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Ergonomic Assessment of a Critical Care Unit

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Direct patient caregivers experience a high incidence rate of musculoskeletal disorders (MSDs) and a high prevalence of musculoskeletal pain [1]. The back is the body part injured most frequently, but injuries to the shoulder, neck, arm, and knees also are reported. Nursing assistants have higher rates of injuries than licensed nurses, but registered nurses (RNs) are a perennial finisher in the Top 10 of most MSDs reported [2]. Although patient handling is the reason cited most recently for MSDs, shift work and long work hours are known to predispose to injury [3,4].

Unlike the body of knowledge that documents the musculoskeletal risks associated with manual patient handling in nursing homes [5–7], there are few studies about similar risks for critical care nurses. There is, however, some evidence that critical care nurses experience MSDs at least as much as other nurses. One study from Canada found a back pain point prevalence of 25% for critical care nurses compared with 30% for orthopedic nurses [8], whereas another study in the Netherlands found a 12-month prevalence of low back pain of 75% in intensive care nurses compared with 76% for nonspecialized nurses [9]. Intensive care nurses in an Australian study had a manual patient handling injury incidence rate of 52% [10]. As researchers, administrators, and legislators implement safe patient handling interventions for nursing homes and other areas with high incidence rates of injury, such as orthopedics, the incidence and severity of injuries to the back, neck, and shoulder in those workplaces will begin to decline. The next challenge is protecting the health and safety of nurses working in lower-risk specialty areas, such as operating rooms and critical care units (CCUs). Because nurses under-report work-related injuries [11,12], the true injury incidence rates of these units likely are much higher than now supposed.

Background

As with many modern approaches to nursing care, the concept of intensive care originated from innovations implemented by Florence Nightingale in the Crimean War, when she grouped the soldiers injured most seriously together and provided revolutionary approaches to the prevention of infection and epidemics [13]. Today, critical care nursing is not limited to a specific unit or area but is located wherever critically ill patients are receiving care. This may be emergency rooms, operating rooms, cardiac catheterization laboratories, progressive care units, telemetry units, postanesthesia care units, or CCUs, also known as ICUs. CCUs are special areas designed to care for patients who are medically unstable and at risk for death. They are characterized by high nurse-to-patient ratios, such as 1:1, 1:2, or 1:3, the most common ratio being 1:2. Even though CCUs may vary significantly by their number of beds, specialty, and design among hospitals, they are designed to provide constant nursing and medical surveillance of patients who have multiple problems and are receiving multiple treatments.

According to the American Association of Critical Care Nurses statement to the Institute of Medicine Committee on Work Environment

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for Nurses and Patient Safety [14], there are nearly 1.3 million RNs taking care of hospitalized patients, with an estimated 403,000 of them critical care nurses. CCUs are staffed with highly trained RNs. These RNs receive advanced education by attending critical care courses, usually offered by the hospitals where they are employed. These courses offer advanced education in systems, such as neurology, cardiovascular, respiratory, gastrointestinal, nephrology, and in areas, such as hemodynamic monitoring and 12-lead EKG interpretation, among other topics. The focus is exclusively on the care of complex patients, not on recognition of and protection from the special occupational risks faced by critical care nurses.

A report released by the Health Resources and Services Administration (HRSA) found that patients in acute care hospitals currently receive more than 18 million days of care in ICUs every year [15]. During the next decade, the demand for ICU services is projected to grow rapidly because of increased acuity of hospitalized patients and the growth of the aging population. According to the HRSA, the number of available physicians who specialize in critical care, also known as intensivists, likely will not meet the demands of the aging population by the year 2020 [15]. This has a direct impact on nursing because this shortage will place increased demands on critical care nurses, who already are scarce because of the current and projected nursing shortage [16]. As patient load or hours of work increase, the risk for MSDs from manual patient handling exposure increases.

Many of the patients located in critical care areas are physically dependent and require specialized medical equipment, such as cardiac monitoring, ventilator support, multiple intravenous (IV) infusions, and possibly other technology that can crowd the work area around patients. This abundance of machines can make it difficult for nurses to provide direct patient care without maneuvering the equipment. A typical patient room in a CCU (often retrofitted from another use) has many pieces of equipment and furniture at the bedside, which can restrict access to patients and force nurses to assume awkward postures when delivering care. There are many cables and IV poles that also put nurses at risk for tripping. Critical care nurses may be at high risk for MSDs from repetitive movements, such as lifting heavy loads and frequent patient repositioning.

