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Effects of a Participatory Ergonomics Team Among Hospital Orderlies

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Background: *High rates of work-related injuries are seen among health care workers involved in lifting and transferring patients. We studied the effects of a participatory worker–management ergonomics team among hospital orderlies.*

Methods: *This prospective intervention trial examined work injuries and other outcomes before and after the intervention, with other hospital employees used as a concurrent control. All orderlies in a 1,200-bed urban hospital were studied using passively collected data (mean employment during study period 100–110 orderlies); 67 orderlies (preintervention) and 88 orderlies (postintervention) also completed a questionnaire. The intervention was the formation of a participatory ergonomics team with three orderlies, one supervisor, and technical advisors. This team designed and implemented changes in training and work practices.*

Results: *The 2-year postintervention period was marked by decreased risks of work injury (RR = 0.50, 95% CI 0.35–0.72), lost time injury (RR = 0.26, 95% CI 0.14–0.48), and injury with three or more days of time loss (RR = 0.19, 95% CI 0.07–0.53). Total lost days declined from 136.2 to 23.0 annually per 100 full-time worker equivalents (FTE). Annual workers' compensation costs declined from $237/FTE to $139/FTE. The proportion of workers with musculoskeletal symptoms declined and there were statistically significant improvements in job satisfaction, perceived psychosocial stressors, and social support among the orderlies.*

Conclusion: *Substantial improvements in health and safety were seen following implementation of a participatory ergonomics program.* Am. J. Ind. Med. 35:358–365, 1999.

KEY WORDS: occupational health; participatory ergonomics; ergonomics teams; health care workers; intervention research; injury prevention; work-related musculoskeletal disorders

INTRODUCTION

Rates of work injuries in health care workers are equal to or higher than those of workers in heavy industry and other occupations that are traditionally considered hazardous. National data compiled by the Bureau of Labor Statistics show that the rate of work-related injury or illness requiring medical treatment or lost work was 11.4 per 100 full-time hospital workers and 16.8 per 100 among nursing home workers in 1994 [BLS, 1996]. Among nurses and nursing aides, the rate was 17.9 per 100 workers (in 1995) [NCHS, 1997]. These data can be compared to national data on work injuries in 1994 showing an annual rate of

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work-related injuries and illnesses of 6.3 per 100 full-time workers in mining, 11.8 per 100 workers in construction, and 12.2 per 100 workers in manufacturing [BLS, 1996].

Injuries to health care workers often result in lost work time or work restrictions, with resultant losses of productivity. Nationally, nursing aides and orderlies rank third among all occupations in number of lost day injuries, exceeded only by truck drivers and nonconstruction laborers [BLS, 1995]. Nursing aides and orderlies, who are often injured during patient transfer activities, are at higher risk of injury than health care workers as a whole. In 1994, 101,800 nursing aides and orderlies had occupational injuries or illnesses that required lost time from work, with a median of 6 lost work days per injured worker. Annual rates for lost time injuries were 4.1 per 100 among all workers in hospitals and 8.4 per 100 workers in nursing homes, compared to rates in both construction and manufacturing of 5.5 per 100 workers [BLS, 1995].

The high rate of injury among health care workers is not a recent phenomenon, but until recently has received little attention. Patient care requires many lifting and transfer tasks which pose a demonstrated risk of injury to workers [Stubbs et al., 1983; Smedley et al., 1997], and high rates of back injuries and other musculoskeletal disorders have been well documented among health care workers [Dehlin et al., 1976; Estryn-Bahar et al., 1990; Wilkinson et al., 1992; Punnett et al., 1985]. A variety of sources demonstrate that the burden of injury and disability posed by acute injuries is far higher than that posed by illnesses, including those caused by infectious and chemical agents [BLS, 1996; Punnett et al., 1985]. Despite the higher burden of morbidity posed by musculoskeletal injuries, most research, training, and regulatory activities aimed at health care workers have focused on prevention of exposure to infectious diseases or chemicals that are unique to the health care setting.

