AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 52:571–578 (2009)

Musculoskeletal Injuries Resulting From Patient Handling Tasks Among Hospital Workers

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Background *The purpose of this study was to evaluate musculoskeletal injuries and disorders resulting from patient handling prior to the implementation of a "minimal manual lift" policy at a large tertiary care medical center. We sought to define the circumstances surrounding patient handling injuries and to identify potential preventive measures.*

Methods *Human resources data were used to define the cohort and their time at work. Workers' compensation records (1997–2003) were utilized to identify work-related musculoskeletal claims, while the workers' description of injury was used to identify those that resulted from patient handling. Adjusted rate ratios were generated using Poisson regression.*

Results *One-third (n = 876) of all musculoskeletal injuries resulted from patient handling activities. Most (83%) of the injury burden was incurred by inpatient nurses, nurses' aides and radiology technicians, while injury rates were highest for nurses' aides (8.8/100 full-time equivalent, FTEs) and smaller workgroups including emergency medical technicians (10.3/100 FTEs), patient transporters (4.3/100 FTEs), operating room technicians (3.1/100 FTEs), and morgue technicians (2.2/100 FTEs). Forty percent of injuries due to lifting/transferring patients may have been prevented through the use of mechanical lift equipment, while 32% of injuries resulting from repositioning/turning patients, pulling patients up in bed, or catching falling patients may not have been prevented by the use of lift equipment.*

Conclusions *The use of mechanical lift equipment could significantly reduce the risk of some patient handling injuries but additional interventions need to be considered that address other patient handling tasks. Smaller high-risk workgroups should not be neglected in prevention efforts.* Am. J. Ind. Med. 52:571–578, 2009. © *2009 Wiley-Liss, Inc.*

KEY WORDS: musculoskeletal injuries; musculoskeletal disorders; patient handling; health care workers; nurses' aides; surveillance

BACKGROUND

Patient handling has been identified as a significant contributor to musculoskeletal injuries among nurses and nurses' aides especially injuries to the back, neck, and shoulders [Engkvist et al., 2000; Smedley et al., 2003a,b; Trinkoff et al., 2003; Byrns et al., 2004]. The consequences of musculoskeletal injuries have included job change, job loss, and chronic pain according to a recent survey of 509 nurses by the United American Nurses Union [Hart, 2006]. Efforts have been made to underscore the burden of work-related

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Contract grant sponsor: National Institute for Occupational Safety and Health; Contract grant numbers: 5 K01 OH007996-03, 5 R01 OH003979-03, 5 R01 OH008375-04.

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Accepted 5 April 2009
DOI 10.1002/ajim.20704. Published online in Wiley InterScience (www.interscience.wiley.com)

musculoskeletal injuries resulting from patient handling activities among these workers. The American Nurses' Association (ANA) has sought to influence state and federal policy to promote safe patient handling through their Handle with Care campaign which began in 2003 [ANA, 2003; de Castro, 2004]. Moreover, they have been instrumental in promoting prevention strategies such as mechanical lift equipment, sliding boards, and gait belts [ANA, 2007].

Nurses and nurses' aides are commonly identified as being at risk for patient handling injuries, but many other health care professionals provide direct care during the course of a patient's hospital stay and are also potentially at risk. It is less likely for these other groups to be highlighted in the literature due to their small sizes.

The purpose of this study was to investigate the rates of musculoskeletal injuries and disorders resulting from patient handling activities among all workers at a tertiary care medical center prior to the implementation of a policy calling for ''minimal manual lifting'' of patients. We sought to better define the types of patient handling injuries that occurred among this cohort for the purpose of identifying appropriate prevention strategies for all workgroups at risk.

MATERIALS AND METHODS

Data from the Duke Health and Safety Surveillance System (DHSSS) were used for these analyses which included workers' compensation and human resource data on health care workers employed at Duke University Medical Center located in central North Carolina. Data were de-identified after being linked on an individual basis. A detailed description of how the DHSSS was constructed and how these data were linked and de-identified has been previously published [Dement et al., 2004]. The Institutional Review Board at the University of Texas and the Duke University Medical Center approved all study procedures.

