

Safe Patient Handling for Rehabilitation Professionals

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KEY WORDS

injury prevention
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Every day, thousands of physical therapists and rehabilitation nurses are required to perform physically demanding therapeutic patient handling tasks that are stressful to the caregiver and increase his or her risk of developing work-related musculoskeletal disorders (MSDs). In rehabilitation, patient handling tasks might be classified as "traditional" or "therapeutic." Traditional tasks have a practical goal, such as transferring a patient from bed to a wheelchair, and therapeutic tasks have more targeted goals such as facilitating patient function and independence. Therapeutic patient handling tasks present a greater risk for caregivers to sustain work-related MSDs than typical patient handling tasks do because caregivers are exposed to high mechanical loads on the spinal tissues for longer amounts of time. The Veterans Health Administration, Association of Rehabilitation Nurses, and the American Physical Therapy Association endorse the use of modern patient handling technology as part of a comprehensive safe patient handling program for providing therapy in rehabilitation settings. Information about patient handling technology that is effective in reducing the risk of work-related MSDs from performing therapeutic patient handling and movement tasks is also presented and discussed in this article.

The purpose of this article is to examine the best practices for safe patient handling (SPH) in the rehabilitation setting. Although SPH is examined from a physical therapy viewpoint, it should be noted that the content and lessons learned by studying physical therapists (PTs) provides valuable information that is readily applicable to nurses. Healthcare workers (e.g., nurses, nurses' aides, PTs, healthcare technicians) who perform physically demanding patient handling tasks as part of their jobs are at high risk for developing work-related musculoskeletal disorders (MSDs). These workers are exposed to significant risk factors for MSDs when lifting and moving heavy patients and equipment, pushing and pulling heavy objects, working in non-neutral postures, and standing for long periods of time without adequate rest periods. When the physical demands of the job exceed the capabilities of the worker, the worker is at increased risk of developing an MSD such as back pain. Moreover, the risk of developing an MSD is even greater when the worker is exposed to more than one risk factor at the same time (Bernard, 1997; National Research Council and Institute of Medicine, 2001). Although healthcare workers report a high number of medical problems in the shoulder, neck, and legs, the most common occupational injuries in the healthcare industry involve back disorders (U.S. Department of Labor, Bureau of Labor Statistics, 2007). Nursing ranks in the top ten in incidence of work-related MSDs. Oftentimes, back disorders prevent workers from doing their jobs and cause many of them to change jobs because of back pain.

According to the American Physical Therapy Association (APTA), there are an estimated 150,000 actively practicing PTs in the United States (K. Harwood,

personal communication, May 10, 2008). Previous research has shown that many PTs are at high risk for developing work-related MSDs (such as low back and shoulder pain and disability) because of the high physical demands associated with patient handling tasks (APTA, 2004). In a survey of occupational therapists (OTs) and PTs, Darragh, Huddleston, and King (2009) reported an annual incidence rate of 16.5 injuries per 100 full-time workers among OTs and 16.9 injuries per 100 full-time workers among PTs—a rate similar to workers employed in heavy manufacturing. In another recent study of workers in rehabilitation centers, researchers reported that work in rehabilitation centers was associated with an increased prevalence of lower back and shoulder symptoms, with the highest prevalence of work-related MSDs reported in the lower back (80% of cases; Rozenfeld, Ribak, Danzinger, Tsamir, & Carmeli, 2009). Studies have shown that PTs sustain high incidence rates of work-related MSDs with a majority of these disorders occurring primarily in rehabilitation, geriatric, pediatric, and acute care settings (APTA). In a survey conducted by Adegoke, Akodu, and Oyeyemi (2008), the reported 12-month prevalence of work-related MSDs among Nigerian physiotherapists was 91.3%, with the low back (69.8%) being the most commonly affected body part, followed by the neck (34.1%). Fifty percent of the physiotherapists first experienced their work-related MSDs within 5 years of graduation and the highest prevalence (61.7%) was found among physiotherapists younger than 30 years old. A majority of respondents (83.5%) reported that treating large number of patients in a day was the most important work factor for their work-related MSDs, and 62.6% changed or modified their treatment because of their work-related MSDs. Rehabilitation nurses and PTs

perform many of the same patient handling tasks, significantly increasing their risk of MSDs (Owen, Garg, & Jensen, 1992). The purpose of this article is to discuss the risks of work-related MSDs due to therapeutic patient transfers and present state-of-the-art evidence-based solutions for reducing the risk to those involved in rehabilitation.

