The Health of Health Workers

COSTS OF OCCUPATIONAL INJURY AND ILLNESS WITHIN THE HEALTH SERVICES SECTOR

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Knowledge of costs is essential to allocate medical resources efficiently. The authors' goal was to estimate and compare costs across occupations, industries, gender, race, and types of nonfatal injuries and illnesses. This is an incidence study of nationwide data, 1993. Nonfatal incidence data were drawn from the Bureau of Labor Statistics Annual Survey. Medical costs were from the Detailed Claims Information data set. Productivity (wage) costs were calculated using the Current Population Survey. Pain and suffering costs were estimated from data on jury verdicts. Injuries and illnesses to nursing aides and orderlies cost $2,200 million; costs were $900 million for registered nurses and $40 million for licensed practical nurses. The ranking of health services industries in terms of costs was: hospitals (52 percent of all costs), nursing care facilities (38 percent), home care services (6 percent), physicians' offices (4 percent), and laboratories (<1 percent). Types of injuries (sprains, strains, fractures) were similar across occupations and industries, but types of illness (carpal tunnel syndrome, respiratory diseases) varied. The most costly injured body parts were: back, shoulder, knee, wrist, and neck. Injuries and illnesses comprised roughly 90 percent and 10 percent, respectively, of total costs. The hospital industry was the third most expensive of 313 U.S. industries. Costs of occupational injury and illness in the health services industry were high and varied across occupation, industry, disease, race, and gender.

Costs of medical care in the United States have now reached 14.9 percent of the gross domestic product and are forecast to rise even more (1). A significant but somewhat overlooked contributor to rising medical costs has been the rapidly rising costs for workers' compensation. For example, workers' compensation costs rose 21 percent in just three years from 1998 to 2001 for all industries combined (2). A related concern is the long-term increasing cost associated with

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administration in the health services sector (3). And nowhere is that concern greater than for the administrative costs of workers' compensation, which appear to be highest in the health services sector (4). An Institute of Medicine report suggests that medical errors affecting patients are unacceptably high, killing 44,000 to 98,000 patients each year, and may be related to unacceptably high rates of occupational injuries to health care workers (5). A research initiative is addressing correlations between workers' and patients' safety (6). In part because of these concerns about costs and workers' compensation and medical errors, job-related injuries and illnesses among health care workers have received increased attention (7–12). Incidence and prevalence of injury and illness, as well as costs, among health care workers appear to be exceptionally high. In a study of more than 20 occupations with high female employment, nursing aides were at the top of the list for costs of occupational injuries (13). The hospital industry, a subcategory of the broad health services sector, has ranked in the top four of more than 300 industries generating occupational injuries and illnesses throughout the 1980s and 1990s (14–17). In part, this is a result of the great number of employees in the health services industry—nearly 10 million people in 1998.

Only a handful of studies have addressed the costs of these injuries and illnesses (19–24), but even among these, cost was the primary research interest in only two studies. In the first study (23), hospital orderlies ranked sixth out of 223 occupations for workers' compensation costs. In the second (24), the hospital industry ranked third of 313 industries for total costs. This lack of attention to cost is unfortunate, since cost has become increasingly important in our era of managed care. In fact, recent re-engineering and cost-reduction strategies in managed care organizations may be resulting in increasing numbers of injuries to nurses and orderlies in hospitals in the United States and Canada (25, 26). Finally, cost is a useful measure because it combines incidence, severity, injury, and illness.

In this study we estimated the costs of nonfatal occupational injuries and illnesses in the health services sector. We excluded deaths, because fatality data were not available in the same rich categories as nonfatal data. However, 97 percent of the overall costs of injuries are due to nonfatal events, and fatal illnesses comprise less than 10 percent of the costs of all occupational injuries and illnesses combined for all industries (27).