Population and Person Time at Work

Human resources' administrative data were used to identify occupational groups of workers who engage in patient handling and were employed at the medical center from 1997 to 2003. Occupation, duration of employment, hours worked, gender, race, and years of age were also obtained. These analyses include employees working at Duke University, which includes all hospital workers, and associated on-site and off-site clinics, laboratories, and administrative support services. Those employed at the two other community hospitals within this surveillance system, Durham Regional and Raleigh Community, were not included in these analyses. Full-time equivalents (FTEs) were estimated for each worker by study year using the employees' usual work schedule of hours worked per week and duration of employment at the medical center per study year. A worker employed for 40 hr per week and employed for the entire year contributed one FTE (1 FTE = 2,000 work hours per year per worker).

Outcomes of Interest

Patient handling MSK claims

Work-related musculoskeletal injuries that resulted from patient handling tasks were captured through the medical center's self-insured workers' compensation program. Methods used to capture musculoskeletal injuries have been previously described in detail [Pompeii et al., 2008].

All musculoskeletal injury and disorder workers' compensation claims from 1997 to 2003 that resulted from patient handling were included in these analyses. An abbreviated description of injury provided by the employee, through either an online reporting system or by completing a workplace injury form, was then used to code each claim as patient handling (yes/no), as well as the type of patient handling activity.

Analyses

Descriptive analyses were generated to characterize the workgroups identified as patient handlers, including frequencies of gender, race, occupational group, and time varying variables of age and years of employment at the medical center, and time at work based on an estimate of the workers' FTE. After identifying all claims meeting our definition of patient handling injuries, frequencies of overall claims were generated, as well as rates by specific types of patient handling injuries. Types of patient handling injuries and crude rates were stratified by occupational group, age, gender, race, and employment tenure allowing for comparisons across demographic and employment characteristics. Incidence density rates were expressed as the number of injuries per 100 FTEs, and 95% confidence intervals (95%) were calculated as described by Haenzel et al. [1962] assuming a Poisson distribution.

Multivariate models were constructed for the purpose of identifying occupational groups at higher risk for patient handling injuries reported through workers' compensation. Nurses were selected as the comparison groups since this workgroup is one of the largest identified as patient handlers. It is not unusual for jobs in the health care industry to be highly segregated by race and gender [King, 1992; Gluck and Oleinick, 1998; U.S. Department of Labor, 2005a]. In previous analyses of this study cohort, labor intensive jobs were highly segregated by race and/or gender [Pompeii et al., 2008], including inpatient nurses (89% female, 11% male, 17% black, 73% white), nurses' aides (80% female, 20% male, 67% black, 23% white), radiology technicians

(68% female, 32% male, 28% black, 72% white), patient transporters (female 48%, male 52%, black, 82%, white 18%), and occupational/physical therapists (female, 72%, male 28%, black 4%, white 95%). Therefore, we chose to exclude gender and race from multivariate models; their inclusion would likely over adjust and diminish effects of job-related tasks which were of primary interest in these analyses. Adjusted rate ratios and 95% confidence intervals were calculated using Poisson regression [Nizim, 2000] with the log of FTEs included as an offset term. Years of age and duration of employment were assessed as possible confounders and were retained in the model if they changed any level of the explanatory variable (occupational group) or other covariates in the model by more than 10%, or if they were independently associated with the rate of injury (based on the Type 3 likelihood ratio statistic). All analyses were conducted using SAS Version 9.1.3 [2002–2004].

RESULTS

This cohort consisted of an average of 19,487 workers employed at the medical center per year over the 7 years of observation. Female workers comprised more than half of the cohort, with the majority (68%) consisting of white workers, and the largest minority group (24%) consisting of black workers. The mean age of workers over this time period was 39.9 years for both men and women, with an average of 8.6 years of employment at Duke University over the 7 years. Details about this study cohort, as well as the types and distribution of musculoskeletal injuries incurred across occupational groups, are described elsewhere [Pompeii et al., 2008].

Patient handling injuries accounted for 31% (n = 876) of the 2,849 musculoskeletal injuries reported over the 7 year time period (Table I). A total of 12 occupational groups reported at least 5 patient handling injuries with an overall rate of 2.1 injuries per 100 FTEs among these workgroups. Female and black workers had a higher proportion of patient handling injuries, but their rates of injury varied little from male and white workers, respectively. There was a steady decline in the rate of patient handling injuries as years of age and duration of employment at the medical center increased. As expected, the majority of patient handling injuries resulted in back pain (65%), and shoulder and neck pain (16%) (data not presented in tables/figures).

