Effects of a Safe Patient Handling and Mobility Program on Patient Self-Care Outcomes

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MeSH TERMS

- guideline adherence
- moving and lifting patients
- outcome assessment (health care)
- patient safety
- self care

OBJECTIVE. The aim of this study was to determine the effect of a safe patient handling and mobility (SPHM) program on patient self-care outcomes.

METHOD. We used a retrospective cohort design. Data were obtained from the electronic medical records of 1,292 patients receiving inpatient rehabilitation services. Self-care scores from the FIM™ for patients who participated in rehabilitation before implementation of an SPHM program were compared with the scores of patients who participated after implementation of the program.

RESULTS. Patients who received inpatient rehabilitation services with an SPHM program were as likely to achieve at least modified independence in self-care as those who received inpatient rehabilitation services without an SPHM program.

CONCLUSION. SPHM programs may not affect self-care performance in adults receiving inpatient rehabilitation services. However, more work must be done to define specific and effective methods for integrating patient handling technologies into occupational therapy practice.

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Work-related musculoskeletal disorders (WMSD) pose an important challenge to occupational and physical therapy professionals (Campo, Weiser, Koenig, & Nordin, 2008; Darragh, Huddleston, & King, 2009; Rice, Dusseau, & Miller, 2011). Current evidence indicates an annual prevalence of 27% for work-related injury or moderate to severe WMSD in occupational and physical therapists (Campo et al., 2008; Darragh, Huddleston, & King, 2009) and a 1-mo prevalence of 48% for mild to moderate WMSD (Campo & Darragh, 2012). Many of these WMSD result from manual patient handling and related activities (Alnaser, 2009; Campo et al., 2008; Darragh, Campo, & King, 2012; Hignett, 2001; Rice et al., 2011). Similarly, high rates of injury associated with manual patient handling have been reported among nursing professionals, which initiated development and implementation of safe patient handling and mobility (SPHM) programs in health care facilities across the country (Bos, Krol, Van Der Star, & Groothoff, 2006; Collins, Wolf, Bell, & Evanoff, 2004; Evanoff, Wolf, Aton, Canos, & Collins, 2003; Nelson et al., 2006).

SPHM programs are based on evidence from biomechanical research demonstrating that proper body mechanics when transferring, lifting, repositioning, or otherwise moving patients do not prevent WMSD (Hignett et al., 2003; Marras, Davis, Kirking, & Bertsche, 1999). Rather than rely on proper body mechanics to protect health care workers, SPHM programs include policies that limit the weight that staff can lift manually and provide guidelines for the selection and use of patient handling and mobility technologies (e.g., ceiling lifts, floor-based lifts, sit-to-stand devices, lateral transfer aids, adjustable hospital beds). The programs combine administrative policies, patient assessments, and the use of algorithms to

guide equipment selection. Investigations of SPHM programs demonstrated decreased injury incidence and severity, as well as reduced workers' compensation and costs related to lost work time injuries, in health care personnel (Bos et al., 2006; Collins et al., 2004; Evanoff et al., 2003; Nelson et al., 2006).

Although originally conceived to protect health care workers from injuries associated with moving and handling patients, SPHM programs have evolved as a viable intervention strategy for enhancing patient recovery. Indeed, the American Nurses Association's (ANA's) interprofessional national standards adopted the phrase "safe patient handling and mobility" as opposed to "safe patient handling and movement" to reflect the paradigm shift toward patient handling technologies as a vehicle for promoting patient recovery (ANA, 2013b). However, SPHM equipment was designed to reduce physical effort during handling tasks, not necessarily to enhance rehabilitation (Rockefeller, 2008; Waters & Rockefeller, 2010).

Widespread adoption of SPHM programs in health care settings has increased, and 11 states have enacted legislation, adopted regulations, or published rules related to the use of SPHM (ANA, 2013a). Additionally, national SPHM legislation has recently been introduced to reduce injuries associated with manual handling (ANA, 2013a); therefore, it is critical to assess whether these programs affect patient functional outcomes.

