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EVIDENCE-BASED PRACTICES FOR SAFE PATIENT HANDLING AND MOVEMENT

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ABSTRACT

Efforts to reduce injuries associated with patient handling are often based on tradition and personal experience rather than scientific evidence. The purpose of this article is to summarize current evidence for interventions designed to reduce caregiver injuries, a significant problem for decades. Despite strong evidence, published over three decades, the most commonly used strategies have strong evidence that demonstrate they are ineffective. There is a growing body of evidence to support newer interventions that are effective or show promise in reducing musculoskeletal pain and injuries in care providers. The authors have organized potential solutions into three established ergonomic solution types: engineering based, administrative, and behavioral. For each intervention, the level of evidence to support its use is provided.

Key words: work-related musculoskeletal injuries, patient handling, no lift policy, ergonomics, lifting techniques, nurse safety

Strategies to prevent or minimize work-related musculoskeletal injuries associated with patient handling are often based on tradition and personal experience rather than scientific evidence. The most common patient handling approaches in the United States include manual patient lifting, classes in body mechanics, training in safe lifting techniques, and back belts. Surprisingly there is strong evidence that each of these commonly used approaches is not effective in reducing caregiver injuries. A major paradigm shift is needed away from these ineffective approaches towards the following evidence-based practices: (a) patient handling equipment/devices, (b) patient care ergonomic assessment protocols, (c) no lift policies, (d) training on proper use of patient handling equipment/devices, and (e) patient lift teams. Promising new interventions, which are still being tested, include use of unit-based peer leaders and clinical tools, such as algorithms and patient

assessment protocols. Given the complexity of this high-risk, high volume, high-cost problem, multifaceted programs are more likely to be effective than any single intervention. This new call for action includes systematic change in health care facilities across the continuum of care as well as a new curriculum for schools of nursing.

Statement of the Problem

Nursing personnel are consistently listed as one of the top ten occupations for work-related musculoskeletal disorders, with incidence rates of 8.8 per 100 in hospital settings and 13.5 per 100 in nursing home settings (Bureau of Labor Statistics, 2002). These are considered to be low estimates, since underreporting of injuries in nursing is common (U.S. Department of Health & Human Services, 1999). Aggregated data on prevalence of back injury, compiled from over 80 studies, revealed an international worldwide point prevalence of approximately 17%, an annual prevalence of 40-50% and a lifetime prevalence of 35-80% (Hignett, 1996). While there has been a steady decline in the rates of most occupational injuries starting in 1992, work-related musculoskeletal disorders in nursing continue to rise (Fragala & Bailey, 2003).

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Patient handling and movement tasks are physically demanding, performed under unfavorable conditions, and are often unpredictable in nature. Patients offer multiple challenges including variations in size, physical disabilities, cognitive function, level of cooperation, and fluctuations in condition. As a load to be lifted, they lack the convenience of handles, even distribution of weight, and have been known to become combative during the lift process. Shockingly, the cumulative weight lifted by a nurse in one typical 8-hour shift is equivalent to 1.8 tons (Tuohy-Main, 1997). Further, many patient lifts are accomplished in awkward positions such as bending or reaching over beds or chairs while the nurse's back is flexed (Blue, 1996; Videman et al., 1984).

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There are significant clinical consequences of awkward patient handling and movement, including negative impact on quality of care, patient safety, and patient comfort (Wicker, 2000). Unintended patient adverse events associated with patient handling tasks include decreased resident comfort (U.S. Department of Labor, OSHA, 2002), fear, pain, damage to the shoulder from manual lifting techniques, hip fractures from dropping the patient, bruising of arms, loss of dignity during lifting procedure, increased

dependency, skin tears, and pressure area damage (Tuohy-Main, 1997).

Recruitment and retention of nurses is a serious problem, and the nursing shortage has been exacerbated by occupational injuries and related disabilities. It is estimated that each year 12% of nursing personnel will consider a job transfer to decrease risk and another 12%-18% will actually leave the nursing profession due to chronic back pain (Moses, 1992; Owen, 1989). Work-related musculoskeletal disorders in nursing are quite expensive and include indirect costs associated with temporary hires for replacement personnel, overtime to absorb the duties of an injured worker, legal fees; time loss costs for claim processing, witnesses; decreased output following traumatic event; training temporary and/or replacement personnel (U.S. Department of Labor, OSHA, 2002; Charney, Zimmerman, & Walara, 1991).

High Risk Patient Handling Tasks

Patient handling tasks are performed in diverse clinical settings and there is no one solution or "fix" likely to be successful across all units in a facility. High-risk patient handling tasks are characterized by significant biomechanical and postural stressors imposed on the caregiver. Not surprisingly, factors such as the patient's weight, transfer distance, confined workspace, unpredictable patient behavior, and awkward positions such as stooping, bending, and reaching significantly contribute to the risk of performing patient handling tasks. Few would argue that one of the highest risk patient handling tasks is a patient transfer.

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High-risk patient handling tasks vary by clinical setting. For example, in geriatric, long-term care settings, over 19 stressful tasks have been identified. These tasks focus primarily on vertical transfers of patients, repositioning patients in bed and chairs, and toileting tasks (Bell, Dalgity, Fennell, & Aitken, 1979; Garg & Owen, 1992; Hui, Ng, Yeung, & Hui-Chan, 2001; Owen, 1987; Owen, Keene, Olson, & Garg, 1995; Schibye & Skotte, 2000; & Smedley, Egger, Cooper, & Coggon, 1995). Many of these same tasks are also apparent in acute care settings (Owen, Keene, & Olson, 2000), where additional high-risk tasks include transferring patients on and off stretchers, repositioning a patient in bed, and patient transport in a bed or stretcher. In the operating room, (Garb & Dockery, 1995; Owen, 2000; Wicker, 2000), high risk tasks include standing for long periods of time, lifting and holding patient's extremities, reaching, vertical transfers of patient from bed to stretcher or operating room table, and lifting and moving equipment. One study examined high-risk tasks in rehabilitation/ spinal cord injury units (Nelson, 1996) where high risk tasks included vertical patient transfers, repositioning a patient in bed or wheelchair, and applying anti-embolism stockings. Little work has been done related to high risks tasks in trauma and emergency setting, where much of the

risk is associated with emergency procedures and patient transport. However, a moderate level of evidence is available to support that ambulance work can result in harmful postures, with the highest risks involving transportation of patients on equipment (Doormaal, Driessen, Landeweerd, & Drost, 1995; Furber, Moore, Williamson & Barry, 1997; Massad, Gambin, & Duval, 2000).

Patient transfers in and out of personal vehicles are considered a high-risk task, particularly when the patient is acutely ill.

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There are special challenges associated with safe patient handling and movement in home care. High-risk tasks in home care (Ballard, 1994; Knibbe & Friele, 1996; Owen & Staehler, 2003; Skarplik, 1988) include bed repositioning, performing tasks alone, applying anti-embolism stockings, giving a tub bath, and providing care in non-height adjustable beds.

It is critical to understand the specific high-risk tasks in each setting since solutions must be specifically applied to address each high-risk task identified. For this reason, there is no standard approach to improving nurse safety that can be generalized to diverse clinical practice settings. Solutions that are effective in long term care settings, which focus on safe vertical transfers, are not likely to be useful in critical care where the high risk tasks include lateral transfers and patient transport.

Evidence-Based Solutions For High Risk Patient Handling Tasks

Various types of interventions have been implemented in an attempt to reduce high risk patient handling tasks. An ergonomic approach has been utilized with supporting evidence for solutions proven to be effective, ineffective, and those that show promise. These solutions can be considered as controls and are therefore divided into three categories, namely engineering, administrative, and behavioral controls.

Engineering controls are changes made to the work environment, layout, tools, or equipment used on the job, or changing the way a job is done to avoid work-related musculoskeletal hazards (Virginia Polytechnic Institute and State University, 2004). These controls are the preferred solution because they create permanent changes that eliminate risks at the identified source. An example is the use of patient handling technology, such as lateral transfer aids or hospital bed improvements.

Administrative controls are management-dictated work practices and policies that reduce or prevent exposures to ergonomic risk factors. Administrative control strategies include (a) modification of job rules and procedures (scheduling more

rest breaks), (b) job rotation or modified duties or length of shift, and (c) training workers to recognize ergonomic risk factors so they can adopt stress reduction techniques while performing their work tasks (Centers for Disease Control and Prevention [CDC], 1997). Examples of administrative controls include a no lift policy (explained later in this article), patient care assessment protocols, and use of clinical tools such as algorithms.

