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Preventing Musculoskeletal Disorders in Nurses

A Safe Patient Handling Curriculum Module for Nursing Schools

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Nursing educators who teach outmoded manual patient handling techniques contribute to the widespread problem of musculoskeletal disorders in student and practicing nurses. The authors discuss the development and implementation of a new safe patient handling curriculum module, which was pilot tested in 26 nursing programs. The module changes the focus of patient handling education from body mechanics to equipment-assisted safe patient lifting programs that have been shown to protect nurses from injury and improve care.

There is a well-documented theory-practice gap in nursing education between what students are taught in the classroom versus what they observe or experience in the clinical setting.[1-3] There is also a research-education gap, resulting from nursing school educators not teaching the most current evidence-based practices in patient handling and movement. For example, US nursing faculty, nursing textbooks, the nursing licensing examination (National Council Licensure Examination for Registered Nurses [NCLEX-RN]), and practicing nurses emphasize manual patient handling,[4-6] despite evidence that this approach leads to musculoskeletal disorders (MSDs), such as back, neck, shoulder, and knee injuries.[7-10] Consequently, nurses experience high rates of MSDs.[11,12] There is evidence that MSDs begin in nursing school, with exposure to patient care activities that require lifting heavy loads, sustaining awkward postures, and repeating stressful movements.[13-16] The focus of this article is on the development and implementation of an evidence-based curriculum module for safe patient handling and movement (SPH&M), rather than on the specifics of the module or the evaluation of its effectiveness.

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Project Overview

No direct patient care specialty area of nursing is immune from the risk of musculoskeletal injury due to manual patient handling. Such injuries result in harm not only to the individual but also to the organization from lost work time, burnout, and recruitment and retention.[17] The occurrence of musculoskeletal disorders in an aging nursing workforce (average age of 46.8 years) may have a pronounced negative effect on the current nursing shortage.[18] The obesity epidemic occurring in the United States is also increasing the risk of MSDs to nurses and other caregivers because of the higher amounts of weight being handled. Patients weighing more than 300 lb are becoming a common occurrence. Reliance on manual patient handling practices has been shown to be unsafe even for normal-weight individuals. The risk of MSDs is even greater when considering these ever-increasing physical demands.

Over the past 10 years, new technology and best practices have emerged to support evidence-based patient handling that is safer for both the caregiver and the patient.[19] Government organizations such as the National Institute for Occupational Safety and Health (NIOSH) and the Veteran Administration's VISN 8 Patient Safety Center of Inquiry (VA Patient Safety Center) have recently published studies demonstrating that evidence-based interventions that incorporate mechanical lifting equipment can be highly effective for reducing worker injuries and associated workers' compensation costs.[20,21] The American Nurses Association (ANA), through its Handle With Care program, NIOSH, and the VA Patient Safety Center have been actively disseminating information to promote the implementation of these evidence-based practices.[22-25] For the past 7 years, the VA Patient Safety Center has held an annual conference that has been extremely successful in communicating the latest scientific information about the application of SPH&M programs to thousands of

healthcare professionals. Several states, including Rhode Island, Texas and Washington, have passed legislation requiring hospitals and nursing homes to reduce MSDs through a variety of interventions, and other states have similar pilot programs or legislation pending.[24,38]

Until the book *Safe Patient Handling and Movement: A Guide for Nurses and Other Health Care Providers* was published in December 2005,[24] evidence-based educational materials did not exist. Coupled with this barrier to teaching evidence-based patient handling were the slow diffusion of applicable research findings to educators and practicing nurses, questions on the NCLEX-RN about manual patient handling, and sparse patient handling technology in the hospitals where students receive clinical training. As a result, most nurse educators have continued to teach outdated techniques and approaches to patient handling, namely, "proper" body mechanics.

Body mechanics training does not provide nursing students with the capability to effectively compensate for loads that exceed recommended limits (51 lb under ideal conditions).[26] In patient care, weight limits for manual lifting should be less than for lifting boxes because patients do not have handles, patients' movements are unpredictable and the worker typically cannot get close to the load being lifted.[26] It is also difficult for caregivers to estimate the percentage of a patient's total body weight that they will be responsible for lifting or supporting during the transferring task.

