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A patient lifting intervention for preventing the work-related injuries of nurses

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Abstract. The average age of nurses is projected to be 50 years in 2010 [17]. Because nurses are older, a work injury prevention program should change how nurses lift patients. The purpose of this evidence-based practice improvement project was to examine a new lifting intervention.
Method: An evidence-based process was used to implement an effective lifting intervention, including a back school, a lift team, and mechanical lifting equipment, on the orthopedic and neurology units in a Minnesota hospital. A two-week pilot determined if enough work would be generated to justify hiring a permanent lift team. Then the entire lifting intervention was studied on the two units.
Results: The injuries for the two units decreased from 21 to 9 injuries, while the salary and work replacement costs were $48,220 and $2,560 in 2001 and 2002, respectively. The lift team averaged 80 lifts per day and 95% of the nursing staff attended the back school.
Conclusion: The lift team and new mechanical lifting equipment were successfully disseminated resulting in significant reductions in costs. Suggested improvements include additional supervision and lift team scheduling changes, regular staff meetings, and ongoing education.

Keywords: Evidence-based practice, patient lifting, safe patient handling

1. Introduction

Critical shortages of nurses in the future will be related in part to the aging of practicing nurses and to their eventual retirement from the workforce [38]. For instance, the average age of working registered nurses (RN) is 43.3 years; while in the 1970s, the average age was 22 years. Currently, only 12% of working RNs are under the age of 30 compared to 25% in 1980. By 2010, it is projected the average age for nurses will be 50 [17]. Even though fewer younger adults are coming into the profession and the majority of practicing nurses are aging, the work environment is still primarily geared toward a younger work force.

The purpose of this study was to examine the effectiveness of a new intervention for lifting hospitalized patients as one type of work redesign for older nurses that lessens the physical demands of bedside care. We used an evidence-based practice method that emphasizes "... the use of research findings and, as appropriate, quality improvement data, other operational and evaluation data, the consensus of recognized experts, and affirmed experience to substantiate practice" [53, pp. 48–49]. The ultimate goal of an evidence-based project is to devise a strategy to change practice in light of best evidence [34].

The questions for the study were sequential in that the answer to one question dictated whether there would be a decision to move forward and answer the next set of questions. These questions included: a) what is the internal and external evidence that would trigger a change in staff nurses' use of manual patient lifting and transferring techniques, b) what are the evidence-

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supported elements for a new lifting intervention and how should the lifting intervention be implemented, c) what evidence of effectiveness will be observed following implementation of a new lifting intervention, and d) what evidence exists that continued improvements will be needed for the lifting intervention?

2. Literature review

Almost 40% of nurses have identified stress and high physical demands as the biggest problems in nursing today [24,31,52]. The practice environment for nurses is often poorly designed and the average weight, size, and severity of illness of hospitalized patients has increased [17,38,45]. The combination of these factors has resulted in nurses having to manually lift and move patients more frequently and with greater difficulty. In 2000, the hospital incidence rate for back injuries associated with missed workdays was 90.1 per 10,000 full-time workers [45]. The injuries most often occurred during a patient transfer or a repositioning procedure [2, 24]. Estimated costs for back injuries are between $24 to $64 billion dollars annually [24].

Patient lifting should be eliminated or substantially reduced so nurses will continue to practice at the bedside and older nurses who want to work past retirement age can do so without risk for injury. Typical lifting interventions have primarily concentrated on education and training; however, because the efficacy of body mechanics education in preventing back injuries has come under scrutiny an educational program should not be the sole intervention [2,3,12,13,23,26,27,35–37,39,41, 49,50,54,55].

3. Methodology

3.1. Setting/participants

This improvement project was implemented at North Memorial Medical Center (NMMC) in Robbinsdale, Minnesota, a 400-bed, community-based level one trauma center. The medical center employs approximately 1,000 RNs to provide care on medical surgical, specialty, critical care, and ambulatory units. Most nurses are direct-care providers, assigned to an inpatient unit where patient lifting is an expected component of patient care.

NMMC's patient population is similar to other hospitals and includes older, sicker patients, with 29% of admissions being 70 years old or older [42]. For general medical surgical, and adult specialty units, the percent of patients greater than 70 years of age ranges from 30–60%. Adult patients weighing 250 pounds or greater for a four-month period in 2002 was 7.4% ($n = 6862$), which is a significant number of patients who could negatively impact the nursing staff's ability to lift and move patients safely. The medical center's focus on trauma tends to increase patient acuity and complexity in lifting and moving patients.

