Research

Differences among nursing homes in outcomes of a safe resident handling program

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A large nursing home corporation implemented a safe resident handling program (SRHP) in 2004–2007. We evaluated its efficacy over a 2-year period by examining differences among 5 centers in program outcomes and potential predictors of those differences. We observed nursing assistants (NAs), recording activities and body postures at 60-second intervals on personal digital assistants at baseline and at 3-month, 12-month, and 24-month follow-ups. The two outcomes computed were change in equipment use during resident handling and change in a physical workload index that estimated spinal loading due to body postures and handled loads. Potential explanatory factors were extracted from post-observation interviews, investigator surveys of the workforce, from administrative data, and employee satisfaction surveys. The facility with the most positive outcome measures was associated with many positive changes in explanatory factors and the facility with the fewest positive outcome measures experienced negative changes in the same factors. These findings suggest greater SRHP benefits where there was lower NA turnover and agency staffing; less time pressure; and better teamwork, staff communication, and supervisory support.

INTRODUCTION

Safe patient handling programs (SPHPs) in healthcare settings are crucial for reducing musculoskeletal injuries to healthcare workers.[1] A 2003 review[2] of patient handling interventions reported that multifaceted interventions typically reduce risk factors related to patient handling more successfully than single-factor and training-only interventions. Components of multifaceted interventions included patient assessment, the introduction of patient handling devices, written policies for effective equipment use, and training on patient handling procedures. Evaluations of patient handling interventions in various healthcare settings have been found to promote reductions in forces on the lumbar spine,[3]

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back injuries,[4] workers' compensation claims and lost injury days,[4–7] OSHA 200 log incidents,[7,8] self-reported injury rates,[7] and claim costs.[5,6]

To date, little research has been conducted into variability of the success of SPHPs among healthcare centers. However, several studies have reported on factors that influence their effectiveness, such as staffing levels, turnover, resident acuity, equipment factors, organizational factors, and relationships with coworkers.

A recent study[5] evaluated the effects of varying resident handling interventions in all nursing homes in Ohio. Inadequate resident-to-staff ratio was found to be a risk factor for musculoskeletal injuries. Additionally, Trinkoff et al.[9] reported that reductions in workers' compensation claim rates at nursing homes in Ohio were associated with increasing hours of staff time available per resident, and Enkvist[10] reported on obstacles to successful interventions identified by hospital nurses, including a lack of time and trained staff.

Employee turnover has also been reported to hinder intervention benefits. Rockefeller[11] reported on the negative effects of administrative turnover on ergonomic interventions in nursing homes in Washington State.

Resident acuity has been identified as a factor that could hamper effective safe resident handling programs (SRHPs). Park et al.[5] reported an association between lower resident acuity and increased risk for musculoskeletal injuries, and Enkvist[10] identified patients with dementia as a possible barrier to the successful SPHPs in hospitals.

A systematic review of SPHP studies reported on individual and environmental barriers and facilitators of interventions in varied healthcare settings.[12] One of the most commonly identified environmental barriers was convenience and easy accessibility of equipment. Hunter et al.[13] identified misplaced or lost equipment as a barrier to successful SPHP implementation, and Enkvist[10] reported lack of equipment to be an obstacle for SPHPs. Park et al.[5] suggested that intervention implementation is more feasible in facilities where organizational factors like ample equipment purchases and fewer changes in facility ownership are present.

Good working relationships between supervisors and coworkers were recognized as important factors for nursing home staffs' general well-being.[14] Koppelaar et al.[12] reported that supportive management climate was a facilitator for successful programs. Poor relationships with coworkers hindered success in 1 intervention.[10]

Further research regarding predictors of effective SPHPs is necessary to identify additional factors hindering effectiveness in order to promote the satisfactory implementation of multifaceted patient handling interventions. Examining individual, environmental, and psychosocial factors over time, including pre-intervention measurements, would help to measure the direction of associations between factors and efficacy of the SPHP better.

The goal of this study was to examine possible explanations for differences in the efficacy of a company-instituted SRHP in 5 nursing homes, measured in 3 ways. Changes in equipment use during resident handling in addition to changes in a physical workload index (PWI) for nursing assistants (NAs), both overall and while handling residents, were examined over a 2-year period following SRHP implementation. Questionnaires, administrative data, employee satisfaction surveys, and staff exit interviews following the collection of ergonomic observations were all sources of variables that potentially explain differences in outcome measures among centers.

METHODS

In 2004, a large nursing home corporation instituted a SRHP in all its facilities to reduce manual resident handling. In each center, prior to receiving equipment, nurses assessed residents' needs for safe patient handling. Third-party trainers conducted orientation meetings with department heads and nurses in each facility. Equipment, based on nurses' assessments, was purchased by each facility, and a third-party firm provided training to all clinical staff on the use of and maintenance procedures for mechanical handling devices.

Follow-up visits were made by the third party after 2, 4, 10, 20, 30, 40, and 50 weeks to provide retraining and emphasize policies and compliance to the clinical staff. All staff demonstrated competency in using all equipment in order to remain in their jobs. Additionally, staff development coordinators were recruited and trained to provide safe resident handling training to newly hired employees.

This prospective study of 5 nursing homes included direct ergonomic observations of NAs at baseline (the week of the department heads' meeting to begin SRHP implementation) and at 3-month, 12-month, and 24-month follow-up periods. A modification of the PATH method[15] was used to make ergonomic observations. This version incorporated resident handling activities, handling equipment, postures, and tasks specific to the healthcare industry. Data were collected by 12 observers on handheld PDAs at fixed 60-second intervals (observation moments) over all or part of a shift. Systematic postobservation exit interviews with participants were conducted and recorded on cover sheets, summarizing these supplemental data for each person–shift in a standardized format.

A PWI was calculated by summing contributions of compressive forces on the L5/S1 joint resulting from 17 combinations of postures and manual handling actions collected with the use of the PATH method.[16] Each of the 17 terms in the index equation consisted of a posture

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combination, weighted by subtracting the standard compressive force of the spine from the compressive force of the spine at the given combination, and a score based on the frequencies of PATH variables.

Self-administered questionnaires focusing on general health, musculoskeletal symptoms, psychosocial risk factors, workplace factors, and demographics were distributed by the investigators to clinical staff members in each facility where job observations were made at each of the 4 time periods. Compensation of $20 was given for completed questionnaires returned with informed consent forms.

Administrative data for the study period were made available by the corporation. This included information such as employee and administrative turnover for the study years and percentage of agency staff for each facility at each time period.

Employee satisfaction surveys, available to employees in all jobs, were designed by a third-party research company, My InnerView,[17] and administered locally at each facility. Survey results were made available to researchers by the nursing home corporation. Employees mailed in surveys to report on global job satisfaction, work environment, training, supervision, management, and demographics. These data were provided to the investigators for 2005–2009. For one center, results from the survey were available only at the 12-month and 24-month follow-ups (2008 and 2009). Results from the remaining centers were available for all time periods (2006–2008). University of Massachusetts Lowell Institutional Review Board reviewed and approved all procedures.