In addition to the theoretical components of nursing education, an integral component of nursing school curricula is student participation in a skills laboratory or practice simulation laboratory as part of teaching the fundamentals of nursing care. Nurse educators have a responsibility to offer evidence-based methods of patient care delivery and to shape the skills and knowledge of new professional nurses. In addition to reducing the risk of work-related injury and influencing practice, educating nurses in safe patient handling methods could also have a positive impact on recruitment and retention of nurses.

In 2004, ANA, NIOSH, and the VA Patient Safety Center ("the consortium") collaborated, with NIOSH funding, to develop and evaluate a new SPH&M curriculum module that could be used in schools of nursing to change the way student nurses are taught to move and handle patients. The topical outline for the module is shown in Figure 1. In addition to the implementation of the module, each school agreed to participate in a pretest and posttest evaluation of the effectiveness of the training materials. The results of the evaluation component will not be described in this article.

The goal of this 18-month project was to develop and evaluate evidenced-based safe patient handling educational materials for use by nursing schools in the United States. The objectives of the project included the following:

1. Develop, implement, and evaluate a "train-the-trainer" program for SPH&M, targeting faculty at 26 schools of nursing
2. Develop, implement, and evaluate an evidence-based safe patient handling curriculum module at 26 schools of nursing throughout the United States
3. Compare the knowledge, attitudes, and beliefs of the students who were educated and trained at the 26 schools of nursing using the evidence-based safe patient handling curriculum module with those of nursing students at 3 schools offering a more traditional fundamental nursing school curriculum
4. Describe the process of implementing this evidence-based safe patient handling curriculum module in schools of nursing throughout the United States.

- Prevalence of musculoskeletal disorders (MSD) in nurses
- Risk factors for development of MSDs, including high-risk care activities
- Ergonomic principles
- Ergonomic solutions to reduce risk factors
- Patient handling equipment types
- Assessing patients for safe handling needs
- Using algorithms to select proper equipment
- Operation of lifting equipment

Figure 1. Topical outline for the safe patient handling and movement curriculum module.

Once funding was obtained in late 2004, ANA sent out letters of invitation and placed a notice on the Web sites of the American Association of Colleges of Nursing and the National League for Nursing to recruit schools to participate in the project. A total of 40 nursing schools responded and provided a letter of support from the dean or chair of the department agreeing to fully commit to the project and indicating a willingness to work with local institutions and ANA-constituent member state associations to disseminate results.

A review panel scored the applications and funded a faculty member from each of 22 geographically dispersed schools to attend the annual SPH&M conference in Florida. All schools but one, an associate degree program, were baccalaureate programs. Four additional baccalaureate schools chose to self-fund participation, resulting in 26 participating schools.

One barrier to project implementation was that the schools of nursing did not have access to the newest technology to promote safe patient handling. Six vendors of modern patient handling equipment agreed to loan updated patient handling equipment and devices to all 26 participating schools, based on a minimum list of required items (ie, overhead and floor-based full body sling lifts, friction-reducing devices, sit-to-stand lifts, and gait belts).

At the 2005 SPH&M conference, faculty members attended preconference and postconference workshops on the fundamentals of patient care ergonomics. They also attended the 3-day main conference, at which experts in the field from the United States and Europe presented evidence-based research and strategies to implement successful safe patient lifting programs The purpose of this immersion experience was to change the paradigm of the educators away from body mechanics to evidence-based patient handling practices.

