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Reduction in Injury Rates in Nursing Personnel Through Introduction of Mechanical Lifts in the Workplace

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Background *Health care workers incur frequent injuries resulting from patient transfer and handling tasks. Few studies have evaluated the effectiveness of mechanical lifts in preventing injuries and time loss due to these injuries.*

Methods *We examined injury and lost workday rates before and after the introduction of mechanical lifts in acute care hospitals and long-term care (LTC) facilities, and surveyed workers regarding lift use.*

Results *The post-intervention period showed decreased rates of musculoskeletal injuries (RR = 0.82, 95% CI: 0.68–1.00), lost workday injuries (RR = 0.56, 95% CI: 0.41–0.78), and total lost days due to injury (RR = 0.42). Larger reductions were seen in LTC facilities than in hospitals. Self-reported frequency of lift use by registered nurses and by nursing aides were higher in the LTC facilities than in acute care hospitals. Observed reductions in injury and lost day injury rates were greater on nursing units that reported greater use of the lifts.*

Conclusions *Implementation of patient lifts can be effective in reducing occupational musculoskeletal injuries to nursing personnel in both LTC and acute care settings. Strategies to facilitate greater use of mechanical lifting devices should be explored, as further reductions in injuries may be possible with increased use.* Am. J. Ind. Med. 44:451–457, 2003. *© 2003 Wiley-Liss, Inc.*

KEY WORDS: musculoskeletal injuries; engineering controls; healthcare workers; injury reduction; ergonomics; mechanical lifts

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 (BLS) show that the rate of work-related injury or illness requiring medical treatment or lost work was 8.8 per 100 full-time hospital workers, and 13.5 per 100 among nursing home workers in 2001 [BLS, 2002]. These data can be compared to national data on work injuries in 2001 showing an annual rate of work-related injuries and illnesses of 4.0 per 100 full-time workers in mining, 7.9 per 100 workers in construction, and 8.1 per 100 workers in manufacturing [BLS, 2002].

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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 non-construction laborers [BLS, 1995]. Nursing aides, 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 workdays per injured worker. In 2001, the annual rates for lost time injuries were 3.8 per 100 among all workers in hospitals and 8.2 per 100 workers in nursing homes, compared to rates in construction of 3.9 and manufacturing of 3.6 per 100 workers [BLS, 2002].

In addition to these national data, numerous studies have documented high rates of back injuries and other musculoskeletal disorders among health care workers [Dehlin et al., 1976; Punnett et al., 1985; Estryn-Behar et al., 1990; Wilkinson et al., 1992]. Back pain has been identified as a major factor in causing nurses to leave the profession. In a British study of nurses leaving the profession permanently, 12% reported back pain as a main or contributory factor [Stubbs et al., 1986]. Nursing aides and orderlies show more frequent work-related back pain than other nursing personnel [Videman et al., 1984; Feldstein et al., 1993]. One study found that nursing aides were at higher risk for back injury than RNs, because they performed twice the amount of lifting, bending, and rotation [Videman et al., 1984].

Patient care requires many lifting and transfer tasks that pose a demonstrated risk of injury to workers [Stubbs et al., 1983; Smedley et al., 1997]. Manual patient transfer tasks place unacceptably high stresses on the low back, with compressive forces at the L5-S1 level greater than the upper limit suggested by NIOSH [Gagnon et al., 1986; Garg et al., 1992; Winkelmolen et al., 1994; Ulin et al., 1997]. In addition to laboratory measures of the compressive forces involved in patient transfers, surveys of nursing assistants and other health care personnel have identified the most physically stressful patient handling tasks. These include transfers of patients between bed, chair, toilet, and bathtub, and lifting and repositioning patients in bed [Owen et al., 1992]. As aptly stated in an editorial more than 30 years ago: ''The adult human form is an awkward burden to lift or carry. Weighing up to 200 pounds and more, it has no handles, it is not rigid, and it is susceptible to severe damage if mishandled or dropped. When lying in a bed, a patient is placed inconveniently for lifting, and the weight and placing of such a load would be tolerated by few industrial workers'' [The Lancet, 1965].