Behavioral or work practice controls are those that involve training of staff in body mechanics, or other joint protection principles (Shepherd, 2001). Such techniques include manual patient lifting, training in proper use of lifting equipment/devices, and the use of unit-based peer leaders.

Engineering Controls

In today's health care environment the two key engineering controls being used to reduce risk to caregivers include back belts and patient handling equipment and devices. Of these, there is evidence to support only one: use of patient handling equipment and devices. Each will be briefly described.

Although in the 1990s back belts were used to prevent work-related injuries...there is no evidence these belts are helpful.

Back belts. Use of back belts in protecting the low back from injury has been a longstanding debate in many industries as well as health care. Although in the 1990s back belts were used in nursing to prevent work-related injuries (Nelson, Fragala, & Menzel, 2003a), there is no evidence these belts are helpful (Alexander, Woolley, & Bisesi 1995; National Institute of Occupational Safety and Health [NIOSH] Back Belt Working Group, 1994; Wassell, Gardner, Landsittel, Johnston, & Johnson, 2000). Back belts are described as breathable, lightweight bands, with double-sided pulls, which allow for different levels of pressure and tautness. Those promoting the use of back belts claim they (a) decrease internal spinal forces during forceful exertions of the back, (b) increase intra-abdominal pressure to counteract spinal forces, (c) stiffen the spine, (d) restrict bending motions, and (e) remind the wearer to lift properly (Nelson et al., 2003a). However, other studies show that intrabdominal pressure does not play a significant role in relieving intradiscal pressure or tension in back extensors (Gracovetsky, Farfan, & Lamy, 1981; Gilbertons, Krag, & Pope 1983; Legg, 1981; Marras, King & Joynt, 1984; McGill & Norman, 1986; Pope et al., 1991), nor is there a relationship between intrabdominal pressure and abdominal musculature (Hemborg & Moritz, 1985; Marras et al., 1993). Two laboratory tests were conducted and findings indicated that with back belt use, there was a significant reduction in average oxygen consumption, but no effect on blood pressure, heart rate or rate of breathing (Bobick, Beland, Hsiao, & Wassell, 2001). Another study found that there was no association between the use of back belts and reduced

incidence of low back pain or back injury (Wassell et al., 2000). According to NIOSH, there is strong evidence that back belts will not be effective in prevention of nursing injuries (NIOSH, 1994).

A more efficient engineering control strategy than back belts is the utilization of patient handling equipment and devices.

Patient handling equipment and devices. A more efficient engineering control strategy than back belts is the utilization of patient handling equipment and devices. Although the evidence supporting the use of mechanical and lifting devices within the health care industry has been mixed, this strategy shows promise. Technology is often incorporated into educational programs and all components are offered together, making it difficult to attribute success to one specific strategy. Another reason that explains why evidence is mixed is because some studies depend on retrospective data (Aird, Nyran, & Roberts, 1988). A review of the literature indicates a need for clinical trials aimed at the prevention of patient handling injuries in health care.

Several technological solutions have been found effective in addressing high-risk tasks. For example, the use of height-adjustable beds and electric beds has proven to have a positive effect in reducing caregivers' strain during patient handling tasks, such as bathing (DeLooze et al., 1994; Knibbe & Friele, 1996; Knibbe & Knibbe, 1995).

...the use of ceiling mounted lifts is becoming a popular choice...Research has shown that this technology...allows for the vertical transfers of patients (bed to chair, floor to bed/chair) without lifting manually.

Many studies concur that mobile mechanical devices have a positive impact on health care workers and on work related injuries (Daynard et al., 2001; Evanoff, Wolf, Alton, Canos, & Collins, 2003; Garg, Owen, Beller, & Banaag, 1991a; 1991b; Yassi et al., 2001). While these devices have decreased risk of injury to caregivers during vertical transfers, the use of ceiling mounted lifts is becoming a popular choice when applicable. Research has shown that this technology is well supported and accepted by health care staff for many reasons. A ceiling lift allows for the vertical transfers of patients (bed to chair, floor to bed /chair) without lifting manually. The patient is suspended in a sling from an overhead track and this track allows patient care activities to be performed within the coverage area of the track. Ceiling lifts require less time for transfers than floor based mobile lifts; are stored overhead on a track and are a lucrative investment (Holliday, Fernie, & Plowman, 1994; Ronald et al., 2002; Villeneuve, 1998). One understudied area is the task of repositioning a patient in bed, as reflected in the associated injuries.

Few evidence-based studies agree that this critical task places caregivers at an increased risk of back injury due to high spinal loads. Although the two-person draw sheet repositioning technique has the lowest low back disorder risk, spinal loads were still high, thus increasing the risk of a back injury (Marras, Davis, Kirking, & Bertsche, 1999). Repositioning devices are already commercially available for use in the health care industry but many nursing staff do not know these exist. Similar to repositioning devices, lateral transfer aids such as friction reducing slide sheets, air assisted devices or mechanical aids are available for use and research has shown that lateral patient transfers also place caregivers at an increased risk of injury (Bohannon, 1999; Bohannon & Grevelding, 2001; Lloyd & Baptiste, 2004 [in press]; Zelenka, Floren, & Jordan, 1996). Many reasons explain why lateral transfers would be considered a high risk task for the caregiver: (a) horizontal reach across to the patient's bed to hold the draw sheet, prior to pulling the patient; (b) posture adopted during task; (c) weight of patient; and (d) lack of handles-poor coupling.

Another problematic task is turning a patient in bed. It is a task performed frequently by nurses and ranked as a task placing caregivers at increased risk of injury (Gagnon, Akre, & Chehade, 1987a; Gagnon, Chehade, Kemp & Lortie, 1987b; Gagnon, Roy, Lortie & Roy, 1988). Beds now have built in features that have mechanized this task of turning a patient to one side, called lateral rotation therapy. This works by inflating specific air bags on one side of the bed while deflating the other side, thus turning the patient to his/her side.

Traditionally, transferring patients from a sitting position to standing one has been performed without any assistive device, but the use of gait belts are a popular low cost solution. These devices are placed around the patient's waist and some offer handles which are beneficial to caregivers, as they can perform the transfer more comfortably without suffering a hand or other injury. Moderate evidence indicates that one caregiver should not use a gait belt for vertical transfers of weight bearing patients (Gagnon et al., 1987a; 1987b; 1988).

While there is agreement that patient handling devices are necessary for safety, (Daynard et al., 2001; Garg et al., 1991a; 1991b; Smedley et al. 1995), several barriers to use of equipment have been identified, including:

- Patient aversion of the equipment
- Unstable equipment or operationally difficult to use
- Storage issues/equipment is located in an inconvenient place
- Poor maintenance and cleaning of equipment
- Time constraints

- Inadequate number of available lifts
- No training on device on floors with high turnover levels
- Space restrictions to control equipment
- Incompatible equipment purchased
- Weight limitations

(Bell, 1987; Bewick & Gardner, 2000; Daynard et al, 2001; Evanoff et al., 2003; Garg et al., 1991a; Green, 1996; Laflin & Aja, 1994; McGuire & Dewar, 1995; McGuire, Moody & Hanson, 1996, 1997; Meyer, 1995; Moody et al, 1996; Nelson, 2001; Nelson, 2003a; Nelson et al., 2003b; Newman & Callaghan, 1993; Owen & Garg, 1991; Retsas & Pinikahana, 2000; Switzer & Porter, 1993; Takala & Kukkonen, 1987; Yassi et al., 2001).

Increased use of patient handling devices can be accomplished through making some improvements regarding design of overhead and mobile mechanical lifts. There is moderate evidence to support the need for improvements with sling design (MDA, 1994; Norton, 2000), position of brakes and handles, mechanisms for raising and lowering, maneuverability (Bell, 1984), and training for proper use of lifts (Olsson & Brandt, 1992). Other issues that need attention are patient dignity and lift instability (Le Bon & Forrester, 1997; McGuire et al., 1996).

Administrative Controls

There are three primary administrative controls being deployed in the United States to reduce injuries associated with patient handling and movement. These controls are no lift policies, ergonomic assessments of patient care areas, and use of patient lift teams. Each will be briefly discussed.