The economic and personal burden of these disorders is very significant. For example, in 1989 the direct costs for a single low back disorder case exceeded \$8,300 (Webster & Snook, 1994). More recent cost data have not been published, but it is likely that the average cost per case has increased dramatically since 1989. In addition, the indirect costs of injuries and illnesses such as back pain cases are often estimated to be 3 to 5 times greater than the direct costs (Liberty Mutual Insurance, 2001). Although the data are not recent, the cost of occupational low back pain alone in the United States in 1992 was estimated to be approximately \$100 billion per year, which represented approximately 34% of the cost of all injuries and illnesses combined that year (Leigh, Markowitz, Fahs, Shin, & Landrigan, 1997). These costs for workers and employers are significant, but the personal burden to workers resulting from disability and inability to work and sustain a living may be more important. In previous studies, PTs reported decreases in productivity and job satisfaction and changes in career plans and quality of life because of work-related MSDs (Campo, Weiser, Koenig, & Nordin, 2008). Cromie, Robertson, and Best (2000) reported that 1 in 6 PTs changed settings or left the profession because of work-related MSDs. In a recent prospective study of work-related MSDs in a cohort of 882 members of APTA, Campo and colleagues reported a 1-year incidence rate of work-related MSDs of 20.7%. Factors that were found to increase risk of work-related MSDs included patient handling (repositioning and transfers), working in bent or twisted postures, joint mobilization, soft tissue work, passive range of motion (PROM) treatments, and job strain.

Background

Physical therapy has been characterized as a hands-on profession. PTs and rehabilitation nurses are involved in transferring, lifting, and handling patients as part of their jobs. Many of these activities have been shown to contribute to the development of work-related MSDs. Biomechanical forces on the spine are increased during patient handling and other patient care activities. The external forces associated with lifting, pushing, and pulling patients produce considerable internal forces on the spinal musculoskeletal system (Marras, Davis, Kirking, & Bertsche, 1999; Rice, Wooley, & Waters,

2009; Zhuang, Stobbe, Hsia, Collins, & Hobbs, 1999). If the forces are too high, they can cause damage to the spine, resulting in severe pain and disability for the worker. In a biomechanical study examining the manual lifting of patients, Marras and colleagues showed that there is no safe way to manually transfer or reposition a fully dependent 110-lb patient, even when two people performed the task. They showed that the disc compression forces created on the spine during such a task exceeded both the accepted spinal disc compression and shear force tissue tolerance limits (3,400 Newtons or 770 lbs of compression force and 1,000 Newtons or 227 lbs of shear force, respectively), even when two caregivers performed the lifts.

A special distinction can be made between "typical" patient transfer tasks and "therapeutic" patient transfer tasks. Because the goal of the rehabilitation professional is to provide therapy to the patient by helping them regain or maintain functional ability, ambulate, or perform other activities requiring muscular activity, the caregiver performing therapeutic patient handling tasks is typically exposed to high internal spine forces for longer periods of time compared with those who perform typical patient handling tasks. The typical manual patient handling task is designed to be completed in as short a time as possible and usually only takes a few minutes, resulting in brief periods of loading on the spinal tissues. Therapeutic patient handling tasks, on the other hand, require the caregiver to lift and hold significant amounts of the patient's body weight in static postures for long periods of time, often taking several minutes to complete. These types of tasks result in exposure to high physical loads on the spinal tissues for the entire duration of the therapeutic task. This extended exposure to spinal loads likely increases the risk of developing a work-related MSD for the rehabilitation professional compared with caregivers who perform typical patient handling tasks. In addition, the rehabilitation professional cannot always perform the transfer in a smooth continuous manner, which is preferred for most lifting tasks; rather, he or she must hold the patient in position while supporting the patient's body weight as he or she provides therapy, which creates high levels of physical loading at the hands and on the spine. This slow static pattern of application of high internal loading on the soft tissues of the spine is particularly hazardous and is likely worse on the spine than typical force application patterns associated with typical lifts in which the weight of the load is placed on the spine and then released after a brief period. The reason slow static application of force may be worse for the spine compared with cyclical loading patterns is because

