Facilitating Repositioning in Bed

by Guy Fragala, PhD, PE, CSP

RESEARCH ABSTRACT

Repositioning patients in bed presents an occupational hazard to direct care nursing staff. Much research has been conducted in the area of safe patient handling and movement. However, little progress has been made in reducing risks associated with patient repositioning, especially pulling patients toward the head of the bed. This laboratory study investigated risk reduction achieved by introducing the gravity assist feature into bed system design for post-acute health care. Through the application of gravity assist, the amount of work required to reposition a simulated 200-pound patient was reduced by 67%. This reduction in work should reduce some of the occupational risk for nurses.

This article presents results from a pilot study conducted to investigate the impact of a bed frame design feature intended to reduce musculoskeletal risk to caregivers during patient repositioning. Positioning and movement in bed are important to immobilized patients or residents in the post-acute health care setting for both comfort and healing. When patients or residents are immobilized for any reason and spend extended periods of the day in bed, frequent and proper position changes are beneficial to the healing process (Fletcher, 2005; Metzler & Harr, 1996).

Clinical experience and research has demonstrated that immobility can adversely affect all body systems. For example, immobility decreases gastrointestinal and genitourinary activity, increasing the risk of constipation, urinary stasis, and fluid retention. Lack of mobility and extended periods in bed also result in diminished muscle tone, general weakness, fatigue, and venous stasis, which may lead to thrombophlebitis, pulmonary embolism, and reduced peripheral perfusion. Reduced peripheral perfusion, in turn, contributes to skin breakdown, particularly over bony prominences (Metzler & Harr, 1996; Vollman, 2010). In coordinating aspects of patients' care, medical diagnosis, physical condition, and comfort level can determine which positions are most therapeutic, which might be harmful, and how often repositioning should occur. Facilitating patient repositioning provides benefits for patients and a safe work environment for caregivers.

To enhance the quality of care, post-acute patients require frequent repositioning, but this can place both patients and caregivers at risk for injury. For example, patients may experience compressed arteries with damage to the brachial plexus when grasped under the axillae to be pulled up in bed (Metzler & Harr, 1996). Similarly, caregivers are often in an awkward posture and at risk for overexertion when moving patients in bed, which can contribute to occupational musculoskeletal disorders. It is common for patients to slide down from the head of the bed and need to be pulled toward the head of the bed by caregivers. Clinical experience and research has demon-

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Applying Research to Practice

The simple, available solution of applying the Gravity Assist feature when attempting to reposition patients in bed can be a great aid in reducing occupational risk to health care workers, an occupation identified to be at high risk for musculoskeletal disorders.

strated that patient repositioning is one activity that exposes caregivers to high risk for occupational injuries.

INJURY STATISTICS

Currently, much attention is focused on occupational risks to health care workers. The U.S. Bureau of Labor Statistics reports that health care workers consistently have one of the highest risk occupations, ranking above truck drivers, laborers, assemblers, and janitors, due to occupational injuries. Musculoskeletal disorders, specifically back injuries associated with patient handling, are a major contributor to this injury problem. On review of a representative year of data specific to health care workers, 66% of all injuries suffered by nursing aides and orderlies and 59% of all injuries suffered by registered nurses were strains and sprains (Bureau of Labor Statistics, 2000). On examining the event leading to an occupational injury in nursing and personal care facilities, overexertion, specifically from lifting and moving residents, is a major contributing factor. The incidence rates calculated for overexertion as the cause of injuries in nursing and personal care facilities are four times higher than the national average for all industry (Bureau of Labor Statistics, 2000). These rates rank as the fourth worst of the hundreds of industries reporting information to the Bureau of Labor Statistics. On review of Bureau of Labor Statistics data published in 2009, 252 per 10,000 health care workers suffered musculoskeletal disorders. This is the highest rate of musculoskeletal disorders among and more than seven times the national musculoskeletal disorder average for all occupations (Bureau of Labor Statistics, 2009).