A few studies have evaluated interventions to reduce injuries among health care workers. These efforts have been based on worker education programs, physical conditioning, or the use of ergonomic interventions which seek to modify or rationalize the physical demands and performance of a job in order to reduce injuries. Although one study found that an intensive (40-hr) training program in patient-handling skills was effective in reducing back injury [Videman et al., 1989], other studies suggest that education alone, in the absence of work modifications, is not effective in reducing back injuries among health care workers [Feldstein et al., 1993]. Physical conditioning, alone or in combination with other changes, may be effective in reducing back injuries [Gundewall et al., 1993; Galka, 1991]. Interventions which modify job tasks, such as the introduction of a lifting team or the utilization of mechanical assistive devices for lifting and transferring patients, have been successful in reducing injuries among health care workers [Garg and Owen, 1992; Owen et al., 1995; Charney et al., 1991].

Another approach — the use of participatory ergonomics programs — has only recently been applied to health care environments, although this approach has been used in the automobile manufacturing and meat packing industries. In this type of program, workers and management work cooperatively to identify safety and health problems, and to implement appropriate changes in work practices or job design. In contrast to the more common ''top-down'' safety programs, participatory ergonomics teams may more effectively take advantage of worker knowledge and problem-solving skills, reduce resistance to change, and improve workplace communication and worker motivation [Gjessing et al., 1990; Schurman et al., 1994; Moore and Garg, 1996]. One study has shown that hospital-based participatory ergonomics teams could identify health and safety problems, suggest appropriate control strategies, and implement some of these controls [Bohr et al., 1997]. The present study sought to determine if the implementation of a participatory ergonomics team among hospital orderlies would result in lower rates of injury, lost time, and musculoskeletal symptoms. We also hypothesized that direct worker participation in problem solving would improve job satisfaction.

METHODS

Setting

All hospital orderlies from the Central Dispatch Office were studied in a nonunionized 1,200-bed metropolitan medical center. During the study period, the Dispatch Office employed, on average, 100–110 orderlies. Orderlies were targeted because historical data showed high rates of back, knee, and shoulder injuries associated with lifting, moving, and transporting patients throughout the hospital.

Intervention

A participatory ergonomics team was formed, consisting of three orderlies and one supervisor. Team members received an initial 8-hr training session, which included exercises for team-building, provision of basic technical information on hazard identification and control, and supervised exercises in observation and measurement. The team began work in October 1995, meeting weekly to identify job factors that contributed to injuries among orderlies and to seek solutions to perceived job hazards. The team had limited authority to make changes in work processes. The three authors provided technical assistance by meeting regularly with the team to address questions and provide information as needed. Team members were responsible for identifying and prioritizing safety problems and for evaluating and implementing possible solutions. The authors attempted to have minimal influence on the team's decision-making while still providing information and assistance.

Several factors contributing to injury were identified by team members. Two major factors identified were the lack of standard procedures for lifting and moving patients and inconsistent training procedures for employees. There were also concerns about specific types of lifts, the underutilization of mechanical lifting equipment, and the occurrence of injuries when moving hospital equipment such as beds and scales.

The primary safety interventions implemented by the team were the development of standardized lifting techniques and the training of all orderlies in the use of these procedures. In early 1996, team members established standardized techniques in 12 common types of lifts and transfers, including those requiring use of mechanical lifting aids. Manual lifts and transfers were all performed by two persons; the procedures emphasized such precautions as using a draw sheet, positioning beds at convenient heights, and the avoidance of a bent-waist posture while lifting. Special procedures were developed for very heavy patients. The lifting procedures also emphasized patient safety and comfort, particularly with regard to devices such as surgical drains, chest tubes, and cervical support ''halos.'' All orderlies received training on the standardized procedures developed by the participatory team, using a lifting manual written by the team members. Training included both practical experience working with a senior orderly and a written examination that had to be completed satisfactorily before the trainee could work independently. New employees were required to successfully complete training before being allowed to work independently. Feedback from supervisors and co-workers was used to improve the orderlies' adherence to the lifting and transfer guidelines. The manual was also distributed to nursing supervisors in patient care areas, and their compliance with the procedures was encouraged. Other team activities included the evaluation and limited use of mechanical lifting aids, requests for mirrors at busy hallway intersections, and improved procedures for maintaining existing equipment in good working order.

