

Impact of Occupational Injuries on Nonworkers' Compensation Medical Costs of Patient-Care Workers

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Objective: The aim of this study was to estimate the extent to which work-related injuries contribute to medical expenditures paid for by group health insurance. **Methods:** Administrative data on OSHA recordable injuries spanning 2010 to 2013 were obtained for female patient care workers ($n = 2495$). Expenditures were aggregated group health insurance claims for 3 and 6-month periods before/after injury. Group health insurance plan type, age group, and job category were control variables. **Results:** Being injured is associated with the odds of having expenditures at both 3 months, odds ratio (OR) 2.17 [95% confidence interval (95% CI) 1.61 to 2.92], and 6 months, 2.95 (95% CI 1.96 to 4.45). Injury was associated with \$275 of additional expenditures (95% CI \$38 to \$549) over 3 months and \$587 of additional expenditures (95% CI \$167 to \$1140) over 6 months. **Conclusions:** Injury was associated with increased odds of positive expenditures and increased expenditures paid for by group health insurance.

Workers' compensation is the primary system that provides insurance against lost earnings and medical and rehabilitation costs incurred by workers with occupational injuries and illnesses. In 2013, state and Federal workers' compensation benefits totaled \$61.9 billion, and employer costs were \$83.2 billion.¹ Yet, despite substantial workers' compensation expenditures, evidence continues to grow about the costs of occupational injuries and illnesses that are paid for outside the systems by workers and their families, by citizens in general through other social safety net programs, and by nonworkers' compensation health insurance.

A growing literature has demonstrated that many workers injured on the job do not file for workers' compensation.²⁻⁴ They may be unaware of their eligibility, be unwilling to spend the time and resources associated with claim filing, be aware of the potential for a disagreeable experience, be concerned about retaliation, pressured by their managers, or may not see the benefits of the filing process. For these workers, the costs of lost income and medical care fall outside the workers' compensation system. Even if they file for and receive benefits, those benefits have been shown to cover only a small fraction of lost earnings.⁵⁻⁹ Recent studies have

estimated the extent to which health care providers may use their discretion to direct claims to either Workers' Compensation or group health insurance depending on which payer provides more generous reimbursement.¹⁰ Nontraumatic injuries may be reclassified from group health to Workers' Compensation, particularly when the group health plan is capitated.¹⁰

Research has also addressed whether workers' compensation insurance covers the full cost of medical care for accepted work-related injury claims. Workers' compensation is unique among health insurance schemes because, in principle, it covers all medical costs related to accepted claims, without deductibles, copays, or coinsurance. However, in about half the states, employers and insurers have control over the initial choice or change of medical providers. In addition, insurers can delay or reject care they do not consider medically necessary. Workers may feel that it is too difficult to get the care they need through workers' compensation and may look elsewhere to pay for it, particularly if they are not missing sufficient work (5 days in MA) to be eligible for wage replacement payments. Also, physicians may prefer payment by group health insurance to avoid low reimbursement rates, difficulty getting paid, or uncompensated time spent completing forms reporting on disability or assessing ability to return to work.¹¹ In addition, a work-related injury may increase the risk of other conditions that are difficult to tie directly to the initial injury and therefore are not paid for by workers' compensation.¹²⁻¹⁵

Some studies addressing this question have used the Medical Expenditure Panel Survey (MEPS), a survey of medical expenditures in a national probability sample of households in the U.S. civilian noninstitutionalized population. The MEPS is a stratified random sample of the U.S. population that captures all injuries relayed by respondents, not just those reported to the employer or receiving workers' compensation benefits. The MEPS captures out-of-pocket costs outside the reach of insurance-based data. One drawback is that the respondent's employment location is not recorded, and most workers' compensation systems are state-based, with substantial programmatic and eligibility variation among states. These differences can create unobserved heterogeneity in workers' compensation coverage of medical care.

Several recent studies using the MEPS focused on specific categories of injured workers. Each showed that workers' compensation covers well under 100% of these costs with estimates ranging from 46% to 56% of medical costs of injured construction workers paid by workers' compensation.¹⁶⁻¹⁸ Estimates for Hispanic construction workers, immigrant workers, and those with persistent disabilities were even lower.¹⁷⁻¹⁹

Bhattacharya and Park¹⁸ used Thomson Reuters MarketScan (workers' compensation and group health insurance data from large employers) to determine whether a workers' compensation claim was associated with subsequent increases in group health. Among those with any group medical expenditures, a prior workers' compensation claim was associated with an 11% increase in those costs and an odds ratio (OR) of 1.25 [95% confidence interval (95% CI) 1.23 to 1.28] for having any expenditures.

