

Objective Measures of Adoption of Patient Lift and Transfer Devices to Reduce Nursing Staff Injuries in the Hospital Setting

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Background *Interventions to reduce patient-handling injuries in the hospital setting are often evaluated based on their effect on outcomes such as injury rates. Measuring intervention adoption could address how and why observed trends in the outcome occurred.*

Methods *Unit-level data related to adoption of patient lift equipment were systematically collected at several points in time over 5 years on nursing units at two hospitals, including hours of lift equipment use, equipment accessibility, and supply purchases and availability.*

Results *Various measures of adoption highlighted the adoption process' gradual nature and variability by hospital and between units. No single measure adequately assessed adoption. Certain measures appear well-correlated.*

Conclusion *Future evaluation of primary preventive efforts designed to prevent patient-handling injuries would be strengthened by objective data on intermediate measures that reflect intervention implementation and adoption.* Am. J. Ind. Med. 54:935–945, 2011. © 2011 Wiley Periodicals, Inc.

KEY WORDS: *mechanical lift equipment; patient handling; occupational injury prevention; intervention; adoption*

BACKGROUND

Patient care requires the moving, assisting, and repositioning of patients for many health care providers including nurses, nurses' aides, physical and occupational therapists, radiology technologists, and others. These activities are responsible for a considerable burden of occupational injury—particularly musculoskeletal disorders—in the health care industry [Engkvist et al., 2000; Goldman et al., 2000; Retsas and Pinikahana, 2000; Trinkoff et al., 2003; Byrns et al., 2004; Engkvist, 2007; Pompeii et al., 2008, 2009; Rodriguez-Acosta et al., 2009].

Over the past two decades, numerous studies [Garg et al., 1991a,b; Winkelmoen et al., 1994; Marras et al., 1999; Nelson and Fragala, 2004; Jang et al., 2007; Waters, 2007; Skotte and Fallentin, 2008] have documented the high biomechanical stress of manually handling patients.

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Substantial compressive forces result from common patient-handling activities [Garg et al., 1991a,b; Jang et al. 2007], and static compressive spinal loads can be considerably higher than recommended levels set by the National Institute for Occupational Safety and Health [National Institute for Occupational Safety and Health, 1981; Waters, 2007]. Even the “safest” tasks and manual transfer methods have significant biomechanical risk involved [Marras et al., 1999].

Growing appreciation for the biomechanical risk imposed by patient-handling activities has led to the development of equipment and assistive devices designed to reduce the physical load of patient-handling tasks to the health care provider [LeBon and Forrester, 1997; Zhuang et al., 1999, 2000; Keir and MacDonell, 2004; Baptiste et al., 2006; Lloyd and Baptiste, 2006; Pellino et al., 2006; Rice et al., 2009] and policies to support their use [Hudson, 2005; Nelson et al., 2007]. There is evidence that implementing mechanical lift and transfer equipment can reduce musculoskeletal injuries and associated costs, though most of these prevention efforts have focused on long-term care settings [Brophy et al., 2001; Evanoff et al., 2003; Collins et al., 2004; Chhokar et al., 2005; Engst et al., 2005; Miller et al., 2006; Alamgir et al., 2008; Park et al., 2009]. Challenges faced by staff in the acute care hospital setting are different in a number of ways that might influence the implementation and adoption of lift equipment: more rapid patient turnover, abrupt and unanticipated changes in patient acuity, and variable patient populations across units (e.g., geriatric, surgical, maternity).

Several studies have observed that mechanical lifts are not regularly used in patient care tasks, [Evanoff et al., 2003; Byrns et al., 2004; Li et al., 2004; Engkvist, 2005, 2007; Wardell, 2007]. Common obstacles indicated by patient care staff include lack of equipment availability, accessibility difficulties, lack of training, time constraints, lack of perceived need, and patient-related factors (e.g., lack of comfort/security, health condition precluding safe lift use). Details of the intervention implementation process and assessment of the impact of barriers and facilitators on intervention effectiveness (and guidance in how to do so) are lacking in the current literature [Roen et al., 2006; Koppelaar et al., 2009]. Initial steps proposed by Koppelaar et al. (2009) consist of assessment of implementation quality, with quantification of specific factors related to implementation. In addition, objectively measuring adoption of an intervention's components would further strengthen evaluations of primary preventive efforts designed to prevent patient-handling injuries by providing measures of intervention fidelity.

The purpose of this report is to describe measures of several aspects of the implementation and adoption of

patient lift equipment at a medical center and community hospital over a 5-year period following the introduction of a policy calling for a “minimal-manual lift environment” on inpatient care units. This research falls under the scope of a larger study designed to evaluate the adoption of the patient lift and transfer equipment and its effectiveness at preventing patient-handling injuries among patient care staff in the acute care hospital setting.