Outcome Measures

Three main sources of outcome data were used in assessing the effectiveness of the participatory ergonomics program: the OSHA 200 log, workers' compensation insurance records, and self-administered surveys of workers. The study was approved by the Institutional Review Board at our university. Informed consent for participation in the study was obtained through a mailed consent form, which was sent and returned with the baseline questionnaire. Questionnaire data were used only with consent of the subjects; consent was not obtained for the use of passively collected data (OSHA log and workers' compensation records). For analyzing these data, the intervention period was defined as January 1, 1996, through December 31, 1997.

The OSHA 200 log is a federally mandated record of work-related injuries or illnesses that require medical treatment or result in lost time or restricted duty. For all hospital employees, this record was maintained by a nurse not connected with the study in the hospital's employee health office. OSHA logs from January 1, 1993, to December 31, 1997, were manually reviewed to code injuries and lost days among the orderlies. Summary data from the OSHA log were used to count injuries and lost days for hospital workers as a whole.

Denominator data for calculation of injury and lost-day rates were obtained from the hospital's Human Resources Department, and consisted of productive hours worked for the Dispatch Department and the hospital as a whole. One full-time equivalent (FTE) was defined as 2,000 productive hours per year. Rates were expressed as injuries or costs per 100 FTE. Workers' compensation costs are expressed as cost per 1 FTE. The workers' compensation insurance records are kept by an external insurance administrator. These records provide information on the total direct costs of each case, including medical treatment, payments for lost time, and settlements for permanent disability resulting from work injuries. These costs also include moneys encumbered for future costs in cases that are not yet settled. Data from January 1, 1995, to December 31, 1997, were available for review.

A 30-item, self-administered questionnaire was sent to all orderlies at 1 month, 7 months, and 15 months following the study inception. The design of the study allowed questionnaire responses to be compared cross-sectionally and by longitudinal paired analysis. The questionnaire included items on physical comfort, the presence or absence of musculoskeletal pain at different sites, pain severity, psychosocial stressors, and job satisfaction. Psychosocial stressors and job satisfaction were evaluated on three summary scales: the Job Satisfaction Scale, the Work Apgar, and the Psychosocial Stressors Scale. The Job Satisfaction Scale combined scores on three questions: ''How satisfied are you with your job?''; ''How strongly would you recommend your job to someone else?''; and ''If you were looking for a job now, how likely is that you would decide to take this job again?'' Higher numbers represent greater satisfaction. The Work Apgar was a seven-question scale that assesses social support from supervisors and fellow workers, adapted from the Boeing back study [Bigos et al., 1991]. This scale asked workers to rate seven statements on a three-point scale from ''Hardly Ever'' to ''Almost Always'' (Table I). The Psychosocial Stressors Scale was based on three questions: ''How often are you faced with conflicting demands of people with whom you work?''; ''How often does your job leave you with too little time to get everything

TABLE I. Selection of Statements in Work Apgar*

- I am satisfied that I can turn to a fellow worker for help when something is troubling me.
- I am satisfied with the way my fellow workers talk things over with me and share problems with me.
- I am satisfied that my fellow workers accept and support my new ideas or thoughts.
- I am satisfied with the way my fellow workers respond to my emotions such as anger, sorrow, or laughter.
- I am satisfied with the way my fellow workers and I share time together.
- I enjoy the tasks involved in my job.
- How well do you get along with your closest or immediate supervisor?

*Adapted from Bigos et al. [1991].

done?''; and ''How often is your supervisor willing to listen to your work-related problems?'' Lower scores represented less reported job stress.

Data Analysis

Injury and lost-day rates were compared by calculation of rate ratios and confidence intervals [Rothman, 1996]. Workers' compensation costs were compared using an unpaired *t*-test. Questionnaire responses were tested using the McNemar test and the Chi-square test for paired and unpaired dichotomous data, and the Wilcoxon paired sign rank test and Wilcoxon rank sum for paired and unpaired ordinal data.

RESULTS

Injury and Lost-Time Rates

As shown in Figures 1 and 2, the rates of injuries and lost days recorded in the OSHA 200 log fell dramatically among the orderlies following implementation of the intervention. Total injuries fell from 110 in the 3 years preceding the intervention to 39 in the 2 years following. The injury rate in 1993–1995 was 32.5 injuries annually per 100 FTE; in 1996–1997, following the intervention, the rate was 16.3 per 100 FTE. Expressed as a rate ratio, the relative risk (RR) for reportable injury in 1996–1997 compared to 1993–1995 was 0.50 (95% CI 0.35–0.72). The relative risk of having a lost-time injury in 1996–1997 compared to 1993–1995 was 0.26 (0.14–0.48), and of having an injury with 3 or more days of time loss was 0.19 (0.07–0.53). Total lost days declined from 136.2 per 100 FTE in 1993–1995 to 23.0 in 1996–1997. Modified duty days declined from 107 per 100 FTE to 14.6 days per 100 FTE. Comparing 1996–1997 to the 3 years prior to the intervention, average days lost per reportable injury decreased from 4.45 to 1.58, a difference that was statistically significant ($P < 0.05$, unpaired *t*-test).