No lift policy. Internationally, health care institutions individually, or as part of national legislation, have developed and implemented policies to address the work-related risk associated with patient handling and movement tasks. These policies vary in wording, but the intent is consistent—that care providers should avoid manual handling in virtually every patient care situation. While the term "No Lift Policy" is most common, it is also known as "Zero Lift," "Minimal Lift," "Lift-free," or "Safe Patient Handling and Movement" there is some confusion with this concept. Common misconceptions about a "No Lift" policy include (a) nurses should never attempt to move a patient, (b) nurses should not use lift equipment, and (c) the policy only applies to high risk tasks associated with patient lifts, and ignores other high risk tasks. The concept of a no lift policy is a pledge from administrators that proper equipment, adequately maintained and in sufficient numbers, will be available to care providers to reduce the risks associated with manual patient handling. Manual patient handling is broadly defined as the transporting or supporting of a patient by hand or bodily force, including pushing, pulling, carrying, holding, and supporting of the patient or a body part (Manual Handling Operations Regulations [MHOR], 1992). In the last few months, the national "No Lift Policy" in the United Kingdom has been challenged in the courts by the family of two disabled young girls who claimed that the focus on "no manual lifting" interfered with their quality of life in the community. The United Kingdom is addressing a plan to address this issue.

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The first national policy was enacted in the United Kingdom in 1992 to implement minimum ergonomic standards and reduce the injury rates associated with manual patient handling (MHOR, 1992). Later, clinical guidelines were introduced by the Royal College of Nursing (RCN) (RCN, 1996). Since then, we have seen similar legislation in Australia (personal communication C. Hayne, as cited in Collins, 1990; Retsas & Pinikahana, 2000), Canada (www.interiorhealth.ca), and several other countries in Europe. Central to all national no lift policies is that manual lifting of patients is to be eliminated in all but exceptional or life threatening situations. To clarify this intent, several other key factors have been included:

- Patients should be encouraged to assist in their own transfers and handling aids must be used whenever possible to help reduce risk if this is not contrary to a patient's needs.
- Manual lifting may only be continued if it does not involve lifting most or all of a patient's weight.

- A no-lift policy does not mean health care providers will never transfer or reposition any resident manually, but rather needs to be based on patients' physical and cognitive status as well as medical conditions.
- Proper infrastructure must be in place before a no lift policy is enforced. Infrastructure is defined as management commitment and support, availability of patient handling equipment, equipment maintenance, employee training, advanced training for resources, and a culture of safety. The culture of safety approach includes collective attitude of employees at all levels taking a shared responsibility for safety in the work environment and by doing so providing a safe environment for themselves and patients.
- In some countries, specific high-risk manual handling techniques have been banned. For example in Canada, the one-person low pivot manual transfer and two person side-by-side transfer is banned while in England hazardous manual lifts such as the drag lift, cradle lift, shoulder lift, and others have been banned.
  (Hignett et al., 2003; Musculoskeletal Injury, 2003; Retsas & Pinikahana, 2000)

The Royal College of Nursing was credited for first proposing the concept of a "lift free hospital." Despite over a decade head start in addressing this problem, the challenge of providing proper equipment in every facility is still a challenge, as is getting nurses to change manual patient handling practices they learned in school. Despite the challenges, the United Kingdom has seen significant decreases in patient handling injuries (National Audit Office [NAO], 2003).

The ANA recently issued a position statement supporting ...the elimination of manual patient lifting to promote a safe environment of care...

The concept of no lift policy has been slow to be accepted in the United States. There are no national or state-wide efforts for legislative action in this area. In 2004, however, the American Nurses Association (ANA) developed a program, "Handle with Care" that supports safe practices for patient handling. The ANA recently issued a position statement supporting actions and policies that result in the elimination of manual patient lifting to promote a safe environment of care for nurses and patients, which is posted on the ANA web site (ANA, 2003). For further details refer to the OJIN article on *Handle With Care: The American Nurses Association's Campaign to Address Work-Related Musculoskeletal Disorders* by Dr. de Castro located in this topic about Nurse Safety.

The effectiveness of no lift policies has been documented in research studies (The State of the CDC, n.d.; Nelson & Fragala, 2004). Nelson et al. (2004) successfully implemented a no lift policy as an integral part of a comprehensive safe patient handling and movement programs in acute care hospitals and long-term care facilities. Similar findings were obtained in studies conducted by the National Institute for Occupational Safety and Health (NIOSH) and BJC Health Care in long-term care facilities (www.cdc.gov) and in seven nursing homes and one hospital by researchers at the University of Wisconsin-Milwaukee.

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In 2003, OSHA released ergonomics guidelines for nursing homes (U.S. Department of Labor, OSHA, 2002) to reduce the number and severity of work related musculoskeletal disorders. These serve as advisory recommendations rather than an enforceable standard. Specific recommendations include:

- Manual lifting of residents should be minimized in all cases and eliminated where feasible.
- Employers should implement an effective ergonomics process that provides management support, involves employees, identifies problems, implements solutions, addresses reports of injuries, provides training, and evaluates ergonomics efforts (U.S. Department of Labor, OSHA, 2002).

Patient care ergonomic assessment protocols. The way patient handling tasks are performed varies widely from one institution to another and is often dependent upon available lifting aids. Due to lack of equipment, caregivers sometimes use these aids inappropriately and fail to match specific patient characteristics to the equipment (Ergonomic Technical Advisory Group, 2001 [Chapter 5]) Standardization of patient assessment protocols and algorithms for safer transfers could greatly benefit all caregivers (Nelson et al., 2003a; Nelson & Fragala, 2004; U.S. Department of Labor, Occupational Safety and Health Administration, 2003). Communication amongst nurses is improved when there are standardized protocols and policies (Nelson, Lloyd, Menzel & Grosset, 2003b).

Patient lift teams. Several clinical trials have been conducted on patient lift teams and found this intervention to be effective in decreasing the lost days, restricted workdays, and compensable injury costs (Caska, Patnode, & Clickner, 1998; Charney et al., 1991; Charney, 1992; 1997; 2000; Davis, 2001; Donaldson, 2000; Meittunen, Matzke, McCormack, & Sobczaket, 1999). The definition of a lifting team includes two physically fit people, competent in lifting techniques, who work together to perform high-risk patient transfers (Meittunen et al.). This term is referred to as "patient transfer team," "lift team" or a combination of these phrases. To help other caregivers perform their duties, high risk patient handling

tasks are assigned to a select few well trained nursing staff. Selection of lift team members is based on individuals with no prior history of a musculoskeletal injury and is dependent upon their physical strength and capabilities. Once selected, they are trained on the use of mechanical lifting devices. The significance of a lift team is evident by the elimination of critical risk factors that contribute to nursing back injuries: (a) lifts that are uncoordinated, (b) unprotected personnel, (c) lifting pairs with anthropometric disparities, (d) fatigue in nurses who lift, (e) injured nurses who lift, (f) lack of using mechanical lifting devices, and (g) lifters who are untrained.

There are several considerations in organizing a lift team. Shortages in nursing staffing make it difficult to hire members for the team, and those selected have to pass a physical exam, have a radiograph of their spine, and have no history of a back injury. Finding staff to fulfill these requirements may be difficult and even considered unfair in the United States (Caska & Patnode, 2000).

First, there are some challenges with lift team use especially when there is staff shortage in one area. Identification of high-risk units and assignment of scheduled versus unscheduled lifts can be a possible solution. A one-year study of patient lift teams was completed at a 220-bed acute care facility and was found to reduce back injuries in nursing (Charney, 2000). The method was to use an already existing transport team of 20 people as a lift team with the addition of mechanical patient lifting equipment.

The second issue is the use of lift teams in areas where transfers are performed frequently (e.g. extended care or geriatric units). Although Charney found that a team of orderlies completed 30 lifts/day and met 95% of day shift lifts in a large hospital, resulting in a significant reduction in lost time accidents, the applicability of these findings remains in question, because most health care facilities perform more than 30 patient lifts per day (Charney et al., 1991; Charney, 1992). Further examination is needed to ascertain whether positive findings are due to the addition of more staff or the lift team itself.