Outcome measures

Changes in equipment use during resident handling and changes in PWI, both overall and during resident handling, were used to examine the efficacy of the SRHP. Values for each outcome measure were calculated for each of the 5 facilities. To ensure that variation in sample sizes did not affect the calculation of outcome measures, standard errors were used to calculate confidence intervals for the percentages of equipment use during resident handling and the overall percentage of observation moments for each facility at each time period.

Equipment use during resident handling

Observational data included use of resident handling equipment (gait belts, slideboards, slipsheets, slings, sit/stand lifts, and total body lifts). Resident handling activities were assisting with ambulation, repositioning, transferring, and transporting. For all resident handling activities, the frequency of equipment use was calculated for each facility at each time period. Linear regression was used to fit slopes across the data points (0 months, 3 months, 12 months, and 24 months) in order to represent the changes in equipment use at each time period for each facility.

Cochran-Armitage tests for trend were calculated.[18] Data analysis was performed with SAS 9.2.

Physical Workload Index

For each time period at each facility, PWI was calculated for NAs, both overall and during resident handling only. Slopes for PWI, both overall and during resident handling, were determined for each facility with the use of linear regression to examine changes over time.

Explanatory factors

Candidate explanatory factors for inclusion in this study were selected based on firsthand experience collecting data in 5 nursing homes. Insight into interpersonal and work environment factors that might help explain differences in outcome measures between facilities informed the selection of variables available from questionnaire responses, administrative data, employee satisfaction surveys, and cover sheets (**Table 1**). Some factors were collected at the facility level and others were collected from individuals and converted to summary statistics by facility.

Factors from questionnaire responses

At each survey, the questionnaire included 2 questions each about coworker support ("The people I work with take a personal interest in me" and "The people I work with can be relied on when I need help") and supervisor support ("My supervisor is helpful in getting the job done" and "My supervisor pays attention to what I am saying"). Responses to these questions were reported on a 4-point Likert scale ("strongly disagree" to "strongly agree"). Responses were averaged for each pair of questions. Percent change from baseline values was calculated for each facility (24 mo – baseline/baseline).

Environmental factors from administrative data

Information regarding turnover by job type was provided by the nursing home corporation; turnover of NAs, administrators, and directors of nursing (DONs) was calculated for each facility. Yearly turnover data for NAs were used to calculate percent change from baseline values for each facility (24 mo – baseline/baseline).

The percentages of NA shifts filled by agency staff were estimated by the investigators for the week of the survey, based on staffing sheets provided by the facilities at the times of data collection. Typically, agency staff were hired to fill shifts when facilities were understaffed. Percent change from baseline agency staffing levels was calculated for each facility (24 mo – baseline/baseline).

Administrators and wellness program champions at the facilities were surveyed to confirm wellness program

Table 1: Explanatory Factors and Data Sources

Data Source	Explanatory Factors
Investigators: questionnaires	Coworker support
	Supervisor support
Company: administrative data	Percent rehabilitation population
	Percent dementia beds
	Baseline equipment usage
	Wellness program
	Administrator turnover
	Director of Nursing turnover
	Nursing assistant turnover
	Percent agency staff
Company: employee satisfaction surveys	Recommendation for job
	Safety of workplace
	Adequacy of equipment and supplies
	Quality of teamwork
	Staff-to-staff communication
Investigators: observation cover sheets	Was today a typical day?
	Were there any obstacles to getting your work done on time today?
	Was there any broken or missing equipment today?
	Was the unit understaffed today?
	Did you feel any time pressure today?

activities. Two of the 5 facilities did not provide feedback, so it was assumed that wellness programs were not established at those locations.

Factors describing the case mix of residents, including "percent rehabilitation beds" and "percent dementia beds," were extracted from investigators' field notes describing unit types and resident censuses.

Baseline equipment use levels (0–2) for each facility were determined by comparing frequencies of PATH observations with field notes recounting types and frequencies of handling equipment observed. Equipment was present, though not observed in use, in all facilities at baseline.

Factors from employee satisfaction surveys

Five questions were chosen as potential explanatory factors: "Rate this facility on the safety of the workplace," "Rate this facility on the adequacy of equipment and supplies to do your job," "Rate this facility on how your coworkers work together as a team," "Rate this facility on staff-to-staff communication," and "What is your recommendation of this facility as a place to work?" A 4-point Likert scale ("poor" to "excellent") was used to rate responses for each item. With the use of responses from NAs at each center, the mean value and percentage of "poor" responses for each question were calculated for each of the study years (2006–2008 for 4 facilities and 2007–2009 for 1). Percent change from baseline values for mean survey responses and percent "poor" responses were calculated for each facility (24 mo – baseline/baseline).

Factors from cover sheet data

Along with individual demographic information, 5 questions were chosen from the investigators' observation cover sheets as potential explanatory variables. At each time period, the center percentage of "yes" responses were calculated for the following questions: "Was today a typical day?" "Were there any obstacles to getting your work done on time today?" "Was there any broken or missing equipment today?" and "Was the unit understaffed today?" The percentage of "never" responses was calculated for

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"Did you feel time pressure today?" Percent change from baseline responses was calculated for each facility (24 mo – baseline/baseline).

Domains for explanatory factors

Explanatory factors from the data sources were further organized by domain to classify their relationships with outcome measures better. The domains examined were facility characteristics, equipment factors, staffing factors, turnover, personal work factors, and interpersonal relationships.

Correlation coefficients

Spearman correlation coefficients (ρ) were computed between outcome variables (slope of equipment use during resident handling over time, slope of PWI over time, and slope of PWI during resident handling over time) and all candidate explanatory and demographic variables.

RESULTS

Between 3 and 21 individual workers were observed at each time period at each facility (mean 12.7, SD = 3.9). This resulted in a range of 160–4323 observation moments (mean 2807, SD = 1088) per facility per time period, which included 31 to 324 resident handling observation moments (mean 171.3, SD = 83.9; **Table 2**).

At all facilities, the study populations were predominantly female; however, more men were observed at Center D and Center E than at the other centers (**Table 3**). Mean job tenure of the observed workers ranged from about 2 years to about 6 years. The observed workers at Center D had the lowest mean job tenure, whereas those at Center E had the highest. The observed population at Center A was much more likely to be white and Centers C and D were more likely to be black compared to the other centers. No observed workers were of Asian or Latino/Hispanic ethnicity.

SAFE RESIDENT HANDLING PROGRAM OUTCOMES

Equipment use during resident handling

Three centers had almost no equipment use at baseline, whereas 2 did use equipment. Confidence intervals for the proportion of work time observed indicated a small amount of variation at baseline; thus differences at the centers were unlikely (**Table 4**). Confidence intervals were similar among centers for the other time periods, demonstrating minimal differences.