This project was piloted and then was implemented primarily on the 35-bed orthopedic and the 32-bed neurology units because patients had diagnoses associated with functional disability, thus requiring more assistance during transfers or repositioning. The lift intervention was then evaluated for future implementation throughout the hospital, with recommendations made for further improvement of the intervention. Patient-to-RN ratios for both units average 3–4, 4–6, and 6–7 patients per nurse on the day, evening, and night shift respectively. High patient-to-RN ratios are positively associated with back injuries related to patient lifting [17, 44,52].

3.2. Design

Soukup [51] described using sequential evidence phases, which included evidence-triggered, evidence-supported, evidence-observed, and evidence-based phases to mediate clinical change. In these phases, team members respectively identified evidence supporting the need for a change; determined the design and implementation of a lifting intervention; gathered information from process and outcome measures; and continued to improve the intervention. A systematic search for and appraisal of the best evidence for making clinical and administrative decisions were essential for each evidence phase [34].

3.3. Procedure

The interdisciplinary task team included a physician specializing in occupational health; the occupational health clinic staff; the manager of patient transport services; quality outcomes department staff; and nurses from the employee health service, administration, and the nursing units. Patient or staff identifiers were omitted from all gathered data, and only aggregate data were reported. Patients and nurses voluntarily completed the surveys; participation was optional.

The study design was flexible because the preceding and subsequent phases influenced and affected decisions that were made. The evidence questions required collecting and examining data, and outcomes for each phase determined to some extent the study methods for the next phase. Consequently, the procedures for each evidence phase are described in the results section of this paper, which is a departure from the usual research reporting process.

3.4. Analysis

In all evidence phases, we used descriptive data, including percentages, measures of central tendency, and visual displays to facilitate decision-making. In the evidence-supported phase, the analysis of the literature was part of the results, rather than part of a literature review as the goal was to develop a lifting intervention that was based on the best available evidence.

The selection of task team members with expertise in occupational injuries and with current lifting practices enhanced the credibility of the evidence gathering and interpretation of the data. Frontline nursing staff may have more readily accepted the lifting intervention because of staff nurse membership on the task team. In addition, experts in quality improvement were included on the team to assist with designing measurement processes and tools to gather key information. Due to the complexity of the lifting issue and the questions embedded in each evidence phase, triangulation of data from multiple sources enhanced the ability to confirm conclusions made from the data, and prevented bias or early adoption of an incomplete intervention [43,48].

NMMC's planning committee members served as independent examiners who reviewed the data to ensure the team's interpretation was supportive of the team's recommendations [33]. The ability of the task team at the end of the study to recommend to the planning committee members that the lifting intervention be applied to all nursing units was dependent on the evidence that the results from the pilot units and units where implemented would transfer to other contexts.

4. Results for each evidence phase and answers to study questions

4.1. Evidence-triggered

What is the internal and external evidence that would trigger a change in staff nurses' use of manual patient lifting and transferring?

The NMMC's employee health service and human resource department, as well as the Minnesota Nurses Association (MNA), were primary sources of information needed to determine if patient lifting was an issue. For 2001, the average age was 43 and 45 years respectively for NMMC and Minnesota nurses, which indicated nurses at NMMC were similar in regards to age of nurses in the US. Because the average age of NMMC nurses reflected the national trend of aging nurses, this data alone suggested that work redesign was probably necessary to accommodate an older workforce.

In 2000, the injuries resulting from nurses transferring and positioning patients accounted for 58% ($n = 79$) of all stress-related back injuries at NMMC. The total number of injuries from nurses handling and moving patients was 73 in 2000 and was 74 in 2001. The orthopedic unit in 2001 had the highest lifting-related injury rate, with 2.3 injuries per 100,000 hours worked. Specifically, the orthopedic staff reported 18 lift-related injuries, which was a significant increase from the five injuries reported in 2000. In contrast, the other 22 nursing units, including the neurology unit, had an average of 3 injuries per unit.

Because the injury rate was substantially higher on the orthopedic unit, orthopedic nurses ($n = 8$) who resigned during 2001 and 2002 were interviewed to determine if a relationship existed between their leaving and patient lifting. An interdisciplinary task team member, who was not a staff nurse, interviewed the nurses, categorized the data into themes, and found that routine heavy lifting was a main consideration for the nurses' decision to resign [32].

The Occupational Safety and Health Administration (OSHA) proposed Ergonomics Program Standard linked musculoskeletal disorders with workplace exposure and therefore served as an external trigger for change [28]. At the public hearings in Washington, D.C. for this proposal, the president of the ANA indicated that between 1990 and 1994, many healthcare institutions increased the number of patients assigned per nurse in order to decrease the costs of hospitalization [14]. The consequence of the staff reductions was a dramatic increase in work-related injuries for nurses. Because the internal and external evidence triggers were impressive, we made the decision that a lifting intervention should be developed and tested to preserve the health of the nursing staff at NMMC.