Development of the Learning-Centered Curriculum Module

There are 3 interwoven themes of a learning-centered curriculum: (1) focus

on student learning, (2) faculty development in effective teaching, and (3) assessment.[28]

To focus on the first theme, student learning, the consortium's goal was to provide teaching materials that answered the question, "What do students need to learn about safe patient handling?" The answer to that was patient care ergonomics (the science of handling and moving patients safely), about which there is extensive evidence.[8,20,21,29-31] The objective was to move students beyond knowing content to applying it in a clinical setting. Accordingly, the consortium prepared both didactic materials and associated nursing skills laboratory exercises. To accommodate the varying course delivery methods of participating schools, the consortium prepared a narrated slide show for student self-study or classroom use. This slide show presented the principles of SPH&M and some case studies to illustrate the use of the lifting algorithms. There was a list of required readings for students to complete before class.[25,32-34] Materials and laboratory exercises were presented in visual, aural, reading/writing, and kinesthetic modes.[35] The narrated slide show developed for this project is available for downloading at http://www.cdc.gov/niosh/review/public/safe-patient/. Information about the availability of a toolkit containing the other curricular materials (didactic assignments, laboratory exercises, and quiz) is provided at the NIOSH web site as well.

Because many schools place students in clinical settings that lack patient handling technology and do not use effective patient handling practices, the didactic content addressed this possibility and suggested ways for students to work safely while educating others about evidence-based solutions for safe patient handling. (In addition, staff from ANA's Center for Occupational and Environmental Health suggested ways to educate practice partners about technology solutions when vendors loaned equipment to the nursing labs, eg, open houses for area nursing directors and press releases to local news media about the project.)

The importance of the second theme, faculty development, emerged when early drafts of the module were sent out for peer review. Faculty expressed concern about teaching the new module given their limited knowledge and skill in evidence-based patient care ergonomics. One of the hallmarks of learning-centered education is that "faculty and students are both defined as active learners engaged in a cooperative effort to achieve defined outcomes."[36] As a result, the module was expanded to include more extensive patient care ergonomics background information for faculty to strengthen their knowledge base.

The third theme of a learning-centered curriculum is assessment. The consortium constructed a multiple-choice quiz to assess student comprehension of the course content, as well as a check sheet for faculty to evaluate student skill competencies.

The first author (N.N.M.) and ANA staff presented the draft materials to faculty from participating schools at the 2005 SPH&M conference. On the basis of the participants' comments and suggestions, the consortium and an expert panel revised and refined the module then distributed it on CDs to the pilot project schools.

Initial Implementation Challenges

Faculty expressed concern about removing body mechanics content when the blueprint for the licensing examination listed it.[4] Based on these concerns, collaborative efforts between the National Council of State Boards of Nursing (NCSBN) and ANA are underway to address the need to update the NCLEX-RN test items related to safe patient handling, based on the current research evidence. There should be a shift away from questions on manual handling toward questions on evidence-based approaches to safe patient handling, including the use of mechanical lifts and other patient handling technology.

Despite these initial implementation challenges, participating schools were able to incorporate the materials as planned and proceed to deliver content to students. Two case studies describing experiences related to implementation of the new training modules are presented below.

2 Case Studies

Belmont University is a small private university located in Nashville, Tenn. It has a total of 4,300 students, including 263 baccalaureate and 15 master's degree nursing students. There are 18 full-time nursing faculty members (including the dean).

Having attended the SPH&M postconference for faculty participating in the pilot study in 2005, the course coordinator (L.S.S.) for Belmont's Introduction to Nursing course was well prepared for implementation of the new curriculum. The students invited to participate in the study were in their first clinical course.

Preparations for the fall semester of 2005 included arranging for installation of new equipment and for faculty orientation to its use; incorporating the recommended current periodical references in course handouts; scheduling time for pretests, posttests, and presentation of the didactic material, including the slide presentation, during the classroom portion of the course; and scheduling time for teaching students to use the lift and transfer equipment during campus laboratory periods.

A key factor that facilitated implementation with ease at Belmont was the manner in which the equipment supplier prepared the faculty to teach with the new equipment. None of the 6 course faculty had previously worked with the ceiling-mounted lift, portable lift, sit-to-stand lift, lateral transfer aid, or the gait belt with handles. The faculty knew that very little up-to-date lift or transfer equipment was available in the school's adult general medical-surgical clinical settings. A few area hospitals had some lift equipment in bariatric (obesity) and other specialty units, but those units were not assigned for beginning students' clinical experiences. The supplier provided an excellent orientation to the equipment for course faculty and made company representatives available for telephone consultation during times when laboratories were conducted.