In 4 centers, equipment use increased markedly by the end of the 24-month follow-up (Cochran-Armitage *P* values < 0.005 in Centers B, D, and E; **Figure 1**).

By the end of the follow-up period, NAs in all centers were observed using equipment for at least 18% of resident handling observations. A slight net decrease in equipment use was observed at Center A by the end of 24 months, although there had been a large increase at 12 months. Workers in Center B showed the steepest increase in equipment use of all centers.

Physical Workload Index

Reductions in both PWI and PWI during resident handling were observed for all facilities (**Figures 2** and **3**). Post- to pre-intervention ratios for PWI scores ranged from 0.58 to 0.92. Center B had the steepest negative slope, indicating the largest decrease in PWI after 2 years, whereas Centers A and C experienced the weakest downward trends, relating to the smallest improvements in PWI.

Post- to pre-intervention ratios for PWI scores during resident handling ranged from 0.57 to 0.83. Centers B and D had the steepest negative slopes for PWI during resident handling, and Centers A and C experienced the weakest negative slopes for PWI during resident handling over 2 years.

Table 2: Data Collection—Observation Periods and Observation Moments

	Observation Periods				Observation Moments				Observation Moments During Resident Handling			
Facility	**F0**	**F1**	**F2**	**F3**	**F0**	**F1**	**F2**	**F3**	**F0**	**F1**	**F2**	**F3**
Center A	13	14	14	12	2884	4323	3466	3033	206	286	305	149
Center B	3	13	21	14	160	3425	3354	3603	38	110	181	143
Center C	12	10	16	8	2400	2392	3442	1892	271	245	127	120
Center D	14	10	15	15	3916	1788	4117	2989	324	214	139	31
Center E	9	8	18	14	1012	1397	2992	3547	76	111	180	170

Table 3: Demographic Information for Observed Nursing Home Workers, by Facility

	Center A	Center B	Center C	Center D	Center E
n (Includes 4 time periods)	53	51	46	54	49
Sex (mean females)	91%	100%	91%	83%	75%
Mean tenure (years)	5.4	4.7	3.6	2.1	6.2
Race					
White	98%	35%	3%	0%	21%
Black	2%	65%	97%	100%	79%

Center characteristics in relation to SRHP effectiveness

Variation in potential explanatory factors was observed among centers (**Table 5**). Center B was the facility with the steepest slope for equipment use during resident handling and the steepest negative slope for PWI. This center also had favorable conditions in terms of NA turnover, the use of agency staff to fill shifts, recommendation for job, adequacy of equipment and supplies, staff-to-staff communication, "never" feeling time pressure, shifts with obstacles to getting work done on time, and understaffing. The weakest slope for equipment use during resident handling and a weak slope for PWI were observed at Center A, where negative changes in these same explanatory factors occurred.

EXPLANATORY FACTORS

Factors from questionnaires, administrative data, employee satisfaction surveys, and cover sheets that were correlated with outcome measures are listed in **Table 6**. Demographic variables of the observed population including gender (mean female), race (% white), and mean tenure were not significantly correlated with the outcome measures.

Explanatory factors from the turnover and personal work factors domains were more highly correlated with the slope of equipment use during resident handling, whereas the slope of PWI was more correlated with explanatory factors from the facility characteristics, equipment factors, and interpersonal relationships domains.

Table 4: Equipment Use During Resident Handling—Proportion of Work Time Observed, Standard Errors, and Confidence Intervals

Equipment Use During Resident Handling		Center A	Center B	Center C	Center D	Center E
Baseline	**Proportion**	21.6%	0.1%	16.3%	2.6%	0.1%
	Standard error	2.4%	0.6%	2.1%	0.6%	0.4%
	Confidence interval	19.2–24.0	0–0.007	14.1–18.4	2.0–3.3	0–0.005
3 month	**Proportion**	21.6%	4.2%	18.6%	3.6%	7.4%
	Standard error	3.5%	0.9%	2.1%	1.3%	2.2%
	Confidence interval	18.1–25.1	3.3–5.1	16.5–20.7	2.4–4.9	5.3–9.6
12 month	**Proportion**	31.5%	12.3%	15.8%	10.8%	20.5%
	Standard error	2.7%	1.8%	2.0%	1.8%	2.3%
	Confidence interval	28.8–34.1	10.5–14.0	13.8–17.8	9.1–12.6	18.1–22.8
24 month	**Proportion**	20.6%	21.7%	37.3%	18.0%	19.0%
	Standard error	2.5%	2.7%	3.8%	3.1%	2.3%
	Confidence interval	18.0–23.1	19.0–24.4	33.5–41.2	14.9–21.1	16.8–21.3

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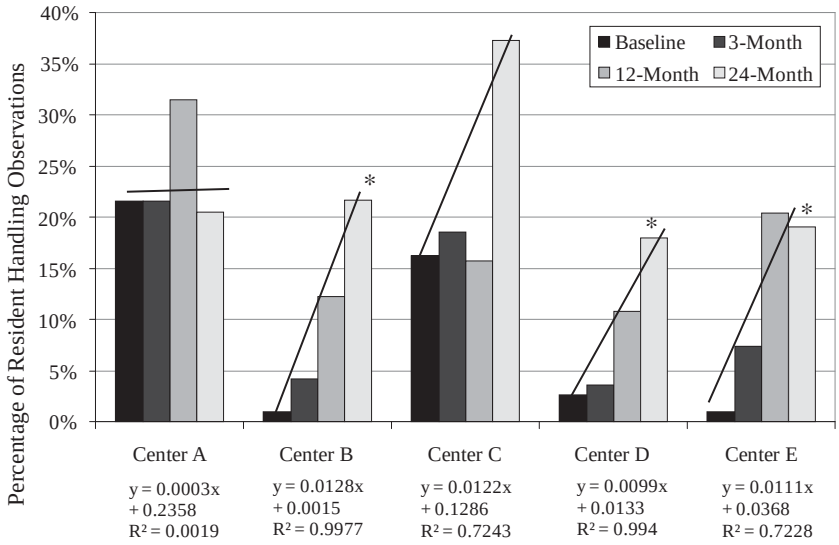
Figure 1:
Equipment Use[a] During Resident Handling[b] by Facility



* p < 0.005 (Cochran-Armitage test of trend)

[a] Equipment includes Total Body Lifts, Sit-Stand Lifts, Slings, Slideboards, Slipsheets, and Gait-belts

[b] Resident Handling includes manual and mechanically assisted Ambulation Assist, Reposition, Transfer and Transport

Facility characteristics

Resident case mix

Small slopes for PWI, representing less change in physical workload, were associated with increases in percentage of rehabilitation beds in a facility (ρ = 0.70, *P* = 0.188; **Table 6**). Centers A and C, with the weakest negative slopes for both PWI and PWI during resident handling, had the largest portion of rehabilitation beds of all centers (**Table 5**). Centers D and E, which had the largest dementia populations, had some of the steepest negative slopes for PWI during resident handling over 2 years (**Table 5**), although only moderately associated (ρ = –0.67, *P* = 0.215; **Table 6**).