A significant proportion (84%) of the patient handling injury burden occurred among inpatient nurses (50.0%), nurses' aides (23.1%), and radiology technicians (11.0%). Nurses' aides reported very high rates of injury (8.8/100 FTEs), as did a number of smaller workgroups including emergency medical technicians (10.3/100 FTEs), patient transporters (4.3/100 FTEs), operating room technicians (3.1/100 FTEs), morgue and decedent care technicians (2.2/100 FTEs), and cardiac catheterization technicians (2.4/100 FTEs). An unexpected finding included 12 patient handling injuries that occurred among secretarial and administrative staff working in outpatient clinics and inpatient units. Based on multivariate modeling, nurses' aides (RR 2.1; 95% CI 2.0, 2.3) and emergency medical technicians (RR 2.3; 95% CI 1.8, 3.0) were at twice the risk of incurring a patient handling injury compared to inpatient nurses (RR 1.0, reference group), after controlling for years of age and duration of employment at the medical center. Radiology technicians (RR 1.1; 95% CI 1.0, 1.2) and patient transporters (RR 1.1; 95% CI 0.86, 1.4) displayed similar risk of patient handling injury as inpatient nurses, while morgue and decedent care (RR 0.59; 95% CI 0.46, 0.77), operating room (RR 0.84; 95% CI 0.63, 1.1), and cardiac catheterization technicians (RR 0.65; 95% CI 0.45, 0.92) were at lower risk.

Seven categories of patient handling were identified from the coding of the employee's description of the injury, including patient lifting, transfer, pulling up in bed, repositioning in bed/chair, transporting in bed/chair, catching a patient to prevent them from falling, being pulled on by the patient, and applying pressure to a patient's puncture site. Forty percent of injuries resulted from either lifting the patient (24.9%), or transferring (15.5%) from the bed to the chair, bed to stretcher, or vice versa (Fig. 1). Repositioning (12.6%) or pulling the patient up in the chair or bed (13.7%) accounted for another 26.3%. A small percentage (4.3%) resulted from catching or preventing a patient from falling. One-fifth (22.6%) of the injury descriptions contained only vague descriptions of assisting a patient, making it difficult to categorize them further.

The distribution of patient handling related injury by occupational group indicated that patient transfers, patient lifting, and patient transport related injuries occurred among most occupational groups; whereas, injuries resulting from pulling a patient up in bed occurred mostly among inpatient nurses, nurses' aides, and radiology technicians (Table II). When we further explored differences in rates of injury by types of patient handling between nurses and nurses' aides, nurses' aides remained twice as likely (RR 2.1; 95% CI 2.0, 2.3) to report all types of patient handling injuries, except pulling patients up in bed where they were almost three times (RR 2.7; 95% CI 2.4, 2.9) as likely to incur an injury (Table III).

DISCUSSION

This study examined the risk of musculoskeletal injuries resulting from patient handling tasks among a large cohort of medical center workers. These analyses precede the implementation of a ''minimal manual lift'' policy in conjunction with the implementation of various types of mechanical lift equipment throughout the medical center. We sought to define the circumstances surrounding these injuries

TABLE I. The Distribution, Crude Rates, and Adjusted Rate Ratios (95% CI) of Patient Handling Injuries: 1997–2003

	No. PH claims[a]	Claims (%)	FTE	Crude rate	Adjusted RR (95% CI)
Overall	861	100	42036.95	2.1	—
Occupational group					
Inpatient nurse (reference)	431	50.0	10624.26	4.1	1.0
Nurses' aide	199	23.1	2260.35	8.8	2.1 (2.0, 2.3)
Radiology technician	95	11.0	2129.45	4.5	1.1 (1.0, 1.2)
Outpatient nurse	33	3.8	4293.38	0.77	0.20 (0.18, 0.23)
Physical/occupational therapist	25	2.9	1945.68	1.3	0.29 (0.18, 0.36)
EMT/flight EMT	14	1.6	136.42	10.3	2.3 (1.8, 3.0)
Patient transporter	14	1.6	327.68	4.3	1.1 (0.86, 1.4)
Morgue/decedent care technician	14	1.6	625.88	2.2	0.59 (0.46, 0.77)
Secretary/administrative staff	12	1.4	18679.61	0.06	0.02 (0.01, 0.02)
Operating room technician	11	1.3	360.70	3.1	0.84 (0.63, 1.1)
Cardiac catheterization tech	7	0.81	291.89	2.4	0.65 (0.45, 0.92)
Nurse anesthetist	6	0.70	361.65	1.7	0.45 (0.35, 0.59)
Gender					
Female	709	82.3	35953.04	2.0	—
Male	152	17.7	6083.91	2.5	—
Race					
White	508	59.0	26535.95	1.9	—
Black	317	36.8	14247.06	2.2	—
Other	36	4.2	1253.94	2.9	—
Years of age					
24 or less	54	6.3	2200.87	2.5	0.85 (0.73, 0.97)
25–34 (reference)	291	33.8	11124.38	2.6	1.0
35–44	258	30.0	12885.41	2.0	0.95 (0.87, 1.0)
45–54	209	24.3	11212.67	1.9	1.1 (1.0, 1.3)
≥55	49	5.7	4613.62	1.1	0.73 (0.62, 0.87)
Years employed at hospital					
≤5	457	53.1	16994.75	2.7	1.7 (1.5, 2.0)
6–10	163	19.0	7705.85	2.1	1.5 (1.3, 1.8)
10–15	123	14.3	6414.88	1.9	1.5 (1.3, 1.8)
16–20	53	6.2	3937.18	1.4	1.1 (0.92, 1.4)
≥21 (reference)	65	7.5	6984.29	0.93	1.0