The slide presentation was easy to use with the students; all faculty who were teaching students at the fundamentals level were required to view it at the beginning of the semester. Students and faculty were extremely receptive to the use of the new equipment. Faculty took a realistic approach with respect to the Nashville area hospitals' progress in the area of SPH&M. Students were told what to expect on

the units where they would practice and were taught how to ask current and future employers about their current or future plans for safe patient handling policies. During the campus laboratories, each student took the role of patient and the role of nurse with each of 5 pieces of patient handling equipment. These laboratories were held in the week just before the students' first actual clinical experience. Several students returned to campus after their first clinical week and said that they had encountered situations at the hospital that called for lifting equipment, but none was available, indicating that the students had learned to recognize high-risk patient handling situations. Unfortunately, this also illustrates the large theory-practice gap.

The pilot study ended for Belmont in December 2005 with the posttest. However, the SPH&M curriculum has been made a permanent part of the Introduction to Nursing course content. Thirty-nine more students were exposed to the SPH&M curriculum in the spring 2006 semester. It is encouraging to note that in the short time from fall semester to spring semester, 2 faculty members and 1 student reported an increase in the use of safe patient handling equipment with general medical-surgical patients at 2 clinical sites.

One of the objectives of the pilot program was that participating schools would share their knowledge with others in their communities. The School of Nursing at Belmont was able to introduce the new lift equipment to a number of area nursing leaders. The school hosted a meeting with equipment representatives. Six influential nurses in the Nashville area attended and participated in a demonstration of the equipment in the school's laboratory. Subsequent to the Belmont meeting, 1 large hospital system hosted lift equipment demonstrations in each of 2 large hospitals, 1 large national healthcare company placed safe patient handling as a topic in its leadership curriculum and at regional meetings, and 1 rehabilitation hospital adopted gait belts with handles and is actively pursuing the purchase of lifting equipment (their nurse manager had never seen gait belts with handles before the meeting). In addition, the national chief nursing officer of a large healthcare system brought 3 company nurse leaders with her for a subsequent equipment demonstration at the Belmont laboratory. In an effort to influence NCLEX-RN item content in the area of safe patient handling, a Belmont faculty member has applied to the NCSBN to be an item writer.

There are several reasons why Belmont did not experience the expected barriers to a curriculum change of this nature. First, the person designated as the leader of the new SPH&M initiative was the course coordinator of the introductory clinical course. She was convinced that the SPH&M curriculum was in the best interest of students and the faculty. She has been in her position for a number of years and is a trusted colleague who actively sought course faculty input and commitment very early in the change process. The full support of the dean also facilitated the change. In addition, when introduced to a new procedure, there are often teachers who are naturally more confident or hesitant than others. For the hesitant persons, more than 1 session of practice with the new equipment was provided before the faculty had to introduce laboratory groups of students to the equipment.

Unlike Belmont University, the University of Florida is a public university with the fourth largest student enrollment (48,000) in the United States. Its College of Nursing has more than 700 undergraduate and graduate students, taught by 70 faculty members at campuses in Gainesville and Jacksonville. Despite the dean's support for the consortium's project, there were implementation challenges. Faculty members from the Adult and Elderly Department teach the Introduction to and Fundamentals of Nursing Care Management courses for 140 generic students in the fall. Because of scheduling conflicts, neither of the course coordinators could attend the 2005 SPH&M conference; instead, a clinical faculty member from the skills laboratory attended. She did present at a faculty meeting a summary of what she learned but left the university before the project was completed. Because the course coordinators did not have extensive training in the principles of SPH&M or a sense of ownership of the project, the department chair (who had applied to participate in the project) had to coordinate grant activities.

A consortium consultant (N.N.M.) was in a separate department, with no responsibility or authority for the courses. However, she did coordinate the loan of vendor equipment for the week that patient positioning skills were taught and arranged for the vendor to train skills laboratory staff members on equipment use. She also invited administrators from practice partners to come to the laboratory to view the equipment. Interestingly, only 1 facility sent visitors, a 618-bed medical center that has already invested heavily in lifting technology and support services (and has cut its MSD rate to one fourth of what it used to be). She also worked with the Florida Nurses Association to disseminate SPH&M information to practicing nurses and hospital administrators.