To control for temporal trends in injury reporting and management that affected all hospital employees, injury rates among the orderlies were compared to rates among all workers at the hospital. As shown in Figures 1 and 2, injury and lost-day rates declined slowly among hospital workers as a whole during the period of observation. Adjusted RRs for the orderlies were determined by calculating the expected numbers of injuries and lost days based on the decreased rates seen for the hospital as a whole during the intervention period. Following adjustment for the temporal trends in rates of injuries and lost-day injuries seen in the hospital as a whole, orderlies still had markedly decreased rates of recordable injury (RR = 0.64 , 95% CI 0.44–0.93), and lost-day injury (RR = 0.40, 95% CI 0.21–0.75) in the intervention period compared to the preceding 3 years. During the intervention period, total lost days declined from an expected value of 79.1 days per 100 FTE to 23.0 per 100 FTE. Although orderlies continued to be at higher risk of injury than hospital workers as a whole, their risks diminished markedly. Expressed as a risk of recordable injury relative to other hospital workers, orderlies had a relative risk of 3.56 (2.93–4.31) for recordable injury in the 3 years prior to the intervention, which fell to 2.00 (1.45–2.76) following the intervention. The risk of incurring a lost-day injury relative to all hospital workers fell from an RR of 7.70 (5.92–10.02) to an RR of 3.10 (1.75–5.48) following the intervention.

In addition to the total injury rates reported above, the rates of low back injuries among orderlies were analyzed separately. Compared to the 3 years preceding the intervention, the relative risk of low back injury among orderlies was 0.25 (95% CI 0.13–0.47) in the postintervention period. Total lost days due to back injury declined from 64.3 to 7.1 annually per 100 FTE.

Workers' Compensation Costs

Nine injuries were reportable under state workers' compensation laws in 1995 (preintervention), and 17 were reportable during 1996 and 1997 (postintervention). For the orderlies, total costs were $24,443 in 1995 ($237/FTE) and $34,207 during 1996–1997 ($139/FTE), representing a 41% decrease in costs per worker. Although not statistically significant ($P = 0.67$, unpaired *t*-test), this decrease in costs among the orderlies can be compared to the 5.6% decrease in costs per worker seen in the hospital as a whole during this same time period ($180/FTE to $170/FTE). Workers' compensation savings among the orderlies over the 2 years following the intervention, adjusted for these temporal trends, were estimated at $22,758. Cost of the intervention, excluding the technical advisors, was less than $5,000 for the 2-year period, including all equipment and wages for time spent on team activities.