Initial research studies report that SPHM programs may not affect patient mobility outcomes and suggest that SPHM technologies can be used therapeutically during rehabilitation (Campo, Shiyko, Margulis, & Darragh, 2013; Darragh, Campo, & Olson, 2009; Darragh et al., 2013). Campo et al. (2013) reported no overall differences in functional mobility outcomes, as measured by the FIM™ (Uniform Data Set for Medical Rehabilitation, 1997), before and after implementation of an SPHM program. In two qualitative studies, therapists reported that SPHM technologies can be useful for therapists (Darragh, Campo, & Olson, 2009; Darragh et al., 2013) and may even be able to promote the recovery of functional mobility (e.g., transfers, standing, weight bearing, and gait) and neuromusculoskeletal functions (Darragh et al., 2013). As such, SPHM programs may not interfere with and may even be useful for facilitating the recovery of functional mobility.

Less is known about the effects of SPHM programs on the performance of basic activities of daily living (ADLs), such as dressing and bathing. Occupational therapists with expertise in SPHM assert that SPHM technologies are useful during therapy sessions addressing ADLs, though these activities were described less often than those related

to mobility (Darragh et al., 2013). Therapists who acknowledge the usefulness of SPHM technologies, however, also express concerns that their use could interfere with patient recovery (Darragh, Campo, & Olson, 2009). They also admit that existing technologies present unique challenges for use during therapeutic activities (e.g., sling size and adjustability, maneuverability of larger lifts; Darragh et al., 2013).

Occupational therapists must provide training in self-care activities, a critical component of recovery, regardless of the presence of an SPHM program in their facility. The effect of requiring therapists to use SPHM technologies on patient self-care outcomes is unknown; therefore, the purpose of this project was to determine the effect of an SPHM program on self-care outcomes.

Method

Research Design

In this retrospective, cohort study, we investigated self-care outcomes before and after the implementation of an SPHM program on an inpatient rehabilitation unit in the northeast region of the United States. The materials and methods of this study were reviewed and approved by the institutional review boards of Mercy College, Hebrew Senior Living, and Northeastern University and by the Office of Responsible Research Practices at The Ohio State University.

Participants

We used deidentified data from the electronic medical records of 1,315 patients admitted to a large hospital system. All patients received rehabilitation services from the Recuperative Services Unit (RSU). To keep the sample relatively homogenous, we excluded from the study any patients who died during the period they were receiving rehabilitation. Additionally, those with a stay of less than 3 days were excluded to eliminate patients who could not tolerate rehabilitation and had to be transferred out of the RSU soon after admission.

Intervention

Intervention (SPHM) and comparison (no-SPHM) groups occurred naturally and comprised patients who were admitted to the RSU before and after the implementation of the SPHM program. A total of 507 eligible patients were admitted between July 2005 and July 2006 and composed the no-SPHM group. Similarly, 785 eligible patients were admitted between April 2008 and April 2009 and composed the SPHM group. The program was initiated in August 2006, and its implementation lasted until March 2008. No

patients admitted during the program implementation period were included. We allowed for a wait period of 20 mo, ensuring that the program was fully integrated into the RSU and physical therapy (PT) and occupational therapy practice.

The SPHM program included patient handling technologies, administrative policies, and a decision-making algorithm. Those patients with a body mass index >35 required a preadmission screening for the selection of bariatric lift equipment. The facility's policy required that all staff, with the exception of occupational therapists and physical therapists, use patient handling technologies for moving and handling all patients at all times except when patients required only close supervision or contact guard or in the event of an emergency. Guidelines for occupational therapists and physical therapists outlined that patient handling technologies were to be used in cases when an activity required >35 lb of effort or if a patient required anything more than minimal assistance. Therapy staff members were trained and tested to use the equipment and decision-making guidelines when first hired and subsequently required to pass annual competency evaluations. Peer leaders were available as consultants for therapy units when necessary. Technologies used on the RSU included floor- and ceiling-based dependent patient lifts, sit-to-stand assists, motorized hospital beds, ambulation aides, multi-handled gait belts, and powered shower chairs.

