of open claims (which is known as right-censoring). The maximum likelihood method that we used was PROC LIFEREG provided by SAS Institute. Costs were modeled in natural log form to enhance the normality of the distribution. The control variables were modeled as sets of dummy variables coded to indicate the presence of each particular characteristic.

Variables Included in the Regressions

Provider experience was defined as the total number of claims treated between 1993 and 2000, and the following nine categories were developed:

- 1 claim
- 2-4 claims
- 5-29 claims
- 30-49 claims
- 50-99 claims
- 100-199 claims
- 200-499 claims
- 500-999 claims
- ≥1000 claims.

For each claim, provider experience was coded using a set of dummy, or indicator, variables, each representing one of the above ranges. Each predominant provider's experience fell into one of the specified ranges, so each had one of the provider experience dummy variables coded with a '1' and the remainder coded with a '0'. We then performed a set of regression analyses using the provider experience variables as independent variables, along with a host of other predictor variables representing the additional factors that have an impact on claim costs.

The predictor variables contained in the regression equations included employee, claim/injury and policy characteristics and features of the claim process. (These variables are listed in Exhibit 14.) The employee characteristics included were age, gender, tenure (time between date of hire and injury) and average weekly wage with the pre-injury employer, and employment status (full- or part-time). The claim/injury factors included claim type (medical-only or indemnity), claim status (open or closed), attorney involvement status, year of injury, diagnosis category, body part, cause of injury, catastrophic claim status, whether or not there had been inpatient services rendered and whether or not the patient died. The policy characteristics included were industry category and audited premium. The measures of claim process included were whether or not the claim had been initially denied, the number of days from injury to first treatment and the number of days from employer notification to insurer notification.

Exhibit 14: Variables Included in the Regressions

Employee Characteristics
Age at injury
Gender (male/female)
Tenure (months)
Average weekly wage
Employment status (full/part time)
Claim/Injury Factors
Claim type (medical-only or indemnity)
Claim status (open or closed)
Attorney involvement status (yes/no)
Year of injury
Diagnosis category
Body part
Cause of injury
Catastrophic claim status
Inpatient admission
Patient died
Policy Characteristics
Industry category
Size of employer (premium)
Claim Features
Claim denied
Days from injury to first treatment
Days from employer notification to carrier notification

Regression Results and Case Mix Adjustment

The regression models allowed the analysts to determine the independent effect of physician experience, controlling for the impact of other measurable factors such as indemnity, litigation, diagnosis, claimant demographics, etc. Three regressions were run using the following dependent variables: (1) total claim costs; (2) medical costs; and (3) indemnity costs. (The output of these three regressions is presented in Exhibit 15.)

Physicians with only one claim during the study period served as the omitted category (i.e., the comparison group). The regression results were then converted into dollar differences to determine case-mix-adjusted costs by level of physician experience. This was done by performing the following steps:

1. A base cost was calculated using only claims treated by providers with one claim during the study period.

2. The parameter estimates were then exponentiated to retransform them from log form to dollar form.

3. For each level of physician experience greater than one claim, the net increment or decrement in costs represented by the relevant parameter estimate was added to the predetermined base cost. This produced the regression-adjusted average cost for each level of physician experience.

Figure 15: Regression Output

CWCI VBO Project: Regression Analysis of Total Paid on Claim CWCIPMPREG1A

The LIFEREG Procedure

Model Information

Data Set	SASDATA.CWCIPMPRECD3
Dependent Variable	Log(TOTCLMPD2)
Censoring Variable	OPEN
Censoring Value(s)	1
Number of Observations	1098445
Noncensored Values	1003501
Right Censored Values	94944
Left Censored Values	0
Interval Censored Values	0
Name of Distribution	WEIBULL
Log Likelihood	-1589892.688
Algorithm converged.	