These cost estimates were examined for a number of categories. First, we considered three occupations: nursing aides and orderlies; registered nurses (RNs); and licensed practical nurses (LPNs). Within these occupations we considered costs across gender and race. Second, we considered costs across four industries: hospitals; nursing and personal care facilities; home health care services; and physicians' offices. Within each of these industries we present estimates across gender, occupations, and race. Third, we considered the types of injuries and illnesses and the corresponding costs. Fourth, comparisons were drawn between the hospital industry and all other industries within the economy.

DATA AND METHODS

The Bureau of Labor Statistics (BLS) Annual Survey, which collects information on nonfatal cases, was the data source that served as a template onto which we merged cost information from other sources described below (28, 29). Medical cost information came from summaries of workers' compensation records in the Detailed Claims Information data set and the National Health Interview Survey (30, 31). We transformed work loss information from the Annual Survey into dollar values using wage data from the 1993 monthly Current Population Survey files (32). We used a survey of jury verdicts related to occupational injuries and illnesses to predict pain and suffering costs for nonfatal cases in the Annual Survey (33–35).

In this section, we present a brief description of our methods. Thorough descriptions are available in unpublished appendices available from the authors (phs.ucdavis.edu/Faculty/Leigh/CostsAcrossIndustries.htm). The appendices are associated with a companion paper analyzing costs across industries (24).

The 1993 Annual Survey contains detailed information on 603,936 cases of nonfatal occupational injury and illness involving one or more days away from work. The Annual Survey represents a total of 2.25 million such cases reported in the United States in 1993 in private industry among those not self-employed, not in small farms, and not in private household occupations. Our cost estimates were based on a subset of 447,643 cases of these 603,936 detailed cases. This subset was selected for two reasons. First, we excluded cases with days lost during the last two months of 1993 to minimize the bias associated with the BLS institutional requirement that days away from work are not recorded beyond December 31 for any given year. Second, some of the 603,936 cases could not be matched to health care cost data.

The costs of occupational injuries and illnesses can be divided into three broad categories: direct costs, indirect costs, and quality-of-life costs. Direct costs include payments for hospital, physician, and allied health services, rehabilitation, nursing home care, home health care, medical equipment, burial costs, insurance administrative costs for medical claims, mental health treatment, police, fire, emergency transport, coroner services, and property damage. Indirect costs refer to (*a*) victim productivity losses, which include wage losses and household production losses; (*b*) employer productivity losses, which include recruiting and training replacements for injured workers; and (*c*) administrative costs, which include administering workers' compensation programs. Quality-of-life costs refer to value attributed to pain and suffering by victims and families.

The costs presented are incidence-based and include all costs of an injury or illness over the person's lifespan. Whenever cost components extended more than a year, we applied a discount rate of 2.5 percent to compute present value.

For injuries, health care costs were estimated separately for those hospitalized and those not hospitalized, by diagnosis. The medical costs for hospitalized

patients are the product of five diagnosis-specific factors: length of stay; hospital cost per day; ratio of professional fee payments to hospital payments; ratio of cost in the first six months to cost during the initial admission; and ratio of the present value of lifetime medical payments to payments in the first six months. The medical costs for nonhospitalized persons are the product of diagnosis-specific factors involving, for example, the probability that an injury requires medical treatment and the number of visits to physicians' offices.

For illnesses, medical costs were computed in a simpler manner since less information was available. The annual medical spending for hospitalizations, for example, was computed as the product of length of stay, cost per day, and ratio of hospital plus professional fee payments to hospital payments.

Indirect or productivity losses for nonfatal cases can be divided into short-term and long-term losses including wage and household productivity losses. To account for the censoring of reported days away from work, we developed a statistical model to estimate the length of time these censored cases would have taken to be resolved (unpublished appendices).

For short-term wage losses, we multiplied the number of days away from work by the predicted daily wage rate received by a worker of the same age group, race, gender, industry, and occupation as the jury victim. The predicted wage rates were derived from a linear regression of hourly wages on these characteristics, using the 1993 Current Population Survey (32). Long-term wage losses resulting from permanent total disability were based on probabilities of permanent partial injuries and estimates of lifetime wage loss.