Measures

The primary outcome measure was self-care performance as measured by the self-care subscale of the FIM. For all categories and items contained in the FIM, see Figure 1. Admission and discharge FIM scores were recorded as the lowest score observed by any member of the care team in the first 3 days after admission and 3 days before discharge. Therapists received training and were certified in FIM scoring procedures when hired and then biannually.

The self-care FIM was defined as the total of six self-care items, including eating, grooming, dressing upper body, dressing lower body, bathing, and toileting. In each category, a score of 1 indicated *total dependence* and 7 indicated

complete independence, with a possible total maximum score of 42. The FIM has high interrater and test-retest reliability (.95) and high internal consistency (.88–.97; Glenny & Stolee, 2009; Ottenbacher, Hsu, Granger, & Fiedler, 1996). Good internal consistency (.86–.98) also has been established for the motor portion of the FIM, which contains the self-care subscale (Glenny & Stolee, 2009). The FIM has also demonstrated good construct (Stineman, Ross, Fiedler, Granger, & Maislin, 2003) and criterion validity (Corrigan, Smith-Knapp, & Granger, 1997; Gosman-Hedström & Svensson, 2000).

We included several covariates in the analysis. Age in years was collected and coded continuously. Length of stay was coded as days of hospital stay. Diagnoses were obtained from the FIM impairment–diagnostic codes and were collapsed into four diagnostic groups: neurological, orthopedic, cardiopulmonary, and complex. Mobility was assessed using the mobility subscale of the motor FIM, defined as the total of the two locomotion and three transfer items (see Figure 1), and coded continuously.

Data Analysis

We computed descriptive statistics for all covariates. A series of independent-sample *t* tests and chi-square tests were run to evaluate group differences on the covariates. The groups differed on most covariates (see Table 1 and the Results section), precluding a direct computation of the intervention effect. A simple inclusion of covariates in the analysis would complicate the interpretation of the findings, because a treatment effect could only be computed for a certain level of covariates.

To estimate the so-called causal effect of treatment, we used the potential outcomes framework (Schafer & Kang, 2008) within marginal structural modeling (MSM; VanderWeele, 2009). MSM is frequently used in observational studies in which no random assignment is possible. The framework of potential outcomes postulates that every patient has the potential to be assigned to either of the two conditions (SPHM or no-SPHM). In a hypothetical scenario, the treatment effect would be computed by taking a difference in outcomes under the two conditions. In reality, every patient belongs only to one group, and only one outcome is observed. Thus, individual effects are not possible to compute; however, the average effect can be estimated by taking the difference between outcomes observed on the group level (i.e., SPHM and no-SPHM groups). When patients are randomly assigned to groups, this average effect is unbiased. The effect is biased, however, in the no-random-assignment situation. To overcome this issue, one can identify a sample of patients in the no-SPHM

Self-Care FIM Categories	Mobility FIM Categories
1. Eating	<i>Locomotion</i>
2. Dressing–Upper Extremity	1. Walk, Wheelchair
3. Dressing–Lower Extremity	2. Stairs
4. Grooming	<i>Transfers</i>
5. Bathing	1. Bed, Chair, Wheelchair
6. Toileting	2. Toilet
	3. Tub, Shower

Figure 1. Self-care categories of the FIM.