Exhibit 15: Analysis of Parameter Estimates (Selected*)

Variable	Label	Estimate	Standard Error	Chi-Square	Pr > ChiSq
Intercept		5.76484	0.01376	175649.871	<.0001
NCLMS24	Providers with 2-4 Claims	-0.15554	0.01101	199.5016	<.0001
NCLMS529	Providers with 5-29 Claims	-0.21023	0.0094432	495.6225	<.0001
NCLMS3049	Providers with 30-49 Claims	-0.26466	0.01014	680.6675	<.0001
NCLMS5099	Providers with 50-99 Claims	-0.38529	0.0096894	1581.2028	<.0001
NCLMS100199	Providers with 100-199 Claims	-0.43025	0.0095332	2036.9005	<.0001
NCLMS200499	Providers with 200-499 Claims	-0.60047	0.0092973	4171.2686	<.0001
NCLMS500999	Providers with 500-999 Claims	-0.62621	0.0094075	4430.8649	<.0001
NCLMS1KUP	Providers with >=1000 Claims	-0.79507	0.0091212	7598.1290	<.0001
INDEMNITY	Indemnity Claims	1.81870	0.0028411	409768.933	<.0001
LITIGATION	Claims with Attorney Involvement	2.09326	0.0035698	343835.634	<.0001
FEMALE	Female Claimants	0.06516	0.0024723	694.6375	<.0001
DENIED	Initially Denied Claims	0.15831	0.0040214	1549.8039	<.0001
ANYINPT	Claims with Hospital Payments	1.41554	0.0068817	42311.3680	<.0001
CATCLAIM	Catastrophic Claims	0.01896	0.01628	1.3562	0.2442
DIED	Death Claims	0.99466	0.03883	656.2121	<.0001
AGE2144	Claimants Aged 21-44	0.14751	0.0044991	1074.9871	<.0001
AGE4564	Claimants Aged 45-64	0.32597	0.0050077	4237.1453	<.0001
AGE65UP	Claimants Aged 65 and Up	0.31175	0.0098489	1001.9496	<.0001
AGEMSNG	Claims Missing Claimant Age	0.20639	0.0064337	1029.0487	<.0001
AWW200499	Average Weekly Wage $200-499	0.10442	0.0039258	707.4564	<.0001
AWW500999	Average Weekly Wage $500-999	0.29729	0.0044859	4392.1865	<.0001
AWW1K3K	Average Weekly Wage $1000-3000	0.40570	0.0074099	2997.6080	<.0001

* Other variables included in the three regressions but not included in the output presented herein were: tenure (5 categories), days from employer notification to carrier notification (5 categories), days from date of injury to first treatment (5 categories), audited premium (5 categories), body part (30 categories), cause of injury (30 categories), employment status (8 categories) and 90 other diagnosis categories.