Despite the challenges resulting from the somewhat fragmented leadership of the project, the college completed all project-related activities. In addition, the department chair sent 2 additional faculty members to the SPH&M conference in 2006 to broaden and deepen the knowledge base of those teaching fundamental skills. They have incorporated SPH&M principles in subsequent courses.

Evaluation

The VA Patient Safety Center and NIOSH developed a detailed evaluation plan for assessing the effectiveness of the new training materials. Details about the design and results of the ongoing evaluation study will be presented in a future article. A brief description of the evaluation follows.

Using a traditional preevaluation/postevaluation design, with intervention and control groups, acceptance and implementation of the developed safe patient handling curriculum module are being evaluated using the theory of planned behavior[37] as a theoretical framework. The interventions included a train-the-trainer program and an evidence-based curriculum module. The sample included all clinical instructors in nursing fundamentals education where patient handling is taught at the participating schools of

Table 1. Force Field Analysis

Driving Forces	Restraining Forces	Strategies for Change
Opinion leader requesting change	Opinion leader objecting to change	Driving force leader should be well-respected
Faculty awareness of SPH&M evidence	Tradition of teaching body mechanics	Faculty development in patient care ergonomics
Textbooks with SPH&M principles	Textbooks lacking evidence-based patient handling practices	Adopt ANA/NIOSH curricular materials
Practice site adoption of SPH&M program	Lack of SPH&M equipment in clinical skills laboratory	Partner with equipment vendor or practice partner
MSDs in faculty and students	Pressure to include more and more content in introductory courses	Emphasize that the module is not additional content but replacement content
SPH&M state legislation	Questions on NCLEX-RN® about manual handling	Become an item writer for NCLEX-RN®, submitting questions on SPH&M
ANA state constituency SPH&M campaigns	Faculty not familiar with patient care ergonomics	Allow faculty to spend time with vendors practicing with equipment

SPH&M indicates safe patient handling and movement; MSD, musculoskeletal disorders; ANA, American Nurses Association; NIOSH, National Institute for Occupational Safety and Health; NCLEX-RN, National Council Licensure Examination for Registered Nurses.

nursing (n = 61) as well as all nursing students (n = 1,600). Quantitative and qualitative data were collected using surveys and semistructured interviews. We assessed knowledge, attitudes, and beliefs about safe patient handling for both faculty and students, pretraining and posttraining. The process evaluation includes changes (pre to post) for curriculum content, teaching methods, patient handling equipment inventory, and level of acceptance. Posttraining, we also assessed by telephone interview the barriers and facilitators for program implementation and intention to continue with new curriculum. Results of the evaluation data will be published separately.

In addition, NIOSH posted the narrated slide show on its Web site and invited public comment. The consortium revised the slide show based not only on these comments but also on the experiences of the participating schools.

Recommendations for Faculty

Faculty members contemplating on incorporating SPH&M into their curricula may find it useful to follow Lewin's Force Field Analysis for implementing this change.[38] Lewin's model describes 2 opposite forces impacting change: driving forces encourage change, whereas restraining forces resist. Table 1 illustrates examples of some driving and opposing forces likely to be encountered in nursing programs, as well as strategies to address the latter.

Lewin[38] described the 3 phases of change as unfreezing, changing, and refreezing. One of the most important components in successful change is having the full support of the dean or program director. In the first phase, the person promoting the change should assess the opposing forces in his or her setting, then develop and carry out strategies to bolster the driving forces and attenuate the restraining ones. During the change phase, the opinion leader would incorporate the NIOSH/ANA SPH&M module into the fundamentals course. An important step in this process is negotiating with practice settings to support safer patient handling practices through purchasing equipment and instituting low lift policies. In the final step, refreezing, the SPH&M module would be adopted permanently as part of the curriculum. This process may take many months, depending on the strength of the opposing forces.