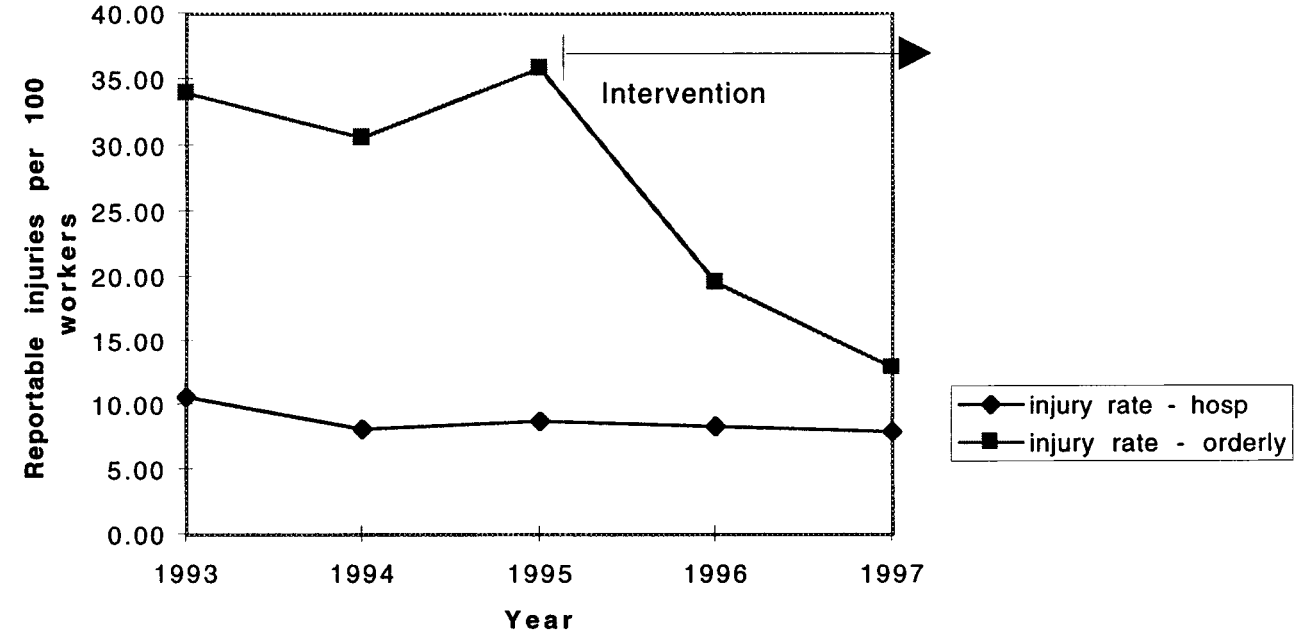

FIGURE 1. Injury rates 1993–1997: hospital and orderlies.

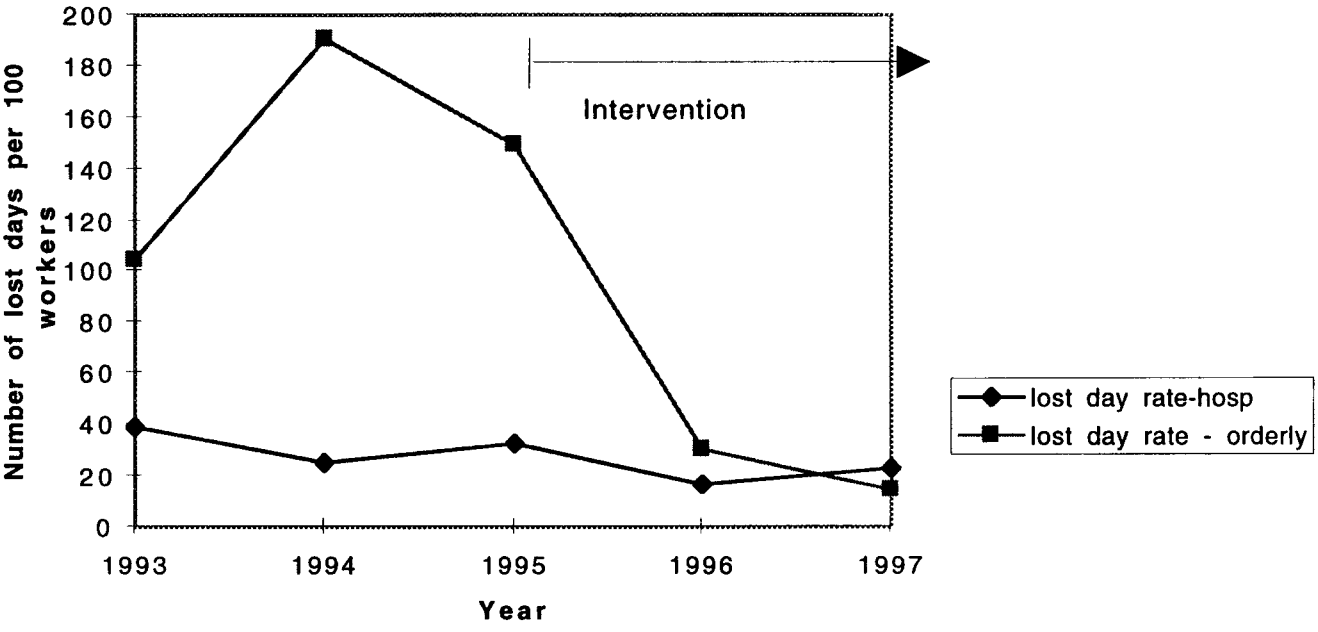

FIGURE 2. Lost day rates 1993–1997: hospital and orderlies.