Exhibit 15: Analysis of Parameter Estimates (Selected*) continued

Variable	Label	Estimate	Standard Error	Chi-Square	Pr > ChiSq
AWW3KUP	Average Weekly Wage $3000 and Up	0.30581	0.03221	90.1179	<.0001
AWWMSNG	Average Weekly Wage Missing	-0.04991	0.0041626	143.7877	<.0001
MFG_METAL	Industry=Manufacturing-Metal	0.04568	0.0054515	70.2123	<.0001
MFG_WOOD	Industry=Manufacturing-Wood	0.03792	0.0084531	20.1251	<.0001
MFG_PLASTIC	Industry=Manufacturing-Plastic	0.10004	0.01008	98.5176	<.0001
MFG_PAPER	Industry=Manufacturing-Paper	0.07649	0.01074	50.7447	<.0001
MFG_TEXTILES	Industry=Manufacturing-Textiles	0.06523	0.0085986	57.5564	<.0001
MFG_FOODS	Industry=Manufacturing-Foods	0.01407	0.0066217	4.5158	0.0336
MFG_ELECTRONICS	Industry=Manufacturing-Electronics	0.01491	0.0081606	3.3385	0.0677
MFG_OTHER	Industry=Manufacturing-Other	0.03471	0.0085439	16.5003	<.0001
AGRICULTURAL	Industry=Agricultural	-0.08663	0.0057795	224.6908	<.0001
MERCANTILE	Industry=Mercantile	-0.02860	0.0045419	39.6618	<.0001
AIRCRAFTOPS	Industry=Aircraft Operations	-0.02140	0.01720	1.5468	0.2136
PROF_CLERICAL	Industry=Professional/Clerical	-0.01330	0.0040619	10.7286	0.0011
INDUSTRY_OTHER	Industry=Other	-0.06304	0.0038142	273.1725	<.0001
DX_0121	Multiple Sclerosis, Parkinson's Disease, Neurologic Degeneration	1.12882	0.17023	43.9733	<.0001
DX_0122	Cerebral Vascular Accident	0.68664	0.09432	53.0000	<.0001
DX_0220	External Eye Disorders	0.06780	0.0087044	60.6680	<.0001
DX_0824	Medical Back Problems w/o Spinal Cord Involvement	0.46036	0.0043563	11167.4835	<.0001
DX_0825	Spine Disorders with Spinal Cord or Root Involvement	1.05443	0.01070	9715.1447	<.0001
DX_0826	Ruptured Tendon, Tendonitis, Myositis, Bursitis	0.63927	0.0060056	11330.8875	<.0001
DX_0829	Sprain of Shoulder, Arm, Knee, Lower Leg	0.36062	0.0043730	6800.7550	<.0001
DX_1020	Diabetes	1.00914	0.08814	131.0854	<.0001
DX_1620	Anemia	1.15680	0.17026	46.1620	<.0001
DX_2123	Other Injuries, Poisonings & Toxic Effects	0.36979	0.0037667	9638.0461	<.0001
YR94	Year=1994	-0.02326	0.0040140	33.5729	<.0001
YR95	Year=1995	-0.005658	0.0042497	1.7723	0.1831
YR96	Year=1996	0.04585	0.0044362	106.8349	<.0001
YR97	Year=1997	0.09947	0.0044064	509.5509	<.0001
YR98	Year=1998	0.16553	0.0044171	1404.3054	<.0001
YR99	Year=1999	0.27115	0.0046039	3468.6560	<.0001
YR00	Year=2000	0.23672	0.0049290	2306.4654	<.0001

Exhibit 15: Regression Output

CWCI VBO Project: Regression Analysis of Total Medical Paid on Claim CWCIPMPREG1A2

The LIFEREG Procedure

Model Information

Data Set	SASDATA.CWCIPMPRECD3
Dependent Variable	Log(TOTMEDPD)
Censoring Variable	OPEN
Censoring Value(s)	1
Number of Observations	1098445
Noncensored Values	1003501
Right Censored Values	94944
Left Censored Values	0
Interval Censored Values	0
Name of Distribution	WEIBULL
Log Likelihood	-1585451.262
Algorithm converged.	

Exhibit 15: Analysis of Parameter Estimates (Selected)