Our household work loss estimates accounted for the fact that household work may be lost on days when wage work is not, and also accounted for results in Marquis (36) showing that 90 percent of the time lost to wage work is also lost to household work (37).

RESULTS

We estimated that job-related nonfatal injuries and illnesses resulting in work loss for all occupations and industries in the private sector cost $61 billion in 1993. The five health services industries combined (hospitals, nursing facilities, home care, physician offices, and laboratories) contributed $4.974 billion. This represented 8.1 percent of the total in the private sector. The three occupations combined (nursing aides, registered nurses, and licensed practical nurses) generated roughly $3.4 billion in costs, or 5.6 percent of the $61 billion. In a companion study (24) we ranked 313 U.S. industries for total cost including fatalities. Hospitals placed third.

Table 1 presents results directly from the BLS Annual Survey regarding injury and illness rates (not costs) for 1993 (38). The data in Table 1 are summary data, not specific case and demographic data used in our cost analysis. The last column lists the ratio of a specific industry's injury rate to the rate of all private industry.

Table 1

Employment, injury, and illness statistics within the Bureau of Labor Statistics Annual Survey, 1993

Industry	Employment, millions	Injury and illness rate[a]	Percent of all private industry[b]
All health services	8.871	9.6	113%
Nursing and personal care facilities	1.615	17.3	204
Hospitals	3.816	11.8	139
Home health care services	0.474	9.6	113
Medical and dental laboratories	0.193	5.8	68
Physicians' offices	1.545	2.8	33
All private industry (combined)	91.932	8.5	100
Hazardous industry comparison			
Agriculture[c]	—	11.5	135
Coal mining	0.105	10.3	121
Construction	4.574	12.2	143

Source: BLS (38).

[a]Per full-time employed worker, per year.

[b]Ratio of the rate for a specific industry to the rate for all industries combined (for example, 113% = 9.6/8.5).

[c]BLS does not publish employment statistics that match injury and illness statistics for agriculture. Rate within agriculture is a BLS estimate with wide confidence intervals.

For example, the number for the nursing and personal care facilities, 204 percent, means that the rate for nursing facilities was more than double the one for all industries combined.

Agriculture, coal mining, and construction are generally regarded as among the most hazardous industries in the economy (39, 40). Their injury rates are listed at the bottom of Table 1. Our top-ranked industry—nursing and personal care facilities—generated an injury and illness rate that was higher than in any of these three most hazardous industries.

Table 2 presents cost results for three occupations. Among these three, nursing aides; attendants, and orderlies generated the most costs—$2.18 billion (or $2,180 million)—which comprised 64 percent of the combined $3.4 billion for all three. The corresponding dollar amounts and percentages were $841 million and 25 percent for RNs and $406 million and 11 percent for LPNs. The highest cost per case occurred among RNs and the lowest among aides. In part, this reflected the higher wage (indirect cost) paid to RNs than orderlies.

There were gender differences. Women generated the highest costs among LPNs (95 percent) and the lowest among RNs (89 percent). These differences were similar to employment differences. Females comprised 96 percent of LPNs,

Table 2

Nonfatal injury and illness costs for occupations

	Nursing aides, attendants, and orderlies				Registered nurses				Licensed practical nurses			
	No. of cases	$ millions	Percent	Cost per case	No. of cases	$ millions	Percent	Cost per case	No. of cases	$ millions	Percent	Cost per case
Total	105,596	$2,180	64%	$20,643	31,988	$841	25%	$26,312	15,417	$406	11%	$26,354
Gender												
Male	11,507	$213	9.8	$18,533	2,847	$95	11.3	$33,320	752	$21	5	$28,409
Female	94,090	$1,967	90.2	$20,901	29,141	$747	88.7	$25,628	14,666	$385	95	$26,249
Race/ethnicity[a]												
White, non-Hispanic	57,660	$1,183	67.6	$20,514	17,660	$481	87	$27,215	9,209	$262	82	$28,497
Black, non-Hispanic	19,719	$420	24.0	$21,294	1,085	$29	5	$26,511	1,598	$40	13	$24,885
Hispanic/Asian and other	6,371	$147	8.4	$23,132	1,368	$43	8	$31,507	597	$16	5	$27,199

Note: In the Total row, percentage sums horizontally; for all other rows, percentage sums vertically.