Thirdly, some high-risk tasks such as repositioning a patient in bed, toileting or dressing a patient are not addressed by lift team intervention and therefore cannot accommodate these requests. Finally, reduction of injury risk needs to be addressed on all nursing shifts, which means the lift team needs to be available all the time. Besides these mentioned challenges, one of the most important restrictions for the success of a lift team is the infrastructure. Proper equipment, programmatic support, adequate training, clear policy and procedures, good communication, and a culture of safety are key to the success of lift teams.

Behavioral Controls

The key behavior based controls being used to reduce risk to caregivers include: (a) manual patient handling and lifting, (b) classes in body mechanics and training in lifting techniques, (c) training in safe use of patient handling equipment, (d) peer leaders, and (e) clinical tools such as patient assessment protocols and algorithms. Of these, there is evidence to support only the last three. Each is briefly described.

Nearly every nurse in the United States was taught manual patient handling techniques...despite the fact that these techniques are not evidence-based, [and] have been found to be unsafe for the nurse and the patient...

Manual patient handling and lifting. Nearly every nurse in the United States was taught manual patient handling techniques.This is despite the fact that these techniques are not evidence-based, have been found to be unsafe for the nurse and the patient (Corlett et al., 1993) and are banned in Europe (Corlett et al., Hignett et al., 2003). Sadly, an evaluation of current practices reveal that 98% of nurses are using the manual patient lifting technique known as the "Hook and Toss" method (also known as the Drag Lift) (Owen et al., 1995), which has been deemed unsafe since 1981. The primary reason this lift is used so extensively in the United States is that it is taught by 83% of nurse educators in schools of nursing (Owen, 1999). Described in the literature as "deplorable.... inefficient, dangerous to the nurses, and often painful and brutal to the patient" (Owen, 1999, p.15), it seems old habits are difficult to break. Even in the United Kingdom, which has national legislation in this area, new nursing staff are receiving proper training, but experienced nurses and nurse managers continue with manual handling approaches and seem to be unaware of new approaches and technologies (Corlett et al.; Hignett et al.).

Traditional training *(classes in body mechanics and training in lifting techniques).* Although it is widely accepted that classes on body mechanics and/or training in lifting techniques prevent job-related injuries, thirty-five years of research reveal that these efforts have consistently failed to reduce the job-related

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injuries in patient care settings (Anderson, 1980; Brown, 1972; Buckle, 1987; Daltroy, 1997; Daws, 1981; Dehlin, Hedenrud, & Horal, 1976; Feldstein, Valanis, Vollmer, Stevens, & Overton, 1993; Harper et al. 1994; Hayne, 1984; Hignett, 1996; Hollingdale & Warin, 1997; Lagerstrom & Hagberg, 1997; Owen & Garg, 1991; Shaw, 1981; Snook, Campanelli, & Hart, 1978; Stubbs, Buckle, Hudson, & Rivers, 1983; Venning, 1988; Wood et al., 1987). While training may improve patient handling and lifting skills in the short term (Feldstein et al., 1993), it has no impact in reducing injuries or musculoskeletal pain. Despite the fact that there is 35 years of evidence that these interventions are not effective, classes in body mechanics and training in lifting techniques remain the primary solution used by health care facilities in the United States.

Education and training in proper use of patient handling equipment. Training in body mechanics and body awareness has been shown to be ineffective. Studies teaching manual lifting techniques have been unsuccessful in changing work practices or affecting injury rates as previously indicated (Billin 1998; Engkvist et al., 2001; Fanello et al., 1999; Harper et al. 1994; Lagerstrom & Hagberg 1997; Nussbaum & Torres 2001; Scopa 1993 ; St Vincent, Tellier, & Lortie, 1989; Stubbs et al., 1983; Troup & Rauhala, 1987; Wachs & Parker, 1987; Wood, 1987).

A more effective approach is to educate and train nursing staff on the use of patient handling equipment emphasizing proper body mechanics. There is strong evidence that patient equipment is not used on units with high turnover due to a lack of training (Bell, 1987; Bewick & Gardner, 2000; McGuire & Dewar, 1995; McGuire et al., 1997; Meyer, 1995; Moody et al., 1996; Retsas & Pinikahana, 2000; Switzer & Porter, 1993). Several studies support the significance of training on equipment related to patient handling for a successful program in injury prevention (Collins, Wolf, Bell, & Evanoff, 2004; Lynch & Freund, 2000; Nelson & Fragala, 2004; Owen et al., 2002; Retsas & Pinikahana, 2000). Positive results indicate that there is a need for new education models to assure competency when using patient handling equipment. Ongoing training is key in health care settings for nurses to achieve proficiency and comfort on equipment use (Nelson et al., 2004; NIOSH, 2001).

Peer leaders as new education model. New education models are needed for assuring competency in use of patient handling technology and new ongoing training practices are needed in health care settings where nurses are employed (Nelson et al., 2004; NIOSH, 2001). One new model that shows promise is use of local peer leaders. A peer safety leader is defined as a nursing staff member who

with coworkers. Unit peer leaders foster knowledge transfer and forge a direct connection between staff and program goals (Paraprofessional Healthcare Institute, 2003). Peer safety leaders have been called Back Injury Resource Nurses (BIRNs) (Nelson et al., 2004), Ergo Rangers (Collins et al., 2004), and Ergo Coaches. Further research is needed regarding this new educational model to promote nurse safety.

Clinical tools *(algorithms and patient assessment tools)*. Clinical tools are useful for applying research to practice and reducing unnecessary variation in practice. Caregivers have become accustomed to using whatever limited lifting aids are available, when accessible, rather than carefully matching equipment to specific patient characteristics. (Nelson, 2001). Use of patient assessment protocols and algorithms can provide a standardized way to assess patients and make appropriate decisions about how to safely perform high-risk tasks (Nelson et al., 2003a; 2004; U.S. Department of Labor, OSHA, 2002). Such a system provides a clear communication between nurses on a unit (Nelson et al., 2003c).

Internationally, nurses have developed useful clinical tools for safer patient handling as described below. In Britain, a Hazard Movement Code was developed (Hayne, 1990); in Canada, a system was developed by the Health Care Occupational Health and Safety Association in Ontario, and in Australia, a system was developed using figures and pictorial notations (Health Care Occupational Health and Safety Association, 1986). In the United States, Nelson and colleagues (Nelson, 2004) developed a patient assessment and series of algorithms for safe patient handling. Each of these tools assist nurses in selecting the safest equipment, technique, and number of staff needed to perform safe patient handling tasks based on specific patient characteristics (Nelson et al., 2003b). The use of assessment and algorithms ensure that patients receive assistance appropriate for their functional level, thus improving safety for patients as well as staff. Nelson's assessment and algorithms were included in the OSHA Ergonomic Guidelines for Nursing Homes (Nelson, 2001; U.S. Department of Labor, OSHA, 2002). Key aspects of patient assessment include:

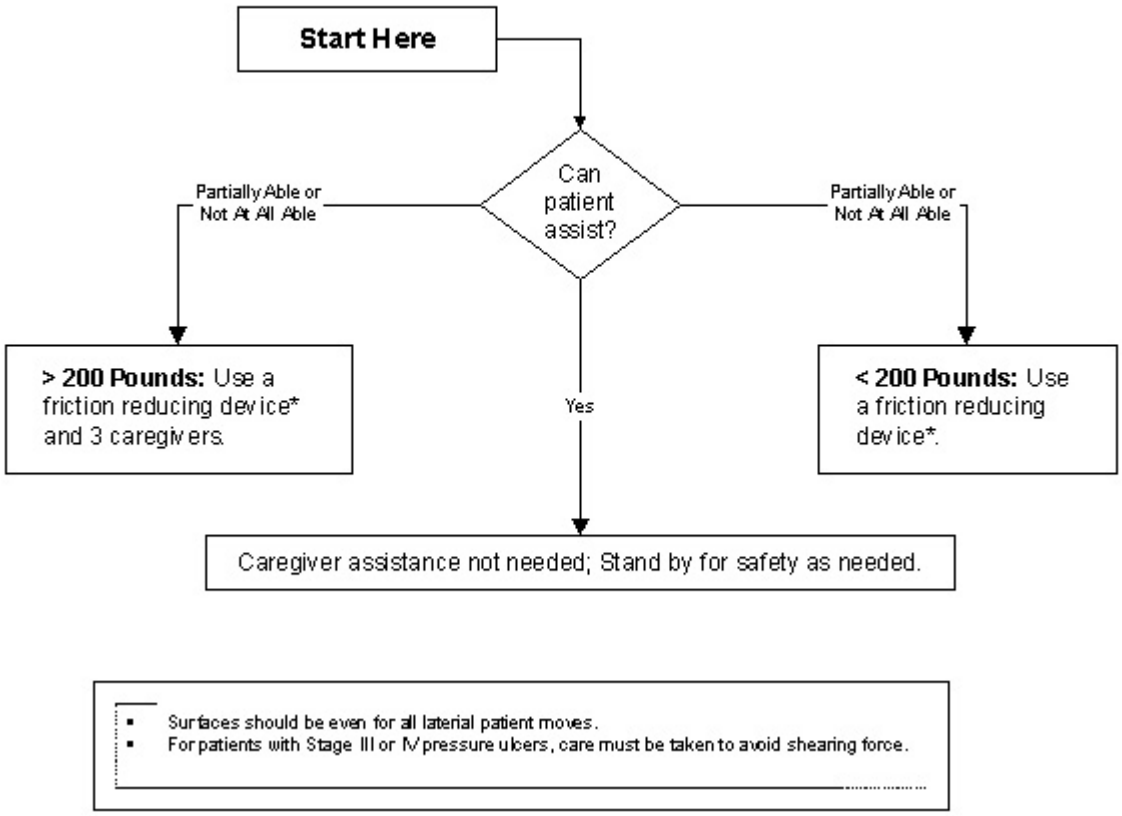
- Ability of the patient to provide assistance.
- Ability of the patient to bear weight.
- Upper extremity strength of the patient.
- Ability of the patient to cooperate and follow instructions.
- Patient height and weight.
- Special circumstances likely to affect transfer or repositioning tasks, such as abdominal wounds, contractures, or presence of tubes, etc.

transferring or repositioning patients (e.g., a patient with a knee or hip replacement may need a specific order or recommendation to maintain the correct angle of knee extension or hip abduction during transfer.)

After the assessment is completed, the information is used to direct recommendations in regards to the proper technique, equipment, and number of staff required for performing high-risk patient handling tasks, through the use of algorithms. Within the scope of patient handling, our operational definition of an algorithm is a procedure consisting of a sequence of logical steps to determine a given task. Nelson and colleagues (Nelson et al., 2003b) developed algorithms for the following high-risk tasks. See Figure 1 for an example of an algorithm.

- Transfer To and From: Bed to Chair, Chair to Toilet, Chair to Chair, or Car to Chair
- Lateral Transfer To and From: Bed to Stretcher, Trolley
- Transfer To and From: Chair to Stretcher, Chair to Chair, or Chair to Exam Table
- Reposition in Bed: Side to Side, Up in Bed
- Reposition in Chair: Wheelchair or Dependency Chair
- Transfer a Patient Up from the Floor
- Bariatric Transfer To and From: Bed to Chair, Chair to Toilet, or Chair to Chair
- Bariatric Lateral Transfer To and From: Bed to Stretcher or Trolley
- Bariatric Reposition in Bed: Side to Side, Up in Bed
- Bariatric Reposition in Chair: Wheelchair, Chair, or Dependency Chair
- Patient Handling Tasks Requiring Sustained Holding of a Limb/Access
- Bariatric Transporting (Stretcher, Wheelchair, Walker)

Figure 1: Algorithm 2: Lateral Transfer to and from: Bed to Stretcher, Trolley



Summary

The purpose of this paper was to summarize current evidence for interventions designed to reduce injuries associated with patient handling tasks. Work-related musculoskeletal injuries associated with patient care have been a problem for decades. Despite strong evidence, published internationally over three decades, most clinical settings have used significant resources to implement strategies that are not evidence-based. There is a growing body of evidence to support interventions that are effective or show promise in reducing musculoskeletal pain and injuries in care providers.

Strategies to prevent or minimize injuries associated with patient handling are often based more on tradition and personal experience rather than scientific evidence. The most common patient handling approaches in the United States include manual patient lifting, classes in body mechanics, training in safe lifting techniques and back belts. Surprisingly there is strong evidence that each of these approaches is NOT effective in reducing caregiver injuries.

...interventions with the strongest level of...evidence-based solutions include...patient handling equipment/devices...ergonomic assessment protocols...no lift policies, and...lift teams.

To date, the interventions with the strongest level of evidence are being implemented in a growing number of facilities; these evidence-based solutions include: (a) use of patient handling equipment/devices, (b) patient care ergonomic assessment protocols, (c) no lift policies, and (d) patient lift teams. Promising new interventions, which are still being tested, include the use of unit-based peer leaders and, clinical tools such as algorithms and patient assessment protocols.

The authors have organized potential solutions into three established ergonomic solution types: engineering based, administrative, and behavioral. For each intervention, the level of evidence to support its use was provided. In some cases there was strong evidence that the intervention was not effective, while others showed evidence to support practice changes. Table 1 is a summary developed by the authors of this article of ergonomic solutions designed to reduce risk associated with patient handling by the type of control and by the level of evidence that supports whether the intervention is effective or ineffective, as well as those that show promise, and where more research is needed.

Table 1: Summary of Solutions Designed to Reduce Risk Associated With Patient Handling by Type of Control and Level of Evidence

Type of Control	Level of Evidence		
	Evidence that the Intervention is Ineffective	Evidence that the Intervention is Effective	Promising New Interventions Under Study
Engineering	Back Belts	Use of Patient Handling Equipment and Devices	
Administrative		Patient care ergonomic assessment	Clinical tools, such as algorithms and patient

		protocols	assessment protocols.
		No lift policies	
		Patient lift teams	
Behavioral	Training in safe lifting techniques	Training in Proper use of Lifting Equipment and devices	Unit-based peer leaders
	Manual patient lifting		
	Classes in body mechanics		

Recommendations

The chasm between current practice and scientific evidence is huge, when assessing interventions to prevent or minimize the risks associated with patient handling. A significant paradigm shift is needed in two areas:

1. Health care facilities need to stop using outdated approaches. The most common patient handling approaches in the United States include manual patient lifting, classes in body mechanics, training in safe lifting techniques and back belts. All of these approaches have been deemed ineffective in reducing caregiver injuries. These outdated approaches should be replaced with evidence-based strategies that include patient handling equipment/devices, patient care ergonomic assessment protocols, no lift policies, and patient lift teams. Promising new interventions, which are still being tested, include use of unit-based peer leaders and clinical tools, such as algorithms and patient assessment protocols.

2. A major change is needed in the current curricula in schools of nursing across the United States. The curriculum change needs to address evidence-based strategies and expose the nursing student to technologies available to reduce risk in the workplace.

Combined, these two recommendations would have a significant impact on nurse safety in the United States. However, the challenges associated with making these changes should not be underestimated. First, behavior is difficult to change. Nurses tend to practice what they learned in school, modified slightly by their work experience over time. A second barrier is that implementation of ergonomic interventions requires significant effort and resources. Thirdly, the outcomes of these interventions are not immediate. Most of the work-related injuries in nursing are cumulative in nature. Interventions put in place today will not prevent injuries that occur as a result of hazard exposures set in motion years ago. Given the nursing shortage, we must overcome these barriers, as we can no longer afford the "human sacrifice" approach to patient handling, defined as replacing the steady stream of injured nurses with newly recruited nurses.

A major change is needed in the current curricula in schools of nursing...to address evidence-based strategies and expose the nursing student to technologies available to reduce risk...

The American Nurses Association and the Veterans Health Administration have both embraced these new evidence-based approaches. It remains to be seen what resources will be mobilized to address this long-standing problem.

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REFERENCES

Aird, J.W., Nyran P., & Roberts, G. (1988). Comprehensive back injury program: An ergonomics approach for controlling back injuries in healthcare facilities. In F. Aghandeh (Ed.), *Trends in ergonomics/human factors V*. Amsterdam: Elselvier (North Holland Division).

Alexander, A., Woolley, S.M., & Bisesi, M. (1995). The effectiveness of back belts on occupational back injuries and worker perception. *Professional Safety, 10,* 22-26.

American Nurses Association. (2003). *Position Statement on Elimination of Manual Patient Handling to Prevent Work-Related Musculoskeletal Disorders.* Retrieved July 20, 2004, from the world wide web at: www.nursingworld.org/readroom/position/workplac/pathand.pdf.