Variable	Label	Estimate	Standard Error	Chi-Square	Pr > ChiSq
Intercept		5.88388	0.01381	181419.614	<.0001
NCLMS24	Providers with 2-4 Claims	-0.17457	0.01104	250.0762	<.0001
NCLMS529	Providers with 5-29 Claims	-0.23058	0.0094679	593.0988	<.0001
NCLMS3049	Providers with 30-49 Claims	-0.30277	0.01017	886.3785	<.0001
NCLMS5099	Providers with 50-99 Claims	-0.42615	0.0097166	1923.4562	<.0001
NCLMS100199	Providers with 100-199 Claims	-0.47258	0.0095589	2444.1674	<.0001
NCLMS200499	Providers with 200-499 Claims	-0.63896	0.0093241	4696.0219	<.0001
NCLMS500999	Providers with 500-999 Claims	-0.65269	0.0094327	4787.7870	<.0001
NCLMS1KUP	Providers with >=1000 Claims	-0.83041	0.0091503	8236.0729	<.0001
INDEMNITY	Indemnity Claims	1.23451	0.0028303	190250.457	<.0001
LITIGATION	Claims with Attorney Involvement	1.71718	0.0035721	231085.689	<.0001
FEMALE	Female Claimants	0.07819	0.0024792	994.6683	<.0001
DENIED	Initially Denied Claims	0.10038	0.0040491	614.6174	<.0001
ANYINPT	Claims with Hospital Payments	1.76184	0.0069093	65023.0610	<.0001
CATCLAIM	Catastrophic Claims	0.07118	0.01644	18.7476	<.0001
DIED	Death Claims	0.25035	0.03873	41.7802	<.0001
AGE2144	Claimants Aged 21-44	0.13276	0.0045056	868.1944	<.0001
AGE4564	Claimants Aged 45-64	0.28447	0.0050134	3219.6204	<.0001
AGE65UP	Claimants Aged 65 and Up	0.25551	0.0098661	670.7148	<.0001
AGEMSNG	Claims Missing Claimant Age	0.17293	0.0064472	719.4910	<.0001
AWW200499	Average Weekly Wage $200-499	0.05228	0.0039376	176.2527	<.0001
AWW500999	Average Weekly Wage $500-999	0.17478	0.0044923	1513.6655	<.0001
AWW1K3K	Average Weekly Wage $1000-3000	0.30394	0.0074317	1672.6583	<.0001
AWW3KUP	Average Weekly Wage $3000 and Up	0.23995	0.03229	55.2289	<.0001
AWWMSNG	Average Weekly Wage Missing	-0.09862	0.0041945	552.7911	<.0001
MFG_METAL	Industry=Manufacturing-Metal	0.08577	0.0054587	246.8835	<.0001
MFG_WOOD	Industry=Manufacturing-Wood	0.09041	0.0084815	113.6376	<.0001
MFG_PLASTIC	Industry=Manufacturing-Plastic	0.14500	0.01010	206.1724	<.0001
MFG_PAPER	Industry=Manufacturing-Paper	0.11824	0.01076	120.7231	<.0001
MFG_TEXTILES	Industry=Manufacturing-Textiles	0.10165	0.0086149	139.2193	<.0001
MFG_FOODS	Industry=Manufacturing-Foods	0.05911	0.0066322	79.4452	<.0001
MFG_ELECTRONICS	Industry=Manufacturing-Electronics	0.06902	0.0081771	71.2426	<.0001
MFG_OTHER	Industry=Manufacturing-Other	0.08055	0.0085609	88.5283	<.0001
AGRICULTURAL	Industry=Agricultural	-0.03889	0.0057876	45.1590	<.0001
MERCANTILE	Industry=Mercantile	0.001382	0.0045465	0.0924	0.7611
AIRCRAFTOPS	Industry=Aircraft Operations	0.01400	0.01724	0.6594	0.4168
PROF_CLERICAL	Industry=Professional/Clerical	0.01187	0.0040679	8.5203	0.0035
INDUSTRY_OTHER	Industry=Other	-0.03395	0.0038183	79.0379	<.0001
DX_0121	Multiple Sclerosis, Parkinson's Disease, Neurologic Degeneration	1.31245	0.17063	59.1616	<.0001
DX_0122	Cerebral Vascular Accident	0.94882	0.09462	100.5596	<.0001
DX_0220	External Eye Disorders	0.08037	0.0087336	84.6830	<.0001
DX_0824	Medical Back Problems w/o Spinal Cord Involvement	0.44039	0.0043703	10154.456	<.0001
DX_0825	Spine Disorders with Spinal Cord or Root Involvement	0.97980	0.01071	8362.3085	<.0001
DX_0826	Ruptured Tendon, Tendonitis, Myositis, Bursitis	0.64216	0.0060207	11376.110	<.0001
DX_0829	Sprain of Shoulder, Arm, Knee, Lower Leg	0.36352	0.0043886	6861.4563	<.0001
DX_1020	Diabetes	1.02299	0.08833	134.1213	<.0001
DX_1620	Anemia	1.26894	0.17064	55.3021	<.0001
DX_2123	Other Injuries, Poisonings & Toxic Effects	0.38076	0.0037764	10165.964	<.0001
YR94	Year=1994	-0.03250	0.0040217	65.3076	<.0001
YR95	Year=1995	-0.02417	0.0042608	32.1914	<.0001
YR96	Year=1996	0.01151	0.0044476	6.6923	0.0097
YR97	Year=1997	0.05989	0.0044175	183.7919	<.0001
YR98	Year=1998	0.12688	0.0044269	821.4311	<.0001
YR99	Year=1999	0.24244	0.0046154	2759.1668	<.0001
YR00	Year=2000	0.20698	0.0049370	1757.7001	<.0001