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spinal tissues have viscoelastic mechanical properties. Viscoelastic materials demonstrate characteristics of both viscous and elastic materials. As a result of these viscoelastic properties, spinal tissues that are exposed to high loads for extended periods of time, such as may occur when lifting and holding a patient during ambulation, can exhibit creep properties. *Creep* is a mechanical term describing the time-dependent nature of materials to lengthen over time while under load. That is, under extended periods of loading, viscoelastic tissues will get longer and weaker over time, reducing their ability to resist applied forces. With a typical lift, when the force is removed (i.e., lift is completed) the spinal tissues can recover their strength and function in a short period of time. However, when the load is applied for an extended time, it takes much longer for the tissues to regain their functional ability, and therefore, excessive application of static spinal loads on the spinal tissues can cause a reduction in their ability to withstand loading, placing them in extreme danger of injury. Exposure to static loads over a long time, even at low levels of spinal loading, can result in changes in the properties of the tissues making them more vulnerable to injury during subsequent loading events, such as another lift. As shown by researchers, lifting heavy weights can lead to high spinal loads that easily exceed the tolerance limits of the intervertebral discs (Waters, Putz-Anderson, Garg, & Fine, 1993).

Using technology as part of a comprehensive SPH and movement program has been shown to be effective in reducing the risk of work-related MSDs for those involved in patient handling and movement (Collins, Wolf, Bell, & Evanoff, 2004; Evanoff, Wolf, Aton, Canos, & Collins, 2003; Garg & Owen, 1992; King, Huddleston, & Darragh, 2009; Nelson, 2006; Silvia, Bloswick, Lillquist, Wallace, & Perkins, 2002). In a recent paper, King and colleagues concluded that "many interventions exist to prevent work-related injuries to therapists and more guidance in the best way to integrate these interventions (e.g., mechanical lift devices) into therapy practice is needed" (p. 274).

Unfortunately, a barrier to using technology in the rehabilitation setting is that the equipment is not designed with therapy in mind, but rather to perform the required task in a typical manner as quickly and with as little physical effort as possible on the part of the caregiver. Anecdotal reports from PTs indicate a concern that overusing mechanical lifting equipment in the rehabilitation setting will reduce the effectiveness of the therapy and delay or impede improvement in the functional status and independence of the patient (APTA, 2004).

Although using technology is the preferred solution for performing physically demanding patient

handling tasks, if the equipment is not available or policies requiring equipment use have not been adopted, it is important to provide adequate assistance to caregivers when performing tasks so that risk is minimized. This may involve using additional people to help with the patient handling task, especially if the task is therapeutic. Relying on multiple caregivers is not always feasible because of space restrictions and often is insufficient to adequately reduce the risk to caregivers. The goal should be to use equipment when possible.

High-Risk Tasks Performed by Rehabilitation Professionals

Researchers have identified a number of tasks performed by PTs and rehabilitation nurses that present inherent risk factors for work-related MSDs, especially low back pain. A number of researchers who conducted epidemiologic studies have shown that tasks associated with direct patient care, such as lifting and moving patients, manual therapy, ambulation assistance, and PROM treatments, were most likely to cause work-related MSDs (Campo et al., 2008). These tasks frequently require applying high levels of muscle exertions—often for long periods of time—in awkward or extremely bent postures. As noted previously, these tasks often create large internal forces on the structures of the spine that can damage spinal discs and other supporting structures of the spine (Marras et al., 1999).

In addition to physical demands, rehabilitation professionals are often exposed to a range of psychosocial and organizational factors that have been shown to increase the risk of developing work-related MSDs, such as increased job strain (low control and high demand), stress, and demanding work schedules (e.g., long hours of work, shift work, mandatory overtime; Bongers, de Winter, Kompier, & Hildebrandt, 1993; Caruso & Waters, 2008; Waters, Dick, Davis-Barkley, & Krieg, 2007).

Recommendations from a National Task Force

In 2004 the Veterans Health Administration (VHA) convened a national task force consisting of representatives from the APTA, the Association of Rehabilitation Nurses (ARN), and the VHA. The goal of the task force was to assemble representatives from affected professions to discuss the unique SPH and movement needs of rehabilitation professionals and develop a position paper that outlined a series of recommendations for balancing the needs of the representative organizations. The purpose of the position paper was to

promote collaboration between rehabilitation nurses and physical therapists to address the mutual goals of improving: (1) safety of patients during handling and movement tasks; (2) functional status and independence of patients to achieve optimal rehabilitation potential; (3) safety of care providers during patient handling and movement tasks; (4) utilization of evidence-based research on safe patient handling and movement; and (5) communication between interdisciplinary team members regarding SPHM methods (APTA, 2004, p. 1).