A number of studies have evaluated interventions to reduce musculoskeletal 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. Training has been shown to improve patient lifting and handling skills [Feldstein et al., 1993], but has not been shown to reduce back injuries or back pain. Although one study found that an intensive (40 hr) training program in patient handling skills led to a small reduction in 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 nursing personnel [Feldstein et al., 1993; Hignett, 1996]. Physical conditioning, alone or in combination with other changes, may be effective in reducing back injuries [Galka, 1991; Gundewall et al., 1993], although widespread implementation of physical conditioning programs face a number of challenges with logistics and employee participation. Interventions which modify job tasks, such as the introduction of a lifting team, have been successful in reducing injuries among health care workers [Charney et al., 1991], though implementation of such a team cannot completely reduce the need for nursing personnel to perform patient transfers.

Mechanical assistive devices such as patient hoists offer an engineering solution to reducing potentially harmful physical exposures to nursing personnel. Both laboratory and field studies have examined the use of these mechanical assistive devices in the prevention of back injuries among nursing personnel [Owen and Garg, 1992; Garg and Owen, 1992; Holliday et al., 1994; Laflin and Aja, 1995; Owen et al., 1995]. These studies have shown that the use of mechanical lifts decreases the amount of perceived physical stress among health care workers, and that use of mechanical aids reduces the lifting forces required for patient transfers. Patients have also reported feeling more comfortable when transferred with a mechanical hoist than manually [Owen et al., 1995]. These studies strongly suggest that use of mechanical aids may result in fewer recorded low back injuries. Unfortunately, few of these trials have utilized adequate control groups, or have shown statistically meaningful decreases in injuries or lost time injuries [Collins and Owen, 1996].

The aim of this study was to evaluate the effectiveness of mechanical patient hoists at reducing musculoskeletal injuries following the deployment of such lifts in acute care hospitals and long-term care (LTC) facilities.

MATERIALS AND METHODS

Setting

This pre–post intervention study took place at four hospitals and five long-term care (LTC) facilities affiliated with the BJC Health Care System in St. Louis, Missouri. The hospitals included a major teaching hospital, two large suburban hospitals, and a smaller community hospital. LTC facilities included three sites in the St. Louis area and two

rural sites. Thirty-one intervention nursing units were chosen within the four acute care hospitals. These units included neurology, orthopedics, intensive care, rehabilitation, general surgery, and general medicine. Intervention units were chosen based on multiple criteria, including past injury rates, the expressed interest of nursing management, and perceived risk of injuries posed by different patient populations. These 31 acute care nursing units, combined with the five LTC facilities, comprised the 36 intervention units in our study.

Intervention

Assistive devices were selected according to criteria delineated through previous laboratory and field research [Collins and Owen, 1996]. These devices incorporate improvements to overcome barriers to use identified in studies of older equipment. The lifts are resistant to tipping over, are maneuverable in tight spaces, are more time efficient than older lifts, require less physical effort for nursing staff, and are safer for patients. Full-body lifts are used to weigh, lift, and transfer patients who are unable to bear weight or are otherwise unable to assist in their transfers between hospital beds and chairs, toilets, or gurneys. Stand-up lifts are used for patients who can partially bear weight, and are used for transfers between beds and chairs or gurneys, or for toilet and shower transfers.

Stand-up lifts (''EZ-Stand'') and full-body lifts (''EZ-Lift'') were deployed on the 36 intervention units during 1997 and 1998. Acute care units included neurology, orthopedics, intensive care, rehabilitation, general surgery, and general medicine. A total of 25 full-body lifts and 22 stand-up lifts were distributed among the intervention units. Depending on unit needs, units received a full-body lift, a stand-up lift, or both. All members of the nursing staff, including nurses, nursing aides, and patient care technicians were requested to attend a 2 hr hands on instructional course on lift operation before the lifts were deployed.

Data Collection

Data on injuries and lost days were collected through OSHA 200 logs kept by each hospital. OSHA 200 logs are a federally mandated record of work-related injuries or illnesses that require medical treatment or result in lost time or restricted duty. The denominator data for calculating injury and lost day rates consisted of productive hours worked for each division. Productive hours were gathered from the Human Resources Departments at all facilities. Rates for injury and lost day rates were expressed as injuries or lost days per 100 full-time equivalents (FTE). One FTE is defined as 2,000 productive hours per year.