Exhibit 15: Regression Output

CWCI VBO Project: Regression Analysis of Total Indemnity Paid CWCIPMPREG1A2

The LIFEREG Procedure

Model Information

Data Set	SASDATA.CWCIPMPRECD3
Dependent Variable	Log(TOTINDPD)
Censoring Variable	OPEN
Censoring Value(s)	1
Number of Observations	395050
Noncensored Values	319772
Right Censored Values	75278
Left Censored Values	0
Interval Censored Values	0
Zero or Negative Response	703395
Name of Distribution	WEIBULL
Log Likelihood	-651452.9857
Algorithm converged.	

Exhibit 15: Analysis of Parameter Estimates (Selected)

		Variable	Label	Estimate	Standard
Intercept		3.72819	0.04817	5990.3688	<.0001
NCLMS24	Providers with 2-4 Claims	-0.13477	0.02172	38.4974	<.0001
NCLMS529	Providers with 5-29 Claims	-0.17078	0.01860	84.3245	<.0001
NCLMS3049	Providers with 30-49 Claims	-0.18646	0.01995	87.3424	<.0001
NCLMS5099	Providers with 50-99 Claims	-0.27679	0.01925	206.7281	<.0001
NCLMS100199	Providers with 100-199 Claims	-0.31384	0.01904	271.7263	<.0001
NCLMS200499	Providers with 200-499 Claims	-0.52593	0.01878	784.4786	<.0001
NCLMS500999	Providers with 500-999 Claims	-0.66304	0.01938	1170.1766	<.0001
NCLMS1KUP	Providers with >=1000 Claims	-0.81873	0.01833	1994.4231	<.0001
INDEMNITY	Indemnity Claims	1.65217	0.03539	2179.9712	<.0001
LITIGATION	Claims with Attorney Involvement	2.73882	0.0057143	229719.789	<.0001
FEMALE	Female Claimants	0.09021	0.0062763	206.5927	<.0001
DENIED	Initially Denied Claims	0.12457	0.01020	149.2357	<.0001
ANYINPT	Claims with Hospital Payments	1.20157	0.01037	13426.2650	<.0001
CATCLAIM	Catastrophic Claims	0.13048	0.03741	12.1640	0.0005
DIED	Death Claims	1.83128	0.06770	731.7336	<.0001
AGE2144	Claimants Aged 21-44	0.41495	0.01198	1200.3534	<.0001
AGE4564	Claimants Aged 45-64	0.72396	0.01298	3108.5272	<.0001
AGE65UP	Claimants Aged 65 and Up	0.78325	0.02339	1121.5697	<.0001
AGEMSNG	Claims Missing Claimant Age	0.36012	0.02309	243.3478	<.0001
AWW200499	Average Weekly Wage $200-499	0.39702	0.0079923	2467.5846	<.0001
AWW500999	Average Weekly Wage $500-999	0.88145	0.0093614	8865.5484	<.0001
AWW1K3K	Average Weekly Wage $1000-3000	0.97012	0.01638	3509.6072	<.0001
AWW3KUP	Average Weekly Wage $3000 and Up	0.64535	0.10907	35.0073	<.0001
AWWMSNG	Average Weekly Wage Missing	-0.01552	0.01727	0.8068	0.3691
MFG_METAL	Industry=Manufacturing-Metal	-0.09570	0.01433	44.6004	<.0001
MFG_WOOD	Industry=Manufacturing-Wood	-0.16856	0.02043	68.0453	<.0001
MFG_PLASTIC	Industry=Manufacturing-Plastic	-0.12576	0.02767	20.6514	<.0001
MFG_PAPER	Industry=Manufacturing-Paper	-0.10279	0.02758	13.8880	0.0002
MFG_TEXTILES	Industry=Manufacturing-Textiles	-0.19117	0.02146	79.3903	<.0001
MFG_FOODS	Industry=Manufacturing-Foods	-0.21623	0.01595	183.7117	<.0001