The paper contained six important recommendations.

1. Implement the Occupational Safety and Health Administration (OSHA) *Ergonomics for Prevention of Musculoskeletal Disorders: Guidelines for Nursing Homes*. This recommendation also suggested establishing an interdisciplinary team responsible for reviewing and implementing the OSHA guidelines and establishing organizational policies and procedures based on the guidelines.
2. Build and support a culture of safety in rehabilitation settings that protects staff as well as patients.
3. Improve communication channels between nurses and PTs to facilitate SPH and movement tasks. This recommendation suggested developing SPH policies, a process for initial plans of patient care with ongoing updates, and routine interdepartmental meetings to discuss staffing and equipment needs.
4. Develop policies and procedures for the therapeutic use of patient handling equipment, including equipment that provides safety for staff and patients and features, as appropriate, that allow for or promote active use of the assistive equipment by the patient for therapeutic benefit.
5. Develop competency-based assessments that demonstrate proficiency for use of all patient handling equipment used on the respective patient care unit, including return demonstration (i.e., training through role playing and teaching other staff members).
6. Encourage research that supports the improvement of patient and staff safety while maximizing patient rehabilitation potential, including investigating the cost-effectiveness of ergonomics interventions, impact of injury-risk reduction to PTs, and the efficacy of patient handling equipment when integrated into therapeutic activities.

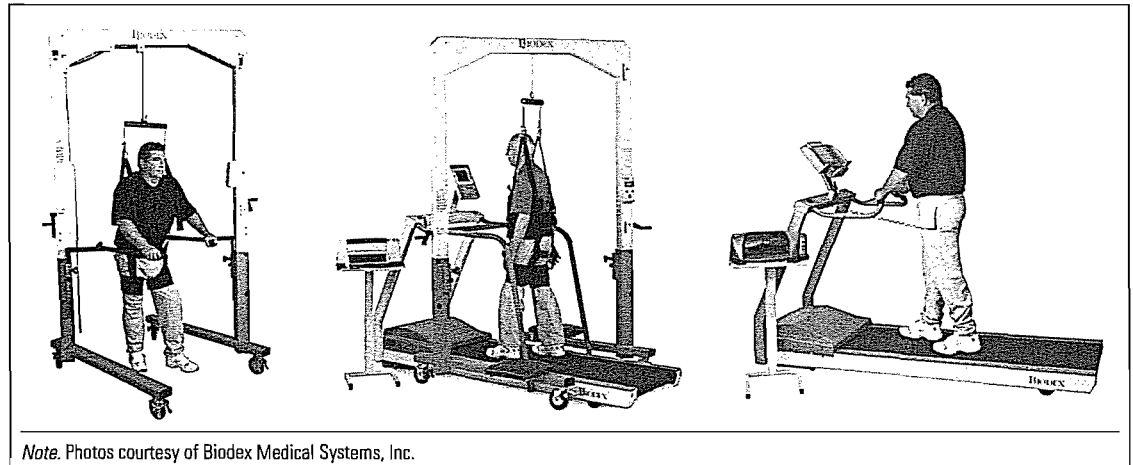
It is likely that widespread implementation of these best practices across the rehabilitation practice setting would significantly reduce or eliminate many work-related MSDs and other negative outcomes associated with patient handling and movement for caregivers. In addition, it would likely improve patients' quality of care. Educational programs for nearly all healthcare providers (including the APTA) are increasingly developing evidence-based curricula pertaining to SPH (Waters, Nelson, Hughes, & Menzel, 2009).