OSHA 200 logs were collected for the years 1996 through 2000. Rates for OSHA-recordable injuries were collected for all employees at each facility. On units which had received one or more patient lifts, job titles and injury description were studied in order to select only nursing personnel who had a recorded musculoskeletal injury. These injuries were predominantly classified as sprains, strains, and muscle pains. These injuries were selected because of their frequent association with patient handling tasks. Injuries that involved body substance or chemical exposure, falls, and contusions were not coded for the study outcome.

For each unit, the pre-intervention period was defined as the time between January 1, 1996 and the date lifts were deployed on that unit in 1997 or 1998. The post-intervention period was defined as the time after the lifts were deployed until December 31, 2000. Since the mechanical lifts were deployed at different times, pre-intervention and post-intervention time varied for each study unit. Data from study units were pooled to calculate injury rates for acute care hospitals, LTC facilities, and all units combined.

To estimate the frequency of lift use, an interviewer visited intervention nursing units on several different shifts to administer a short interview to all available nursing personnel. Interviews were anonymous and workers gave consent to be interviewed. Interviews were performed at all five LTC facilities and at four acute care hospitals, covering 35 of the 36 units in our study. The interview asked how many times the worker had personally used a lift for transferring or weighing patients during the previous full-shift they worked, how many times they saw others use a lift for transferring or weighing patients on the previous shift, and why they did not use lifts more often.

Statistical Methods

All data gathered from the OSHA logs and interviews were entered into Microsoft Excel, which was used to perform statistical tests and analyses. The χ^2 statistic was used for comparing differences in patient lift use between different groups. Injury and lost day rates were compared by calculating relative risks (RR) and confidence intervals (CI).

RESULTS

Injury and Lost Time Rates

We observed 412 recordable musculoskeletal injuries during the study period, from a health care worker population of 13.6 million productive hours (equivalent to 6835 full-time work years). Nursing units that had mechanical lifts installed showed marked declines in musculoskeletal injuries, lost day injuries, and lost days in the post-intervention period. These findings are shown in Table I. Data combining the acute care and LTC units showed a RR of recordable injury of 0.82 (95% CI: 0.68–1.00), RR of lost day injury of 0.56 (0.41–0.78), and RR for lost day rate of

TABLE I. Numbers and Rates of Musculoskeletal Injuries, Lost Days, and Lost Day Injuries Pre- and Post-Intervention on Nursing Units, St. Louis, MO

Study group	Interval: pre- or post-intervention	Productive hours	No. of injuries	No. of lost day injuries	No. of days lost from injuries	Injury rate (injuries per 100 FTE)	Lost workday injury rate	Lost day rate	Injury rate ratio, post-intervention (95% CI)	Lost workday injury RR, (95% CI)	Lost day RR
Combined	Pre-	6,193,718	207	94	1,149	6.68	3.04	37.1	0.82 (0.68–1.00)	0.56 (0.41–0.78)	0.42
	Post-	7,475,469	205	64	577	5.48	1.71	15.4			
Acute care	Pre-	4,337,909	143	65	694	6.59	32.0	3.00	0.86 (0.69–1.08)	0.67 (0.47–0.97)	0.47
	Post-	5,441,658	155	55	406	5.70	14.9	2.02			
Long-term care (LTC)	Pre-	1,855,809	64	29	455	6.90	3.13	49.04	0.71 (0.49–1.03)	0.28 (0.13–0.60)	0.34
	Post-	2,033,811	50	9	171	4.92	0.89	16.82			

0.38, comparing the post-intervention to the pre-intervention period.

Injury rates for the study groups in acute care hospitals decreased from 6.59 injuries annually per 100 FTE during the pre-intervention period to 5.70 injuries annually per 100 FTE during the post-intervention period. Expressed as a rate ratio, RR for reportable injury in the pre-intervention compared to post-intervention period was 0.86 (95% CI: 0.69–1.08). The rate of incurring a lost time injury fell from 3.00 to 2.02 per 100 FTE annually (RR = 0.67, 95% CI: 0.47–0.97). The lost day rate fell from 32 days lost per 100 FTE to 14.9 days per 100 FTE annually, a RR of 0.47.