4.2. Evidence-supported

What are the evidence-supported elements for a new lifting intervention and how should the lifting intervention be implemented?

4.2.1. Evidence for selecting and designing lifting intervention components

We searched the literature of health and evidence-based practice databases, reviewed references of pertinent literature we found, and examined health-related and governmental web sites. The total yield from searching was 63 intervention articles in which 30 were used during this evidence-supported phase. The web site searches led us to review ergonomic equipment, a resource guide, and a position paper on the nursing shortage that addressed job-related-injuries [17,28]. Approximately 40% of the articles were research studies, testing different types of educational programs and their potential benefit for reducing back or other lift-related injuries. Nine studies described the effects of a lift team on patient and staff outcomes [4–11,18]. Five research studies and four non-research papers examined the benefits of using lifting aids [1,8,19–21,23–25, 29].

4.2.2. Lifting education

The initial education studies repeatedly demonstrated that education alone does not change work-related injury rates [16,24,27,30]. Studies of nursing practice show that it is often impossible to lift and transfer within ergonomic recommendations while providing direct patient care [22]. Ill patients often cannot assist or cooperate with transferring or moving, which adds significantly to the physical burden of the task.

Education has shown some benefit when exercise training, practice opportunities, and lifting equipment were components of the training [2,3,12,13,15,25,26]. A survey that we administered at NMMC demonstrated that the orthopedic, medical, and surgical nurses thought education on patient lifting was unnecessary, and 34% ($n = 38$) of the respondents did not want any education. In addition, 95% of the nurses reported that they had received training on lifting techniques during their career. However, 71% of nurses indicated they have had a lifting-related injury. The survey results implied that before nurses are convinced an educational program is necessary, this type of education should provide added value to nursing work and should be more helpful in preventing injuries.

Data gathered from other community hospitals ($n = 13$), indicated that education on patient lifting most often included a brief presentation in general hospital orientation classes for all new employees, or was part of a back-to-work program after injury. Only one hospital had a lift team, in which lifting education was a strong component of the team's orientation and competency program. In another area hospital, there was a competency-based training program that included basic patient transfer and moving principles, general lifting guidelines, contraindications for using a transfer belt for moving patients, and use of equipment.

The occupational health clinic staff on the interdisciplinary task team designed an educational program that combined the best elements delineated in the literature and in the phone survey [14,24]. A three-and-a-half hour "back school" for the orthopedic and neurology nursing staff was developed as part of the lifting intervention. The back school curriculum included information on the anatomy of the spine, back injuries, exercises, lifting techniques, and instructions on using lifting equipment (see Table 1). The nurses were provided with continuing education credits to reflect the importance of the class and as a benefit for attending.

4.2.3. Lift teams

Another intervention to prevent injury assumes that patient lifting and transfer is a specialized skill, which professional patient movers on a lift team should perform [7]. Lift team members are specifically screened, trained, equipped and dispatched throughout an organization to assist with patient lifts, freeing nurses to provide patient care [18]. Lift teams are effective in decreasing injuries and their costs, improving staff and patient satisfaction, and removing the majority of lifting tasks from staff nurses' daily practice [4–11,18]. Charney found a 69% reduction in lifting-related injuries in ten hospitals after implementing lift teams [7].

Based on task team analyses of observations of a lift team implemented in a neighboring hospital, we believed success of the lift team was due to the institution selecting and training team members and making the lifters consistently available. The hospital we observed had a central dispatch process, through which requests for assistance were relayed to the lift team to help nurses on units throughout the hospital who needed lifting assistance.

Based on the evidence, the task team made a decision to implement a lift team at NMMC, composed of male or female nursing assistants who used lifting aids and who were readily available to lift patients [4,5]. Applicants had to be free from previous back injuries, physically fit, normal in strength and range of motion, good communicators, and in favor of the program [24]. The employee health service and the occupational health clinic were to assess the applicant's physical health and lifting abilities, and team members were to attend the newly created back school as a part of their orientation.

Table 1
Back School Curriculum

Topics	Description
Spinal Anatomy and Mechanics	– Basic anatomy – Physiology of the disc – Forward flexion and relationship with injury
Causes of Back Injury	– Poor Posture and physical fitness – Improper body mechanics – Stress
Prevention of Back Injury	– Postural corrections and appropriate lifting positions – Appropriate lifting techniques – Use of proper equipment – Preparation of the environment for lifting – Communication with the patient
Back Care Exercises	– Stretching exercises – Strengthening exercises – Posters displays to remind lifters and nursing staff to exercise before lifting
Demonstration of Transfer Techniques	– Lifting techniques demonstrated with transfer equipment. – Demonstrated Transfers: repositioning in bed; supine to sitting; bed to chair, cart, cardiac chair; and total lift. – Each participant expected to demonstrate safe technique to "pass" the class and receive continuing education credit

The interdisciplinary team recommended that a pilot be conducted to test the feasibility of the team prior to hiring a permanent lift team.