Study Setting, Intervention, and Historical Context

This study was conducted in a large tertiary-care medical center and an affiliated community hospital within a university-based health care system in North Carolina. In October of 2004, the medical center implemented a “minimal-manual lift environment” (MMLE) policy on its inpatient nursing units; the policy was adopted by the community hospital in January 2005. The purpose of the policy was “to provide for the safety of patients and staff during all patient-handling tasks and movements,” “to provide minimal manual lifting of patients” within the hospital setting, and “to reduce the work intensity involved with handling or lifting patients” [Duke University Hospital, 2004]. Lift equipment and transfer devices were purchased for and implemented on inpatient units.

Ergonomists from the university Occupational and Environmental Safety Office (OESO) began working with inpatient nursing staff surrounding patient-handling concerns several years earlier. An official nursing ergonomics committee of direct care nurses, nurses' aides, and a patient care ergonomist was formed in the summer of 2001 at the medical center and met monthly to seek solutions to patient-handling challenges. Prior to the 2004 MMLE policy, this committee was instrumental in promoting low technology solutions, such as friction-reducing devices for transfers and repositioning, gait belts and Trendelenberg positioning of beds.

As part of an effort to improve patient satisfaction, several pieces of lift equipment, including a powered portable full-body sling lift, a powered portable stand-assist lift, a non-powered portable stand-assist device, a powered ceiling-mounted full-body sling lift, an air-assisted lateral transfer device and friction-reducing plastic liners were trialed during a 3-month pilot study on one medical center unit in the fall of 2003. Positive feedback from staff on the unit, encouragement from the ergonomics staff, and interest from other nursing staff led to immediate purchase of equipment for this unit and the pilot study's comparison unit. Soon after, the chief nursing officer decided to purchase equipment on a more wide-spread basis and initiate the MMLE at the medical center.

After the pilot study at the medical center, the community hospital began to purchase lift and transfer equipment as well. They adopted the MMLE policy in early 2005 and conducted a successful pilot study on their oncology/neurology unit before deciding to implement equipment hospital-wide.

Implementation Plan

Equipment selection and roll-out

Nursing unit managers individually selected pieces of mechanical lift equipment for their units through an equipment vendor identified by the hospital's ergonomics group. The hospital capital budget paid for these initial 54 pieces of equipment, which were implemented in 21 inpatient nursing units and the physical and occupational therapy (PT/OT) unit at the medical center between October 2004 and May 2005. At the community hospital, 19 pieces of lift equipment went to seven inpatient units, the PT/OT unit, the radiology department and the emergency department between August 2005 and July 2006. Both hospitals established contracts with vendors of bariatric equipment, allowing rapid delivery of oversized equipment, such as beds, lifts, chairs, and bedside commodes.

Staff training

A train-the-trainer approach was used to support the instruction of nursing staff on each unit in safe use of equipment as well as orientation to the MMLE policy. Staff members on each unit, including RNs, LPNs, and nurses' aides, were trained to be "coaches" (range, 1–11 coaches per unit). Before being approved to train fellow staff, coaches attended an 8-hr training session designed by the equipment vendor to cover topics such as risks associated with patient-handling, problem solving discussions, equipment use and maintenance (e.g., changing batteries, cleaning equipment), and tips for "coaching" unit staff. Hands-on practice on each piece of equipment was followed by return-demonstration of competency. The Ergonomics Division in the Occupational and Environmental Safety Office at the University Hospital provided coaches with information on MMLE policy guidelines, important contacts (e.g., for supply re-ordering, equipment maintenance), and lift equipment/supply locations.

The Education Services Department in the University Health System provided coaches with forms on which performance expectations were defined and assessments could be captured for each staff member on their unit. Staff members were instructed not to use the equipment until they had received instruction and demonstrated correct use

to the coach, at which time an equipment competency form was placed in their personnel folder.

Promotion of effort and support

Nurse managers and educators were encouraged by hospital ergonomists and nursing administration to promote the MMLE program on their unit, and details of the promotion efforts were left up to each unit manager. Common venues for promotion by unit managers, often through coaches, included unit-level staff meetings and annual skills days. Annual coaches' conferences, beginning in 2007, recognize and support front-line staff involved in program implementation at both hospitals and provide a continuing education opportunity for patient care staff in the university health care system. The conferences, which have been organized by the OESO ergonomists and financially supported through nursing administration, have featured internationally recognized speakers and vendor demonstrations, and they have drawn attendees from NC and adjacent states.