PREVIOUS RESEARCH

When attempts are made to manually reposition patients in bed, it has been well documented that caregivers are at high risk for a musculoskeletal injury (Coggan, Norton, Roberts, & Hope, 1994; Collins, Nelson, & Sublet, 2006; Engkvist, Hagberg, Linden, & Malker, 1992; Enos, 2003; Harber et al., 1985; Hignett, 1996; Jensen, Nestor, Myers, & Rattiner, 1988; Khuder, Schaub, Bisesi, & Krabill, 1999; Knibbe & Friele, 1996; Ljungberg, Kilbom, & Hagg, 1999; Pheasant & Stubbs, 1992; Pompeii, Lipscomb, Schoenfisch, & Dement, 2009; Skotte & Fallentin, 2008; Trinkoff, Lipscomb, Geiger-Brown, & Brady, 2002). Both workers' posture and the weights involved in repositioning place excessive forces on caregivers' musculoskeletal structure. A study conducted in a biodynamics laboratory demonstrated that traditional repositioning techniques applied within the health care industry present one of the highest occupational risks tolerated by caregivers in hospitals (Marras, Davis, Kirking, & Bertsche, 1999). In this study, attempts were made to quantify the risk for specific tasks performed by patient handlers. The method commonly called the single person hook, where a single caregiver must reach over the bed and grasp the patient under the axillae to reposition the patient, was found to have the highest predicted risk of low back disorder for caregivers for all occupational tasks studied. Other repositioning techniques, such as the manual two-person draw sheet method, the manual two-person hook method, and the manual two-person thigh and shoulder method, were also found to present a high probability of low back disorder for caregivers. Another quantitative study further demonstrates the occupational risks associated with manual patient repositioning. The objective of this study was to investigate the low back load during repositioning of patients in bed and to assess the influence of patients' weight and disability. The tasks were performed with the optional use of simple, low-tech assistant devices (draw and sliding sheets). Peak low back compression exceeded the National Institute for Occupational Safety and Health (NIOSH) action level of 3400 newtons in 25% of 418 trials (Skotte & Fallentin, 2008).

In addition to these laboratory studies, field investigations reviewing causation of low back pain in nurses have further demonstrated that repositioning patients is one of the highest risk activities for workers. In a survey of hospital staff nurses at a large tertiary care hospital, the task of lifting or pulling a patient toward the head of the bed was the leading activity reported to be the cause of back pain (Harber et al., 1985). Forty-eight percent of nurses reported the task of lifting or pulling a patient in bed caused the individual to suffer back pain. Lifting or pulling a patient in bed was also reported to be a common required activity for nurses working on adult medical, surgical, and critical care units. Forty percent of critical care unit nurses, 34% of adult medical unit nurses, and 27% of surgical unit nurses reported lifting or pulling patients in bed more than six times per shift. A large tertiary care hospital in Athens, Greece, used the same questionnaire. Lifting or pulling a patient in bed was reported to be the cause of back pain for 29% of the respondents (Vasiliadou, Karvountzis, Soumilas, Roumenliotis, & Theodosopoulou, 1995). Lifting or pulling patients in bed was the activity listed as the second leading cause of back pain. This Greek study also demonstrated the task of lifting a patient in bed to be a high-frequency activity. When heavy, physically demanding tasks were considered, lifting or pulling patients in bed placed the highest task frequency demand on nurses questioned in this study.

A cross-sectional survey of 2,405 nurses employed by a group of teaching hospitals in England added more evidence that repositioning patients presents risks to workers. Manually moving patients in bed resulted in one of the highest risk estimates for back pain among the nurses surveyed. Of those nurses surveyed, 51% (270 of 530) who were required to do 10 or more repositionings

in a work shift reported back pain. For those who repositioned patients five to nine times per work shift, 49% reported this task was the cause of low back pain (Smedley, Egger, Cooper, & Coggon, 1995). Those nurses who were required to more frequently reposition patients reported a higher rate of back pain.