[a]Occupations and their number of cases and total dollar amount in the "race not reported" category are: nursing aides: 21,846 cases, $430 million; registered nurses: 11,875 cases, $288 million; licensed practical nurses, 4,013 cases, $88 million. Percentages in the race/ethnicity category apply only to the three categories given, not to the "race not reported" category. This allows for a better comparison with figures on race and ethnicity in the U.S. population at large.

93 percent of RNs, and 89 percent of aides in 1993 (41). There were racial and ethnic differences across occupations. However, race was not recorded in 20 to 30 percent of the cases, depending upon the classification. Such a large omission raised a concern about the validity of our race/ethnicity results. To partially adjust for this omission bias, we expressed the percentage in the race/ethnicity categories in terms of only those persons who indicated their race and ethnicity. We did not use data from cases where the race/ethnicity was not reported when calculating the percentage. This adjustment allowed a more direct comparison with race and ethnicity statistics for the United States as a whole. Non-Hispanic whites comprised roughly 85 percent of the labor force in 1993, and non-Hispanic blacks roughly 11 percent (18). The remaining 4 percent consisted of Hispanics, Native Americans, Asians, and Pacific Islanders. The highest percentage of cases among blacks was for nursing aides (24 percent); the lowest was for RNs (5 percent).

Table 3 presents cost estimates across industries. The costs and percentage contribution per industry were: hospitals, $2,567 billion, 52 percent; nursing and personal care facilities, $1.879 billion, 38 percent; home health care services, $0.306 billion, 6 percent; and physicians' offices, $0.183 billion, 4 percent. Information on medical and dental laboratories was omitted because of its small size ($0.039 billion, <1 percent of total). The total cost for all five industries was $4.974 billion.

In all four industries, females contributed more than males to injury and illness costs. The highest percentage contribution occurred in physicians' offices (91.3 percent) and the lowest in hospitals (78.8 percent).

Regarding occupations, the ranking of greatest to least costs in hospitals was: RNs; aides, attendants, and orderlies; administrative support; LPNs; maids and janitors; and technologists. For nursing and personal care facilities the ranking was: aides, attendants, and orderlies; LPNs; RNs; maids and janitors; administrative support; and technologists.

Table 4 provides information on costs by occupation and four broad classifications of the injury or illness: nature of injury, part of body, event or exposure, and nature of disease or infection. The "part of body" and "event or exposure" categories are different classification schemes from the "nature" category. Only the top five types in each classification are listed. Because far more injuries than diseases were reported to the BLS, injuries are largely responsible for the "top five" lists under "part of body" and "event or exposure." Injuries accounted for roughly 90 percent of all costs.

The rankings in the top three classification schemes (nature of injury, part of body, and event or exposure) were similar across occupations. For example, in the nature of injury category, the top four ranking was the same for all three occupations: back sprains and strains, other sprains and strains, fractures and dislocations, and surface wounds. The same body parts were listed within the

Table 3

Nonfatal injury and illness costs across industries

	Hospitals				Nursing and personal care facilities			
	No. of cases	$ millions	Percent	Cost per case	No. of cases	$ millions	Percent	Cost per case
Total	113,824	$2,567	52%	$22,559	90,796	$1,879	38%	$20,696
Gender								
Male	26,366	$545	21.2	$20,661	12,147	$244	13.0	$20,051
Female	87,458	$2,023	78.8	$23,132	78,649	$1,636	87.0	$20,796
Occupation[a]								
Registered nurse	24,682	$631 (1)	24.6	$25,561	3,600	$90 (3)	4.8	$25,058
Nursing aides and orderlies	22,321	$446 (2)	17.4	$19,964	61,559	$1,250 (1)	66.5	$20,308
Administrative support, clerks	10,376	$238 (3)	9.3	$22,920	664	$16	0.9	$23,363
Licensed practical nurse	8,110	$218	8.5	$26,883	4,862	$129 (2)	6.9	$26,307
Maids and janitors	9,268	$174	6.8	$18,804	4,322	$73	3.9	$16,893
Laboratory technologist	3,061	$79	3.1	$25,753	121	$2	0.1	$19,158
Race/ethnicity[b]								
White, non-Hispanic	54,756	$1,283	74.2	$23,429	53,239	$1,130	70.6	$21,218
Black, non-Hispanic	13,581	$290	16.8	$21,389	16,684	$355	22.2	$21,287
Hispanic/Asian and other	7,546	$156	9.0	$20,728	6,184	$116	7.2	$18,763