At the medical center, OESO ergonomists organized equipment roll-out efforts and were available for program support. Two ergonomists, one part-time and one full-time, were devoted to patient-handling issues, making monthly visits to all of the units who had received lift equipment and communicating regularly with each unit's nurse manager to discuss and follow-up on issues related to the intervention. Several hospital-wide promotion efforts were coordinated and implemented by the OESO ergonomists and the nursing ergonomic committee, including placement of "Lift Decision Guides" on units, hospital newspaper articles, an expo to provide teaching strategies to unit nursing staff who orient new hires (began in 2005), an information booth during Nurses' Week (May 2005), a Safety Fair (October 2005), posters on units encouraging lift use and addressing relevant topics, and an MMLE Awareness Day (March 2006).

Although the implementation process at the community hospital was modeled on that at the medical center, fewer vendor hours were available for use for coach training, and the number of staff trained as coaches per unit was less than that at the medical center. Support from the ergonomics division was limited to one ergonomist with duties other than patient-handling issues. The community hospital did not have an organized nursing ergonomics committee at the time of implementation; however, they did form a "Clinical Lift Team" of several nursing managers (including a designated MMLE facilitator) and one hospital safety officer. Several obstacles to a smooth roll-out process were met, including delayed arrival of the powered portable stand-assist lifts, a lack of staff training (requiring equipment already on the units to be removed

for about a month), and interruptions in the training process due to a Joint Commission visit. Physical remodeling of several units at the community hospital resulted in movement of units to new areas during the time of equipment implementation and continuing several years after initial roll-out of the equipment. A summary of the implementation of the MMLE policy and lift equipment by hospital is provided in Table I.

METHODS

Measures of Adoption

To examine adoption of the equipment and assess the incorporation of the MMLE policy into patient care, several objective measures were captured through monthly visits to the hospital units and equipment supply purchase

TABLE I. Comparison of the Implementation of the “Minimal Manual Lift Environment” Policy and Lift Equipment by Hospital

Medical center	Community hospital
Management of patient-handling concerns prior to the intervention	
Nursing Ergonomics Committee established in 2001 and promoted low-technology solutions to address physical demands of patient-handling Pilot study of lift equipment, Fall 2003	No organized nursing ergonomics committee prior to implementation Pilot study of lift equipment, Spring 2005
MMLE policy implementation	
October 2004	January 2005
Selection and implementation of lift equipment	
Selected by nursing unit managers Implemented between Oct. 2004 and May 2005	Selected by nursing unit managers Implemented between Aug. 2005 and July 2006
Implementation support	
Patient-care ergonomist devoted full-time to MMLE implementation; additional ergonomist provided part-time support Nursing Ergonomics Committee members available to assist with MMLE promotional efforts	One ergonomist devoted part-time to MMLE implementation Clinical Lift Team formed at the time of implementation, composed of several nursing managers and the hospital safety officer
Ergonomists communicated regularly with unit managers to discuss concerns and provide recommendations Vender hours available for coach training, trouble-shooting An expo to provide MMLE-related teaching strategies to unit nursing staff who orient new hires	Relative to medical center, fewer vendor hours available for coach training, trouble-shooting Quarterly lift coach meetings
Early MMLE promotional efforts	
Development/use of “Lift Decision Guides” Hospital newspaper articles Posters on units encouraging lift use An information booth during Nurses’ Week A safety fair highlighting lift equipment An MMLE Awareness Day	Development/use of “Lift Decision Guides” Hospital newspaper articles Posters on units encouraging lift use
Staff training	
Train-the-trainer approach Relative to community hospital, more coaches per unit to train staff	Train-the-trainer approach Relative to medical center, fewer coaches per unit to train staff Staff training “blitz” efforts
Implementation obstacles	
Difficulty in movement of equipment in/out of some storage rooms; maintenance required Equipment recall required temporary removal of five in-house lifts	Delayed arrival of powered portable stand-assist lifts Lack of/interruptions in staff training required lifts to be temporarily removed from some units
Purchase of new recliner chairs for patient rooms temporarily limited use of the lift equipment (chairs altered to accommodate equipment)	Physical remodeling of several units during the intervention implementation time period

data. In addition, monthly project meetings with the hospital ergonomists involved in the implementation of the MMLE policy and lift equipment at the study hospitals provided the researchers with regular opportunities to receive updates on efforts to move the MMLE forward at both hospitals. The meetings also provided a time to ask questions related to our research efforts (e.g., important contacts, intervention details), a necessary component given the dynamic nature of both the setting and the intervention on which this research was focused.