In an investigation conducted in the Netherlands, a different questionnaire was administered to nurses asking whether they could describe any moments they considered to be physically demanding. The majority answered in the affirmative and 89.9% described those situations. The activities most often cited as physically demanding involved repositioning patients in bed, specifically pulling patients up in bed, moving them sideways, or turning them (31.3%), and transferring patients to and from bed associated with nursing activities (37.3%) (Knibbe & Friele, 1996).

A study conducted by the author further confirmed repositioning of patients as one of the highest risk occupational activities for health care workers. Insurance injury records for seven hospitals during a 2-year period were reviewed. The most common activity causing strains and sprains to hospital workers was repositioning patients, including turning and lifting patients in bed (Fragala & Pontaini-Bailey, 2003).

This work as well as laboratory studies of biomechanical modeling and reviews of actual injury reports confirmed that repositioning patients in bed, specifically pulling a patient toward the head of the bed, is one of the most significant causes of back injuries and back pain among caregivers in the health care industry. Although in recent years progress has been made in improving the safety of patient lifting with the increased use of mechanical lifting equipment, repositioning tasks have remained a major problem needing effective solutions.

When introducing safe patient handling solutions into the health care environment, it is desirable to build these solutions into existing furnishings (e.g., the bed) rather than require caregivers to find an additional piece of equipment. In the acute care setting, some caregivers will use the Trendelenberg position on the bed to lower the head of the bed below the foot of the bed. Caregivers in acute care settings report that changing bed frames and surface positioning facilitates the task of pulling patients toward the head of the bed. The Trendelenberg position is integrated into many acute care beds; however, until recently, bed frames in other health care settings did not include the Trendelenberg position and for clinical applications nurses did not need this bed position. To find effective solutions for the difficult task of pulling patients toward the head of the bed in post-acute care, nurses might want to build on the solution employed by caregivers in acute care. Recently, the gravity assist position, similar to the Trendelenberg position, has been introduced into bed frames appropriate for post-acute care. Gravity assist is a new term in the post-acute care setting referring to both a bed frame feature and a repositioning technique.

STUDY DESIGN

The concept of gravity assist may make sense in theory, but nurses may question how much actual improvement is gained through application of this feature. To quantify and objectively measure the risk reduction achieved with the gravity assist feature, a laboratory experiment was designed and conducted to simulate the task of pulling a resident toward the head of the bed. In a laboratory setting, a 200-pound mannequin was used to simulate the resident or load to be moved; the load was moved 12 inches with mechanical power and the force required was measured with instrumentation. As the load was moved, the force required was plotted at various points along the 12-inch distance. This pilot study investigated a new concept and does have limitations. In actual practice, the force curve generated by an actual caregiver may vary from movement created by mechanical pulling. However, the force curves generated demonstrate how force differs as a static load is brought into motion and the load is moved in the repositioning task.

To evaluate the effectiveness of the gravity assist feature in reducing physical demands and risk of injury to the caregiver, two quantitative measures were evaluated. A third measure was considered and is discussed. The first measure is the total force and peak force required during the move of 12 inches recorded in pounds. The second measure is the total work required to move the load a distance of 12 inches along the mattress surface recorded in inch pounds. The third measure is the slope of the force curve generated as the load is moved 12 inches. As the force required to move the resident increases, the risk of injury to the caregiver also increases. The force required to move the resident also varies over the 12-inch travel distance and the peak force required can present a significant risk for injury because the caregiver must exert maximum effort. The amount of work required to conduct the entire resident repositioning task is also a significant measure because pulling a resident toward the head of the bed is repeated frequently over the course of the workday. Caregivers are at risk of cumulative trauma strain and sprain injuries resulting from repeated overexertion while moving and assisting dependent residents.