4.2.4. Lifting equipment

Lifting equipment can be effective in decreasing injuries, but the equipment is unavailable or underutilized. Issues affecting the use of lifting equipment include patient acuity, time pressures, and poor training on using the equipment [24]. The interdisciplinary task team reviewed the available lifting equipment and found that many nurses did not know that equipment was already on their units. The team also brought in new equipment for nursing staff to evaluate during the hospital's "equipment or learning fairs." At the fairs, nurses used the equipment, and then recorded their evaluations regarding the equipment's ease of use and comfort, their ability to use the equipment with one or two staff members, and whether they would actually use the lifting equipment on their unit. Nursing staff's evaluations were important in determining the need for additional equipment [24].

4.2.5. The final lifting intervention solution

The interdisciplinary team determined there was enough evidence to support testing a lifting intervention that included a lift team, a back school for the nursing staff and the lift team members, and the use of lifting equipment. Each nurse at risk for injury was given a personal transfer belt to use when assisting patients in transferring activities. Units share the larger lifting equipment, such as the full body sling lifts and transfer chairs. Better locations were found to store equipment that would facilitate its use. Air assisted lateral sliding aids and sit-to- stand equipment were newly purchased [19,24]. The lift team was given responsibility for the lift equipment in order to ensure the equipment's use.

The back school was implemented for the orthopedic and neurology units in April 2002. Prior to implementing the permanent lift team in August 2002, an eight-day pilot on the orthopedic and neurology units tested the feasibility in terms of productivity for implementing a lift team. Volunteer nursing assistants worked four-hour shifts from 10:30 A.M. to 2:30 P.M. as lift team members after they attended the back school. The patient transport department dispatched the lift team during the pilot using the same process, as did the lift team we observed during the site visit. The lift team members recorded information on tracking forms about the patient lifts they completed. A secretary entered the lift information manually into a database.

4.3. Evidence-observed

What evidence of effectiveness will be observed following implementation of a new lifting intervention?

The nursing assistants completed 51 lifts primarily on the orthopedic and neurology units, totaling 88 lifts over an 8-day period ($n = 32$ hours). This equated to approximately 22 lifts in 8-hours. According to the literature, the number of scheduled lifts that lift teams

can complete ranges from 29–70 lifts per day, with some teams reporting 24 lifts per 8 hours [24]. Because the lift team feasibility pilot was successful, it was decided to implement the permanent lift team solution for the orthopedic and the neurology units. Permanent lift team members began their work in August 2002.

The evaluation outcomes for the full implementation of the lifting intervention on the two units included: a) before and after measures of lifting-related injuries and of salary and replacement costs for staff who were unable to work because of a lifting-related injury, b) use of effective lifting principles before and after the back school, and c) nursing staff and patient satisfaction with the lift team [24]. Process measures included the average number of lifts the lift team completed in an eight-hour shift, the number of shifts without a lift team, and the percent of nursing staff completing the back school. These process measures helped to ensure the lifting intervention was consistently implemented, thereby increasing confidence that the outcomes were attributable to the intervention.

4.3.1. Work-related injuries/associated costs

In examining the injury rates for 2000, 2001, and 2002 for the orthopedic and neurology units, a dramatic increase in injuries occurred in 2001 followed by a decline in 2002. The orthopedic unit had the majority of the injuries in 2001, and while fewer injuries occurred in 2002, the number of injuries was still higher than in 2000. However, when examining the injuries that occurred in 2002, six were reported before staff had completed the back school, and seven occurred before the implementation of the lift team. Only two injuries were reported from August–December 2002, which represents a substantial improvement from the previous year. In 2001, the orthopedic and neurology units' replacement and salary cost for staff unable to work due to a work-related injury were $48,220 and in 2002 the cost declined to $2,560.

4.3.2. Use of lifting techniques pre- and post-back school implementation

The occupational health clinic staff observed staff on the orthopedic and neurology units pre- and post-implementation of the back school that focused on staff: a) availability to help lift and ability to use the lifting equipment, b) preparation for and use of appropriate lifting techniques, c) engagement in prolonged posturing or repetitive motion during nursing activities, including lifting, and d) difficulty in moving during patient care activities because of space limitations. The observers watched staff complete bedside care activities, including lifting and transferring techniques, one month before the back school and three months after 75% of staff on the two units had completed the school.

Substantial improvements were seen for both nursing units in all observational categories (see Table 2). The task team recognized, however, that duration of the improvements was not known, and repeated education may be needed. Additionally, the validity of their observations depended on the specific staff members working on the units, the workload of the units, the presence of the observers, and the observers not being blinded to whether the intervention observations were pre- or post-intervention implementation. The occupational clinic staff may have unintentionally looked for more negative behaviors prior to and more positive behaviors after the back school.