Conclusions

Preliminary findings from qualitative interview data indicate that all participating faculty members were able to successfully integrate the new approach into their existing curricula. The completed evaluation will quantify this success. Several ANA-constituent member state associations have initiated efforts to change curricula in schools of nursing in support of evidence-based patient care ergonomics. Strong support from the ANA, NIOSH, and the VA Patient Safety Center continues. The NCLEX-RN Test Plan for 2007, effective April 2007, now has questions on "Ergonomic Principles" (p5) under the subcategory of Safety and Infection control.[39] The effort to include safe patient handling information in the nursing curriculum is an investment in the future nursing workforce as the nation deals with the current nursing shortage.

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References

1. Landers MG. The theory-practice gap in nursing: the role of the nurse teacher. *J Adv Nurs*. 2000;32(6):1550-1556.
2. Corlett J. The perceptions of nurse teachers, student nurses and preceptors of the theory-practice gap in nurse education. *Nurse Educ Today*. 2000;20(6):499-505.
3. Meyer T, Xu Y. Academic and clinical dissonance in nursing education: are we guilty of failure to rescue? *Nurse Educ*. 2005;30(2):76-79.
4. National Council of State Boards of Nursing. *Detailed Test Plan for the NCLEX-RN® Examination*. Chicago: NCSBN; 2003.
5. Taylor C, Lillis C, LeMone P. *Fundamentals of Nursing: The Art and Science of Nursing Care*. Philadelphia: Lippincott Williams & Wilkins; 2005.