PH, patient handling; FTE, full-time equivalents; crude rate, no. claims/100 FTEs; RR, rate ratio; CI, confidence interval; —, not included in adjusted model.
[a]Fifteen of the 876 claims not included in this table were incurred by 11 workgroups who had <5 patient handling claims each, including physicians, nurse managers, dental techs, EKG techs, phlebotomists, respiratory care techs, clinical trial techs, neurology techs, lab techs, parking service assistants, and information coordinator.

using the employees' description of injury included in an existing workers' compensation database.

One-third of all musculoskeletal injuries resulted from patient handling tasks in this cohort. As expected, a large majority of the incidents were reported by inpatient nurses, nurses' aides, and radiology technicians, with nurses' aides being at twice the risk of a patient handling injury compared to inpatient nurses. Our findings are consistent with national surveillance reports [U.S. Department of Labor, 2005b], as well as observational studies [Fuortes et al., 1994; Engkvist et al., 2000; Menzel et al., 2004] that have reported higher musculoskeletal injury and disorder rates among nurses' aides compared to inpatient nurses. The higher injury rates among nurses' aides are consistent with reports that aides performed more lifting, bending, and twisting compared to nurses [Videman et al., 1984], and their work is mostly concentrated in direct patient care activities at the bedside [Spilsbury and Meyer, 2004].

Smaller occupational groups were also identified as being at risk for patient handling injuries, including EMTs, morgue technicians, and patient transporters. Prior research identified patient handling tasks that place EMTs at risk for injury [Lavender et al., 2000], as well as patient transfer interventions to reduce this risk [Lavender et al., 2007]. Overall, the literature is sparse or absent for these small workgroups. At this particular hospital, workers who conduct

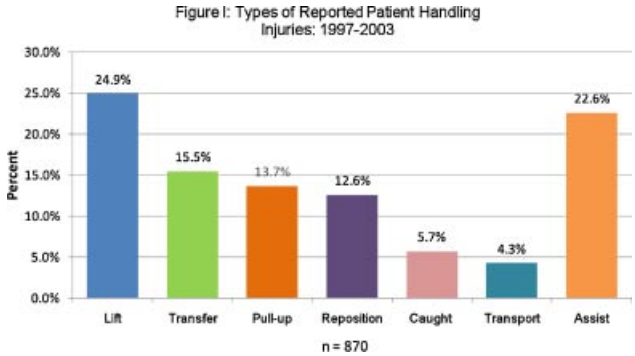

FIGURE 1. This figure includes all reported claims except 6 (0.68%) claims that resulted from applying pressure to puncture post-cardiac catheterization. See Table II for detailed description of each patient handling task.

post-mortem tasks recently implemented mechanical lift equipment into their practice.

Forty percent of the injuries incurred among this cohort included lifting or transferring of patients, which may have been prevented with the use of mechanical lift equipment designed to do the heavy lifting and transferring for the worker. This equipment has shown promise in some studies for preventing these types of injuries [Ronald et al., 2002; Evanoff et al., 2003; Chhokar et al., 2005; Engst et al., 2005], and supported by biomechanical testing [Zhuang et al., 1999]. Our assessment of a possible reduction in injuries is based solely on the potential effectiveness of using mechanical lift equipment without considering issues of integrating such machinery into daily patient care practices. In this institution resistance to use of lift equipment has been reported for a variety of reasons including time required, comfort with the use of the equipment, difficulty maneuvering in small patient rooms, patient and family fears, and concerns that their use will hinder patients' rehabilitation efforts. Addressing these issues and concerns will be important as the institution focuses on the adoption of this equipment. However, it is important to recognize what burden of patient handling injuries are not realistically going to be addressed by the use of lift equipment even with full adoption.