Solutions for High-Risk Tasks in the Rehabilitation Setting

Technology for assisting patient handling and movement has improved greatly in the past decade. Previously, patient-lifting equipment resembled car repair lift devices that were heavy, bulky, and incorporated labor-intensive, manually operated mechanisms. Modern patient handling equipment, however, has vastly improved ergonomics because of battery-powered lifting mechanisms, more user-friendly control functions, and strong, lightweight materials used for construction. This new array of modern equipment provides an increased number of options for helping patients across the spectrum of mobility needs. At the same time, rehabilitation research, especially for patients with neurological disorders, has moved from models of helping patients to compensate for impairment to models based on facilitating the activity-dependent plasticity of the nervous system (Behrman, Bowden, Nair, 2006). According to Rockefeller (2008), creative use of technology in rehabilitation can increase the overall amount and intensity of therapy provided to patients, which has been shown to improve outcomes for poststroke patients in nursing homes and patients with orthopedic conditions.

One of the most important categories of patient handling equipment used in rehabilitation is overhead-mounted or floor-based vertical lifting or ambulation devices with partial body weight support (PBWS). An example of this type of equipment is shown in **Figure 1**. These devices incorporate slings and straps that support all or part of the patient's body weight. The devices can be used for both traditional and therapeutic patient handling tasks. During transfers, repositioning, or supporting a limb, the devices can decrease loads for the caregiver. For therapeutic tasks, the devices help support a patient while on a treadmill, the floor, or other pieces of equipment. For gait training in poststroke rehabilitation, there is evidence that some traditional therapy methods using compensatory or neurofacilitory approaches may not produce the amount of intensive, task-specific gait

Figure 1. Floor-Based Vertical Lifting Device Used in Combination with a Treadmill for Partial Body Weight Support Training



training that can help patients improve ambulation (Bogey & Hornby, 2007). Using this equipment may decrease exposure to high-risk activities for caregivers and provide more security for patients. Protocols associated with providing PBWS treatments, on the other hand, often require 1–3 therapists to provide manual assistance and facilitate the limbs or trunk of patients (Hornby et al., 2008.). Preliminary work has begun to document the associated risks for therapists' exposure to repetitive, awkward postures and excessive muscle loads (Corbridge, Goldman, Shu, Buster, & Burnfield, 2009). This area requires additional research.

Another important category of assistive equipment is sit-to-stand (STS) devices that allow the caregiver to help patients stand without manually lifting the patient. An example of this type of device is shown in Figure 2. The device requires the patient to bear a percentage of his or her own weight. The device helps the patient move from a sitting to a standing position. Therapeutic tasks can be performed while the patient is in the device (i.e., practicing balance activities or working on repetitive practice for rising to stand).

Research Needs

A review of the scientific literature reveals a number of important research gaps.

1. Development and evaluation of evidence-based guidelines for using patient handling equipment in the rehabilitation setting would be helpful. Findings from these studies will be vital in changing the paradigm regarding SPH and movement in the rehabilitation setting.
2. Information is needed on precisely which physically demanding tasks are performed by rehabilitation professionals in practice

Figure 2. Example of a Sit-to-Stand Device



and what the risk levels are for work-related MSDs for those tasks.

3. Research is needed to develop clinical decision-making guidelines to match technology with appropriate groups of patients.
4. Development of new patient handling equipment specifically aimed at therapeutic rehabilitation is needed.

5. Evidence-based training curriculum and educational materials focusing on the application of technology in the rehabilitation setting are needed.
6. Demonstration studies documenting the qualitative and quantitative efficacy of technology on treatment in the rehabilitation setting are needed.
7. Detailed case studies describing the use of newer patient handling equipment in delivering patient care with associated outcomes would be helpful.
8. Studies comparing outcomes between facilities that use (or don't use) newer patient handling equipment would be helpful.

Summary

Physically demanding patient handling and transferring tasks in the rehabilitation setting have been shown to increase the risk for therapists to develop work-related MSDs. Factors that have been shown to increase risk of work-related MSDs in the rehabilitation setting include patient transfers, patient repositioning, working in bent or twisted postures, joint mobilization, soft tissue work, PROM treatments, and job strain. Using mechanical assistive equipment to perform patient handling and movement tasks has been effective in reducing the risk of work-related MSDs for nurses involved in direct patient care. From a rehabilitation professional standpoint, however, there is a concern that overusing mechanical lifting equipment could reduce the rehabilitation potential of the therapy and impede improvement in patient functional status and independence. For this reason, specific equipment is needed that ensures the therapeutic needs of the patient are being met and that the safety and health of the healthcare provider are protected. Although additional research about the development of therapeutic technology in the rehabilitation setting is needed, a commitment to use available technology is critical to changing the existing paradigm of manual patient handling that is prevalent in physical therapy practice and has been linked to increased risk for work-related MSDs.