Monthly Walk-through Assessments

Monthly walk-through assessments of units with lift equipment at both hospitals were conducted beginning in January 2006. For the first 6 months of data collection, one study researcher (AS) and one hospital ergonomist (either YY or EF) visited units together in order to allow the researcher to become familiar with the layout of the hospital and units, ask questions related to the MMLE policy and lift equipment implementation, and meet unit managers with whom the ergonomics division had a positive, long-standing relationship. After this initial time period, unit visits were made by either a study researcher or a hospital ergonomist. Study researchers (AS, HL) and an ergonomist (YY) were involved with monthly data collection at the medical center; AS and HL collected monthly unit-level data at the community hospital.

A standard 14-item form (Appendix) was used to collect data during the walk-through visits. This form was developed through collaborative efforts between study researchers and hospital ergonomists involved in the implementation of the intervention. Data were collected related to condition of the equipment storage area, availability of supplies and equipment battery charge. Equipment storage areas were categorized as “excellent” if they provided equipment accessibility and were clear of items not intended to be stored there. Disposable slings for the powered portable full-body sling lift were considered “available” if three of each size sling (M, L, XL) were in the storage area. Re-useable slings for the powered portable stand-assist lift were considered “available” if one of each size sling (M, L, XL) was in the storage area. Efforts were made to locate in-use powered portable stand-assist lift slings not in the central storage area during the visit. Battery charge (acceptable, not acceptable) was assessed for both spare and in-use batteries; spare battery charge was acceptable if batteries were properly docked in their charging station, and in-use battery charge was acceptable if the equipment’s battery charge indicator was green, indicating full or near-full charge (For equipment with a yellow or red indicator light indicating lower charge, staff had been trained to replace the in-use battery with a fully charged one).

The walk-through form also captured lift use data for the powered portable full-body sling lift and the powered portable stand-assist lift. Digital displays on each piece of lift equipment provided net hours of equipment use which were logged when the equipment was both turned on and engaged in battery-powered up-down movement of the sling bar (on the powered portable full-body sling lift) or the arm rest (on the powered portable stand-assist lift). Subtracting the net use reading in a given month from that in the previous month provided an estimate of monthly use. Prior to initiation of the monthly walk-through visits, lift use data were collected in a similar manner by hospital ergonomists beginning in July 2004 (when the first pieces of lift equipment were trialed at the medical center).

Equipment Supply Purchase Data

We examined lift equipment supply purchase data including unit-level daily purchase and return orders of disposable full-body lift slings at each hospital, as well as boxes of friction-reducing plastic liners (100 liners per box) at the medical center only.

Analyses

Data were entered, stored, and checked for accuracy in Microsoft ACCESS [Microsoft, 1997] and imported into SAS v8.2 [SAS Institute Incorporated, 1999–2001] for descriptive analyses. Linear regression models were used to describe lift equipment use over time. *T*-tests were used to compare lift equipment use (in hours) by hospital and by equipment type.

All procedures were approved by Institutional Review Board at Duke University Medical Center.

RESULTS

Monthly Walk-through Assessments

Between January 2006 and July 2009, a total of 1,282 unit walk-through assessments were conducted on 33 inpatient nursing units with lift equipment, averaging 39 observations per unit. Fewer months of data were collected per unit at the community hospital where lift equipment was implemented later than the medical center.

An increase in the proportion of “excellent” storage areas was seen over time at the medical center; considerable variability was observed at the community hospital (Fig. 1a). At the medical center, improvements to storage areas over time included labeled supply bins/shelves, door/wall hooks for non-disposable slings, and easily visible ordering, laundering, and maintenance contact information. Also, many units installed holders for the

canisters of germicidal disinfecting wipes used to clean equipment.

Considerable variability was observed between hospitals in terms of availability and accessibility of friction-

reducing plastic liners on the units (Fig. 1b). At the medical center, these low-tech devices were already in use on some units prior to the implementation of the policy and lift equipment; however, these items were not seen consistently on all units at this hospital until more than 2 years after the policy shift. On a few units, the liners were placed in several areas across the unit to increase accessibility. At the community hospital, we sometimes had difficulty locating the friction-reducing plastic liners, and when staff were asked, there were several occasions when they indicated they had never heard of these devices.