Note: In the Total row, percentage sums horizontally; for all other rows, percentage sums vertically.

[a]Occupations other than the six listed here were grouped in the "all other" category. The industries and their number of cases in the "all other" category are: hospitals, 36,006; nursing and personal care facilities, 15,668; home health care services, 1,635; offices of physicians, 2,609. The cost rankings for occupations are in parentheses: (1), (2), (3), or (4).

[b]Industries and their number of cases and total dollar amount in the "race not reported" category are: hospitals, 37,941, $1,729 million; nursing and personal care facilities, 14,689, $1,517 million; home health care services, 4,743, $184 million; offices of physicians, 1,842, $140 million.

Table 3 (Cont'd.)

Home health care services				Offices and clinics of physicians			
No. of cases	$ millions	Percent	Cost per case	No. of cases	$ millions	Percent	Cost per case
13,327	$306	6%	$22,935	6,560	$183	4%	$27,983
1,103	$35	11.4	$32,039	843	$16	8.7	$19,007
12,224	$271	88.6	$22,114	5,717	$167	91.3	$29,306
1,680	$55 (2)	18.0	$32,691	299	$7 (4)	3.8	$25,059
8,613	$182 (1)	59.5	$21,073	301	$9 (2)	4.9	$30,247
237	$6	2.0	$26,732	2,789	$100 (1)	54.6	$36,000
1,162	$24 (3)	7.8	$20,437	309	$8 (3)	4.4	$24,725
—	—	—	—	79	$2	1.1	$20,496
—	—	—	—	174	$7 (4)	3.8	$38,781
6,321	$146	79.3	$23,164	3,282	$113	80.1	$34,579
1,631	$13	7.1	$21,938	598	$15	10.7	$25,543
632	$25	8.2	$39,568	838	$12	8.6	$14,433

Table 4

Type of injury or illness within occupations

	Nursing aides, attendants, orderlies	Registered nurses	Licensed practical nurses
Nature of injury	1. Back sprains and strains ($900 million) 2. Other sprains and strains ($643 million) 3. Fractures, dislocations, excluding back, head, neck ($166 million) 4. Surface wounds, bruises ($125 million) 5. Other traumatic injuries, disorders ($61 million)	1. Back sprains and strains ($318 million) 2. Other sprains and strains ($185 million) 3. Fractures, dislocations, excluding back, head, neck ($85 million) 4. Surface wounds, bruises ($42 million) 5. Multiple traumatic injuries, disorders ($22 million)	1. Back sprains and strains ($142 million) 2. Other sprains and strains ($122 million) 3. Fractures, dislocations, excluding back, head, neck ($24 million) 4. Surface wounds, bruises ($19 million) 5. Other traumatic injuries, disorders ($15 million)
Part of body affected	1. Back ($992 million) 2. Shoulder ($234 million) 3. Knee ($132 million) 4. Wrist ($95 million) 5. Neck, throat ($44 million)	1. Back ($353 million) 2. Knee ($46 million) 3. Shoulder ($45 million) 4. Neck, throat ($33 million) 5. Wrist ($27 million)	1. Back ($157 million) 2. Shoulder ($29 million) 3. Knee ($28 million) 4. Wrist ($17 million) 5. Neck, throat ($10 million)
Event or exposure	1. Bodily reaction and exertion, unspecified ($1,463 million) 2. Falls ($292 million) 3. Assaults, violent acts ($161 million) 4. Contact with objects, equipment ($136 million) 5. Exposure to harmful substances or environments ($63 million)	1. Bodily reaction and exertion, unspecified ($507 million) 2. Falls ($125 million) 3. Exposure to harmful substances or environments ($76 million) 4. Contact with objects or equipment ($50 million) 5. Assaults or violent acts ($37 million)	1. Bodily reaction and exertion, unspecified ($248 million) 2. Falls ($59 million) 3. Exposure to harmful substances or environments ($30 million) 4. Assaults or violent acts ($29 million) 5. Contact with objects or equipment ($25 million)