Thirty-two percent of patient handling injuries in this study resulted from repositioning patients in bed, pulling patients up in bed, and catching patients who fall, which may not be prevented through the use of mechanical lift equipment. For example, Ronald et al. [2002] observed a significant decrease in musculoskeletal injuries associated with lifting and transferring of patients with the use of ceiling lifts, but no reduction in these types of injuries associated with repositioning of patients. These findings support the American Nurses Association's efforts through their Handle with Care campaign to reinforce the need not only for mechanical lift equipment, but other types of equipment such as sliding boards and gait belts [ANA, 2003, 2007]. Lloyd and Baptise [2006], who evaluated the biomechanical efficacy of several lateral transfer devices/techniques, recommended that health care professionals use devices made with low-friction material and those with extendable straps (that were optimally placed) for pulling the patient. At this particular medical center, recent interventions, in addition to mechanical lift equipment, have included the use of disposable Hover Mats in the emergency room, and the use of plastic liners on inpatient units to reduce friction when pulling a patient up in bed, and/or encouraging staff to allow gravity to assist when moving a patient up in bed by placing the bed in Trendelenburg position (feet higher than head). While not found to be as efficacious in reducing friction as some other devices, the liners do decrease friction, are simple to use, are easily accessible, and are popular with the staff.

Data used for this study are self-reported, excluding those who incurred a patient handling injury, but did not file an injury report, resulting in a conservative estimate of risk [Pransky et al., 1999; Shannon and Lowe, 2002]. For example, among a subset of nurses and nurses' aides in this health care system, 68% reported not filing a workers' compensation claim for a patient handling injury that required medical care [Schoenfisch and Lipscomb, in press]. In the analyses of these surveillance data only an estimate of workers' FTE (based on work hours and work months per year) were available as an estimate of time-at-risk for injury, which is not a direct measure of the actual time workers spent conducting patient handling tasks. Time spent engaged in patient handling varies within occupational groups, especially among more senior workers who may have more administrative type roles compared to workers with less job tenure. Only abbreviated descriptions of employee injuries were available, which contributed to our inability to define 200 injuries beyond the category of "assisting patient." However, this study has several strengths including the population size and length of follow-up, which allowed us to capture cases of patient handling injury among a large and diverse cohort of health care workers. Occupational groups not typically considered to be at risk for patient handling injuries were identified in these analyses. Although these workgroups are not large, the burden of injury within each group is significant. For most of the cases we were able to discern between various types of activities for purposes of estimating the proportion that may not be prevented from mechanical lift equipment, requiring other types of prevention strategies needed to be developed to improve worker safety. These data are unique in that they provide details that can be useful in developing safety interventions targeted at specific patient handling tasks. Based on prior study findings, there is no one intervention that will reduce the risk of patient handling injuries. These findings are important in informing intervention evaluation efforts by documenting the potential magnitude of injuries that can be prevented with lift equipment. These diverse patient handling tasks must be

TABLE II. The Frequency of Different Types of Patient Handling Resulting in Musculoskeletal Injury by Occupational Groups: 1997–2003