Spare batteries for each piece of equipment were mounted on a wall, often in the equipment storage area. Some units incorporated daily tasks logs that assigned twice-daily battery-changing to a particular staff member. On other units, it was clear that batteries regularly remained unplugged from their charging stations. Overall, the proportion of units at both hospitals with spare batteries being charged increased over time (in the first 12 months following equipment implementation: 70% at the medical center, 71% at the community hospital; in subsequent months, 90% at the medical center, 81% at the community hospital). In-use batteries (i.e., those already in the pieces of equipment) were often well-charged for the powered portable full-body sling lift (95% medical center, 88% community hospital) and powered portable stand-assist lift (97% medical center, 85% community hospital), with little variability by unit or over time. At the medical center, the proportion of powered ceiling-mounted full-body sling lifts properly docked and charged (or charging) improved over time (61% in 2006 to 94% in 2009).

The proportion of available equipment slings at both hospitals was particularly low in the first year (Fig. 1c,d), especially for the disposable slings. At the medical center, most units eventually assigned the responsibility of keeping slings stocked to a staff member(s). At the community hospital, several units incorporated these slings into their automated ordering system to allow them to be automatically re-stocked as needed.

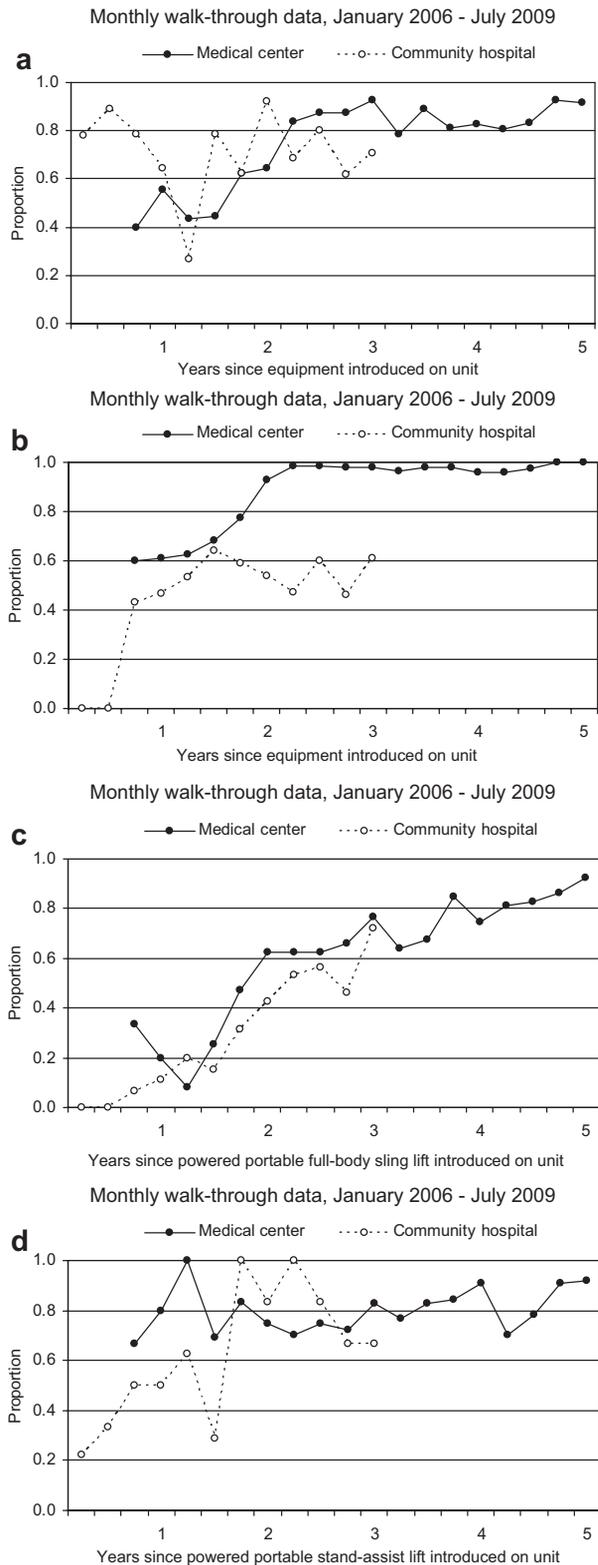


FIGURE 1. **a:** The proportion of inpatient nursing units with "excellent" storage areas (i.e., fostering accessibility to equipment and free of items not meant to be stored there) by hospital, Monthly unit walk-through data, January 2006–July 2009¹. **b:** The proportion of inpatient nursing units with friction-reducing plastic liners available and accessible by hospital, monthly unit walk-through data, January 2006–July 2009¹. **c:** Proportion of inpatient nursing units with at least three of each size of sling available for the powered portable full-body sling lift by hospital, Monthly unit walk-through data, January 2006–July 2009¹. **d:** Proportion of inpatient nursing units with at least one of each size of sling available for the powered portable stand-assist lift by hospital, Monthly unit walk-through data, January 2006–July 2009. ¹Fewer months of data were collected per unit at the community hospital where lift equipment was implemented later than the medical center.