Exhibit 15: Analysis of Parameter Estimates (Selected) continued

Variable	Label	Estimate	Standard Error	Chi-Square	Pr > ChiSq
MFG_ELECTRONICS	Industry=Manufacturing-Electronics	-0.13844	0.02333	35.2108	<.0001
MFG_OTHER	Industry=Manufacturing-Other	-0.20377	0.02251	81.9234	<.0001
AGRICULTURAL	Industry=Agricultural	-0.26347	0.01277	425.4731	<.0001
MERCANTILE	Industry=Mercantile	-0.22268	0.01056	444.5054	<.0001
AIRCRAFTOPS	Industry=Aircraft Operations	-0.22326	0.04529	24.3033	<.0001
PROF_CLERICAL	Industry=Professional/Clerical	-0.19740	0.0091937	461.0105	<.0001
INDUSTRY_OTHER	Industry=Other	-0.25965	0.0085412	924.1692	<.0001
DX_0121	Multiple Sclerosis, Parkinson's Disease, Neurologic Degeneration	1.35873	0.33362	16.5867	<.0001
DX_0122	Cerebral Vascular Accident	1.06282	0.17368	37.4457	<.0001
DX_0220	External Eye Disorders	0.08998	0.04042	4.9548	0.0260
DX_0824	Medical Back Problems w/o Spinal Cord Involvement	0.64890	0.01116	3381.4349	<.0001
DX_0825	Spine Disorders with Spinal Cord or Root Involvement	1.38601	0.01920	5208.7991	<.0001
DX_0826	Ruptured Tendon, Tendonitis, Myositis, Bursitis	0.93473	0.01491	3931.9008	<.0001
DX_0829	Sprain of Shoulder, Arm, Knee, Lower Leg	0.53297	0.01186	2020.5268	<.0001
DX_1020	Diabetes	1.01430	0.15907	40.6591	<.0001
DX_1620	Anemia	1.98947	0.33374	35.5358	<.0001
DX_2123	Other Injuries, Poisonings & Toxic Effects	0.60600	0.01059	3273.5789	<.0001
YR94	Year=1994	-0.04979	0.0091594	29.5510	<.0001
YR95	Year=1995	0.06382	0.0097858	42.5354	<.0001
YR96	Year=1996	0.23551	0.01020	533.3814	<.0001
YR97	Year=1997	0.37399	0.01020	1344.4408	<.0001
YR98	Year=1998	0.56371	0.01043	2919.7962	<.0001
YR99	Year=1999	0.81229	0.01127	5193.2838	<.0001
YR00	Year=2000	0.95095	0.01300	5352.1241	<.0001

REFERENCES

Bernacki EJ. Guidera JA. The effect of managed care on surgical rates among individuals filing for workers' compensation. Journal of Occupational & Environmental Medicine. 40(7):623-31, Jul 1998.

Black N, Johnston A. Volume and outcome in hospital care: evidence, explanations and implications. [Review] Health Services Management Research, 1990, 3(2):108-14.

Blay, N., Smithwine, N., Swedlow, A. The Integration Movement In California Workers' Compensation Market. Journal of Ambulatory Care Management, Vol. 23:3, July 2000.

Brook, R. H., J. B. Kosecoff, et al. (1988). "Diagnosis and treatment of coronary disease: comparison of doctors' attitudes in the USA and the UK." Lancet 1, 8588: 750-3.

California Workers' Compensation Institute, Shifting Age and Gender Demographics Among California Workers' Compensation Injured Workers. ICIS Says, Jan 2002.

California Workers' Compensation Institute, Inpatient Clinical Severity in California Workers Compensation, July 2001

Chassin, M. R., R. H. Brook, et al. (1986). "Variations in the use of medical and surgical services by the Medicare population." NEJM 314, 5: 285-90.

Commission on Health and Safety and Workers' Compensation, 1999 – 2000 Annual Report.

Cohen DI, Jones P, Littenberg B and Neuhauser D. Does cost information availability reduce physician test usage? A randomized clinical trial with unexpected findings. Medical Care, 1982, 20(3):286-292.