Asfaw et al²⁰ also used Thomson Reuters MarketScan data to determine whether group health insurance at least partially covered work-related injury costs. Controlling for pre-injury group health

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insurance cost, they found increased group health insurance utilization and costs regardless of the value of workers' compensation medical claims; increases were higher for zero-cost workers' compensation claims than for positive workers' compensation claims. The MarketScan database has some advantages over the MEPS data, because insurer payments may be captured more accurately. However, work-related injuries are only identified when workers' compensation claims are filed, potentially missing less severe or other injuries not eligible for workers' compensation.

Injury rates in some occupations are much higher than others; types and severity of injuries vary by occupation as well.²¹ In the private sector, nursing assistants were one of the three occupations with the highest number of cases resulting in days away from work in 2015.²¹ In a sample of direct patient care workers and Occupational Safety and Health Administration (OSHA) reportable injuries, back injuries were the most common injury that required days away from work, while sharps injuries were the most common injuries that did not require days away from work.²²

Given the general level of concern from employers about the costs of both workers' compensation and group health insurance, we use a sample of health care workers to estimate the extent to which work-related injuries contribute to higher medical expenditures paid for by group health insurance after controlling for other factor.

METHODS

Study Design and Data Sources

This study was conducted by the Harvard T.H. Chan School of Public Health Center for Work, Health, and Well-being. We determined work-related injury status and date using individuals injured from July 1, 2010, through June 30, 2013, in the hospitals' injury and illness reporting system that fulfills OSHA requirements.

Expenditures were derived from claim-level group health insurance data aggregated to the individual level based on time period. We integrated data from several different systems, including the hospitals' injury data, payroll data, staffing and human resources data, and health insurance claims. This study was approved by the Harvard T.H. Chan School's Office of Human Research Administration.

Setting/Participants

The study population was female nurses and aides in two large tertiary care hospitals in the same hospital system in the northeastern United States. All were patient-care workers (nurses and aides) working at two large teaching hospitals. Both hospitals are in the same urban area and the same hospital system and covered through an employer self-insurance program using a single third party administrator. All nurses and aides are covered by one of three group health insurance plans, all preferred provider organization, which differ by premium and benefit generosity. Only individuals with 12 months of group health insurance coverage before and after the date of injury were included in the sample to reduce the likelihood of noise from changes in health care plans and providers. Using the major diagnostic category codes available in the data, we excluded women who were pregnant to reduce the noise in the data. During the study period, 674 individuals had hospital-recorded occupational injuries. For each injured worker, three workers who did not have a work-related reported injury were randomly selected with replacement after being matched on job (nurse or aide) and whether they worked in a low-injury-risk unit (pediatric, neonatal, and postpartum obstetrics) to create a sample of 2696. We began observation of all uninjured workers at the injury date of their matched injured counterparts.

Variables

The hospital system provided group health insurance data at the claim level. We cleaned the data to eliminate duplicate claims

and combine claims that were adjustments. Remaining negative claim amounts (adjustments) were dropped from the analysis (0.8%). Amounts paid reflected only the employer's payment, not the employee's cost. Payments were aggregated for 3 and 6-month periods before and after dates of injury. Expenditures included medical, outpatient, pharmacy, and mental health/substance abuse claims. Because we have a relatively small sample and inpatient expenditures are large, sporadic, and rare, we excluded them in this analysis. We Winsorized ($P = 0.002$) expenditures after injury to limit the most extreme values.

We included OSHA-recordable injury in the model as a binary indicator. An injury is OSHA-recordable if it involves death, days away from work, restricted work or transfer to another job, medical treatment beyond first aid, or loss of consciousness. Sharps injuries involving potentially infectious materials are also OSHA-recordable.