Patient handling task	Inpatient nurse, N (%)	Nurses' aide, N (%)	Radiology tech, N (%)	EMT, N (%)	Operating room tech, N (%)	Physical occup. therapist, N (%)	Nurse anesthetist, N (%)	Secretary admin staff, N (%)	Cardiac cath tech, N (%)	Morgue tech, N (%)	Outpatient nurse, N (%)	Patient transport, N (%)	Total (n = 855)[a], N (100%)
Lift (lifting patient)	108 (52.9)	41 (20.1)	26 (12.7)	8 (3.9)	5 (2.5)	2 (1.0)	1 (0.50)	2 (1.0)	—	1 (0.50)	7 (3.4)	3 (1.5)	204
Transfer (moving patient between bed and stretcher, chair and bed, wheel-chair and chair, and reverse)	61 (45.5)	28 (20.9)	16 (11.9)	1 (0.74)	2 (0.15)	7 (5.2)	2 (0.15)	2 (0.15)	2 (0.15)	5 (3.7)	5 (3.7)	3 (2.2)	134
Pull-up (pulled patient up in bed)	71 (60.2)	41 (34.7)	4 (3.0)	—	—	—	—	—	—	1 (0.85)	1 (0.85)	—	118
Reposition (repositioning of patient in bed involving turning, rolling, or moving)	60 (54.5)	25 (22.7)	11 (10.0)	—	1 (0.90)	1 (0.90)	2 (1.8)	2 (1.8)	—	—	6 (5.4)	2 (1.8)	110
Caught (caught patient to prevent them from falling. Patient could be ambulating or in bed)	21 (41.1)	14 (27.5)	6 (11.8)	—	1	5 (9.8)	—	—	1 (0.90)	1 (0.90)	2 (3.9)	—	51
Transporting (pushing or pulling patient in a wheel chair or bed from one location in the hospital to another)	13 (34.2)	5 (13.2)	6 (15.8)	1 (2.6)	1 (2.6)	—	1 (2.6)	3 (7.9)	—	3 (7.9)	1 (2.6)	4 (10.5)	38
Assist (assisting patient, assisting patient to bathroom, assisting patient to bed)	95 (47.5)	44 (22.0)	25 (12.5)	4 (2.0)	10 (5.0)	3 (1.5)	—	—	3 (1.5)	3 (1.5)	11 (5.5)	2 (1.0)	200

—, no claims filed.

[a]Fifteen claims not included in table were incurred by 11 workgroups who had <5 patient handling claims each, including physicians, nurse managers, dental techs, EKG techs, phlebotomists, respiratory care techs, clinical trial techs, neurology techs, lab techs, parking service assistants, information coordinators. An additional six claims not included in the table were occurred from applying pressure to puncture site post-cardiac catheterization.

TABLE III. Adjusted Rate Ratios (95% CI) of Patient Handling Injuries in Nurses'Aides Compared to Inpatient Nurses: 1997–2003

	Overall patient handling	Lifting patient	Transferring patient	Pulling-up patient	Reposition/turning patient
Nurses'aide	2.1 (2.0. 2.3)	1.7 (1.6, 1.8)	2.1 (1.9, 2.3)	2.7 (2.4, 2.9)	1.9 (1.8, 2.1)
Inpatient nurse	1.0	1.0	1.0	1.0	1.0

Adjusted for years of age and years employed at hospital.
See Table II for detailed description of each patient handling task.

examined by safety and health care professionals in their efforts to develop and implement targeted and effective prevention strategies.

CONCLUSION

Current study results support intervention efforts focused on prevention of patient handling injuries among inpatient nurses and nurses' aides. However, there are a number of smaller workgroups in an inpatient hospital setting who are also at high risk of patient handling injury. Efforts on their behalf should not be ignored, particularly since many of the same types of interventions currently being studied, such as mechanical lift equipment, are likely to benefit them. Radiology suites seem particularly well suited for built-in lift equipment as they are being built or renovated, but this will not address bedside X-rays which may account for some of these injuries. Similarly, operating rooms where there are constant patient transfers would benefit from permanent equipment such as built-in ceiling lifts. Finding interventions to help emergency medical technicians is more challenging, especially since their work tasks are highly variable and their work environments are unpredictable.

More careful surveillance and collection of qualitative data from these workers may assist with identifying effective intervention strategies. A number of injuries identified require further exploration for appropriate types of prevention strategies, such as injuries resulting from catching falling patients. This type of unpredictable incident occurred across all occupational groups found to be at risk in our study. The findings from this study reinforce the need for interventions beyond mechanical lift equipment to reduce the risk of patient handling injuries.

ACKNOWLEDGMENTS

We thank Kristie Wicker, Senior Program Coordinator, Division of Occupational and Environmental Medicine at Duke University Medical Center, for her many efforts with coordinating this project. We used the term black as opposed to African-American due to the way race is recorded in our Human Resources database. This work was funded by the National Institute for Occupational Safety and Health (Contract grant # 5 K01 OH007996-03, 5 R01 OH003979-03 and 5 R01 OH008375-04). This project could not have been accomplished without the support and commitment from Duke University Medical Center. We express our appreciation to Clint H. Davidson, Vice President, Human Resources, Lois Anne Green, Director, Human Resources Benefits Administration, and Joyce Williams, J.D., Director, Workers' Compensation. Lastly, the support and assistance of George Jackson, M.D., Director, Employee Occupational Health and Wellness in establishing the surveillance system is gratefully acknowledged.

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