4.3.3. Patient and staff satisfaction

Patient and nursing satisfaction was obtained through a "report card" type survey that used 4-point Likert scales, and measured team members' explanations and performance, and efficiency of team members, respectively [40]. The surveys were tested with 3 patients and 3 nurses to determine clarity of the directions, of the questions, and of the stems and anchors for the scales. The satisfaction ratings of the patients and nurses were positive. The patients ($n = 65$) believed that the lifting procedures were well explained ($M = 3.6$, $SD = 0.7$) and that the lift team members were gentle ($M = 3.6$, $SD = 0.577$). The nurses ($n = 69$) thought the lift team members were prompt in responding to their lifting requests ($M = 3.6$, $SD = 0.707$), and that having the lift team saved them time ($M = 3.7$, $SD = 0.657$).

4.3.4. Process measures indicating the strength of the intervention

Following the eight-day pilot, the interdisciplinary team decided to eliminate the patient transport service as the "middle man" for the communication process, due to a substantial number of calls that resulted in delayed response times. Instead, nurses paged the lift team directly through a beeper system and the lift team members recorded prospectively information about the lifts into handheld computers. The Palm Vx handheld computers were used with a Pendragon forms application (Version 3.1) for recording unit, time of the call, time the lift was started and completed, the lifting equipment used, type of lift and the name of the lift team members [46,47].

Table 2
Ergonomics observations pre- and post-Back School for the Orthopedic and Neurology Nursing Units

Pre Back School observations	3 Months Post Back School observations
Availability of staff assistance and use of lifting equipment	
– Cardiac Chairs not readily available	– Cardiac chairs on the unit
– Transfer aids rarely used: Staff not using transfer belts, vertical lifts and lateral transfer equipment.	– Observed 4 out of 5 staff using transfer belts
	– Observed lateral transfer equipment being used correctly
– Some staff unfamiliar with how to use lifting equipment on the unit.	– Observed staff calling the lift team and using the equipment
– Staff completing lifts with out help	– Staff waiting for help telling each other to "save your back"
Site preparation prior to lifting and use of appropriate lifting techniques	
– Area was not prepared (e.g. phone, call lights, furniture in the way)	– Staff preparing the room for the activity that is needed.
– Water spill on floor not cleaned up	– Observed staff using techniques for lifting, moving, and handling of patients
– Staff rarely raised the bed to reposition patient or provide cares except during bathing.	– Observed staff providing care with bed at appropriate heights
Prolonged posturing and repetitive movements during lifting	
– Staff on feet continually except for breaks	– Staff are not doing stretches but stated they see the lift team frequently doing them
– Significant amount of walking down long halls	– Could use posters showing stretches
– Staff reaching and pulling	– Staff observed sitting more between activities
Space constraints	
– Patient rooms cluttered	– Reduction in patient room clutter
– Unused equipment left in the rooms taking up needed space.	– Staff observed moving furniture before taking patient to the bathroom.

As the lift team gained proficiency, the number of lifts per day increased. The average number of lifts was initially 40, increased in October to 60 lifts, and by the end of the project were approximately 80 lifts per day (Fig. 1). This data represents a high functioning lift team [24]. A creative scheduling process allowed nursing assistants to work five out of ten days on the lift team and five days on an inpatient unit. At the end of December 2002, 95% of the orthopedic and neurology nursing staff had attended the back school. The number of lifts per day, lift team coverage, and back school attendance indicated the intervention was consistently implemented. As a result, the interdisciplinary task team had confidence in attributing the positive outcomes to the lifting intervention.

4.4. Evidence-based

What evidence for continued improvement exits for the lifting intervention?

Because of the success of the lifting intervention, the interdisciplinary task team plans to initiate the back school for all current nursing staff and for new employees. The back school was decreased from 3 1/2 to 2 1/2 hours due to cost and the difficulty staff had in being away from their respective nursing units. Before purchasing lifting equipment, the nursing staff, occupational health department, and the lift team tests the equipment under realistic conditions, and if purchased, the skills to use the equipment are added to the back school.

Since the end of the study, a 50% turnover of the lift team staff has occurred in part due to scheduling and unresolved operational issues. The expansion of the lift team to 24 hours a day may improve scheduling, so that traditional shift times can be offered instead of requiring lift team members to work the unpopular 12:00 A.M.–9:00 P.M. shift. Also, the lift team having monthly meetings with administration have been added to discuss concerns. Through these meetings, we learned that the lift team members were having substantial difficulty operating the handheld computers and the beeper system. Additional education and a mandatory competency for the equipment were developed. A new supervisor position was created to assume responsibility for continued development of the lift team members.