Sharps injuries involve a needle, blade, or other sharp instrument that penetrates the skin, as well as fluid splashes to mucous membranes, resulting in a risk of infection. The vast majority of sharps injuries require only blood testing of the source patient to determine infectivity. Also, the hospitals' occupational health services department provides specialized evaluation and care for sharps injuries that is not charged to group health insurance. As a consequence, significant medical treatment is uncommon. We separated injuries into sharps and non-sharps to evaluate whether sharps injuries have an impact on group health insurance costs as a sensitivity analysis.

To allow for potentially nonlinear effects, we first aggregated pre-injury expenditures into 3 and 6-month periods to match our outcomes and then entered the variable into each model based on indicators for quartiles. For example, in the 3-month model, we summed expenditures for the 3 months before injury and used indicator variables for each quartile of pre-injury expenditures. To control for differences in the out-of-pocket costs to employees that might influence their utilization of healthcare, we also controlled for the type of insurance during the study period. There were two primary plans available to employees over the period, a "value plan," that entailed greater cost-sharing for care and higher annual out-of-pocket maximums but lower premiums and the "premium plan" that entailed lower cost-sharing but higher premiums. Both plans were preferred provider organization. In addition, a few employees were eligible for grandfathered plans during the period (hereafter "grandfathered") that had higher deductibles and co-pays but lower premiums.

Age categories were 22 to 29, 30 to 39, 40 to 49, and 50 to 77 years. Job category was an indicator for whether the employee worked as an aide or a nurse.

Statistical Methods

The expenditure data were highly skewed, and many individuals in the sample had no expenditures. To deal with these issues we constructed a two-part model.²³ The first part of the model used all observations to predict whether individuals had expenditures greater than zero. The second part included only individuals with positive expenditures and predicted the amount of those expenditures. The expected value of the overall effect is given by multiplying the estimated probability of having positive medical expenditures times the expected level of medical expenditures.

We estimated the first using logistic regression and the second part using log-linear regression. We chose the functional form of the second part of the model after examining studentized residuals from log-OLS (Kurtosis was 4.12—well above 3), and conducting a modified Park test to evaluate the shape parameter (gamma and other tested families were all rejected with $P < 0.001$).²⁴

Results are shown with ORs and 95% CIs for the first part and the impact on adjusted mean expenditures conditional on having

nonzero expenditures (second part). The overall effect was estimated by multiplying the expectation of positive expenditures by the expected cost per person, and then averaging across all observations for those with and without recorded injuries. The difference in these expectations was then averaged across observations. We estimated 95% CIs of the overall effect using 1000 bootstrap replications with bias-corrected intervals. After conducting a Cook–Weisberg test for constant variance (Chi-squared of 26.04 and 37.97 for 3 and 6-month samples, respectively) and inspecting residual plots, we chose the normal heteroskedastic form for the smear factors used to estimate the unconditional margin for the second part of the model.^{25,26} We selected the matched noninjured controls using SAS version 9.4 (SAS Institute Inc., Cary, NC), and all other analyses were conducted in STATA 13 (College Station, TX).²⁷

RESULTS

Sample Description

Although most of the sample had positive expenditures in the 3 and 6-month post-injury periods (Fig. 1 and Table 1), the range of expenditures was quite large with a long right tail—typical for expenditure data. Most of the injuries were not related to sharps. Almost all employees were part of the Premium health insurance plan, with small groups in the Grandfathered and Value plans. The sample primarily includes nurses rather than aides.

Main Results

The results for the adjusted model of medical expenditures after injury are given in Tables 2 (3 month) and 3 (6 month) with coefficient estimates given in the Appendix, <http://links.lww.com/JOM/A342>. Columns (a) and (b) in each table give the results for each part of the two-part model using ORs and change in expenditures conditional on having nonzero expenditures. Column (c) of each table gives the full impact of each covariate based on both parts of the model (the unconditional margin). Injury is significantly associated with the odds of having group health expenditures both 3 and 6 months following injury (OR 2.17 and 2.95, respectively). The coefficients from the second part of the model were not statistically significant at the 5% level for 3-month expenditures, but were for the 6-month expenditures. The estimated change in expenditures in the conditional model was significant at the 5% level for the 6-month model. Being injured was associated with an additional \$275 expenditure over 3 months (95% CI \$38 to \$549), and an average of an additional \$587 of expenditures in the 6-month model (95% CI \$167 to \$1140).