6. Potter PA, Perry AG. *Fundamentals of Nursing*. 6th ed. St. Louis, Mo: Elsevier Mosby; 2006.
7. Smedley J, Trevelyan F, Inskip H, Buckle P, Cooper C, Coggon D. Impact of ergonomic intervention on back pain among nurses. *Scand J Work Environ Health*. 2003;29(2):117-123.
8. Garg A, Owen B. Reducing back stress to nursing personnel: an ergonomic intervention in a nursing home. *Ergonomics*. 1992;35(11):1353-1375.
9. Lagerstrom M, Hansson T, Hagberg M. Work-related low-back problems in nursing. *Scand J Work Environ Health*. 1998;24(6):449-464.
10. Owen BD. Preventing injuries using an ergonomic approach. *AORN J*. 2000; 72(6):1031-1036.
11. US Department of Labor Bureau of Labor Statistics. Table R9: Number of nonfatal occupational injuries and illnesses involving days away from work by occupation and selected natures of injury or illness, 2005. Available at http://www.bls.gov/iif/oshwc/osh/case/ostb1665.pdf. Accessed April 5, 2007.
12. Daraiseh N, Genaidy AM, Karwowski W, Davis LS, Stambough J, Huston RI. Musculoskeletal outcomes in multiple body regions and work effects among nurses: the effects of stressful and stimulating working conditions. *Ergonomics*. 2003;46(12):1178-1199.
13. Smith DR, Leggat PA. Musculoskeletal disorders among rural Australian nursing students. *Aust J Rural Health*. 2004; 12(6):241-245.
14. Klaber Moffett JA, Hughes GI, Griffiths P. A longitudinal study of low back pain in student nurses. *Int J Nurs Stud*. 1993;30(3):197-212.
15. Smith DR, Sato M, Miyajima T, Mizutani T, Yamagata Z. Musculoskeletal disorders self-reported by female nursing students in central Japan: a complete cross-sectional survey. *Int J Nurs Stud*. 2003; 40(7):725-729.
16. Videman T, Ojajarvi A, Riihimaki H, Troup JD. Low back pain among nurses: a follow-up beginning at entry to the nursing school. *Spine*. 2005; 30(20):2334-2341.
17. Fochsen G, Josephson M, Hagberg M, Toomingas A, Lagerstrom M. Predictors of leaving nursing care: a longitudinal study among Swedish nursing personnel. *Occup Environ Med*. 2006;63(3):198-201.
18. Health Resources and Services Administration. Preliminary findings: 2004 National Sample Survey of Registered Nurses. Available at: http://bhpr.hrsa.gov/healthworkforce/reports/rnpopulation/preliminaryfindings.htm. Accessed April 7, 2006.
19. Nelson AL, Baptiste A. Evidence-based practices for safe patient handling and movement. *Online J Issues Nurs*. 2004; 9(3):4.
20. Collins JW, Wolf L, Bell J, Evanoff B. An evaluation of a "best practices" musculoskeletal injury prevention program in nursing homes. *Inj Prev*. 2004;19:206-211.
21. Nelson A, Matz M, Chen F, Siddharthan K, Lloyd J, Fragala G. Development and evaluation of a multifaceted ergonomics program to prevent injuries associated with patient handling tasks. *Int J Nurs Stud*. 2006;43(6):717-733.
22. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. *Patient Care Ergonomics Resource Guide: Safe Patient Handling and Movement*. Cincinnati, OH: NIOSH; October 2001. DHHS (NIOSH) Publication No. 2006-117.
23. Nelson A, ed. *Safe Patient Handling and Movement: A Guide for Nurses and Other Health Care Providers*. New York, NY: Springer Publishing Company.
24. American Nurses Association. Welcome to Handle With Care. Available at: http://www.nursingworld.org/handlewithcare/. Accessed April 7, 2006.
25. Nelson A, Fragala G, Menzel N. Myths and facts about back injuries in nursing. *Am J Nurs*. 2003;103(2):32-40. 41 (quiz).
26. Waters TR, Putz-Anderson V, Garg A, Fine LJ. Revised NIOSH equation for the design and evaluation of manual lifting tasks. *Ergonomics*. 1993;36(7):749-776.
27. Frye R. Assessment, accountability, and student outcomes. *Dialogue*. 1999;(2):1-11.
28. Marras WS, Davis KG, Kirking BC, Bertsche PK. A comprehensive analysis of low-back disorder risk and spinal loading during the transferring and repositioning of patients using different techniques. *Ergonomics*. 1999;42(7): 904-926.
29. Zhuang Z, Stobbe TJ, Hsiao H, Collins JW, Hobbs GR. Biomechanical evaluation of assistive devices for transferring residents. *Appl Ergon*. 1999;30(4):285-294.
30. Nelson A, Lloyd JD, Menzel N, Gross C. Preventing nursing back injuries: redesigning patient handling tasks. *AAOHN J*. 2003;51(3):126-134.
31. Nelson A, Owen B. Safe patient handling movement. *Am J Nurs*. 2003;103(3): 32-44.
32. American Nurses Association. Position statement on elimination of manual patient handling to prevent work-related musculoskeletal disorders. June 21, 2003. Available at: http://nursingworld.org//readroom/position/workplac/pathand.htm. Accessed June 16, 2006.
33. VISN8 Patient Safety Center of Inquiry. Algorithms for safe patient handling and movement. Available at: http://www.visn8.med.va.gov/patientsafetycenter/safePtHandling/default.asp. Accessed June 16, 2006.
34. Fleming N. VARK: a guide to learning styles. Available at: http://www.vark-learn.com/english/index.asp. Accessed April 7, 2006.
35. Candela L, Dalley K, Benzel-Lindley J. A case for learning-centered curricula. *J Nurs Educ*. 2006;45(2):59-66.
36. Ajzen I, Fishbein M. *Understanding Attitudes and Predicting Social Behavior*. Englewood Cliffs, NJ: Prentice-Hall; 1980.
37. Lewin K. *Resolving Social Conflicts; Field Theory in Social Science*. Washington, DC: American Psychological Association; 1997.
38. AORN. Safe patient handling, patient lift, or ergonomics laws and regulations. Available at: http://www.patientsafetyfirst.org/government-affairs/current-laws/positioning.html. Accessed April 5, 2007.
39. National Council of State Boards of Nursing. NCLEX-RN test plan. Chicago, IL: Author; 2007. Available at: https://www.ncsbn.org/RN_Test_Plan_2007_Web.pdf. Accessed April 5, 2007.