We have observed a positive change in the attitude of the nursing staff who were resistant to change. These nurses are now planning ahead and calling the lift team for assistance. An assessment tool has been added to the nursing admission database to provide a trigger for the admission nurse to assess the patient's level of mobility and to develop a lift plan based on that assessment.

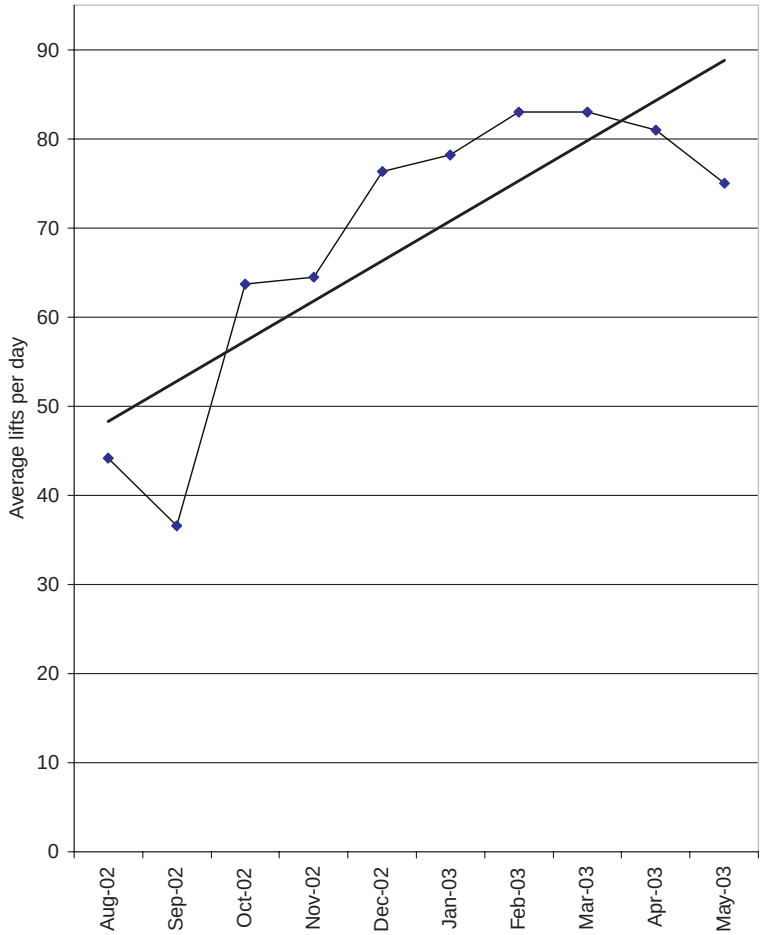

Fig. 1. The Lift Teams average number of lifts per day: Study data August 2002 through December 2002, continuous quality improvement data February 2003 through May 2003.

An ergonomics committee is being formed to develop a zero-lift philosophy for the organization. A zero-lift concept means there will be organizational resources designated for work redesign that incorporates the latest equipment so expectations that staff avoid manual patient handling during repositioning, transferring or lifting patients is realistic [24]. The lift team has become a valuable asset to NMMC. Although there continues to be minor problems, the nurses have stated they do not want to be without the aid of the lift team. The positive results also indicated the evidence-based process was effective in ensuring best practice informed all decision-making. Future evidence-based effectiveness studies are needed to examine the outcomes of a proposed no-lift organizational philosophy.

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References

[1] F. Bell, Ergonomic aspects of equipment...patient lifting devices, *International Journal of Nursing Studies* **24**(4) (1987), 339–344.

[2] N. Bewick and D. Gardner, Manual handling injuries in health care workers, *International Journal of Occupational Safety and Ergonomics* **6** (2000), 209–221.

[3] B.O. Brophy, L. Achimore and J. Moore-Dawson, Reducing incidence of low back injuries reduces cost, *AIHAJ* **62** (2002), 508–511.