As expected, expenditures before injury were significantly positively associated with the odds of having any postinjury group health expenditures and with greater expenditures among those who had expenditures in both models. Having the grandfathered plan compared with the premium plan was associated with an OR of 0.36 in the 3-month model, and 0.26 in the 6-month model (both significant at the 1% level). Younger ages were generally associated with lower expenditures for people with any expenditure, but the effect was only significant at the 5% level for ages 22 to 29 and 30 to 39 compared with those aged 50 to 77 years in both 3 and 6-month estimates. Aides had lower expenditures than nurses, with an OR of 0.72 (95% CI 0.55 to 0.93), in the 3-month estimates, and of 0.52 (95% CI 0.38 to 0.72) in the 6-month estimates.

Comparing the Impact of Sharps and Non-Sharps Injuries

About one-third of reported injuries were sharps injuries. Using an indicator for the type of injury (sharps or non-sharps) yielded estimates for non-sharps injuries that were close to the estimates from the main model (Table 4). The unconditional margin

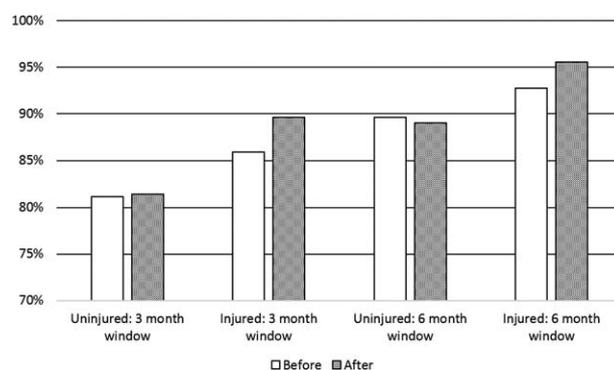


FIGURE 1. Percent of patient care workers with medical expenditures. This chart shows the percentage of patient care workers with medical expenditures greater than zero based on 3 and 6-month periods before and after injury (or simulated injury date after matching for uninjured workers).

for non-sharps injury in the 3-month model was \$420 (95% CI \$120 to \$779), and was \$777 (95% CI \$300 to \$1455), in 6-month model. The indicator for sharps injuries was not statistically significant except in the 6-month model wherein it was associated with an OR of 2.99 for having expenditures greater than zero. (Given that the probability of positive expenditures was over 90%, an OR of 2.99 translates into less than a 7% increase in this probability.) The unconditional margin of the indicator for sharps injuries was not statistically significant in either the 3-month or 6-month models.

Removing individuals with sharps injuries (and their matched controls) from the model also yielded qualitatively similar results to the main analyses (Table 4). Being injured at work was significantly associated with the odds of having group health expenditures greater than zero at the 1% level using 3-month and 6-month intervals, ORs of 2.57 and 2.86, respectively. In the 3-month model, being injured was associated with an additional \$396 expenditures overall (95% CI \$77 to \$768), larger than in the main results as was the unconditional margin in the 6-month model, \$806 (95% CI \$293 to \$1460).

DISCUSSION

Given that all medical expenditures related to work-related injuries should by law be covered by worker's compensation insurance,²⁸ there should be no association between injury and workers' group health insurance expenditures after controlling for other relevant factors. In this study, we have shown a significant difference between the two groups, implying that at least some of the medical costs of work-related injuries are borne by group health insurance plans rather than the workers' compensation system. These group health insurance costs may occur because a workers' compensation claim has not been filed or has not been accepted, because workers' compensation paid only some of the costs of treating the injury, or because group health insurance covered additional care caused by an unrecognized work-related injury. An example of the last category is treatment of disability-related depression.

We studied a relatively sophisticated health care organization with an onsite occupational health service, so we think that spillovers from workers' compensation to group health insurance are likely to be lower than for many other employers. As a consequence, ours are likely to be lower-bound estimates of the spillover from workplace injuries to group health insurance among patient care workers. In addition, we did not use inpatient data, and therefore, our estimates of the increase in health care costs may underestimate the full impact of occupational injuries on general health insurance costs.