Wellness programs

Patterns in the increase of equipment use during resident handling and the decrease in PWI based on wellness programs were not observed. Centers A and B were the only facilities with wellness program activities. Center A experienced the smallest change in equipment use during resident handling; whereas Center B experienced the strongest increase. The second lowest decrease in PWI over time was observed at Center A; the largest decrease was at Center B (**Table 5**).

Equipment factors

Access to handling equipment at baseline

Smaller slopes for PWI were moderately associated with increases in the level of equipment used for resident handling at baseline (ρ = 0.79, *P* = 0.111; **Table 6**). Centers A and C, the 2 facilities observed using the most equipment during resident handling at baseline, had the weakest negative slopes for PWI overall and during resident handling (**Table 5**).

Adequacy of supplies and equipment

The decrease in mean adequacy of equipment and supplies was significantly correlated with slopes decreasing in magnitude for PWI (–0.90, *P* = 0.037; **Table 6**; **Figure 4**), and associated with slopes decreasing in magnitude for PWI during resident handling (ρ = –0.80, *P* = 0.104; **Table 6**).

The facility with the steepest slope for equipment use during resident handling and the steepest negative slope for PWI (Center B) had the largest increases in mean adequacy of equipment and supplies and decreases in the percentage of "poor" responses to this question. Conversely, Center A, the facility with the weakest slope

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Figure 2:
Physical Workload Index for Nursing Assistants by Facility

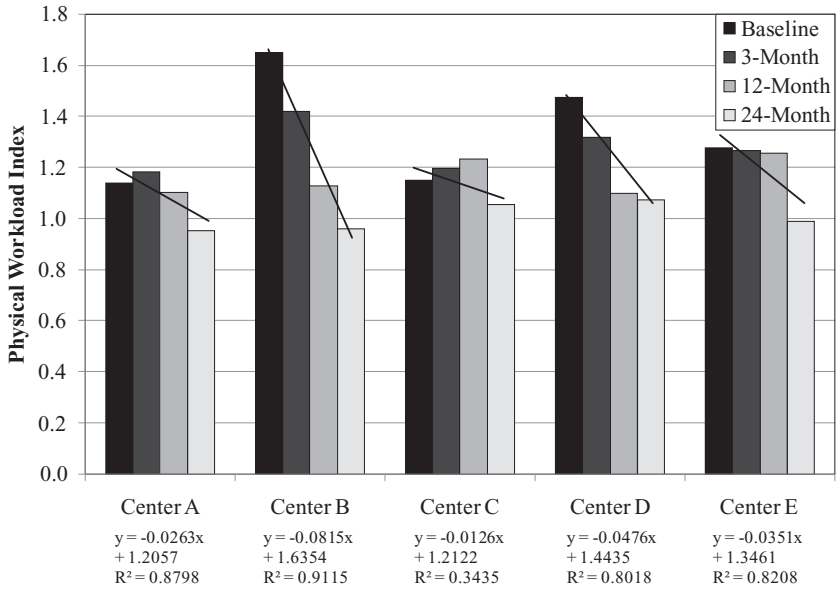

Figure 3:
Physical Workload Index for Nursing Assistants During Resident Handling by Facility

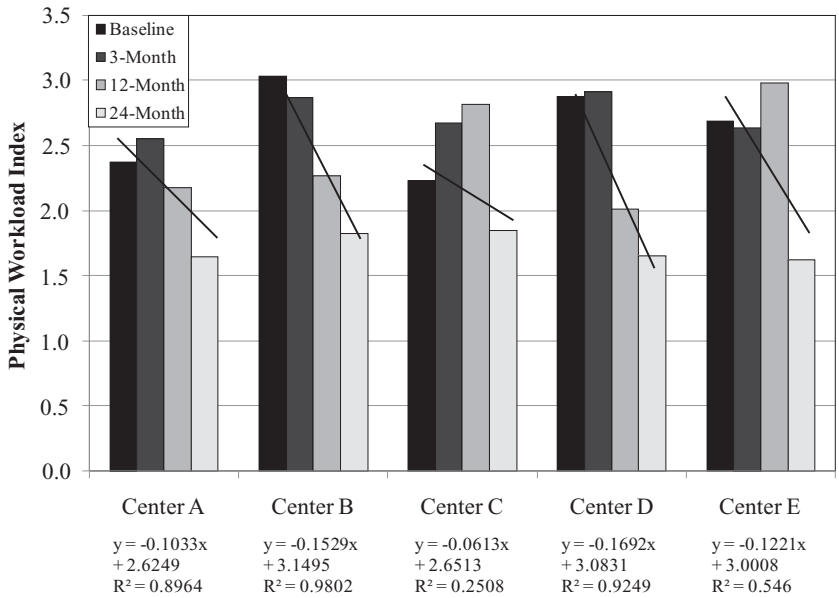

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Table 5: Summary of Center-Specific Explanatory Factors and Outcome Measures

	Data Source	Outcome Variables	Center A	Center B	Center C	Center D	Center E
	Observational data	Slope of physical workload index	–0.0263	–0.0815	–0.0126	–0.0476	–0.0351
		Slope of physical workload index during resident handling	–0.1033	–0.1529	–0.0613	–0.1692	–0.1221
		Slope of equipment use during resident handling	0.0003	0.0132	0.0122	0.0099	0.0115
Domain	**Data Source**	**Explanatory Factors**	**Center A**	**Center B**	**Center C**	**Center D**	**Center E**
Facility characteristics	Administrative data	Rehab population (% beds)	31.0%	22.5%	48.6%	26.2%	14.0%
		Dementia population (% beds)	0%	0%	0%	26.2%	11.2%
		Wellness program	Yes	Yes	No	No	No
Equipment factors	Administrative data	Level of baseline equipment use during resident handling	2	0	2	1	0
	Employee satisfaction surveys	Change in mean adequacy of supplies and equipment	–8%	55%	–3%	39%	18%
		Change in % "poor" adequacy of supplies and equipment	–36%	–53%	123%	–22%	–57%
Staffing factors	Administrative data	Change in agency staffing	1567%	–46%	0%	69%	–1%
	Cover sheets	Change in observed understaffed shifts	1567%	–97%	50%	–88%	–57%
Turnover	Administrative data	Change in nursing assistant turnover	27%	–78%	–57%	–57%	42%
		Total administrator turnover	1	3	0	2	1
		Total Director of Nursing turnover	1	4	3	4	3
Personal work factors	Employee satisfaction surveys	Change in mean recommendation for job	–41%	303%	14%	41%	–16%
		Change in % "poor" recommendation for job	–	–73%	67%	–52%	98%
	Cover sheets	Change in obstacles to getting work done on time	160%	–79%	–40%	4%	140%
		Change in never feeling time pressure	–96%	1329%	313%	–67%	320%
Interpersonal relationships	Questionnaires	Change in supervisor support	–18%	–7%	–12%	2%	–5%
	Employee satisfaction surveys	Change in mean staff-to-staff communication	–36%	161%	–3%	34%	–22%
		Change in % "poor" staff–to–staff communication	27%	–50%	59%	–31%	24%
		Change in % "poor" quality of teamwork	–16%	30%	–34%	160%	–