Table 1. Descriptive Statistics and Group Comparisons on Major Study Covariates

Covariates	No-SPHM Group (n = 507)	SPHM Group (n = 785)	Group Differences
<i>M (SD)</i>			
Self-care FIM at admission	23.95 (6.55)	25.76 (6.19)	$t_{1290} = -4.99, p < .001$
Age	82.34 (9.09)	80.85 (10.65)	$t_{1290} = 2.69, p < .007$
Days of hospital stay ^a	20.89 (11.56)	19.59 (13.62)	$t_{1191.4} = 3.60, p < .001$
Mobility score at admission	12.35 (4.29)	12.44 (3.58)	$t_{941.7} = -.385, p = .70$
Self-care FIM at discharge	33.92 (8.74)	34.64 (8.04)	—
<i>n (%)</i>			
Neurological diagnosis	54 (10.7)	40 (5.1)	$\chi^2 = 13.28, p < .001$
Orthopedic diagnosis	188 (37.1)	294 (37.5)	$\chi^2 = 0.01, p = .94$
Cardiopulmonary diagnosis	94 (18.5)	111 (14.1)	$\chi^2 = 4.15, p = .04$
Complex diagnosis	171 (33.7)	340 (43.3)	$\chi^2 = 11.44, p < .001$
Self-care FIM ≥ 36 at discharge	283 (55.8)	472 (60.1)	—

Note. *M* = mean; *SD* = standard deviation; SPHM = safe patient handling and mobility. — = not applicable; only *M* and *SD* provided for outcome measure.

^aDays of hospital stay was log transformed to account for negative skewness of the distribution ($p < .001$).

group that resembles those in the SPHM group (Rosenbaum & Rubin, 1983, 1984, 1985; Schafer & Kang, 2008).

Accordingly, patients were matched on the basis of their propensity to belong to the SPHM group, as predicted by all covariates. Thus, two patients from different groups but with similar propensity scores constituted a matched pair. Logistic regression was used to compute propensity scores for these data. Because the goal of the model was to predict members of the SPHM group, the *p* value was set at the liberal level of .25. The final list of covariates included age, diagnosis, baseline FIM self-care scores, and baseline FIM mobility scores. Further, weights were computed based on estimated propensities by the following formula:

$$w_{SPH} = 1/p(SPH_i | Confounders_i) \text{ for the SPHM group}$$

$$w_{noSPH} = 1/(1 - p(SPH_i | Confounders_i)) \text{ for the no-SPHM group.}$$

In other words, weights for patients in the SPHM group were computed as inverse probability of being in that group, given all the confounders. Weights for patients in the no-SPHM group were computed as an inverse of 1 minus the probability of being in the SPHM group, given all the confounders.

In addition, sensitivity analysis was conducted to evaluate the success of the propensity model. Figure 2 displays standardized group differences (an equivalent of effect sizes) on study confounders. Group differences disappear in the matched sample, indicating a successful propensity model.

Finally, a weighted logistic regression was run to estimate the effect of the SPHM program on the probability of scoring *independent* on self-care discharge score. To account for the severe negative skew of the self-care data, we dichotomized the self-care outcome into *independent* and *not independent*. According to FIM scoring guidelines,

scores of 6 (*modified independence*) and 7 (*independence*) are considered independent. We defined *independent* as a total score of 36, derived by summing scores across the six categories.

Similar to survey weights, weights based on propensity scores were used to down-weight patients in the no-SPHM group with little resemblance to those in the SPHM group, and, on the contrary, patients similar to those in the SPHM group were up-weighted (Cole & Hernán, 2008; Robins, Hernán, & Brumback, 2000; VanderWeele, 2009).

Results

Twenty-three patients with a length of stay of less than 3 days were excluded. Of the 10 patients discharged before SPHM program implementation, 5 were discharged home

Figure 2. Funnel plot for sensitivity analysis evaluating group differences on covariates for unweighted and weighted-by-propensity scores samples.

Note. Adm = score at admission.

(median [*Mdn*] discharge mobility FIM = 25), 3 to acute care (*Mdn* discharge mobility FIM = 18), 1 to assisted living (discharge mobility FIM = 24), and 1 to a long-term care facility (discharge mobility FIM = 7). Of the 13 patients discharged after the SPHM program was implemented, 7 were discharged to acute care (*Mdn* discharge mobility FIM = 7), and 6 were discharged home (*Mdn* discharge FIM mobility = 24). As a result, the final sample included 1,292 patients.