TABLE 1. Sample Descriptive Statistics ($N = 2,696$)

| Variable | Injured ($N = 674$) | | Uninjured ($N = 2,022$) | |
|--------------------------------|-----------------------|-----------------|---------------------------|------------------|
| | Mean (SD) or Percent | Range | Mean (SD) or Percent | Range |
| Medical expenditures | | | | |
| 3 months after injury | \$1,459 (\$2,591) | [\$0, \$27,809] | \$1,357 (\$4,739) | [\$0, \$14,813] |
| 3 months before injury | \$1,273 (\$2,876) | [\$0, \$51,477] | \$1,318 (\$4,208) | [\$0, \$137,433] |
| 6 months after injury | \$2,889 (\$4,289) | [\$0, \$41,649] | \$2,461 (\$4,938) | [\$0, \$60,168] |
| 6 months before injury | \$2,570 (\$4,184) | [\$0, \$52,546] | \$2,546 (\$6,029) | [\$0, \$176,530] |
| Injured (25% of entire sample) | | | | |
| Sharps | 24.2% | | NA | |
| Non-sharps | 75.8% | | NA | |
| Health insurance plan | | | | |
| Plus | 86.8% | | 91.5% | |
| Grandfathered | 8.8% | | 5.5% | |
| Value | 4.5% | | 3.0% | |
| Age | | | | |
| 22–29 years | 17.2% | | 16.4% | |
| 30–39 years | 26.1% | | 26.1% | |
| 40–49 years | 24.6% | | 23.7% | |
| 50–77 years | 32.1% | | 33.8% | |
| Job | | | | |
| Nurse | 78.3% | | 78.3% | |
| Aide | 21.7% | | 21.7% | |

Dollar amounts were rounded to the nearest dollar.

The increase in group medical costs in the 6 months after injury was about twice the 3-month increase, suggesting that there was a little decline in expenditure over the observed period. Our observation period was inadequate for a longer follow-up, but future studies could address whether the increase in expenditures continues.

In addition, we rely on hospital reported work-related injuries through records mandated by the OSHA, rather than on workers' compensation claim data. By doing so, we were able to identify a

subset of work-related injuries (sharps injuries) that do not normally incur significant medical costs, and test whether they also increased group health insurance costs. In running the models with separate indicators for the type of injury, we found that sharps injuries were generally not significantly associated with increased group medical expenditures, while non-sharps injuries had very similar results to the main model. The same was true when we excluded individuals and matched controls with sharps injuries from the model. People with sharps injuries do not experience increased group health costs,

TABLE 2. Two-Part Model of 3-Month Postinjury Medical Expenditures, Nurses, and Aides (95% Confidence Interval in Brackets)

| | (A) Part One: Odds Ratio For Any Expenditure ($N = 2,696$) | (B) Part Two: Change In Expenditures Given Any Expenditure ($N = 2,250$) | (C) Overall: Change In Expenditures ($N = 2,696$) |
|---|--|--|---|
| Injured | 2.17 [1.61–2.92] | \$176 [–\$84 to \$474] | \$275 [\$38–\$549] |
| Quartile of previous medical expenditures | | | |
| 1st | Reference | reference | reference |
| 2nd | 4.15 [3.14–5.49] | –\$54 [–\$323 to \$169] | \$222 [\$47–\$401] |
| 3rd | 7.28 [5.27–10.04] | \$447 [\$172–\$692] | \$736 [\$515–\$935] |
| 4th | 10.08 [7.06–14.40] | \$2253 [\$1,754–\$2,818] | \$2464 [\$2,013–\$2,999] |
| Health insurance plan | | | |
| Premium | Reference | Reference | reference |
| Grandfathered | 0.36 [0.23–0.56] | –\$189 [–\$365 to \$1,080] | –\$72 [–\$509 to \$615] |
| Value | 0.86 [0.51–1.44] | \$335 [–\$371 to \$1,585] | \$265 [–\$352 to \$1,419] |
| Age | | | |
| 22–29 years | 0.90 [0.63–1.28] | –\$914 [–\$1,267 to \$615] | –\$827 [–\$1,130 to –\$552] |
| 30–39 years | 0.80 [0.58–1.09] | –\$528 [–\$871 to –\$192] | –\$502 [–\$810 to –\$198] |
| 40–49 years | 0.58 [0.44–0.78] | –\$81 [–\$515 to \$302] | –\$177 [–\$552 to \$153] |
| 50–77 years | reference | Reference | reference |
| Job | | | |
| Nurse | reference | Reference | reference |
| Aide | 0.72 [0.55–0.93] | –\$49 [–\$320 to \$264] | –\$101 [–\$344 to \$168] |

The model also included a constant term and was estimated using a two-part model. The first part of the model used logit regression to predict whether an individual had any expenditures and the second part predicted the amount of expenditures for individuals who had at least some expenditures using log-transformed expenditures and ordinary least squares. Dollar amounts were rounded to the nearest dollar. Estimates using the log-OLS portion of the model were obtained using the appropriate retransformation algorithm for normal heteroskedastic residuals and bias-corrected bootstrapped 95% confidence intervals with 1,000 replications.