Table 6: Selected Spearman Correlation Coefficients for Explanatory Factors and Program Outcome Measures

	Explanatory Factor	Slope for Equipment Use While Resident Handling	Slope for the Physical Workload Index	Slope for the Physical Workload Index While Resident Handling
Facility characteristics	Rehab population	–	0.70 (P = 0.188)	–
	Dementia population	–	–	–0.67 (P = 0.215)
Equipment factors	Levels of baseline use of handling equipment	–	0.79 (P = 0.111)	–
	Decrease in mean adequacy of supplies and equipment	–	–0.90 (P = 0.037)	–0.80 (P = 0.104)
Staffing factors	Decrease in the percentage of agency staff used	–0.90 (P = 0.037)	–	–
	Increase in understaffing on observation day	–	0.90 (P = 0.037)	0.80 (P = 0.104)
Turnover	Decrease in nursing assistant turnover	–0.70 (P = 0.188)	–	–
	Total Director of Nursing turnover	0.88 (P = 0.051)	–	–
	Total administrator turnover	–	–0.97 (P = 0.005)	–0.87 (P = 0.054)
Personal work factors	Change in mean recommendation for job	0.70 (P = 0.188)	–0.70 (P = 0.188)	–
	Decrease in % "poor" responses to recommendation for job	–	–0.80 (P = 0.200)	–
	Decrease in obstacles to getting work done on time	–0.90 (P = 0.037)	–	–
	Increase in never feeling time pressure	0.90 (P = 0.037)	–	–
Interpersonal relationships	Increase in supervisor support	–	–	0.80 (P = 0.104)
	Change in mean staff-to-staff communication	0.70 (P = 0.188)	–0.70 (P = 0.188)	–
	Increase in % "poor" responses to staff-to-staff communication	–	1.0 (P = <0.0001)	0.90 (P = 0.037)
	Increase in % "poor" responses to quality of teamwork	–	0.80 (P = 0.200)	1.0 (P = <0.0001)

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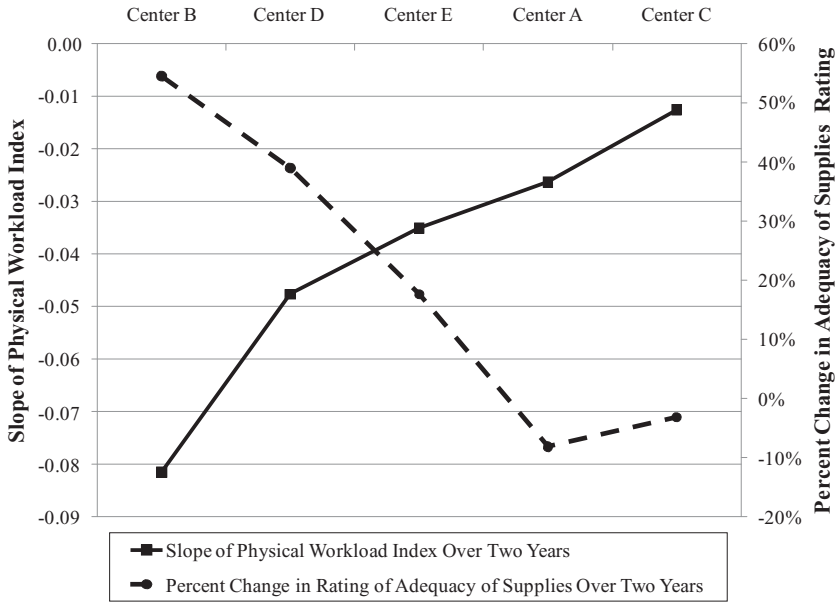
Figure 4:
Slope for Physical Workload Index vs Percent Change in Perceived Adequacy of Supplies and Equipment



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for equipment use during resident handling and a weak negative slope for PWI had the largest decrease in adequacy of equipment and supplies and an increase in the percentage of "poor" responses.

Staffing factors

Agency staff

An increasing slope for equipment use during resident handling was significantly correlated with a decrease in the percentage of agency staff used to fill shifts (–0.90, $P = 0.037$; **Table 6**). The only facility with an increase in the use of agency staff was Center A, where the weakest slope was observed for equipment use during resident handling over time (**Table 5**).

Understaffing

Increases in the percentage of observed understaffed shifts were significantly correlated with slopes decreasing in magnitude for PWI ($\rho = 0.90$, $P = 0.037$; **Table 6**), and associated with slopes decreasing in magnitude for PWI during resident handling ($\rho = 0.80$, $P = 0.104$; **Table 6**). Center B had the largest decrease in reported understaffing compared to the other centers (**Table 5**).

Turnover

Nursing assistant turnover

Increasing slopes for equipment use during resident handling were associated with a decrease in NA turnover over 2 years ($\rho = -0.70$, $P = 0.188$; **Table 6**). Center A experienced an increase in NA turnover over 2 years, and Center B, with the steepest positive slope for equipment use during resident handling, had the largest decrease in NA turnover (**Table 5**).

Administrative turnover

Generally, higher turnover of DONs was correlated with slopes increasing in magnitude for equipment use during resident handling (0.88, $P = 0.051$; **Table 6**), and higher administrator turnover corresponded to weaker negative slopes for PWI ($\rho = -0.97$, $P = 0.005$; **Table 6**) and PWI during resident handling ($\rho = -0.87$, $P = 0.054$; **Table 6**).

Personal work factors

Job satisfaction

Increases in mean rating of "would recommend this job" were associated with increasing slopes for equipment use during resident handling ($\rho = 0.70$, $P = 0.188$; **Table 6**) and slopes decreasing in magnitude for PWI ($\rho = 0.70$, $P = 0.188$; **Table 6**). The largest increase in mean recommendation for job was at Center B, the facility with the steepest slope for equipment use during resident handling and the steepest negative slope for PWI. The facility with the weakest slope for equipment use during resident handling and a weak negative slope for PWI (Center A) had the largest decrease in mean recommendation for job (**Table 5**).

Decreases in the percentage of "poor" ratings for the same survey question were also associated with weaker slopes

for PWI (ρ = 0.70, P = 0.188; **Table 6**). Center B had the largest decrease in the percentage of "poor" responses to "would recommend this job," and Center A had the largest increase in the percentage of "poor" responses.

Obstacles to getting work done on time

Increasing slopes for equipment use during resident handling were significantly correlated with a decrease in the percentage of work shifts involving obstacles to getting work done on time (–0.90, P = 0.037; **Table 6**).

Centers B and C were the 2 facilities with the steepest slopes for equipment use during resident handling over time, and they had the largest decreases in reported obstacles to getting work done on time. Center A, the facility with the weakest slope for equipment use and second weakest slope for PWI, had the largest increase in obstacles to getting work done on time.