[4] B.A. Caska, R.E. Patnode and D. Clickner, Feasibility of a nurse staffed lift team, *AAOHN Journal* **46**(6) (1998), 283–288.
[5] B.A. Caska, R.e. Patnode and D. Clickner, Implementing and using a nurse staffed lift team: Preliminary findings, *AAOHN Journal* **20**(2) (2000), 42–45, 48.
[6] W. Charney, The lifting team: Second year data reported (News), *AAOHN Journal* **40**(10) (1992), 503.
[7] W. Charney, The lift team method for reducing back injuries: A 10 hospital study, *AAOHN Journal* **45**(6) (1997), 300–304.
[8] W. Charney, Reducing back injury in nursing: A case study using mechanical equipment and a hospital transport team as a lift team, *Journal of Healthcare Safety, Compliance, and Infection Control* **4**(3) (2000), 1–4.
[9] W. Charney, K. Zimmerman and E. Walara, The lifting team: A design method to reduce lost time back injury in nursing, *AAOHN Journal* **39**(5) (1991), 231–234.
[10] A. Davis, Birth of a lift team: Experience and statistical analysis, *Journal of Healthcare Safety, Compliance, and Infection Control* **5**(1) (2001), 15–18.
[11] A.W. Donaldson, Lift team intervention: a six-year picture, *Journal of Healthcare Safety, Compliance and Infection Control* **4**(2) (2000), 65–68.
[12] B.A. Evanoff, P.C. Bohr and L.D. Wolf, Effects of a participatory ergonomics team among hospital orderlies, *American Journal of Industrial Medicine* **35** (1999), 358–365.
[13] A. Feldstein, B. Valanis, W. Vollmer, N. Stevens and C. Overton, The back injury prevention project pilot study: assessing the effectiveness of Back Attack, an injury prevention program among nurses, aides, and orderlies, *Journal of Occupational Medicine* **35** (1993), 114–120.
[14] M. Foley, *Testimony of the American Nurses Association on OSHA's Proposed Ergonomics Standard Online*, Available: http//:www.nursingworld.org/gova/federal/legis, Accessed 2001.
[15] A. Gundewall, M. Liljeqvist and T. Hansson, Primary prevention of back symptoms and absence from work: a prospective randomized study among hospital employees, *Spine* **18** (1993), 587–594.
[16] J. Harvey, Back to the drawing board: Training in correct lifting techniques may even increase the amount of back injury, *Nursing Times* **83**(7) (1987), 47–48.
[17] Joint Commission on Accreditation of Healthcare Organization, Health care at the Crossroads, Strategies for Addressing the Evolving Nursing Crisis Online, Available: http://www.jcaho.org, Assessed 2003.
[18] E.J. Meittunen, K. Matzke, H. McCormack and S.C. Soczak, The effect of focusing ergonomic risk factors on a patient transfer team to reduce incidents among nurses associated with patient care, *Journal of Healthcare Safety, Compliance, and Infection Control* **3**(7) (1999), 306–312.
[19] A. Nelson, B. Owen, J. Lloyd, G. Fragala, m. Amato, J. Bowers, S. Moss-Cureton, G. Ramsey and K. Lentz, Safe Patient Handling Movement, *American Journal of Nursing* **103**(3) (2003), 32–43.
[20] B.D. Owen, Preventing injuries using an ergonomic approach, *AORN Journal* **72** (2000), 1031–1036.
[21] B. Owen and A. Garg, Assistive devices for use with patient handling tasks, in: *Advances in Industrial Ergonomics and Safety*, B. Das, ed., Taylor & Frances, Philadelphia PA, 1990.
[22] B.D. Owen and A. Garg, Reducing risk for back pain in nursing personnel, *AAOHN Journal* **39**(1) (1991), 24–33.
[23] B.D. Owen, K. Keene and S. Olson, An ergonomic approach to reducing back/shoulder stress in hospital nursing personnel: a five year follow up, *International Journal of Nursing Studies* **39** (2002), 295–302.
[24] Patient Safety Center of Inquiry, Patient care ergonomics resource guide: Safe patient handling and movement, *Veterans Health Administration and Department of Defense*, Tampa, Florida, 2001, 1–124.
[25] A. Prezant, P. Demers and K. Strand, Back problems, training experience and use of lifting aids among nurses, *Trends in Ergonomics/Human Factors* **4** (2000), 839.
[26] R.J. Schenk, R.L. Doran and J.J. Stachura, Learning effects of a back education program, *Spine* **21** (1996), 2183–2189.
[27] M.St. Vincent and C. Tellier, Training in handling: An evaluative study, *Ergonomics* **32**(2) (1989), 191–210.
[28] U.S. Department of Labor, Occupational Safety & Health Administration, Ergonomics Program Standard, Notice of proposed rulemaking, Online, Available: http://www.osha.gov/Reduction_Act/FINAL_ERGWINITIAL.html, Accessed 2003.
[29] J.T. Wassell, I. Lytt, L.I. Gardner, D.P. Landsittel, J.J. Johnston and J.M. Johnston, A prospective study of back belts for prevention of back pain and injury, *Journal of American Medical Association* **284**(21), Online, Available: httpa;//www.cdc.gov/niosh/jamapapr.html, Assessed 2001.
[30] M. Zachrisson-Forssell, The Back School, *Spine* **6** (1981), 104–106.
[31] American Nurses Association, On-line Health and Safety Survey, *Nursing World, Org, Official Website of the American Nurses Association*, September 2001.
[32] J.C. Boyle, Styles of ethnography, in: *Critical issues in qualitative research methods*, J.M. Morse, ed., Sage, London, 1994
[33] M. Byrne, Evaluating the findings of qualitative research, *AORN Journal* **73**(3) (2001), 703 704, 706.
[34] Carnwell, Ros, Essential differences between research and evidence-based practice, *Nurse Researcher* **8**(2) (2000), 55–68.
[35] L.H. Daltroy, M.D. Iversen, M.G. Larson, R. Lew, E. Wright, J. Ryan, C. Zwerling, A.H. Fossel and M.H. Liang, A controlled trial of an educational program to prevent low back injuries, *New England Journal of Medicine* **337** (1997), 322–328.
[36] D. Daynard, A. Yassi, J.E. Cooper, R. Tate, R. Norman and R. Wells, Biomechanical analysis of peak and cumulative spinal loads during simulated patient-handling activities: a substudy of a randomized controlled trial to prevent lift and transfer injury of health care workers, *Applied Ergonomics* **32** (2001), 199–214.
[37] P. Harber, L. Peña, P. Hsu, E. Billet, D. Greer and K. Kim, Personal history, training, and worksite as predictors of back pain in nurses, *American Journal of Industrial Medicine* **25** (1994), 519–526.
[38] P.D. Hart, The nurse shortage: Perspectives from current direct care nurses and former direct care nurses, *Healthwire* (July/August, 2001), 1–6.
[39] M. Lagerstrom and M. Hagberg, Evaluation of a 3 year education and training program for nursing personnel at a Swedish hospital, *AAOHN* **45** (1997), 83–92.
[40] W. Leebov and C.J. Ersoz, *The health care manager's guide to continuous quality Improvement*, American Hospital Publishing, Chicago, IL, 1991.
[41] R.M. Lynch and A. Freund, Short-term efficacy of back injury intervention project for patient care providers at one hospital, *AIHAJ* **61** (2000), 290–294.
[42] E.S. McConnell, Conceptual bases for gerontological nursing practice: Models, trends and issues, in: *Gerontological Nurs-*