TABLE 3. Two-Part Model of 6-Month Postinjury Medical Expenditures, Nurses, and Aides (95% Confidence Interval in Parentheses)

| | (A) Part One: Odds Ratio For Any Expenditure (N = 2,696) | (B) Part Two: Change in Expenditures Given Any Expenditure (N = 2,444) | (C) Overall: Change In Expenditures (N = 2696) |
|---|--|--|--|
| Injured | 2.95 [1.96–4.45] | \$469 [\$30–\$1,032] | \$587 [\$167, \$1140] |
| Quartile of previous medical expenditures | | | |
| 1st | Reference | Reference | reference |
| 2nd | 2.43 [1.76–3.37] | \$152 [–\$142 to \$451] | \$312 [\$63, \$551] |
| 3rd | 6.26 [4.09–9.57] | \$1,211 [\$843–\$1,625] | \$1429 [\$1085, \$1825] |
| 4th | 19.60 [10.14–37.87] | \$4,376 [\$3,710–\$5,330] | \$4631 [\$3995, \$5362] |
| Health insurance plan | | | |
| Premium | Reference | Reference | reference |
| Grandfathered | 0.26 [0.15–0.43] | \$388 [–\$568 to \$1797] | \$27 [–\$790, \$1228] |
| Value | 1.05 [0.53–2.07] | \$280 [–\$640 to \$1685] | \$272 [–\$599, \$1595] |
| Age | | | |
| 22–29 years | 1.29 [0.80–2.06] | –\$1,354 [–\$1,801 to –\$906] | –\$1252 [–\$1678, –\$831] |
| 30–39 years | 1.09 [0.72–1.65] | –\$730 [–\$1,235 to –\$254] | –\$676 [–\$1160, –\$221] |
| 40–49 years | 0.72 [0.50–1.04] | –\$146 [–\$688 to \$521] | –\$198 [–\$705, \$441] |
| 50–77 years | reference | Reference | reference |
| Job | | | |
| Nurse | reference | Reference | reference |
| Aide | 0.52 [0.38–0.72] | –\$2 [–\$484 to \$467] | –\$112 [–\$561, \$328] |

The model also included a constant term and was estimated using a two-part model. The first part of the model used logit regression to predict whether an individual had any expenditures and the second part predicted the amount of expenditures for individuals who had a least some expenditures using log-transformed expenditures and ordinary least squares. Dollar amounts were rounded to the nearest dollar. Estimates using the log-OLS portion of the model were obtained using the appropriate retransformation algorithm for normal heteroskedastic residuals and bias-corrected bootstrapped 95% confidence intervals with 1,000 replications.

while those with other injuries do. Given these results, it is likely that using all injuries reported on the job, including sharps, would create a downward bias in the estimates of medical care use after injury and support the inference that the increase in these costs for other work-related injuries is related to the injury itself.

Our results are similar to previous studies that evaluated the group health insurance costs of injuries, especially when we consider the stark differences in samples (workers in many industries and occupations compared with hospital patient care workers), definitions of injuries (worker’s compensation claims compared to hospital reporting), and heterogeneity of health insurance plan (unobserved plan variation compared to three defined plans). Our results were qualitatively similar to the results from Asfaw et al,²⁰ but our ORs and

estimated expenditures were higher than the results from Bhattacharya and Park,¹⁸ although they looked only at 1-month postinjury rather than 3. We evaluated only patient care workers, a group with higher than average injury rates and presumably good access to care and were able to capture a wide array of injuries including those without worker’s compensation claims. Our results also support the conclusions of the previous studies that used the MEPS data to evaluate the costs associated with workplace injuries.