Cummings KM, Frisof KB, Long MJ and Hrynkiewich G. The effects of price information on physician's test-ordering behavior: Ordering of diagnostic tests. Medical Care, 1982, 20(3):293-301.

Dobson, A, Koenig, L, Siegal, J., Gilani, J., Ho, S., DaVanzo, J. Practice Expense Study of Evaluation and Management Services, Industrial Medical Council, The California Department of Industrial Relations, Sept 2002.

Epstein, A. Public Release of Performance Data: A Progress Report From the Front. JAMA, 283: 14: 1884-86. April 2000.

Estes, E, Sullivan, R. Standards for practice: effectiveness and acceptance. Annals of Internal Medicine, 89: 5 Pt 2 Suppl:826-8, 1978,.

Freeland MS, Hunt SS, Luft HS. Selective contracting for hospital care based on volume, quality, and price: prospects, problems, and unanswered questions. Journal of Health Politics, Policy & Law, 12(3):409-26, 1987.

Gardner L, Swedlow A. The Effect of 1993 – 1996 Legislative Reform Activity on Medical Cost, Litigation and Claim Duration in the California Workers' Compensation System. California Workers Compensation Institute Research Note. May 2002

Galvin, R., Milstein, A. Large Employers' New Strategies in Health Care, NEJM, 437, 12, 939-942. Sept 2002.

Gehlbach SH, Wilkinson WE, Hammond WE, Clapp NE, Finn AL, Taylor WJ and Rodell MS. Improving drug prescribing in a primary care practice. Medical Care, 22(3):193-201, 1984.

Green-McKenzie J., Parkerson J. Bernacki E. Comparison of workers' compensation costs for two cohorts of injured workers before and after the introduction of managed care. Journal of Occupational & Environmental Medicine. 40(6):568-72, June 1998.

Groopman , J. Knife in the Back, The New Yorker Magazine, April 8, 2002.

Hamilton BH, Ho V. Does practice make perfect? Examining the relationship between hospital surgical volume and outcomes for hip fracture patients in Quebec. Medical Care, 36: 6: 892-903, 1998.

Henry J. Kaiser Family Foundation. National survey on Americans as healthcare consumers: an update on the role of quality information. Agency for Health Care Quality and Research, Dec 2000

Hughes RG, Garnick DW, Luft HS, McPhee SJ, Hunt SS. Hospital volume and patient outcomes. The case of hip fracture patients. Medical Care, 26: 11:1057-67, 1988.

Hughes RG, Hunt SS, Luft HS. Effects of surgeon volume and hospital volume on quality of care in hospitals. Medical Care, 25:6:489-503, 1987.

Jencks, S. Clinical Performance Measurement – A Hard Sell, JAMA 283;15; 2015-16.

Johnson, T. The Effect of California's PTP Legislation on the Utilization of Healthcare, California Workers Compensation Institute, Scheduled for Publication Dec 2002.

Johnson, W.G., M.L. Baldwin, and S.C. Marcus. The impact of workers' compensation networks on medical costs and disability benefits. Cambridge, MA: Workers Compensation Research Institute. 1999.

Kerns MP and Meyer GE. Concurrent antibiotic-use review in a small hospital. American Journal of Hospital Pharmacy, 1986, 43(6):1476-8.

Komisky & Gardner. Inpatient Hospital Fee Schedule and Outpatient Surgical Surgery Study , Commission on Health and Safety and Workers Compensation. Dec 2001

Luft HS, Bunker JP, Enthoven AC. Should operations be regionalized? The empirical relation between surgical volume and mortality. NEJM 301(25):1364-9, 1979.

Luft HS, Garnick DW, Mark DH, Peltzman DJ, Phibbs CS, Lichtenberg E, McPhee SJ. Does quality influence choice of hospital?. JAMA, 1990, 263(21):2899-906.

Luft HS, Hunt SS, Maerki SC. The volume-outcome relationship: practice-makes-perfect or selective-referral patterns?. Health Services Research 22(2):157-82, 1979.