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References

- American Physical Therapy Association. (2004). *Improving patient and health care provider safety: Task force develops recommendations on patient handling*. White Paper published by the American Physical Therapy Association. Retrieved October 28, 2008, from www.apta.org/AM/Template.cfm?Section=Archives3&Template=/Customsource/TaggedPage/PTMagIssue.cfm&Issue=04/01/2005.
- Adegoke, B. O., Akodu, A. K., & Oyeyemi, A. L. (2008). Work-related musculoskeletal disorders among Nigerian physiotherapists. *BMC Musculoskeletal Disorders*, 18(9), 112.
- Behrman, A., Bowman, M., & Nair, P. (2006). Neuroplasticity after spinal cord injury and training: An emerging paradigm shift in rehabilitation and walking recovery. *Physical Therapy*, 86(10), 1406-1425.
- Bernard, B. P. (Ed.). (1997). *Musculoskeletal disorders (MSDs) and workplace factors: A critical review of epidemiological evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back*. [DHHS (NIOSH) Pub. No. 97-141]. Cincinnati, OH: U.S. Department of Human Services, National Institute for Occupational Safety and Health.
- Bogey, R., & Hornby, T. G. (2007). Gait training strategies utilized in poststroke rehabilitation: Are we really making a difference? *Topics in Stroke Rehabilitation*, 14(6), 1-8.
- Bongers, P. M., de Winter, C. R., Kompier, M. A. J., & Hildebrandt, V. H. (1993). Psychosocial factors at work and musculoskeletal disease. *Scandinavian Journal of Work, Environment, & Health*, 19, 297-312.
- Campo, M., Weiser, S., Koenig, K., & Nordin, M. (2008). Work-related musculoskeletal disorders in physical therapists: a prospective cohort study with 1-year follow-up. *Physical Therapy*, 88(5), 608-619.
- Caruso, C., & Waters, T. (2008). A review of work schedule issues and musculoskeletal disorders with an emphasis on the healthcare sector. *Industrial Health*, 46, 523-534.
- Collins, J., Wolf, L., Bell, J., & Evanoff, B. (2004). An evaluation of a "best practices" musculoskeletal injury prevention program in nursing homes. *Injury Prevention*, 10, 206-211.
- Corbridge, L., Goldman, A., Shu, Y., Buster, T., & Burnfield, J. (2009 June). *Clinician's muscle effort during partial body weight support treadmill training: Is it hard work?* Paper presented at Physical Therapy, Baltimore, MD.
- Cromie, J., Robertson, V., & Best, M. (2000). Work-related musculoskeletal disorders in physical therapists: Prevalence, severity, risks, and responses. *Physical Therapy*, 80, 336-351.
- Darragh, A. R., Huddleston, W., & King, P. (2009). Work-related musculoskeletal injuries and disorders among occupational and physical therapists. *American Journal of Occupational Therapy*, 63(3), 351-362.
- Evanoff, B., Wolf, L., Aton, E., Canos, J., & Collins, J. (2003). Reduction in injury rates in nursing personnel through introduction of mechanical lifts in the workplace. *American Journal of Industrial Medicine*, 44, 451-457.
- Garg, A., & Owen, B. (1992). Reducing back stress to nursing personnel: An ergonomic intervention in a nursing home. *Ergonomics*, 35, 1353-1375.
- Hornby, T. G., Campbell, D. D., Kahn, J. H., Demott, T., Moore, J. L., & Roth, H. R. (2008). Enhanced gait-related improvements after therapist- versus robotic-assisted locomotor training in subjects with chronic stroke: a randomized controlled study. *Stroke*, 39(6), 1786-1792. Epub May 8, 2008.