Time pressure

In general, as the slopes weakened for equipment use during resident handling over time, NAs reported "never" feeling time pressure less frequently (ρ = 0.90, P = 0.037; **Table 6**; **Figure 5**).

The facility with the weakest slope for equipment use and second weakest slope for PWI (Center A) had the largest decrease in "never" feeling time pressure.

Interpersonal relationships

Supervisor support

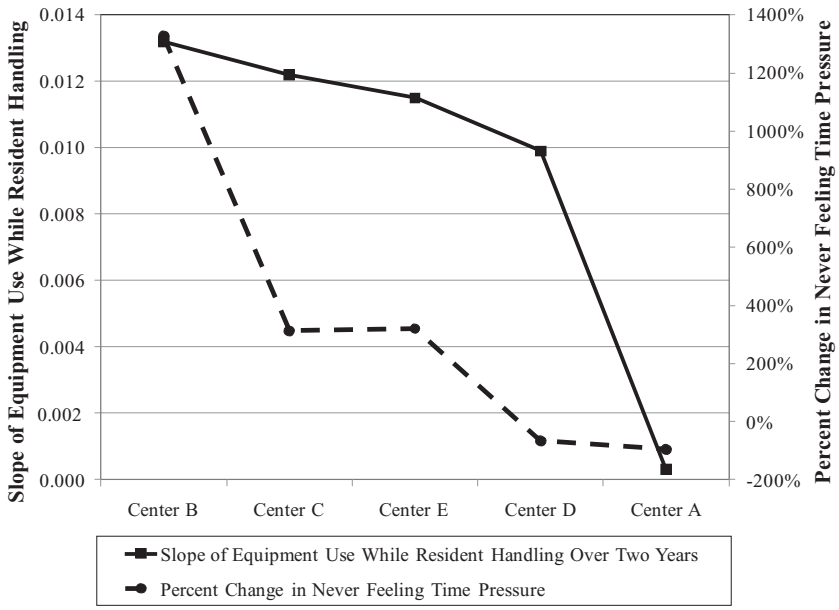
Weaker slopes for PWI during resident handling were associated with increases in percentage of supervisor support (ρ = 0.80, P = 0.104; **Table 6**). Center D, with the steepest negative slope for PWI during resident handling (ie, reduced physical workload), had the highest mean perceived supervisor support compared to the other facilities. Supervisor support scored highest for Center D at each time period except baseline, and this was the only facility that reported increased supervisor support at the 24-month follow-up.

Center A, which had the smallest change in equipment use during resident handling and the second smallest change in PWI, also had the largest decrease in perceived supervisor support over the 24-month follow-up (**Table 5**).

Staff-to-staff communication

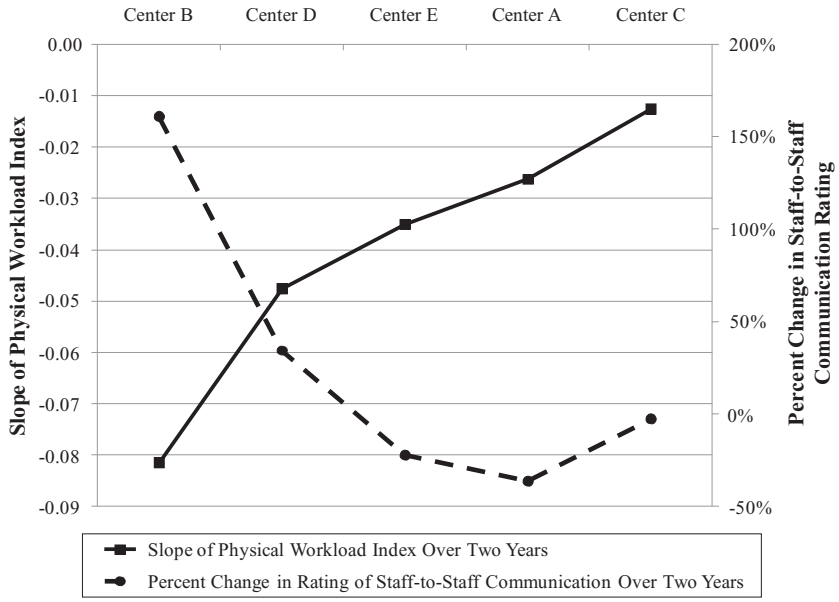
As change in mean staff-to-staff communication decreased, the magnitude of the slope for PWI decreased (ρ = –0.70, P = 0.188; **Table 6**; **Figure 6**). In addition, increases in the percentage of "poor" responses for staff-to-staff communication were significantly correlated with the slopes decreasing in magnitude for PWI (1.0, P < 0.0001; **Table 6**) and PWI during resident handling (0.90, P = 0.037; **Table 6**).

Figure 5:
Equipment Use During Resident Handling vs Percent Change in Never Feeling Time Pressure



DOI: 10.1002/jhrm

Figure 6:
Slope for Physical Workload Index vs Percent Change in Perceived Staff-to-Staff Communication



Center B, the facility with the steepest slope for equipment use during resident handling and the steepest negative slope for PWI, had the largest increase in staff-to-staff communication and a corresponding decrease in percentage of "poor" responses to this question (**Table 5**). The largest decrease in staff-to-staff communication occurred at Center A, the facility with the weakest slope for equipment use during resident handling and a weak negative slope for PWI. An increase in the percentage of "poor" responses to this survey question was also reported at Center A (**Table 5**).

Quality of teamwork

Increases in the percentage of "poor" ratings for quality of teamwork were associated with weaker slopes for PWI (ρ = 0.80, p = 0.20; **Table 6**), and significantly correlated with weaker slopes for PWI while resident handling (ρ = 1.0, $P < 0.0001$; **Table 6**). The facility with a weak negative slope for PWI and the weakest slope for equipment use while resident handling (Center A) had an increase in the percentage of "poor" responses to the quality of teamwork question. Additionally the largest decrease in mean quality of teamwork occurred at this facility (**Table 5**).

DISCUSSION

After 2 years, all facilities experienced decreases in PWI and PWI during resident handling and all facilities excluding Center A had more equipment use during resident handling compared to baseline. There were noticeable differences in these outcomes among facilities, however.

When considering outcome measures, it appears that increasing equipment use influenced decreases in PWI, as expected. In this study, positive outcome measures were associated with positive changes in many explanatory factors such as NA turnover, the use of agency staff to fill shifts, recommendation for job, adequacy of equipment and supplies, staff-to-staff communication, "never" feeling time pressure, shifts with obstacles to getting work done on time, and understaffing. Weaker outcome measures resulted in negative changes in these same explanatory factors.

The slope for equipment use during resident handling was related to more explanatory factors from the turnover and personal work factors domains, and the slope for PWI was correlated with more explanatory factors from the facility characteristics, equipment factors, and interpersonal relationships domains. Firsthand experience offered insight into the domains of explanatory factors associated with the outcome measures.