Manning PR, Lee PV, Clintworth WA, Denson TA, Oppenheimer PR and Gilman NJ. Changing prescribing practices through individual continuing education. JAMA, 256(2):230-32, 1986.

Marshall, M., Shekelle, P., Leatherman, S. Brook, R. The public release of performance data: what do we expect to gain? A review of the evidence. JAMA 283;1866-74, April 2000.

Martin AR et al. A trial of two strategies to modify the test-ordering behavior of medical residents. NEJM 303:1330-1336, 1980.

McElwee JW. Medical staff relations and physician practice in the DRG environment. Topics in Health Care Financing, 1985, 11(3):22-27.

Myers LP and Schroeder SA. Physician use of services for the hospitalized patient: A review, with implications for cost containment. Milbank Memorial Fund Quarterly 59:481-507, , 1981.

Office of State Health Planning and Development, Inpatient Admission data for 1998-1999.

Phillips KA, Luft HS. The policy implications of using hospital and physician volumes as "indicators" of quality of care in a changing health care environment. International Journal for Quality in Health Care 9: 5:341-8, 1997.

Restuccia JD. The effect of concurrent feedback in reducing inappropriate hospital utilization. Medical Care 20:1:46-62, 1982,.

Rhyne RL and Gehlbach SH. Effects of an educational feedback strategy on physician utilization of thyroid function panels. Journal of Family Practice 8; 5:1003-7, 1979.

Rosen HM and Feigin W, Sr. Quality assurance and data feedback. Health Care Management Review 8: 1: 67-74,1983.

Rosenfeld K, Luft HS, Garnick DW, McPhee SJ. Changes in patient characteristics and surgical outcomes for coronary artery bypass surgery 1972-82. American Journal of Public Health 77: 4:498-500, 1987.

Rosenstein, A., Swedlow, A. "Benchmarking Outcomes For Acute Myocardial Infarction: A Multidisciplinary Hospital Performance Improvement Project." Best Practices and Benchmarking in Healthcare, 2: 2: 71-81. April 1997.

Showstack JA, Rosenfeld KE, Garnick DW, Luft HS, Schaffarzick RW, Fowles J. Association of volume with outcome of coronary artery bypass graft surgery. Scheduled vs nonscheduled operations. [erratum appears in JAMA 1987 May 8;257(18):2438.]. JAMA, 257: 6: 785-9, 1987.

Smithline, N., Swedlow, A., Johnson, G., Nethercut, G. Selbovitz, L. "Outpatient Surgery for Injured Workers." The Journal of Ambulatory Management, 13: 1:47-54, February 1990.

Swedlow, A., Johnson, G. "Workers' Compensation Managed Care: The Search for Integration." The Managed Health Care Handbook, 4th Edition, Chapter 61. (August 2000).

Swedlow, A., Johnson, G., Smithline, N., Milstein, A. "Increased Costs and Rates of Use In The California Workers' Compensation System As A Result Of Self-Referral By Physicians." NEJM, 327: 2: 1502-1506, November 1992.

Tierney WM, Hui SL and McDonald CJ. Delayed feedback of physician performance versus immediate reminders to perform preventive care. Effects on physician compliance. Medical Care, 24: 8: 659-66, 1986.

Wennberg, J. E., J. L. Freeman. "Hospital use and mortality among Medicare beneficiaries in Boston and New Haven." NEJM 321: 17: 1168-73, 1989.

Winslow, C. M., J. B. Kosecoff. "The appropriateness of performing coronary artery bypass surgery." JAMA 260:4: 505-9, 1988.

Winickoff RN, Coltin KL, Morgan MM, Buxbaum RC and Barnett GO. Improving physician performance through peer comparison feedback. Medical Care, 22:6:527-34, 1984.

Workers' Compensation Insurance Rating Bureau of California, California Workers' Compensation Estimated Ultimate Medical Per Indemnity Claim (as of June 30, 2002), September 2002.

Woods JR, Saywell RM Jr, Nyhuis AW, Jay SJ, Lohrman RG, Halbrook HG. The learning curve and the cost of heart transplantation. Health Services Research, 27:2:219-38, 1992.

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