Table 4 (Cont'd.)

	Nursing aides, attendants, orderlies	Registered nurses	Licensed practical nurses
Nature of systemic disease and infections	1. Musculoskeletal disorder ($31 million) 2. Carpal tunnel syndrome ($26 million) 3. Disorders of the skin ($16 million) 4. Digestive system disease ($12 million) 5. Viral disease ($7 million)	1. Musculoskeletal disorder ($33 million) 2. Viral diseases ($20 million) 3. Disorders of the skin ($17 million) 4. Carpal tunnel syndrome ($10 million) 5. Respiratory disease ($8 million)	1. Musculoskeletal disorder ($9 million) 2. Disorders of the skin ($9 million) 3. Respiratory disease ($7 million) 4. Carpal tunnel syndrome ($7 million) 5. Viral disease ($3 million)

occupations, only in slightly different order: back, shoulder, knee, wrist, and neck. In the event or exposure category, assaults and violent acts generated $161 million in costs for aides, attendants, and orderlies; $37 million for RNs; and $29 million for LPNs.

The similarity was less striking for the nature of systemic disease and infection category. The following were prominent: musculoskeletal disorder, carpal tunnel syndrome, disorders of the skin (e.g., dermatitis), digestive system disease (e.g., hernia), viral disease (e.g., hepatitis C), and respiratory disease (e.g., tuberculosis). But the order was not identical across occupations. Carpal tunnel syndrome was second for aides, attendants, and orderlies, but fourth for RNs and LPNs. Viral diseases were second for RNs, but fifth for aides, attendants, and orderlies and for LPNs. Finally, respiratory diseases were important for both RNs and LPNs, but not on the "top five" list for aides, attendants, and orderlies.

We also estimated costs for the same classification schemes across the five industries. Again, we found striking similarities in the rankings in the nature of injury, part of body, and event or exposure categories and somewhat similar rankings in the nature of disease category. Consequently, we do not present these results. There was one notable exception to these similarities, however. "Mental disorders," which include alcohol and drug abuse, were ranked number 1 and 2, respectively, for the home health care industry ($11 million) and the physician office industry ($12 million).

DISCUSSION

One finding was that the health services sector generated high costs for occupational injuries and illnesses. As Table 1 suggests, this finding in part reflects the sheer number of employees. But the injury and illness rate was also high. The rate is a measure of risk. These high rates suggest that nursing and personal care facilities, hospitals, and home health care services are especially hazardous industries. A second finding was that injuries, especially back strains as well as "all other" sprains and strains, were far more prevalent than diseases. In this regard, the health services sector is similar to other large industrial sectors such as manufacturing, agriculture, and mining for which injuries, especially sprains and strains, far exceed diseases (42).

Comparison with the Literature

A number of studies have shown that nurses, aides, and orderlies are at high risk of injury and illness (7–16). Back injuries (10–12, 13, 19), assaults (7), and needlesticks (12) have received the greatest attention. Our study confirms the importance of these causes, but adds several new ones, including carpal tunnel syndrome, respiratory disease, and skin diseases. The fact that rankings from BLS studies using data from the Annual Survey and from these independent studies (7–12, 14–16) resemble our findings lends credibility to our rankings, despite the limitations mentioned below.