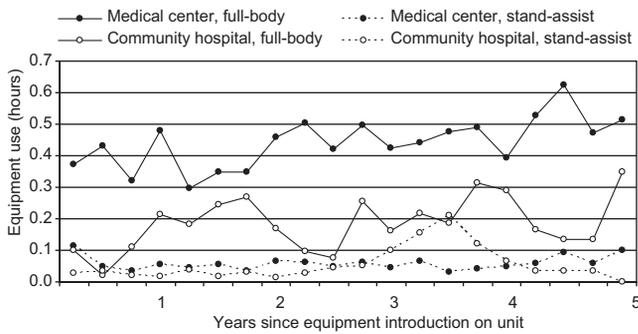


FIGURE 2. Average monthly powered portable full-body sling lift and powered portable stand-assist lift use per inpatient nursing unit by hospital over time, monthly lift equipment use data, July 2004–July 2009.

Equipment use (in hours) is presented in Figures 2 and 3. In general, the powered portable full-body sling lift was used more than the powered portable stand-assist lift (difference in mean monthly use = 0.38 hr ($P < 0.0001$) at the medical center; 0.13 hr ($P < 0.0001$) at the community hospital). Average monthly use of the powered portable full-body sling lift was greater at the medical center than the community hospital (0.44 vs. 0.18 hr, $P < 0.0001$); no difference was observed by hospital in the average monthly use of the powered portable stand-assist lift. An increase in the average powered portable full-body sling lift use per month was observed as the time since implementation increased at both hospitals (Medical center: 0.009 hr increased use for every additional 3-months of time since implementation, $P = 0.0020$; Community hospital: 0.006 hr increased use for every additional 3 months since implementation, $P = 0.0578$). No change in use of the powered portable stand-assist lift was observed over time at either hospital.

Variability in equipment use by units was observed. For example, monthly use of the powered portable full-

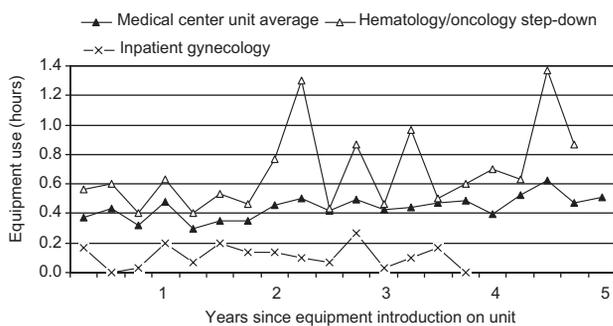


FIGURE 3. Average monthly powered portable full-body sling lift use on the medical center's hematology/oncology step-down and gynecology units compared to the hospital-wide average use per unit over time, monthly lift equipment use data, July 2004–July 2009.

body sling lift on the hematology/oncology step-down unit was greater than the hospital-wide unit average over time, whereas use was lower on the inpatient gynecology unit (Fig. 3).

Several unit-level efforts toward a MMLE were observed during the walk-through assessments. Promotional efforts, in terms of large posters and staff clinical ladder project boards, were often seen at the medical center. There were also times when we were unable to locate equipment in its storage area and learned it was being used for a transfer or had been moved to an area closer to the room of a patient for whom it was used regularly. We also captured examples of a lack of progression toward a MMLE. “Lifting assistance needed in room X” indicating a call for manual lifting assistance was sometimes heard over the unit intercom during walk-throughs. Also, in fall 2008, we were approached by a lift coach at the community hospital who was unsure what her role was as a coach. She noted having used the equipment before but not a lot. Specific barriers to equipment use were also observed, including maintenance requests not being filled for months (e.g., installing the wall-mounted equipment battery pack) or years (e.g., removing a storage room door lip to allow equipment to roll in/out easily).

Purchasing Data

Data on purchase of patient slings for the powered portable full-body sling lift were graphed with data related to use of the powered portable full-body sling lifts over time for each hospital. At both hospitals, the number of slings purchased increased over time and conformed well to lift use. Sling purchase data for the medical center only are presented in Figure 4.