Anderson, J. (1980). Back pain and occupation. In M.I.V. Jayson (Ed.), *The lumbar spine and back pain,* (2nd ed.). London: Pitman Medical Ltd.

Ballard, J. (1994). District nurses—who's looking after them? *Occupational Health Review, Nov/Dec,* 10-16.

Bell, F. (1984). *Patient lifting devices in hospitals.* London: Croom Helm.

Bell, F. (1987). Ergonomic aspects of equipment. *International Journal of Nursing Studies, 24,* 331-337.

Bell, F., Dalgity, M., Fennell, M., & Aitken, R. (1979). Hospital ward patient-lifting tasks. *Ergonomics, 22*(11), 1257-1273.

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

Billin, S.L. (1998). Moving and handing practice in neuro-disability nursing. *British Journal of Nursing, 7*(10), 571-8.

Blue, C.L. (1996). Preventing back injury among nurses. *Orthopaedic Nursing, 15,* 9-22.

Bobick, T.G., Beland, J.L., Hsiao, H., & Wassell, J.T. (2001). Physiological effects of back belt wearing during asymmetric lifting. *Applied Ergonomics, 32*(6), 541-547.

Bohannon, R. (1999). Horizontal transfers between adjacent surfaces: forces required using different methods. *Archive of Physical Medicine Rehabilitation, 80*,

851-853.

Bohannon, R., & Grevelding, P. (2001). Reduced push forces accompany device use during transfers of seated subjects. *Journal of Rehabilitation Research and Development, 38*, 135-139.

Brown, J. (1972). *Manual lifting and related fields. An annotated bibliography.* Toronto, Ontario, Canada: Labor Safety Council of Ontario.

Buckle, P. (1987). Epidemiological aspects of back injuries within the nursing profession. *International Journal of Nursing Studies, 24*(4), 319-324.

Bureau of Labor Statistics. (2002, December 19). *Survey of occupational inquiries and illnesses, 2001.* U.S. Department of Labor.

Caska, B.A., & Patnode, R.E. (2000, September 26). Reducing lower back injuries in VAMC nursing personnel. *Research Report #94-136*. Veterans Health Administration.

Caska, B.A., Patnode, R.E., & Clickner, D. (1998). Feasibility of nurse staffed lift team. *AAOHN Journal, 46*(6), 283-288.

Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (NIOSH). (1997). *Elements of ergonomic programs*. Retrieved July 8, 2004, from the world wide web at: www.cdc.gov/niosh/third.

Charney, W. (1992). News. The lifting team: Second year data reported. *AAOHN Journal, 40*(10), 503.

Charney, W., Zimmerman, K., & Walara, E. (1991). The lifting team: A design method to reduce lost time back injury in nursing. *AAOHN Journal, 39*(5), 231-234.

Charney, W. (1997). The lifting team method for reducing back injuries: A 10 hospital study. *AAOHN Journal, 45*(6), 300-304.

Charney, W. (2000). Reducing back injury in nursing: A case study using mechanical equipment and a hospital transport team as a lift team. *Journal of Healthcare Safety, Compliance, and Infection Control, 4*(3), 117-120.

Collins, J.W., Wolf, L., Bell, J., & Evanoff, B. (2004). An Evaluation of "Best Practices" musculoskeletal injury prevention program in nursing homes. *Injury Prevention, 10*, 206-211.

Collins, M. (1990). *Occupational back pain in nursing: Development, implementation and evaluation of a comprehensive prevention program.* Australia: Worksafe Australia, National Occupational Health and Safety Commission.

Corlett, E.N., Lloyd, P.V., Tarling, C., Troup, J.D.G., & Wright, B. (1993). *The guide to handling patients* (3rd ed.). London: National Back Pain Association and the

Royal College of Nursing.

Daltroy, L. (1997). A controlled trial of an educational program to prevent low back injuries. *The New England Journal of Medicine, 337*, 322-328.

Davis, A. (2001). Birth of a lift team: Experience and statistical analysis. *Journal of Healthcare Safety, Compliance and Infection Control 5*(1), 15-18.

Daws, J. (1981). Lifting and moving patients: A revision training programme. *Nursing Times, 77*(48), 2067-2069.

Daynard, D., Yassi, A., Cooper, J.E., Tate, R., Norman, R., & Wells, R. (2001). Biomechanical analysis of peak and cumulative spinal loads during patient handling activities: a sub-study of a randomized controlled trial to prevent lift and transfer injury health care workers. *Applied Ergonomics, 32,* 199-214.

Dehlin, O., Hedenrud, B., & Horal, J. (1976). Back symptoms in nursing assistants in a geriatric hospital. *Scandinavian Journal of Rehabilitation Medicine, 8*(2), 47-53.

De Looze, M.P., Zinzen, E., Caboor, D., Heyblom, P., Van Bree, E., Van Roy, P., et al. (1994). Effect of individually chosen bed-height adjustments on the low-back stress of nurses. *Scandinavian Journal of Work, Environment & Health, 20*, 427-434.

Donaldson, A.W. (2000). Lift team intervention: A six year picture. *Journal of Healthcare Safety, Compliance and Infection Control, 4*(2), 65-68.

Doormaal, M., Driessen, A., Landeweerd, J., & Drost, M.R. (1995) Physical workload of ambulance assistants. *Ergonomics, 38*(2), 361-76.

Engkvist, I-L., Kjellberg, A., Wigaeus, H.E., Hagberg, M., Menckel, E., & Ekenvall, L. (2001). Back injuries among nursing personnel – identification of work conditions with cluster analysis. *Safety Science, 37*, 1-18.

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.

Fanello, S., Frampas-Chotard, V., Roquelaure, Y., Jousset, N., Delbos, V., Jarmy, J., et al. (1999). Evaluation of an educational low back pain prevention program for hospital employees. *Revue Du Rhumatisme (Eng. Ed.), 66*(12), 711-716.

Feldstein, A., Valanis, B., Vollmer, W., Stevens, N., & Overton, C. (1993). The back injury prevention project pilot study: Assessing the effectiveness of back attack. An injury prevention program among nurses, aides, and orderlies. *Journal of Occupational Medicine, 35*, 114-120.

Fragala, G., & Bailey, L.P. (2003). Addressing occupational strains and sprains:

musculoskeletal injuries in hospitals. *AAOHN Journal, 51*(6), 252-259.

Furber, S., Moore, H., Williamson, M., & Barry, J. (1997). Injuries to ambulance officers caused by patient handling tasks. *Journal of Occupational Health & Safety – Australia & New Zealand, 13*(3), 259-65.

Gagnon, M., Akre, F., Chehade, A., Kemp, F., & Lortie, M. (1987a). Mechanical work and energy transfers while turning patients in bed. *Ergonomics, 30*, 1515-1530.

Gagnon, M., Chehade, A., Kemp, F., & Lortie, M. (1987b). Lumbo-sacral loads and selected muscle activity while turning patients in bed. *Ergonomics, 30*, 1013-32.

Gagnon, M., Roy, D., Lortie, M., & Roy, R. (1988). Evolution of the execution parameters on a patient handling task*. La Travail Humain, 51*, 193-210.

Garb, J.R., & Dockery, C.A. (1995). Reducing employee back injuries in the perioperative setting. *AORN Journal, 61*(6), 1046-1052.

Garg, A., & Owen, B. (1992). Reducing back stress to nursing personnel: an ergonomic intervention in a nursing home. *Ergonomics, 35*(11), 1353-1375.

Garg, A., Owen, B., Beller, D., & Banaag, J. (1991a) A biomechanical and ergonomic evaluation of patient transferring tasks: Bed to wheelchair and wheelchair to bed. *Ergonomics, 34*, 289-312.

Garg, A., Owen, B., Beller, D., & Banaag, J. (1991b). A biomechanical and ergonomic evaluation of patient transferring tasks: wheelchair to shower chair and shower chair to wheelchair. *Ergonomics, 34*, 407-419.

Gilbertons, L.G., Krag M.H., & Pope, M.H. (1983). Investigation of the effect of intra-abdominal pressure on the load bearing of the spine. *Transactions of the Orthopedic Research Society, 8*, 177.

Gracovetsky, S., Farfan, H.F., & Lamy, C. (1981). The mechanism of the lumbar spine, *Spine, 6*, 249-262.