ing, M.A. Matterson, E.S. McConnell and A.D. Linton, W.B. Saunders, Philadelphia, 1997.
[43] J.M. Morse, Approaches to qualitative-quantitative methodological triangulation, *Nursing Research* **40**(1) (1991), 120–123.
[44] J. Needleman, P. Buerhaus, S. Mattke, M. Stewart and K. Zelevinsky, Nurse-Staffing Levels and the Quality of Care in Hospitals, *New England Journal of Medicine* **346** (2002), 1715–1722.
[45] A. Nelson, G. Fragala and N. Menzel, Myths and Facts About Back Injuries in Nursing, *American Journal of Nursing* **103**(2) (2003), 32–41.
[46] Palm Handhelds, Online, Available: http//www.palms.com, accessed 2002.
[47] Pendragon Software Corporation, Online, Available: http://www.pendragonsoftware.com, accessed 2002.
[48] M. Sandelowski, Focus on Research Methods: Combining Qualitative and Quantitative Sampling, Data collection, and Analysis Techniques in Mixed-Method Studies, *Research in Nursing and Health* **23** (2000), 246–255.
[49] M. Scopa, Comparison of classroom instruction and independent study in body mechanics, *Journal of Continuing Education in Nursing* **24** (1993), 170–173.
[50] S.H. Snook, R.A. Campanelli and J.W. Hart, A study of three preventative approaches to low back injury, *Journal of Occupational Medicine* **20** (1978), 478–481.
[51] Soukup, M. Sister, The Center for Advanced Nursing Practice Evidence-Based Practice Model, Evidence-Based Nursing Practice, *Nursing Clinics of North America* **35**(2) (2000).
[52] R. Steinbrook, Nursing in the Crossfire, Health Policy Report, *New England Journal of Medicine* **346**(22) (2002), 1757–1766.
[53] C.B. Stetler, M. Brunnell, K.K. Giuliano, D. Morsi, L. Prince and V. Newell-Stokes, Evidence based practice and the role of nursing leadership, *Journal of Nursing Administration* **28**(7 8) (1998a), 45–53.
[54] T. Videman, H. Rauhala, S. Asp, K. Lindström, G. Cedercreutz, M. Kämppi, S. Tola and J.D.G. Troup, Patient-handling skill, back injuries, and back pain: an intervention study in nursing, *Spine* **14** (1989), 148–156.
[55] Yassi, J.E. Cooper, R.B. Tate, S. Gerlach, M. Muir, J. Trottier and K. Massey, A randomized controlled trial to prevent patient lift and transfer injuries of health care workers, *Spine* **26** (2001), 1739–1746.

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