The sample comprised 507 no-SPHM and 785 SPHM patients. Major patient characteristics are summarized in Table 1. Patients in the no-SPHM group tended to be older ($p = .007$), with lower average self-care scores at admission ($p < .001$) and longer hospital stays ($p < .001$). The no-SPHM group also contained more patients with neurological ($p < .001$) and cardiopulmonary ($p = .04$) disorders and fewer patients with complex diagnoses ($p < .001$). Groups were comparable on baseline mobility FIM scores ($p = .7$). The propensity model described above accounted for the group differences, and logistic regression was used to assess the likelihood that members of the SPHM and no-SPHM groups would achieve independence. In the SPHM group, 60.1% of patients reached the top self-care FIM evaluation score, compared with 55.8% in the no-SPHM group. Results of the weighted-logistic regression revealed no overall group differences ($\beta = -.138$, $SE = 0.118$, $p = .242$), implying that the rate of scoring *independent* on the self-care discharge FIM score was equivalent across the groups and estimated to be 60.1%.

Discussion

The purpose of this study was to evaluate the effect of the SPHM program on self-care outcomes in patients receiving rehabilitation services. The results provide no evidence of an effect of the SPHM program on FIM self-care scores. Patients who underwent rehabilitation services after implementation of an SPHM program were just as likely to achieve independence as those who underwent rehabilitation without the SPHM program.

Our study is the first to examine self-care outcomes and SPHM. The results add to the current body of literature on rehabilitation outcomes and provide preliminary evidence that the implementation of SPHM programs on inpatient rehabilitation units does not interfere with patient outcomes. Our previous work (Campo et al., 2013) evaluating effects of an SPHM program on functional mobility scores also indicated that patients were able to achieve similar outcomes with and without the SPHM program in rehabilitation. In concert with the evidence that SPHM programs can reduce

the physical demands of moving, lifting, and handling patients, these findings suggest that SPHM is a practical option for preventing injuries in therapists while preserving patient recovery.

Fear that the use of equipment will impede patient progress, however, is a major barrier to the adoption of SPHM programs by therapy personnel (Darragh, Campo, & Olson, 2009; Nelson, Harwood, Tracey, & Dunn, 2008; Waters & Rockefeller, 2010). Therapists have expressed concern that using SPHM technologies will foster dependence and therefore slow the pace of recovery (Nelson et al., 2008). This study can mitigate concerns about the effects of an SPHM program on global patient outcomes. Patients appear to be able to achieve the same level of independence in self-care and, according to previous work, in functional mobility (Campo et al., 2013) with an SPHM program in place.

The process of rehabilitation also may benefit from the use of SPHM technologies. SPHM technologies, when used appropriately, can be used to increase rather than reduce patient effort in rehabilitation programs; may allow therapists to work with patients, regardless of their weight or diagnosis complexity, to provide a higher therapeutic dose of activity; and may also be used to mobilize patients earlier and at a higher frequency than would normally be possible (Darragh et al., 2013). These findings are particularly salient given current emphases on early mobilization (Cumming et al., 2011; Needham, Truong, & Fan, 2009) and task practice (Gillen, 2011; Shumway-Cook & Woollacott, 2001) for optimization of patient functional recovery.

Patient recovery is not defined solely by functional independence or time. Recovery also includes the quality of movement and activity performance and the return of typical movement patterns. Therapist concerns often center on their ability to facilitate normal movement patterns when using SPHM devices. Investigation into the effects of SPHM technologies on task performance is a critical component of this area of inquiry.

Several studies have examined movement patterns and muscle activation during transfers, and the conclusions are mixed. Device-assisted, sit-to-stand transfers resulted in atypical movement patterns and lower overall muscle activation (Burnfield et al., 2013; Ruszala & Musa, 2005). However, stand-assist devices may be preferable to incorrectly performed manual transfers (Ruszala & Musa, 2005). Also, when participants received encouragement to put forth more effort, muscle activation increased, and several studies indicated the potential for using the stand-assist device for increasing muscle strength and improving joint flexibility (Boyne, Israel, & Dunning, 2011; Burnfield et al., 2012).