Green, C. (1996). Study of the moving and handling practices on two medical wards. *British Journal of Nursing, 5*, 303-11.

Harper P., Pena, L., Hsu, P., Billet, E., Greer, D., & Kim, K. (1994). Personal history, training and worksite as predictors of back pain of nurses. *American Journal of Industrial Medicine, 25*, 519-526.

Hayne, C. (1984). Ergonomics and back pain. *Physiotherapy, 70*(1), 9-13.

Health Care Occupational Health and Safety Association. (1986). *Transfer and lifts for caregivers.* Ontario, Canada: HCOSHA Publications.

Hemborg, B., & Moritz, U. (1985). Intra-abdominal pressure and trunk muscle activity during lifting. *Scandinavian Journal of Rehabilitation Medicine, 17*, 5-13.

Hignett. S. (1996). Work-related back pain in nurses. *Journal of Advanced Nursing, 23*(6), 1238-1246.

Hignett, S., Crumpton, E., Ruszala, S., Alexander, P., Fray, M., & Fletcher, B. (2003). Evidence-based patient handling: systematic review. *Nursing Standard, 17*(33), 33-36.

Holliday, P.J., Fernie, G.R., & Plowman, S. (1994). The impact of new lifting technology in long-term care. *AAOHN Journal, 42*, 582-589.

Hollingdale, R., & Warin, J. (1997). Back pain in nursing and associated factors: a study. *Nursing Standard, 11*(39), 35-38.

Hui, L., Ng, G.Y.F., Yeung, S.S.M., & Hui-Chan, C.W.Y. (2001). Evaluation of physiological work demands and low back neuromuscular fatigue on nurses working in geriatric wards. *Applied Ergonomics, 32*, 479-483.

Knibbe, J.J., & Friele, R.D. (1996). Prevalence of back pain and characteristics of the physical workload of community nurses. *Ergonomics, 39*, 186-198.

Knibbe, N., & Knibbe, J.J. (1995). Postural load of nurses during bathing and showering of patients. *Internal Report* . The Netherlands: Locomotion Health Consultancy.

Laflin, K., & Aja, D. (1994). Healthcare concerns related to lifting: an inside look at intervention strategies. *The American Journal of Occupational Therapy, 1*, 63-72.

Lagerstrom M., & Hagberg, M. (1997). Evaluation of a 3-year education and training program for nursing personnel at a Swedish hospital. *AAOHN Journal, 45*, 83-92.

Le Bon, C., & Forrester, C. (1997). An ergonomic evaluation of a patient handling device: the elevate and transfer vehicle. *Applied Ergonomics, 28*, 365-374.

Legg, S.J. (1981). The effect of abdominal muscle fatigue and training on the intra-abdominal pressure developed during lifting. *Ergonomics, 24*, 191-195.

Lloyd, J., & Baptiste, A. (2004, In Press). Biomechanical evaluation of friction-reducing devices for lateral patient transfers. *Research Rehabilitation & Development Journal*.

Lynch, R.M., & Freund, A. (2000). Short-term efficacy of back injury intervention project for patient care providers at one hospital. *AIHAJ: Journal for the Science of Occupational & Environmental Health & Safety, 61*, 290-294.

Manual handling operations regulations. (1992). London: The Stationery Office.

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*(7), 904-926.

Marras, W.S., King, A.I., & Joynt, R.L. (1984). Measurements of loads on the lumbar spine under isometric and isokinetic conditions. *Spine, 9*(2), 176-187.

Marras, W.S., Lavender, S.A., Leurgans, S.E., Rajulu, S.L., Allread, W.G., Fathallah, F.A. et al. (1993). The role of the dynamic three-dimensional trunk motion in occupationally-related low back disorders. *Spine, 18*(5), 617-628.

Massad, R., Gambin, C., & Duval, L. (2000). The contribution of ergonomics to the prevention of musculoskeletal lesions among ambulance technicians. *Proceedings of the IEA2000/HFES 2000 Congress, The Human Factors and Ergonomics Society, California: Santa Monica, 4*, 201-204.

McGill, S.M., & Norman, R.W. (1986). Partitioning of the L4/L5 dynamic moment into disc, ligamentous and muscular components during lifting. *Spine, 11*(7), 666-678.

McGuire, T., & Dewar, J. (1995). An assessment of moving and handling practices among Scottish nurses*. Nursing Standard, 9*, 35-39.

McGuire, T., Moody, J., & Hanson, M. (1997). Managers attitudes towards mechanical aids*. Nursing Standard, 11*, 33-38.

McGuire, T., Moody, J., & Hanson, M. (1996). An evaluation of mechanical aids used within NHS. *Nursing Standard, 11*, 33-38.

MDA. (1994). *Slings to accompany mobile domestic hoists.* Norwich: HMSO.

Meittunen, E.J., Matzke K., McCormack, H., & Sobczak, S.C. (1999). The effect of focusing ergonomic risk factors on a patient transfer team to reduce incidents among nurses associated with patient care. *Journal of Healthcare Safety, Compliance and Infection Control, 2*(7), 306-312.

Meyer, E. (1995). Patient lifter in a practical test. a spine-saving aid or bulk in the storage room? *Pflege Aktuell, 49*, 597-600.

Moody, J., McGuire, T., & Hanson, M. (1996). A study of nurses' attitudes towards mechanical aids. *Nursing Standard, 11*, 37-42.

Moses, E.B. (Ed.). (1992). *The registered nurse population: Findings from the national sample survey of registered nurses.* Washington DC: U.S. Department of Health and Human Services, U.S. Public Health Service, Division of Nursing.

Musculoskeletal injury: A practical guide to resident handling. (2003). Retrieved September 2, 2004 from the world wide web at www.interiorhealth.ca/Information/Documents/Documents?MSIP+Manual.htm

National Audit Office. (2003). *A safer place to work: Improving the management of health and safety risks to staff in NHS trusts.* Retrieved July 20, 2004, from www.nao.gov.uk/publications/nao_reports/02-03/0203623.pdf.

National Institute of Occupational Safety & Health (NIOSH). (2001). *National research agenda (NORA), 2001.* Atlanta, GA: DHHS (NIOSH) Publication No. 2001-147.

National Institute of Occupational Safety & Health (NIOSH) Back Belt Working Group. (1994). *Workplace use of back belts: Review and recommendations* (Publication No. 94-122). Rockville, MD: National Institute for Occupational Safety and Health. Retrieved July 8, 2004 from http://www.cdc.goc/niosh/94-122.html.

Nelson, A. (1996). *Unpublished research data from pilot study.* Tampa, FL: James A. Haley Veterans Administration Medical Center.

Nelson, A.L. (Ed.). (2001). *Patient care ergonomics resource guide: Safe patient handling and movement.* Tampa, FL: Veterans Administration Patient Safety Center of Inquiry.

Nelson, A.L., & Fragala, G. (2004). Equipment for safe patient handling and movement. In W. Charney and A. Hudson (Eds.). *Back injury among healthcare workers*, pp. 121-135. Washington, DC: Lewis Publishers.

Nelson, A.L., Fragala, G., & Menzel, N. (2003a). Myths and facts about back injuries in nursing. *American Journal of Nursing, 103*, 32-40.

Nelson, A.L., Lloyd, J., Menzel, N., & Gross, C. (2003b). Preventing nursing back injuries: redesigning patient handling tasks. *AAOHN Journal, 51*(3), 126-134.

Nelson, A.L., Owen, B., Lloyd, J., Fragala, G., Matz, M., Amato, M., et al. (2003). Safe Patient Handling & Movement. *American Journal of Nursing, 103*(3), 32-43.

Newman, S., & Callaghan, C. (1993). Work-related back pain. *Occupational Health (London), 45*, 201-205.

Norton, L. (2000). *An ergonomic evaluation into fabric slings used during the hoisting of patients.* Unpublished master of science dissertation, University of Nottingham.

Nussbaum, M.A., & Torres, N. (2001). Effects of training in modifying working methods during common patient-handling activities. *International Journal of Industrial Ergonomics, 27*, 33-41.

Olsson, G., & Brandt, A. (1992). *An investigation of the use of ceiling mounted hoists for disabled people.* Denmark: Danish Centre for Technical Aids for Rehabilitation and Education.

Owen, B. (1987). The need for application of ergonomic principles in nursing. *Trends in Ergonomics: Human Factors IV*, 831-838.