Injury and lost time rates at LTC facilities also declined markedly in the post-intervention period. The rate of recordable injuries fell from 6.9 to 4.9 per 100 FTE (RR = 0.71, 95% CI: 0.49–1.03). The lost day injury rate for LTC groups in the pre-intervention period was 3.13 lost day injuries per 100 FTE. Following the intervention, the rate was 0.89 lost day injuries per 100 FTE. The relative risk for having lost time injuries during pre-intervention compared to post-intervention was 0.34 (95% CI: 0.13–0.60). The rate of lost days fell from 49.0 lost days per 100 FTE to 16.8 (RR = 0.34).

Adjusted risk ratios were calculated for workers in acute care units by estimating the expected number of injuries and lost days in the post-intervention period based on temporal changes in rates among all other hospital workers at each facility. After adjustment for temporal trends seen among all other hospital workers, nursing personnel on intervention units continued to show decreased rates of musculoskeletal injury (RR = 0.83, 95% CI: 0.66–1.04) and injuries resulting in lost workdays (RR = 0.57, 95% CI: 0.40–0.80) during the post-intervention period. Because the intervention encompassed all nursing personnel at the LTC facilities, no adjustment of rates was possible.

Interview Results

One hundred ninety healthcare workers completed the interviews about lift utilization on the previous shift. Interviews were performed at each of the five LTC facilities included in the study and at 30 of the 31 acute care units (Table II). Nursing units included surgical, general medical, orthopedics, neurology, and rehabilitation units. Self-reported frequencies of lift use by registered nurses and by nursing aides were higher in the LTC facilities (10 and 50%, respectively) than in acute care hospitals (6 and 34%). There was a significant difference ($P = 0.003$) between the use of the mechanical lifts between acute care hospitals (N = 156, %yes = 16.0) and LTC facilities (N = 34, %yes = 38.2). The most common reasons given for non-use of lifts included lack of perceived need for lifts, insufficient training in lift use, and lack of time (Table III). In both acute and LTC facilities, lifts were used more by other

TABLE II. Self-Reported Use of Mechanical Lifts on Previous Shift

Group	Used lift themselves (%)	Saw lift used by someone else (%)
Acute care total (n = 156)	14.57	19.21
Acute care RN (n = 100)	6.0	14.00
Acute care other[a] (n = 56)	33.9	35.71
LTC total (n = 34)	38.24	70.59
LTC RN (n = 10)	10.00	70.00
LTC other[a] (n = 24)	50.00	70.83
Combined total (n = 190)	20.00	30.53
Combined RN (n = 110)	6.36	19.09
Combined other[a] (n = 80)	38.75	46.25

[a]Other indicates nursing aides, patient care technicians, and LPNs.

nursing staff employees (i.e., nursing aides, patient care technicians, and LPNs) than RNs ($P < 0.001$). Only 6.4% (N = 110) of the RNs interviewed said they used the lift compared to 38.8% (N = 80) of the other health care workers interviewed. There was no significant difference ($P = 0.18$) in lift usage between non-RN health care workers in acute care hospitals (N = 56, %yes = 33.9) compared to LTC facilities (N = 24, %yes = 50.0).

Changes in Rates of Injury Affected by Lift Injury

To evaluate the effects of lift use on injury rates, we also evaluated the reductions in risk of musculoskeletal injury separately on units in acute care nursing facilities that recorded higher and lower rates of lift use. Interview respondents on 20 units indicated that they had personally used the lift or seen it used on the previous shift; on 15 units respondents indicated that they had not used the lift or seen it used on the previous shift. Table IV shows that the recordable injury rates and lost day rates were similar on these two groups of units in the pre-intervention period; units where lifts were reportedly used had markedly lower rates in the post-intervention period.

DISCUSSION

We found that the installation of mechanical patient lifts was associated with decreased rates of injury and lost day injuries, both in acute care hospitals and in LTC facilities. These study data represent a large worker population using the lifts in diverse settings. We found that reductions in injury and lost day injury rates were greater on nursing units where workers reported use of the lifts. Reductions in injuries and lost days were greater in LTC facilities than in acute care hospitals, and reductions in lost days and lost day injuries were greater than reductions in injury rates.

Greater reductions in injuries observed in the LTC facilities were likely influenced by a policy of mandatory lift usage implemented after installation of the lifts. Though the policy did not eliminate manual lifting, there was clearly more active encouragement by management to use the lifting devices in the LTC facilities than there was in the acute care hospitals. Care activities and patient characteristics are also more stable in LTC settings, which may make it easier for staff to plan lift use.