For example, facility characteristics such as rapidly changing rehabilitation populations result in changes in resident acuity and more variability in day-to-day workload of

NAs. Rehabilitation units also prioritize having patients move on their own. The characteristics of this type of resident population affect the amount of handling equipment used, which then affects physical workload.

Equipment factors like high levels of baseline equipment usage generally produce a population of NAs accustomed to safe resident handling practices. The adequacy of supplies and equipment directly relates to the frequency of equipment used during resident handling and also physical workload. In this study, centers with minimal baseline equipment use benefited the most from the intervention. These centers had steeper increases in equipment use during resident handling and decreases in physical workload.

Understaffed shifts may lead to lack of time or personnel to use equipment for transferring residents properly. Another staffing factor, the percentage of agency-staffed shifts, results in knowledge gaps. Regular employees must spend time reviewing care procedures for each resident. Extra time spent with agency staff may result in lack of time to use equipment properly.

Turnover of NAs can lead to gaps in training and may result in less frequent use of handling equipment and a higher physical workload. Lower administrator turnover could hypothetically provide a higher level of management commitment to SRHPs, which would, consequently, encourage increased use of equipment. In this study, however, higher administrator turnover rates were actually associated with slopes increasing in magnitude for PWI. An explanation for this outcome is unclear.

The personal work factor, increased recommendation for the job, indicates more supportive work environments where equipment use would potentially be promoted. Additionally, fewer obstacles to getting work done on time and never feeling time pressure may result in more time to use equipment properly.

Interpersonal relationships such as higher levels of supervisor support suggest higher management commitment to the SRHP or to general employee well-being, influencing NAs to use equipment more frequently to reduce physical workload. Better staff-to-staff communication and quality of teamwork could also result in more supportive work environments, more effective use of available equipment, and reduced physical workload.

To date, few studies have examined the impact of factors affecting successful SPHPs and SRHPs. Although most studies have not quantified determinants of effective SPHPs, they have identified some barriers to success, including adequate staffing[19] and staff turnover rates.[20–22] In this study, understaffing of shifts was strongly correlated with PWI both overall and during resident handling. NA turnover was associated with equipment use during resident handling. The largest decrease in NA turnover was observed where equipment use increased the most and PWI decreased the most, and the largest increase was observed where equipment use increased the least and the change in PWI was weaker. Decreasing totals of administrator turnover were correlated with slopes decreasing in magnitude for PWI, and increasing totals of DON turnover were correlated with slopes increasing in magnitude for equipment use during resident handling. This direction of these correlations was unexpected, and future investigations should address this result.

Although this study evaluated a SRHP in nursing homes, many of the identified factors that may affect equipment use and physical workload are relevant to other healthcare environments, including hospitals. Adequacy of supplies and equipment, the use of agency staffing, understaffing, staff turnover, employee satisfaction, obstacles to getting work done, time pressure, supervisor support, staff communication, and teamwork are all important factors for the efficacy of work practices and physical workload of healthcare workers in many settings.

Implications for risk management

Successful safe handling programs, such as the SRHP described in this study, result in increased equipment use and decreased physical workload for nursing personnel. These outcomes can lead to reduced lost injury days[4–7] and workers' compensation claim costs,[5,6] reducing insurance costs for the company. These programs have been shown to be economically beneficial in healthcare settings.[4–7]

The provision of handling equipment to reduce heavy manual handling is a job factor that may be related to decreased NA turnover, as was seen in this study. It has been reported that, on average, yearly NA turnover is 74.5%, RN turnover is 56.1%, and LPN turnover is 51%.[23] It has been estimated that the ratio of turnover costs to annual wages is 1.0 for RNs[24,25] and 0.25 for other clinical staff,[26,27] which can result in high costs for healthcare facilities.

In this study, increased supervisor support and increased communication were related to reductions in physical workload following the intervention. Risk management is affected by relationships between individuals and can be used to reduce risks to healthcare staff and increase workplace safety. These interpersonal relationship factors may also mediate turnover rates.

In addition to cost savings resulting from safe handling interventions, another asset to consider is the human asset. Before the initial costs of an intervention, a healthcare facility has not invested in itself, but after investing in a safe handling program the facility has assets. The facility would be investing in the health of its employees, thus showing them respect for their health and their work.

Limitations and strengths of this study

In this study regression modeling was not an appropriate method for data analysis because of the small sample of facilities, so the effects of explanatory factors could not be quantified. Computing correlation coefficients is useful for examining relationships, although statistical power was very limited.

Although these data were longitudinal, there was no way to determine the temporal direction of the observed associations because both dependent and independent variables were measured over the same time period. For example, increase in equipment use was highly correlated with a decrease in obstacles to getting work done on time and with an increase in the percentage of "never" feeling time pressure. It could be argued that these explanatory factors are either a cause or an effect of the increased use of handling equipment. Future analysis of outcome measures on the individual level may help quantify the effects of explanatory factors using regression modeling.

Ergonomic observations were collected from a convenience sample focused on NAs. A random sample of individuals might have provided a more representative population; however, convenience sampling was the only method used for recruiting participants in this study because of difficulties gaining individuals' consent and facility access limitations. The research team attempted to recruit NAs across all types of units, patient populations, and seniority levels at each facility. Additionally, to standardize for any possible differences in work technique, the research team attempted to observe the same workers at each follow-up visit.

Response rates for employee satisfaction surveys varied among centers and across time periods, and it is possible that selection bias exists in this data source. The possibility of information bias also exists, because the investigators have no way of knowing how confidentiality was guaranteed to survey participants. If confidentiality was not properly ensured, workers may have felt obligated to report socially acceptable answers on the survey. However, "poor" ratings were reported at each time period for each of the 5 questions examined in this study, so it appears that honest responses were reported and this form of information bias is unlikely.

Selection bias and information bias are unlikely in the data collected in the questionnaire distributed by investigators. Workers' responses were kept confidential and high response rates among centers and over time were recorded, indicating a low likelihood of bias in this data source.

Information bias resulting from observed workers providing socially acceptable answers to cover sheet questions is unlikely as well. Observed employees usually develop a rapport with observers by the end of a work day, resulting in honest replies. Additionally, responses to questions regarding understaffing and broken equipment, for example, can be verified by the investigators making the observations.

At baseline, few observation moments were collected at Center B because of logistical externalities, but narrow confidence intervals for the percentages of resident handling observations at each time period indicate that the variation in number of observation moments did not affect the outcome measures much.

Wellness program information was not provided for 2 of the 5 facilities; thus it was assumed that those facilities did not participate. It is possible, however, that the facilities have wellness programs, which could change the outcome of that analysis. The opportunity to follow up with these facilities regarding wellness activities has been presented, though the results of the wellness program analysis suggest that the presence of a wellness program does not affect the outcome measures, as it was observed that the 2 facilities with wellness programs experienced opposing results for outcome measures and some explanatory factors.