At the medical center, the number of boxes of plastic liners purchased over time was fairly constant, with the exception of a sharp increase in the number of boxes purchased in January 2006 (data not shown). Of note,

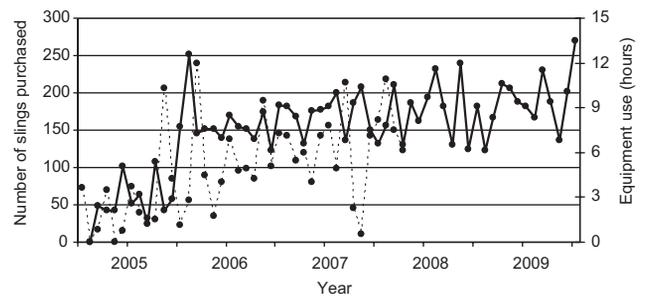


FIGURE 4. Quantity of powered portable full-body sling lift patient slings purchased per month (dotted line; left y-axis) and average monthly powered portable full-body sling lift use among inpatient nursing units at the medical center (solid line; right y-axis) over time, Medical center equipment supply purchase data and lift equipment use data, July 2004–July 2009.

of the 21 nursing units from which these data came, nearly one-third of the plastic liner purchases during the time period in question came from three inpatient units: two were the pilot study units (intervention and comparison) and one was a unit on which a specialized lift team was in place.

DISCUSSION

As health and safety interventions are implemented in the workplace, the ability to measure the implementation and adoption processes is important. While injury rates may be the end outcome of interest, many factors can influence reporting of work-related injuries [Azaroff et al., 2002, 2004] including efforts to control injury risk [Lipscomb et al., 2008, 2010]. In this particular case, if measures of adoption do not indicate use of lift equipment designed to reduce the biomechanical stress of patient-handling job tasks, it would be inappropriate to attribute any decline in injury rates to this intervention.

We identified several measures that were useful in assessing and understanding aspects of adoption of lift and transfer equipment and a “minimal manual lift environment” policy in the acute care hospital setting. Strengths and limitations of each of the measures highlighted to us the importance of not relying on one single measure. Meter readings and purchasing data provided measures of direct use of equipment, but we lacked information on patient census, acuity and tasks performed on each unit over time that could be useful in assessing whether the equipment was used as indicated based on patient-handling needs. Also, meter readings were subject to inflation during times of staff training and equipment maintenance. These events were documented during data collection and accounted for in analyses. The meter readings captured in this study reflect time (in hours) that each machine was in battery-powered motion. It is unclear how this measure translates to number of patient lifts, and whether use time per lift varies by type of equipment, task performed and operator. To our knowledge, similar measures have not been provided in the literature, with the exception of Li et al. (2004) who reported “counter data” from the lifts to provide a measure of the number of times per day each lift was used.

Battery charge and supply availability data provided insight into equipment readiness for use. However, there are difficulties in interpreting these measures alone. Although a piece of equipment with full battery charge (or available slings) is more ready-to-use than one with low battery charge (or a lack of slings), the battery could remain at full charge (or with available slings) for months if it was not used (i.e., adoption is not truly taking place).

Purchase data mirrored well with hours of lift equipment use. Compared to equipment meter readings, these data may be easier to collect over time for the purpose of monitoring equipment use. During our walk-through assessments, we learned that supply purchases were sometimes made well in advance of equipment use (i.e., at the community hospital where they were incorporated into the automated supply ordering system), and other times they were purchased “stat” in a quick attempt to have one sling shipped to the unit for immediate use.

Several measures suggested variability in adoption between hospitals and among hospital units within the same hospital. Patient care units in the acute care hospital setting may vary considerably in terms of their perceived need for lifting devices and readiness for change—factors which may affect whether staff adopt the equipment into routine patient care. Differences in observed measures of adoption by hospital may be attributed, in part, to variability in intervention implementation processes and early support initiatives. Of note, much of the insight we gained into the implementation processes at each hospital was gathered through monthly project meetings with hospital ergonomists involved with implementing the MMLE policy and lift equipment onto the patient care units. These meetings provided a means of understanding the level of ergonomic staff involvement at both hospitals, implementation of additional pieces of equipment, initial and subsequent staff training efforts, and barriers encountered during equipment implementation. Over time, the meetings also increased our awareness regarding initiatives that were unplanned at the beginning stages of program implementation (e.g., implementation of a Lift Assist Team on one floor of the medical center), and changes in the hospital system’s protocol for equipment purchases over time.

As part of the larger study under which this report falls, we delivered anonymous surveys to nursing units with equipment at 18 and 36 months after equipment rollout for purposes of assessing MMLE policy awareness, training in use of the equipment, and actual use of the equipment. The response rate was low (<20%), particularly at 36 months post-intervention. The surveys were lengthy, as they were designed to collect data specific to each piece of equipment. The collection of copious amounts of data per survey may have come, in part, at the expense of fewer participants. In addition, nursing staff at the two study hospitals are frequently asked to complete surveys, many of which are administered by the health system under which the hospitals fall. To maintain our project timeline, we were unable to administer our survey around other survey-based efforts. Because of the low response rate, we did not include results from the survey in this article.