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- King, P., Huddleston, W., & Darragh, A. R. (2009). Work-related musculoskeletal disorders and injuries: differences among older and younger occupational and physical therapists. *Journal of Occupational Rehabilitation, 19*(3), 274–283. Epub June 6, 2009.
- Langhorne, P., Coupar, F., & Pollack, A. (2009). Motor recovery after stroke: A systematic review. *Lancet, 8*, 741–754.
- Leigh, J., Markowitz, S., Fahs, M., Shin, C., & Landrigan, P. (1997). Occupational injury and illness in the United States. Estimates of costs, morbidity, and mortality. *Archives of Internal Medicine, 157*(14), 1557–1568.
- Liberty Mutual Insurance. (2001). *The Executive Survey of Workplace Safety*. Retrieved May 25, 2010, from www.mrodaily.com/mropress/083101/a_majority_of_u.htm.
- Marras, W. S., Davis, K. G., Kirking, B. C., & Bertsche, P. K. (1999). A comprehensive analysis of low-back disorder risk and spinal loading during the transferring and repositioning of patients using different techniques. *Ergonomics, 42*, 904–926.
- National Research Council and Institute of Medicine. (2001). *Musculoskeletal disorders and the workplace: Low back and upper extremities*. Washington, DC: National Academy Press.
- Nelson, A. (2006). *Safe patient handling and movement: A practical guide for health care professionals*. New York: Springer.
- Owen, B. D., Garg, A., & Jensen, R. C. (1992). Four methods for identification of most back-stressing tasks performed by nursing assistants in nursing homes. *International Journal of Industrial Ergonomics, 9*, 213–220.
- Rice, M., Wooley, S., & Waters, T. (2009). Comparison of required operating forces between floor-based and overhead-mounted patient lifting devices. *Ergonomics, 52*(1), 112–120.
- Rockefeller, K. (2008). Using technology to promote safe patient handling and rehabilitation. *Rehabilitation Nursing, 33*(1), 3–9.
- Rozenfeld, V., Ribak, J., Danziger, J., Tsamir, J., & Carmeli, E. (2009). Prevalence, risk factors and preventive strategies in work-related musculoskeletal disorders among Israeli physical therapists. *Physiotherapy Research International, April 22*. [Epub ahead of print].
- Silvia, C. E., Blomswick, D. S., Lillquist, D., Wallace, D., & Perkins, M. S. (2002). An ergonomic comparison between mechanical and manual patient transfer techniques. *Work (Reading, Mass.), 19*, 19–34.
- U. S. Department of Labor, Bureau of Labor Statistics. (2007). *Nonfatal occupational injuries and illnesses requiring days away from work, 2006*. Retrieved July 10, 2010, from www.bls.gov/iif/oshwc/osh/case/osnr0029.pdf.
- Waehrer, G., Leigh, J. P., & Miller, T. R. (2005). Costs of occupational injury and illness within the health services sector. *International Journal of Health Services: Planning, Administration, Evaluation, 35*, 343–359.
- Waters, T., Dick, R., Davis-Barkley, J., & Krieg, E. (2007). A cross sectional study of the risk factors for musculoskeletal symptoms in the workplace using data from the general social survey (GSS). *Journal of Occupational and Environmental Medicine, 49*(2), 172–184.
- Waters, T., Nelson, A., Hughes, N., & Menzel, N. (Eds.). (2009). *Safe patient handling training for schools of nursing: Curricular materials*. [DHHS (NIOSH) Pub. No. 2009-127]. Cincinnati, OH: U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health.
- Waters, T., Putz-Anderson, V., Garg, A., & Fine, L. J., (1993). Revised NIOSH equation for the design and evaluation of manual lifting tasks. *Ergonomics, 36*(7), 749–776.
- Webster, B., & Snook, S. (1994). The cost of 1989 workers' compensation low back pain claims. *Spine, 19*(10), 1111–1115.
- Zhuang, Z., Stobbe, T. J., Hsiao, H., Collins, J. W., & Hobbs, G. (1999). Biomechanical evaluation of assistive devices for transferring residents. *Applied Ergonomics, 30*, 285–294.

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The NORA publication cited in this article's reference list offers additional statistics and information related to this editorial's discussion. The document discusses many of the risks encountered in the health-care work environment, challenges connected to the healthcare culture, and recommendations for progress.

References

- Bureau of Labor Statistics & U.S. Department of Labor. (2006, October 19). *Workplace injuries and illnesses in 2005*. Retrieved July 2, 2010, from www.bls.gov/iif/oshwc/osh/os/osnr0025.txt.
- National Occupational Research Agenda Healthcare and Social Assistance Sector Council. (2009). *State of the sector—Health care and social assistance: Identification of research opportunities for the next decade of NORA* (DHHS [NIOSH] Publication No. 2009-139). Cincinnati, OH: Author.