Owen, B. (1989). The magnitude of low-back problems in nursing. *Western Journal of Nursing Research, 11*, 234-242.

Owen, B.D. (1999). Decreasing the back injury problem in nursing personnel. *Surgical Services Management, 5*(7), 15-21.

Owen, B. (2000). Preventing injuries using an ergonomic approach. *AORN Journal, 72*(6), 1031-1036.

Owen B., & Garg, A. (1991). Reducing risk for back pain in nursing personnel. *AAOHN Journal, 39*, 24-33.

Owen, B.D., Keene, K., & Olson, S. (2000). Patient handling tasks perceived to be most stressful by hospital nursing personnel. *Journal of Healthcare Safety, Compliance, and Infection Control, 5*(1), 19-25.

Owen, B.D., Keene, K., & Olson, S. (2002). An ergonomic approach to reducing back/shoulder stress in hospital nursing personnel: A five year follow up. *International Journal of Nursing Studies, 39*(3), 295-302.

Owen, B.D., Keene, K., Olson, S., & Garg, A. (1995). An ergonomic approach to reducing back stress while carrying out patient handling tasks with a hospitalized patient. In Hagberg, Hofmann, Stobel, & Westlander (Eds.). *Occupational Health for Health Care Workers.* Landsberg, Germany: ECOMED.

Owen, B.D., &Staehler, K. (2003). Approaches to decreasing back stress in homecare. *Home Healthcare Nursing Manual, 21(3),* 180-186.

Paraprofessional Health Institute. (2003). *Workforce strategies: Introducing peer mentoring in long-term care settings.* Retrieved September 2, 2004 from the world wide web at www.paraprofessional.org/publications/WorkforceStrategies2.pdf.

Pope, M.H., Andersson, G.B., Frymoyer, J.W., & Chaffin. (1991). *Occupational low back pain: assessment, treatment and prevention.* St. Louis: Mosby-Year Book.

Retsas, A., & Pinikahana, J. (2000). Manual handling activities and injuries among nurses: An Australian hospital study. *Journal of Advanced Nursing, 31*, 875-883.

Ronald, L.A., Yassi, A., Spiegel, J., Tate, R.B., Tait, D., & Mozel, M.R. (2002). Effectiveness of installing overhead ceiling lifts. *AAOHN Journal, 50*, 120-126.

Royal College of Nursing (RCN). (1996). *RCN Code of Practice for Patient Handling. Publication Code 000-604.*. London: Royal College of Nursing.

Schibye, B., & Skotte, J. (2000). The mechanical loads on the low back during different patient handling tasks. *Proceedings of the IEA2000/HFES 2000 Congress, The Human Factors and Ergonomics Society,* pp. 785-788. Santa Monica: CA.

Scopa, M. (1993). Comparison of classroom instruction and independent study in body mechanics. *The Journal of Continuing Education in Nursing, 24(4),* 170-3.

Shaw, R. (1981). Creating back care awareness. *Dimensions of Health Service, 58*(3), 32-33.

Shepherd, C. (2001, Summer). Dimensions of care: ergonomics for the hospital setting. *Occupational Health Tracker, 4*(2). Retreived July 8, 2004, from the world wide web at: www.systoc.com/Tracker/Summer01/ErgonHosp.asp.

Skarplik, C. (1988). Patient handling in the community. *Nursing, 3*(30), 13-16.

Smedley, J., Egger, P., Cooper, C., & Coggon, D. (1995). Manual handling activities and risk of low back pain in nurses. *Occupational and Environmental Medicine, 52*, 160-165.

Snook, S., Campanelli, R., & Hart, J. (1978). A study of three preventative approaches to low back injury. *Journal of Occupational Medicine, 20*(7), 478-481.

Stubbs, D., Buckle, P., Hudson, M., & Rivers, P. (1983). Back pain in the nursing profession II. The effectiveness of training. *Ergonomics, 26*(8),767-779.

St. Vincent, M., Tellier, C., & Lortie, M. (1989). Training in handling an evaluative study. *Ergonomics 32*(2), 191-210.

Switzer, S., & Porter, J.M. (1993). The lifting behavior of nurses – in their own words. In F. Darby& P. Turner (Eds.) *Proceedings 7th Conf. NZ Ergonomics Soc. 2-3 August 1996,* pp. 33-43. Wellington: New Zealand Ergonomics Society.

Takala, E.P., & Kukkonen, R. (1987). The handling of patients on geriatric wards. *Ergonomics, 18*, 17.

The state of the CDC, fiscal year 2003 (2nd ed.). (n.d.). Retrieved from the world wide web on September 2, 2004 from www.cdc.gov/CDC.pdf.

Troup, J.D., & Rauhala, H.H. (1987). Ergonomics and training. *International Journal of Nursing Studies 24*(4), 325-330.

Tuohy-Main, K. (1997). Why manual handling should be eliminated for resident and career safety. *Geriaction, 15*, 10-14.

U.S. Department of Health & Human Services. (1999, 23 November). *Federal Register, Part II, Department of Labor, Occupational Safety and Health Administration, 29 CFR Part 1910; Ergonomics Program: Proposal Rule* .

U.S. Department of Labor, Occupational Safety and Health Administration. (2002). *Ergonomics guidelines for nursing homes*. Retrieved June 22, 2003 from the world wide web at: www.osha.gov/ergonomics/guidelines/nursing home/final_nh_guidelines.html.

Venning, P. (1988). Back injury prevention among nursing personnel. *AAOHN Journal, 36*(8), 327-333.

Videman, T., Nurminen, T., Tolas, S., Kuorinka, I., Vanharanta, H., & Troup, J. (1984). Low back pain in nurses and some loading factors of work. *Spine, 9*(4), 400-404.

Villeneuve, J. (1988, January). The ceiling lift: an efficient way to prevent injuries to nursing staff. *Journal of Healthcare Safety, Compliance & Infection Control* 19-23.

Virginia Polytechnic Institute and State University, Environmental Health and Safety Services. (n.d.). *Workplace ergonomics: Engineering controls.* Retrieved July 8, 2004, from www.ehss.vt.edu/Programs/OHIH/Ergo/08_Engineering Controls.htm.

Wachs, J.E., & Parker, J.E. (1987). Registered nurses' lifting behaviour in the hospital setting. In S. Asfour (Ed.), *Trends in Ergonomics/Human Factors IV*. Holland: Elsevier Science Publishers, B.V.

Wassell, J.T., Gardner, L.I., Landsittel, D.P., Johnston, J.J., & Johnston, J.M. (2000). A prospective study of back belts for prevention of back pain and injury. *Journal of the American Medical Association, 284*(21), 2727-2732.

Wicker, P. (2000). Manual handling in the perioperative environment. *British Journal of Perioperative Nursing, 10(5)*, 255-259.

Wood, D. (1987). Design and evaluation of a back injury prevention program within a geriatric hospital. *Spine 12*, 77-82.

Yassi, A., Cooper, J.E., Tate, R.B., Gerlach, S., Muir, M., Trottier, J., et al. (2001). A randomized controlled trial to prevent patient lift and transfer injuries of healthcare workers. *Spine, 26*, 1739-1746.

Zelenka, J.P., Floren, A.E., & Jordan, J.J. (1996). Minimal forces to move patients. *The American Journal of Occupational Therapy, 50*, 354-361.

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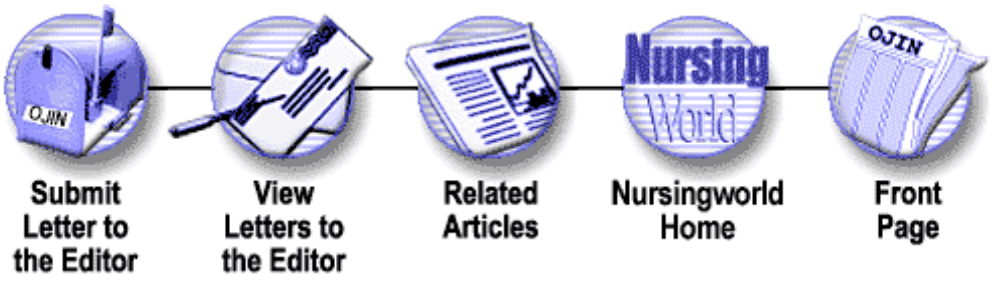

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