STUDY RESULTS

The first measurement evaluated to quantify risk reduction was the amount of force and peak force required to move the load over the 12-inch travel distance. Figure 1 illustrates the force required to pull the load over the entire 12-inch distance. The high points on the curves in Figure 1 represent the maximum or peak forces required by the caregiver while moving the 200-pound resident toward the head of the bed. Considering the high point of each force curve, the peak force recorded at each bed angle was 107.91 pounds at 0°; 89.84 pounds at 4°; 81.54 pounds at 6°; 69.34 pounds at 8°; and 58.59 pounds at 12°. To evaluate the force reductions achieved through the Gravity Assist feature, the highest maximum force or 100% recorded force when the bed is at 0° and no slide sheet is applied was considered. Using bed angle alone to reduce required force, maximum force demands on the caregiver decreased from 100% of the maximum or peak force as follows: at 4°, maximum force decreased

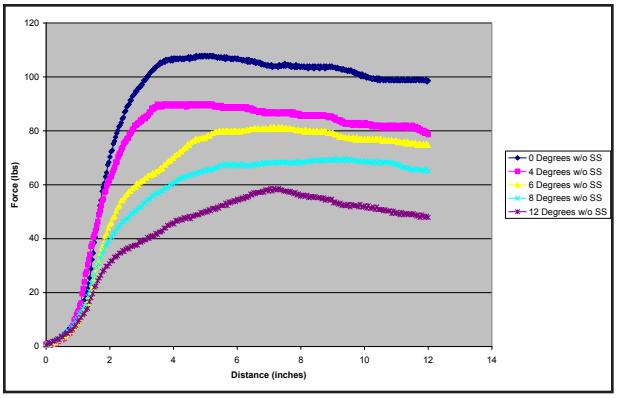

Figure 1. Force required to pull residents toward the head of the bed at different gravity assist angles. Repositioning without slide sheet (SS).

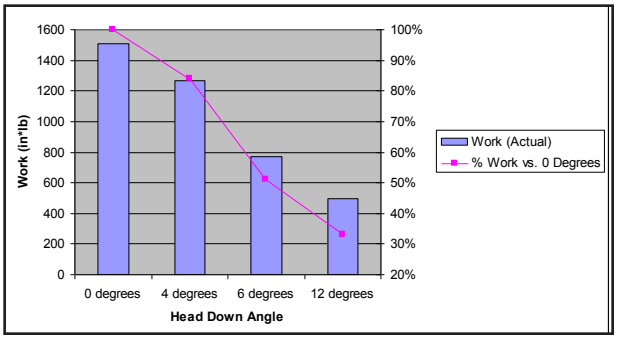

Figure 2. Work demand reduction when pulling residents toward the head of the bed at different gravity assist angles. Work to reposition a 200-pound resident 12 inches.

17%; at 6°, maximum force decreased 24%; at 8°, maximum force decreased 36%; and at 12°, maximum force decreased 46%. Maximum or peak force required by the caregiver also decreased with application of a slide sheet and increase in the angle of the bed with the head down. Maximum force requirements decreased as follows: at 0°, with slide sheet, maximum force decreased 33%; at 4°, with slide sheet, maximum force decreased 45%; and at 6°, with slide sheet, maximum force decreased 54%.

The second measurement used for comparative evaluations was the total work required to move the resident 12 inches toward the head of the bed. This was calculated from the area under the curves in Figure 1. The Table presents how work demands on the caregiver decreased as the angle of the bed with the head down increased. The greatest amount of work or 100% effort was recorded when the bed was at 0° and the load was moved without a slide sheet. Using bed angle alone, work demands for the caregiver decreased from 100% or greatest amount of work required as follows: at 4°, work demands decreased 16%; at 6°, work demands decreased 49%; at 8°, work demands decreased 59%; and at 12°, work demands decreased 67%. Figure 2 presents the same information as listed in the Table, illustrating how work demands on the caregiver decreased as the gravity assist angle increased. When the load was moved with a friction-reducing slide sheet on the surface, work demands also decreased. With