Currently there is not much literature on the topic of factors that affect SRHP effectiveness, so we relied on our own observations and information we learned from staff, although other explanatory factors with higher correlations to the outcome measures may exist.

However, the investigation of explanatory factors in this study was not unsystematic; rather, it was informed by firsthand experience obtained while the investigators were conducting ergonomic observations in the facilities. This type of experience provided insight into the domains of explanatory factors that were associated with the outcome measures of interest.

A strength of this study is that the data were collected longitudinally. The only other study to examine factors impacting SRHPs was cross-sectional,[28] resulting in temporal ambiguity. Additionally, the observational method for collecting data allowed for systematic quantification of exposures in nonroutinized jobs, and the large samples of observation moments collected at baseline and each follow-up period helped create an extensive exposure profile for NAs.

Because this study analyzed data from multiple workplaces within a single company, evaluations across facilities were more comparable than centers owned by different companies. Information from the different sources was collected systematically across centers, reducing variability in data collection methods and reporting.

The mixed-methods approach used in this study produced robust results. Because multiple data sources were used, the results were not solely dependent on 1 source of information, such as worker self-report or administrative data.

CONCLUSIONS

Few studies have attempted to quantify the effects of factors that predict successful SRHP interventions. This study reported significant correlations between the outcome measures of equipment use during resident handling and PWI with explanatory factors, including the percentage of agency staff used to fill shifts, work shifts involving obstacles to getting work done on time, the percentage of "never" feeling time pressure, adequacy of supplies and equipment, the percentage of "poor" ratings for quality of teamwork, the percentage of "poor" ratings for staff-to-staff communication, and the percentage of observed understaffed shifts. The factors correlated with the outcome measures are also important in various other healthcare settings, and could be further explored in other environments, including hospitals.

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REFERENCES

1. Collins JW, Nelson A, Sublet V. *Safe lifting and movement of nursing home residents*, Publication No. 2006–117. Cincinnati, OH: National Institute of Occupational Safety and Health (NIOSH); 2006.
2. Hignett S. Intervention strategies to reduce musculoskeletal injuries associated with handling patients: A systematic review. *Occup Environ Med.* 2003;60:e6.
3. Nelson A, Lloyd JD, Menzel N, Gross C. Preventing nursing back injuries: Redesigning patient handling tasks. *AAOHN.* 2003;51(3):126–134.
4. Engkvist IL. Evaluation of an intervention comprising a no lifting policy in Australian hospitals. *Appl Ergon*. 2006;37(2):141–148.
5. Park RM, Bushnell PT, Bailer AJ, Collins JW, Stayner LT. Impact of publicly sponsored interventions on musculoskeletal injury claims in nursing homes. *Am J Ind Med*. 2009;52(9):683–697.
6. Nelson A, Matz M, Chen F, Siddharthan K, Lloyd J, Fragala G. Development and evaluation of a multifaceted ergonomics program to prevent injuries associated with patient handling tasks. *Int J Nurs Stud.* 2006;43(6):717–733.
7. Collins JW, Wolf L, Bell J, Evanoff B. An evaluation of a "best practices" musculoskeletal injury prevention program in nursing homes. *Inj Prev*. 2004;10(4):206–211.
8. Evanoff B, Wolf L, Aton E, Canos J, Collins J. Reduction in injury rates in nursing personnel through introduction of mechanical lifts in the workplace. *Am J Ind Med*. 2003;44(5):451–457.
9. Trinkoff AM, Johantgen M, Muntaner C, Le R. Staffing and worker injury in nursing homes. *Am J Public Health*. 2005;95:1220–1225.
10. Enkvist IL. Nurses' expectations, experiences, and attitudes towards the intervention of a "no lifting policy." *J Occup Health*. 2007;49:294–304.
11. Rockefeller K. *Evaluation of an ergonomic intervention in Washington State nursing homes* [dissertation]. Lowell: University of Massachusetts; 2002.
12. Koppelaar E, Knibbe JJ, Miedema HS, Burdorf A. Determinants of implementation of primary preventive interventions on patient handling in healthcare: A systematic review. *Occup Environ Med*. 2009;66:353–360.
13. Hunter B, Branson M, Davenport D. Saving costs, saving health care providers' backs, and creating a safe patient environment. *Nurs Econ.* 2010;28(2):130–134.
14. Schaefer JA, Moos RH. Effects of work stressors and work climate on long-term care staff's job morale and functioning. *Res Nurs Health*. 1996;19:63–73.
15. Buchholz B, Paquet V, Punnett L, Lee D, Moir S. PATH: A work sampling-based approach to ergonomic job analysis for construction and other nonrepetitive work. *Appl Ergon*. 1996;27:177–187.
16. Kurowski, A. *Ergonomic exposures of nursing home personnel following a safe resident handling intervention* [Doctoral dissertation]. Retrieved from proquest Dissertations & Theses database. (UMI No. 3459175).
17. Datapoint Workforce Commitment Suite. My InnerView Web site. http://www.myinnerview.com/opis/opis%20data%20sources/employees.php. Accessed April 2, 2011.
18. Agresti A. *Categorical data analysis.* 2nd ed. Hoboken, NJ: Wiley; 2002.

19. Garg A, Owen B. Reducing back stress to nursing personnel: An ergonomic intervention in a nursing home. *Ergonomics.* 1992;35(11):1353–1375.

20. Li J, Wolf L, Evanoff B. Use of mechanical patient lifts decreased musculoskeletal symptoms and injuries among health care workers. *Inj Prev*. 2004;10(4):212–216.

21. Peterson EL, McGlothlin JD, Blue CL. The development of an ergonomics training program to identify, evaluate and control musculoskeletal disorders among nursing assistants at a state-run veterans' home. *J Occup Environ Hyg*. 2004;1:D10–16.

22. Charney W, Simmons B, Lary M, Metz S. Zero lift programs in small rural hospitals in Washington State: Reducing back injuries among health care workers. *AAOHN*. 2006;54:355–358.

23. Donoghue C. Nursing home staff turnover and retention: An analysis of national level data. *J Appl Gerontol*. 2010;29(1):89–106.

24. Jones CB. The cost of nurse turnover, part 1: The economic perspective. *J Nurse Admin.* 2004;34:562–570.

25. VHA. The business case for workforce stability. www.healthleadersmedia.com/pdf/white_papers/wp_vha_120103.pdf. Published 2002. Accessed August 5, 2010.

26. Seavey D. The cost of frontline turnover in long-term care, better jobs, better care. Practice & policy report. Washington, DC: Institute for the Future of Aging Services; 2004:1–32.

27. Employment Policy F. *Employee Turnover—A Critical Human Resource Benchmark*. Washington, DC: Employment Policy Foundation; 2002.

28. Koppellaar E, Knibbe JJ, Miedema HS, Burdorf A. 2010. Individual and organizational determinants of use of ergonomic devices in healthcare. *Occup Environ Med*. 2011;68:659–665.

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