Symptom Questionnaires

Response rates for the questionnaires distributed at 1 month, 7 months, and 15 months were 68%, 66%, and 80%, respectively. Employee turnover was significant during the study period, with 65 of the original group of 99 orderlies leaving their jobs before the 15-month survey. This turnover resulted in a limited number of orderlies available for longitudinal data analysis.

There were large and statistically significant reductions in the proportion of employees who reported symptoms of pain in the shoulders/upper arm, upper back, and lower back (Table II). Other improvements in symptoms were noted that did not reach statistical significance. The percentage of

TABLE II. Percentage of Orderlies Reporting Pain at Baseline and 15 Month Follow-Up of a Participatory Ergonomic Team Effort

Body part	Baseline (n = 67)	15 month follow-up (n = 87)
Neck	57	41**
Shoulders/upper arm	52	34*
Upper back	57	39*
Lower back	73	56*
Forearm	37	28
Wrist/hand	42	37
Hips/buttocks	37	29
Knee	51	44
Foot/ankle	61	54

*$P < 0.05$.
**$P < 0.10$, Chi-square test.

TABLE III. Percentage of Orderlies Reporting ''Pain Slightly or Substantially Interfering With Work During the Last Week''

Body part	Baseline (n = 67)	15 month follow-up (n = 87)
Neck	15	17
Shoulder/upper arm	19	17
Upper back	23	17
Lower back	34	23
Forearm	18	12
Wrist/hand	19	18
Hips/buttocks	17	8**
Knee	36	17*
Foot/ankle	35	24

*$P < 0.05$.
**$P < 0.10$, Chi-square test.

dispatch workers reporting ''pain interfering with work during the past week'' declined for most body sites (Table III), although only the change in knee pain was statistically significant. As shown in Table IV, orderlies had statistically significant improvements in musculoskeletal comfort at the end of the workday in the neck, lower back, forearm, and knee.

The orderlies reported statistically significant improvements on all three psychosocial scales (Table V). These included job satisfaction (would you take this job again or recommend it), the Work Apgar (social support from fellow workers and supervisors), and psychosocial stressors (conflicting demands and time pressure).

TABLE IV. Mean Body Comfort Rating at the End of a Typical Work Day (1 = Uncomfortable, 5 = Comfortable) by Orderlies in a Participatory Ergonomic Team Effort

Body part	Baseline (n = 67)	15 month follow-up (n = 87)
Overall physical comfort	3.4	3.7
Neck	3.5	3.9*
Shoulders/upper arm	3.6	3.8
Upper back	3.5	3.7
Lower back	3.0	3.4**
Forearm	3.7	4.0**
Wrist/hand	3.5	3.7
Hips/buttocks	3.7	4.0
Knee	3.3	3.8*
Foot/ankle	3.2	3.3

*$P < 0.05$.
**$P < 0.10$, Wilcoxon rank sum test.

TABLE V. Changes in Psychosocial Variables at Baseline and Follow-Up Among Orderlies in a Participatory Ergonomic Team Effort

Variable	Baseline (n = 67)	15 month follow-up (n = 87)
Job satisfaction	7.7	8.8**
Work Apgar	14.6	15.8*
Psychosocial stressors	8.2	7.2**

*$P < 0.05$.
**$P < 0.01$, Wilcoxon rank sum test.

Similar but smaller magnitude changes in symptoms and psychosocial scales were seen at the time of the 7-month survey, but these changes generally did not attain statistical significance. Longitudinal data were available on 27 orderlies who completed both the 1- and 15-month surveys. These comparisons showed improvement in symptoms and psychosocial scales that were not statistically significant, but similar in magnitude to those reported in the cross-sectional data above.

DISCUSSION

Formation of a participatory ergonomics team among hospital orderlies enabled the workers to define and implement safe working practices. The team established standardized lifting procedures and training in a job characterized by high turnover, high physical demands, and high rates of

injury compared to other hospital workers. This intervention resulted in decreased rates of injury and lost time, diminished musculoskeletal symptoms, and improved job satisfaction among the orderlies.