A quick calculation using data for the study subjects shows the relative importance of group medical costs from injury. In our sample worksites, we used workers’ compensation data to derive paid workers’ compensation medical benefits. About 54% of workers with OSHA-recordable injuries received worker’s compensation

TABLE 4. Results of the Analysis of Model of 3 and 6 Months Postinjury Medical Expenditures Accounting for Sharps versus Non-Sharps Injuries

| | Model With Indicators for Sharps vs Non-Sharps Injury | | Model Excluding All Sharps Injuries | |
|--|--|-------------------------|-------------------------------------|------------------------|
| | 3 Months (N = 2,696) | 6 Months (N = 2,696) | 3 Months (N = 2,044) | 6 Months (N = 2,044) |
| Sharps injury | | | | |
| Part one: odds ratio for any expenditure | 1.40 [0.85, 2.29] | 2.99 [1.31, 6.84] | — | — |
| Part two: change in expenditures given any expenditure | –\$215 [–\$540, \$319] | –\$129 [–\$756, \$649] | — | — |
| Overall: change in expenditures | –\$136 [–\$427, \$334] | \$7 [–\$584, \$771] | — | — |
| Non-sharps injury | | | | |
| Part one: odds ratio for any expenditure | 2.57 [1.80, 3.66] | 2.94 [1.86, 4.65] | 2.57 [1.79, 3.69] | 2.86 [1.80, 4.55] |
| Part two: change in expenditures given any expenditure | \$311 [–\$19, \$679] | \$665 [\$168, \$1384] | \$278 [–\$72, \$681] | \$696 [\$162, \$1,366] |
| Overall: change in expenditures | \$420 [\$120, \$779] | \$777 [\$300, \$1,455] | \$396 [\$77, \$768] | \$806 [\$293, \$1,460] |

All models controlled for quartile of pre-injury medical expenditures, health insurance plan type, age group, and job category. Each model also included a constant term and was estimated using a two part model. The first part of the model used logit regression to predict whether an individual had any expenditures and the second part predicted the amount of expenditures for individuals who had a least some expenditures using log-transformed expenditures and ordinary least squares. Dollar amounts were rounded to the nearest dollar. Estimates using the log-OLS portion of the model were obtained using the appropriate retransformation algorithm for normal heteroskedastic residuals and bias-corrected bootstrapped 95% confidence intervals with 1,000 replications.

benefits. The average 6-month increase in group health insurance costs per injured worker (including those who received no workers' compensation benefits) was \$587, about half the mean workers' compensation medical benefits per injured worker of \$1162.

Limitations

Our estimates apply only to these patient care workers, all of whom had group health insurance. The expenditure information excludes individuals' out-of-pocket costs and other sources of medical care payment. Although we cannot measure out-of-pocket costs, we can reasonably assume that workers also paid some deductible, copayment, or coinsurance amount. However, by including expenditures before injury and the type of health insurance plan, we have limited bias from existing care patterns/preferences and likely degree of cost-sharing. The reliance on a single employer data source limits the variation in health care plan type and other work policies that may affect utilization. By restricting our focus to a relatively homogenous population, we cannot generalize to the U.S. population. On the contrary, we see advantages to this approach in that geographic factors and health insurance plan generosity are constant across the sample. We offer this study as a proof of concept that a reasonably large employer can determine the extent to which its group health insurance costs are affected by occupational injuries and illnesses.

We could not capture the costs of unreported injuries/illnesses or measure the severity of the injuries (although all costs of work-related injuries should, in principle, appear in worker's compensation rather than private health insurance). It is also possible that some costs directly tied to work-related injuries might eventually be recovered by the group health insurer. On the contrary, the use of a single employer's data source and a relatively narrow spectrum of workers limit the probability of unobserved confounding. There are of course, many factors that influence health care utilization, such as preference for health care and additional social factors; however, we do not have evidence that these factors would affect injured workers differentially. Our control for previous expenditures likely reduces this potential source of bias.

CONCLUSIONS

Using a sample of matched patient care workers at two different hospitals, we found that injury was associated with increased group health insurance expenditures after controlling for previous expenditures, health insurance plan type, age, and job category. This result held for non-sharp injuries and when individuals with sharp injuries were excluded from the model. Although workers' compensation is designed to cover all medical costs stemming from work-related injuries, some costs are likely borne by group health insurance. Workers' compensation costs are often used as one key indicator of the impact of occupational injuries and illnesses. To the extent that we understate their true medical costs, we understate their importance as preventable conditions.

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