When we consider all occupations outside health care, the disease that claims the greatest number of days away from work is carpal tunnel syndrome (17). Our research demonstrates that when considering costs in the health care sector, carpal tunnel is not at the top of the list of diseases. Musculoskeletal disease is. Our data also confirm the increasing importance of viral diseases (hepatitis C and HIV) and respiratory disease (tuberculosis) among health care workers (43, 44).

Implications

The finding on the hazardous nature of nursing facilities, hospitals, and home care was somewhat surprising. Workers in this sector are thought to be the most knowledgeable about health and safety of all persons in society. One would think that employers in this sector would want their workplaces to be shining examples of health and safety (5). The first implication of our results, therefore, pertains to workers' knowledge of hazards and employers' responses to hazards. One occupation (aides, attendants, and orderlies) and one industry (nursing facilities) stand out in this regard. Aides, attendants, and orderlies were at the top of the list in Table 2, and nursing facilities were at the top of Table 1. Aides

and orderlies as well as most workers in the nursing facilities industries hold dangerous jobs.

There are second, related implications. Any reduction in occupational injury and illness costs has the potential to reduce costs in health services in general. Moreover, efforts to improve job safety are likely to have a positive spill-over effect to improve patient safety.

A third implication pertains to regulatory directions. The Occupational Safety and Health Administration (OSHA) has limited resources to police industries. To have the greatest impact, OSHA might consider targeting for intervention those industries and occupations with high costs. These include hospitals, nursing facilities, aides and orderlies, RNs, and LPNs. Currently, OSHA targets firms for inspection based only upon lost-day injury and illness rates. But rates may not capture the magnitude of the injury or illness. Rates do not measure the cost of medical care or of training replacement employees, for example. Costs are a better measure of the overall magnitude than simply the numbers of work days lost.

Limitations

The Annual Survey is limited by excluding federal, state, and local government workers, workers on farms with fewer than 11 employees, and the self-employed. This may especially be a problem for the health care sector, which contains many government-run enterprises. Moreover, economic incentives exist for workers to over- and under-report injuries and for employers to under-report. Workers may seek to collect workers' compensation benefits (over-report) or may fear being labeled "accident-prone" (under-report). Firm owners may seek to reduce workers' compensation premiums by under-reporting (45). Whereas these limitations figure prominently in an estimate of total national costs for all industries combined, they are less prominent for an occupation-by-occupation or industry-by-industry ranking, assuming these limitations apply equally across occupations and industries.

Illnesses are likely to be severely underestimated. Workers' compensation is paid to people who were working immediately prior to the time of the injury or illness. If the illness does not manifest until retirement, it becomes difficult, if not impossible, to collect workers' compensation benefits. But many occupational diseases are not apparent until retirement (42). One of these is job-related osteoarthritis. Job-related injuries to joints early in life could result in osteoarthritis in these joints later in life. Job-related arthritis was estimated to cost $8.3 billion in 1994 (46).

Our data do not include deaths. It is likely that the health services sector may appear more hazardous in comparison to other industries by excluding deaths than by including them. Whereas the health services sector is relatively high in nonfatal injuries, it is lower in fatal ones (less than 1 per 100,000 in 1993,

whereas the U.S. average for all industries in 1993 was 5 per 100,000) (47). Finally, our data were a little old, dating from 1993.

Some have argued that economic incentives may exaggerate the "true" cost of injuries for low-wage workers (48). Ratios of workers' compensation benefits to wages are sometimes higher for low-wage than for high-wage workers. On the other hand, the recorded injuries may underestimate the "true" injuries. Low-wage workers may simply quit a job after an injury. Measures of job hazard, in fact, are strong predictors of quit rates (49), and aides, attendants, and orderlies have annual turnover rates as high as 75 percent (50). Moreover, evidence exists that low income itself is an independent risk factor for injuries and illnesses, whether or not job-related (51).

In conclusion, we found total costs of occupational injuries and illnesses were especially high in this sector, suggesting health care organizations should devote more resources to prevention. A reduction in occupational safety and health costs could have two much broader implications: one cause of rising health care costs for the nation could be eliminated, and patient safety would also likely improve (5).

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