This study found a decrease in reportable injuries and a much larger decrease in days lost from work. A similar finding was reported by Owen et al. [1995] in a study that eliminated most manual lifting through the widespread adoption of mechanical lifting and transfer devices. Reductions in lost days that exceed the reductions in injuries can occur through several mechanisms. Injuries could be less severe, resulting in less temporary disability, or the job demands could have been changed through the intervention such that workers can safely return earlier to usual work. Musculoskeletal disorders may also be the result of previous exposures over months or years, and injury rate may thus show a slower decline than lost days, which are more affected by current working conditions. It is likely that some combination of these factors occurred in our study. Among the orderlies, there was no change in policy regarding restricted or modified duty during the study period.

Workers' compensation costs per employee decreased by 41% during the study period, although this decrease was not statistically significant. Due to the small number of claims and the large inherent variability in the cost of claims, a much larger sample size would be needed to demonstrate a statistically significant change in costs. The estimated workers' compensation savings of $22,758 compares favorably with the intervention costs of $5,000. This intervention cost excludes the time spent by the technical advisors, as it was difficult to assess how much of their time should be attributed to the implementation rather than the evaluation of the intervention.

This study is unique in the literature on health care worker injury in that it documents symptoms and job satisfaction as well as injuries and workers' compensation costs. We found that musculoskeletal symptoms and job satisfaction improved during the study period. Symptoms may be more sensitive than reported injuries as a measure of the effectiveness of work changes in reducing physical demands. Job satisfaction may have improved because of the changes themselves or due to the visible input that front-line employees had in developing and implementing changes.

There are several possible limitations to this study. Temporal trends in injuries or lost days may account for some of the observed differences in the orderlies, as there were decreases in injuries and lost days seen among the employee population as a whole during the study period, probably due to improvements in occupational health and safety programs. Marked beneficial effects among the orderlies were seen after adjustment for these temporal trends. The persistence of low injury rates 24 months following the initial intervention argues against a nonspecific effect as the sole cause of these changes. Selective underreporting or selective treatment of orderlies by occupational health personnel could account for some of the observed changes. This seems unlikely since initial medical treatment, including decisions regarding time loss and referral to specialists, was provided to all hospital employees by the same group of occupational physicians throughout the observation period. This group of physicians had no direct involvement with the study and were, in most cases, unaware of the study. The orderlies may have been discouraged from reporting injuries, though the authors saw no evidence of this phenomenon. Indeed, the training program developed by the team and given to all orderlies specifically encouraged early reporting of symptoms. Also, the improvements in symptom scores and job satisfaction on the confidential survey argue that the observed reductions in injuries and lost time were accompanied by beneficial changes in the work environment rather than coercive measures. Finally, employee turnover was high, and observed changes may have resulted from symptomatic or disgruntled employees leaving the job. Several factors argue against significant bias in our results as the result of employee turnover. First, injury and lost-time rates were stable for the 3 years prior to the intervention; employee turnover was similarly high during this period. Second, longitudinal symptom and job satisfaction results were generally congruent with the cross-sectional data, indicating that long-term employees also noted positive changes.

The positive outcomes reported in this study followed a simple and basic intervention that was largely driven by front-line workers. We anticipate further improvements in injury rates, lost time, and workers' compensation costs after changes implemented by the team have been in place longer, and as other interventions are introduced by the team. Additional interventions will include the use of mechanical hoists and alternative transfer assist devices, which are currently being evaluated by the team and scheduled for introduction in the coming year.

It is difficult to identify which aspect of the intervention was responsible for the outcomes we observed. The institution of standardized lifting procedures and mandatory training were probably responsible for much of the observed reduction in injuries. We feel that the orderlies' active and visible role in developing the procedures and training materials was also an important and inseparable element of the intervention.

Success of this team has prompted other participatory ergonomics teams to be formed in this hospital system. The training program and lifting procedures established by the orderlies are now being introduced to other groups of health care workers who frequently perform lifts and transfers. The team continues to function with minimal participation by the technical advisors. By all of our measures, the participatory ergonomics team has been a viable approach to reducing the rate of musculoskeletal disorders among this group of

orderlies. Similar results may be possible among other groups of health care workers. In addition to improving the health of the patients they serve, this study suggests that health care workers can improve their own workplace health and safety when given the opportunity.

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