Although this study has demonstrated the utility of several objective measures of adoption collected systematically over time, an understanding of additional factors related to implementation and adoption (and how to measure these factors) is needed. Future studies are needed to better understand staff training programs, perhaps through measures of the number of coaches per unit/shift, the coach-to-staff ratio, the proportion of staff trained in lift equipment use (overall, by unit, by shift), and the frequency of re-training. In a study of workers at the medical center prior to the intervention, it was suggested that lift equipment would have prevented less than half of the observed musculoskeletal patient-handling injuries [Pompeii et al., 2009]. Measures of the proportion of patient-handling tasks for which appropriate pieces of lift equipment are available would be informative. Data related to type of patient-handling task, patient census and patient weight/acuity are of interest in this regard. In addition to the collection of quantitative measures of adoption, qualitative data gathered through ethnographic methods, key informant or small group interviews, or focus groups are needed to provide an understanding of the cultural and organizational factors influencing intervention implementation and adoption.

CONCLUSIONS

As part of a larger study focused on measuring and understanding the effectiveness of an intervention to prevent patient-handling injuries among patient caregivers, we have provided several examples of periodic measures of adoption used to monitor progress and provide earlier assessment of the potential for program effectiveness than end outcomes such as injury rates. With no single measure to adequately assess adoption, we collected a mix of objective measures at several points in time; these data were supplemented with insight gained through monthly visits to the units and meetings with hospital ergonomists involved in implementation of the intervention. Information on adoption may be the best data available in situations where both numerator and denominator data are not available, where evaluation of injury rates may be unstable (e.g., in small workplaces or units), or when there is not a long enough follow-up period for changes in rates to be meaningful. Furthermore, without information about the fidelity of an organizational intervention, erroneous conclusions can be reached regarding effectiveness, making the assessment of implementation and adoption as important as the evaluation methods being used to assess more distal outcomes.

Adoption is not a static condition that can be easily measured; it is a dynamic process that can be complex to assess. However, once the efficacy of an intervention has been demonstrated, a major focus should shift to

understanding implementation and adoption; this type of activity provides more insightful information than traditional quantitative long-term evaluation measures. Unfortunately, work focused on implementation and adoption of interventions as part of effectiveness evaluation is still largely lacking in the occupational injury literature [Roen et al., 2006; Koppelaar et al., 2009]. We recognize the measures of adoption presented here, while informative at addressing gaps in intervention evaluation literature, only capture specific aspects of adoption. Cultural and organizational factors—the focus of our second piece [Schoenfisch et al., in preparation]—cannot be ignored when seeking to understand the implementation and adoption processes.

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APPENDIXUnit-Level Walk-Through Assessment Data Collection Form^a

Unit:	For month of:	Date completed:		
Completed by:				
1	All items used in the MMLE are accessible (e.g., lifts, plastic liners, slings, spare batteries, wipes)	Y ^b	N ^b	N/A ^b
2	The area is free of items that are not supposed to be stored there.	Y	N	N/A
3	Battery on the powered portable full-body sling lift is green.	Y	N	N/A
4	Battery on the powered portable stand-assist lift is green.	Y	N	N/A
5	Spare batteries are being charged.	Y	N	N/A
6	Powered portable full-body sling lift is operational and clean for use. Meter Reading: ____ (CE#-)	Y	N	N/A
7	Powered portable stand-assist lift is operational and clean for use. Meter Reading: ____ (CE#-)	Y	N	N/A
8	Non-powered portable stand-assist device is operational and clean for use.	Y	N	N/A
9	At least 3 disposable powered portable full-body lift slings of each size are available.	Y	N	N/A
10	All 3 sizes of the belt-like powered portable stand-assist lift slings are available and clean for use.	Y	N	N/A
11	Germicidal disinfecting wipes are available and in view for use.	Y	N	N/A
12	Blue plastic liners are stocked in the designated area for use.	Y	N	N/A
13	All ceiling lifts are docked in the charging station.	Y	N	N/A
14	All ceiling lifts are operational and clean.	Y	N	N/A
Comments:				

^aThe form shown is a generic version of the forms utilized on the units. Blank unit-specific forms were generated prior to each unit visit to facilitate the ease of data collection. They contained unit-specific information, such as lift equipment identifiers (i.e., Clinical Engineering (CE) number) needed to distinguish pieces of equipment on units with more than one of each type of device.

^bY, yes; N, no; N/A, not applicable.