Table

Work Required to Pull Residents Toward the Head of the Bed at Various Gravity Assist Angles

Angle	*Work to Reposition (pounds)*	*% Reduction in Work*
0°	1507	0
4°	1265	16
6°	769	49
12°	499	67

application of a slide sheet, work demands decreased from 100% or greatest amount of work required as follows: at 0°, with slide sheet, work demands decreased 35%; at 4°, with slide sheet, work demands decreased 46%; and at 6°, with slide sheet, work demands decreased 64%. Work demands decreased further if the bed angle was increased to 8° and 12°. However, the load continued to move and it did not stop at 12 inches with these increased bed angles. In actual field applications, with caregivers moving residents, the researchers assumed that an additional decrease in work could be achieved with greater bed angles and slide sheets. When caregivers are required to move larger residents toward the head of the bed, these greater bed angles might be used in conjunction with slide sheets.

The third measurement considered was the slope of the force curve generated as the load was moved. Some studies have indicated that the acceleration in force generated to body parts might be a significant factor when considering risk of musculoskeletal injuries. When the slope of the force curve decreases, more time is needed to attain the peak force required to move the load. This decrease in time and acceleration to attain peak force provides a more gradual progression and results in less physical stress to the caregiver. In analyzing the slope of the force curves in Figure 1, it is apparent that the slope rising to the maximum force required decreases as the bed angle increases. However, a comprehensive evaluation of the force curve slope and acceleration in force generation is beyond the scope of this initial study. These preliminary results further support the reduction in physical demands on the caregiver with application of gravity assist when pulling a resident toward the head of the bed.

CONCLUSION

Application of the gravity assist feature (Fig. 3) is an effective approach to reducing the risk of injury to caregivers when they are required to perform the high-risk activity of pulling a resident toward the head of the bed. By using the gravity assist feature alone, the amount of work required for a single simulated resident repositioning task can be reduced by approximately 67%. When required to move larger residents, work demands can be decreased even further by using a slide sheet. With gravity assist, the maximum or peak force required in the same simulated

Figure 3. UltraCare XT bed system in gravity assist position. (Photograph courtesy of Joerns Healthcare.)

repositioning activity can be reduced approximately 46% and decreased even further by using a slide sheet. Considering the cumulative trauma on caregivers resulting from the demands of frequent repositioning of residents, these reductions in work and maximum force are even more significant in reducing the risk of injury.

These findings are of interest to the occupational health community because they offer opportunities to implement effective solutions to the high rate of occupational injuries resulting from patient repositioning. This initial study has demonstrated the value and potential impact gravity assist can have for reducing risk. The feature is also integrated into bed systems, making gravity assist more acceptable and easier to use in the care environment. The concept of gravity assist is simpler and easier to apply than other approaches that have been proposed to limit the stress of resident repositioning. As with any procedure or technique, proper resident assessment is essential to determine residents' needs and appropriateness of the technique for residents' conditions. It is the opinion of this author that gravity assist will set the standard as the best approach available to facilitate the task of pulling a resident toward the head of the bed. As application of this feature becomes more widespread throughout the industry, caregivers should experience significant reductions in injuries related to resident repositioning activities. When acquiring and replacing bed systems at health care facilities, selecting bed frames that include the gravity assist feature is a valuable consideration.

IMPLICATIONS FOR OCCUPATIONAL HEALTH NURSES

Many occupational health nurses have responsibilities beyond occupational health clinical roles and are assuming important positions in safety management and loss prevention. The health care industry has been identified as presenting a high level of occupational risk for those workers involved in directly caring for patients.

Occupational health nurses will continue to be called on to assist with safe patient handling programs within health care facilities directed at preventing injury among staff. Knowledge about effective solutions to reduce risk to health care workers is important and valuable. Understanding how to apply and implement patient in-bed repositioning solutions such as gravity assist can help occupational health nurses be more effective in their safety and injury prevention responsibilities.

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