Other investigators [Owen et al., 1995] have also found greater reductions in lost time injuries or lost days than in musculoskeletal injuries following the installation of lifts in health care settings. This may be due in part to the ability of workers with an injury to return to work earlier when the presence of assistive equipment has reduced some of the most strenuous physical demands of work.

Despite evidence that mechanical lifting and transfer devices can be effective at reducing rates of musculoskeletal injuries, a number of studies in addition to ours have found that these devices are not routinely used even when they are available [Bell, 1987; Jenson, 1987; Garg et al., 1992]. These authors have identified a number of barriers to the use of mechanical aids by nursing personnel. Reasons for the lack of

TABLE III. Reasons Given for Failure to Use Mechanical Patient Lifts

Response	Acute care (%)	LTC (%)	Combined (%)
Too time consuming/slow	14	6	13
Don't know where slings are/not enough slings	3	0	3
Patients do not like it/feels unstable	5	0	4
Patients in isolation/connected to too many lines	3	0	3
Don't know how to use/never been trained	17	0	14
Have staff to lift manually/do not need it	23	36	25
Aides or patient care techs use it	9	3	8
Don't know/no answer/refuse to answer	15	42	19
Other	11	13	11

TABLE IV. Injury Reduction Varied by Reported Lift use: Nursing Units Classified by Use or Non-use of Lifts Reported in Interviews

	Musculoskeletal injuries		Lost day injuries	
	Lift used (n = 20)	Lift not used (n = 15)	Lift used (n = 20)	Lift not used (n = 15)
Rate pre-intervention (events/100 FTE)	6.30	6.34	2.86	2.87
Rate post-intervention (events/100 FTE)	5.53	6.69	1.50	2.54
RR	0.88	1.06	0.52	0.88

use included: lack of ready availability of mechanical aids, the extra time required for their use compared to a manual transfer; the requirement of too much physical effort for use of some aids, too little room to maneuver lifts in some rooms, staff shortages which increase time pressure, inadequate training in use of the equipment, and concerns for patient safety including the patient body positions required by some slings on full-body lifts. Garg et al. [1992] showed that nursing assistants used mechanical aids only for 2% of transfers performed.

When training has been paired with ergonomic intervention the impact on injury rates has been more substantial but still the knowledge gained from training is not always applied in the health care setting [Kane and Parahoo, 1994]. Training alone does not seem to ensure that nursing staff will use mechanical aids to transfer patients. Other investigators have found it difficult to promote widespread use of mechanical aids in health care settings. Clearly, there are a number of organizational and logistical factors that must be explicitly addressed when employing mechanical aids in acute patient care environments. Of particular importance is management cooperation and visible support for the intervention.

Most of the literature on lift use has come from LTC settings, where patients' conditions and need for assistance with transfers are more stable. The barriers to implementation of mechanical aids are likely to be higher in acute care settings due to the rapidly changing nature of patients and the need to frequently assess their needs for assistance with transfers. More information is required about factors promoting or inhibiting use of mechanical aids in the acute care setting.

Strengths of this study include the use of a large study population, working in diverse health care settings, followed for 5 years, including 2–3 years post-intervention (over 6,800 worker years of observation on the intervention floors). Common injury reporting mechanisms and data coding were applied to these data.

Potential weaknesses of the study include those common to pre–post intervention studies. We were able to control for temporal changes in injury reporting or management due to our access to common data on both intervention floors and the rest of the hospital workers, which should minimize these biases. Our sampling strategy for obtaining interview data attempted to obtain a representative sample of workers on different shifts, but without a random sample of the worker population, may thus over- or under-estimate the frequency of lift use among health care workers. Our question asked about use on only the last shift used and may thus underestimate the true frequency of lift use. Lifts were not randomly allocated to nursing units, but were distributed based on the interest of the staff and a perceived need. Differences between units that received a lift and those which did not may account for some of the effects we observed. Reporting bias of injury data was not likely to be a factor, as data were collected using existing centralized reporting mechanisms, and because the nursing units involved were not aware that data on injury rates was being analyzed following implementation of the lifts.

We conclude that the implementation of patient lifts can be effective in reducing occupational musculoskeletal injuries to nursing personnel in both LTC and acute care settings. Further reductions in injuries may be possible with increased use of mechanical assistive devices. Future work should focus on strategies to facilitate greater use of mechanical lifting devices.

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