In their study of adults with stroke, Burnfield et al. (2013) compared device-assisted, clinician-assisted, and combined device- and clinician-assisted sit-to-stand transfers. Using kinematic analysis and electromyographic assessment, they found that device-assisted sit-to-stand transfers took twice as long as clinician-assisted transfers, and they resulted in reduced trunk and ankle motion in patients with stroke. But when device-assisted transfers were combined with clinician assistance (clinicians were able to provide either verbal or physical cuing), lower-extremity muscle activity increased. Also, although the device-assisted movement patterns differed from normal sit-to-stand movement patterns, so did the clinician-assisted transfers.

Perhaps a combination of clinician assistance and SPHM devices is the best option for therapeutic application. Modification of existing devices to more closely approximate normal movement patterns, paired with clinician verbal and physical cueing, could result in an effective and safe way to facilitate activity performance, motor relearning, muscle strengthening, and joint mobility and could potentially be more effective than clinician facilitation alone.

These studies demonstrate the importance of evaluating and modifying SPHM technologies for use in therapy and assessing the effects of such devices on patient activity performance. It is critical that occupational therapists develop specific guidelines for the use of SPHM technologies as well as the frequency, duration, and dosage of SPHM technologies during rehabilitation.

Study Limitations and Recommendations for Future Research

This study is the first to examine the effects of an SPHM on self-care outcomes in a large, diverse sample of patients receiving inpatient rehabilitation. The SPHM program was completely integrated into the rehabilitation service, with readily available patient handling technologies and well-trained and invested staff. There was no misclassification of participants with respect to group membership—no participants from the no-SPHM group received any services associated with the SPHM program, and all participants in the SPHM group received rehabilitation with a fully integrated SPHM program in place.

We noted several important limitations, however. The study was limited by use of the FIM as the outcome measure. The FIM, though widely used and administered (in this case, by highly trained staff), is vulnerable to inconsistent or inaccurate scoring. In addition, the scoring guidelines may not present an accurate portrayal of a patient's performance (Cournan, 2011). Alternative measures that specifically assess self-care activities would be a useful and important alternative

for use in future studies. Additionally, the cutoff score used to indicate that self-care is performed with at least modified independence does not elucidate the effects of the technologies on performance of specific activities. Clinically, it is important to understand a patient's overall performance, but it will be critical for future research to further define use and methods for specific self-care activities.

Implications for Occupational Therapy Practice

Occupational therapists are the professionals tasked with facilitating the highest level of independence in self-care for clients in rehabilitation. We as a profession must understand the most effective methods for supporting performance of self-care activities. SPHM programs, which require the use of SPHM technologies during most rehabilitative activities, have the potential to affect both the methods that occupational therapists use for self-care training and patient outcomes. It is imperative that occupational therapy researchers carefully assess the effect of these technologies. This study is a first step in this process. Our results have the following implications for occupational therapy practice:

- Integration of an SPHM program into inpatient rehabilitation may not affect patient self-care outcomes.
- Investigation of the effects of SPHM technologies on the quality of patient performance is critical.
- More work on the most effective methods for using patient handling technologies to facilitate improved self-care performance is necessary.

Conclusion

Rehabilitation under an SPHM program yielded similar self-care outcomes to those obtained with no-SPHM rehabilitation. These findings support the assertion that effective rehabilitation services can be delivered within the context of an SPHM program. It is possible, then, to protect occupational therapy practitioners from work-related injuries associated with the handling and movement of patients while preserving patient recovery. It is imperative, however, that more work on the most effective and efficient ways to use SPHM technologies in rehabilitation practice is completed. Closer evaluation of the effects of specific SPHM devices on activity performance also is needed. ▲

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