Ergonomics is the science of adjusting job tasks to match the capabilities of the worker. The nursing workforce is approximately 95% female [16], meaning that work tasks should be designed to accommodate a workforce that is shorter and has less upper body strength, a shorter reach, and less grip strength than a workforce with a higher percentage of men. Health care, however, has lagged behind many other industries, such as warehousing and transportation, that long ago instituted protections for their primarily male workers from heavy, frequent lifting and holding awkward postures. Reasons that nurses have not received similar protections include a singular focus on patient (not worker) health; a tradition in nursing schools of teaching ineffective lifting procedures, such as body mechanics [17]; lack of occupational health and safety regulation; and a primarily female workforce kept at the bottom of a hierarchic management structure [18].

Because the nursing shortage is severe and persistent, some institutions have begun to look at ways to improve retention of their existing nursing workforce. One key is reducing the number and severity (length of absence) of work-related injuries, of which MSDs are the most costly and most likely to result in days lost from work or on modified duty [19]. The most effective way to reduce these injuries is by conducting a thorough ergonomic assessment that identifies hazardous tasks and conditions and instituting an ergonomics program designed to reduce these risks.

Purpose

Because of the dearth of knowledge about specific risks associated with the provision of critical care, the authors conducted an ergonomic assessment of a 23-bed medical ICU in 409-bed, acute-care hospital in Las Vegas. The second purpose was to evaluate the applicability to critical care settings of the instrument, Ergonomic Workplace Assessment Protocol for Patient Care Environments in the Patient Care Ergonomics Resource Guide (the Guide) [20].

Methods and materials

This was a qualitative study. The researchers followed steps 1 through 7 of the protocol described in the Guide:

1. Collect baseline injury data.
2. Identify high-risk units.
3. Obtain presite visit data.

4. Identify high-risk tasks.
5. Conduct team site visit at each high-risk unit.
6. Perform risk analysis.
7. Formulate recommendations.
8. Implement recommendations; involve end users in selecting equipment
9. Monitor results; evaluate program; continuously improve safety.

Steps 1 and 2: collect baseline data and identify high-risk units

Because this was purposive and convenience sampling, the authors did not select among areas for the one with the highest injury rate. The hospital allowed the researchers access to its 23-bed medical ICU (MICU), where the staffing ratio was one nurse for every two patients.

Step 3: obtain presite visit data on high-risk units

After receiving Institutional Review Board approval, the authors requested that the CCU manager complete the Pre-Site Visit Unit Profile (Fig. 1) before their visit. Because of a recent change in the position, however, the new nurse manager did not feel she had the required knowledge or time to complete the questionnaire. She, therefore, designated another management-level RN (the supervisor) who assists with the MICU (and also is the facility's risk manager) as the person to complete the Pre-Site Visit Unit Profile before the visit.

The Occupational Safety and Health Administration log showed no MSDs for the MICU in 2004, 2005, and the first 9 months of 2006. The maximum number of RN full-time equivalent RNs assigned to the unit was 51. The supervisor did not answer the question about the percent of full-time equivalents filled. On the day of the focus groups, two participants from the MICU were not regular employees (one agency nurse and one travel nurse). There were no planned changes to staffing levels or bed numbers. The manager checked the box next to "dependent" without filling in a percentage. In focus groups with staff members, nurses estimated the percentage of dependent patients as 85% to 90%. For patient handling equipment, the supervisor listed four Hoyer lifts ("rarely used") and two slide boards ("frequent use"). The Hoyer lifts were stored on another floor, however. Staff seemed unaware of their existence. She did not identify built-in scales in the beds. The supervisor identified as a problem area the inability of patients to move and a need for "improved beds." Although she identified storage as a problem, she felt there was adequate room in patient units to carry out patient care tasks.

Step 4: identify high-risk tasks

The authors then conducted three focus groups with 11 RNs (two men) working on the 12-hour day shift (7:00 AM to 7:00 PM) on August 18, 2006, to identify high-risk tasks. The focus groups were conducted in the nurses' break room, which was located within the MICU. This was a private, convenient location. Participation in the focus groups was voluntary. Breakfast items were offered to those RNs who inquired or participated in the focus groups. After a prospective participant read the informed consent and had an opportunity to ask questions about the study, the researchers gave a $20 gift card to a local store to those who agreed to participate. Both researchers were present during the entire interview process. The focus group outline, modified from the one in the Guide, is as follows:

1. What conditions or situations in critical care put you at risk for back strain and injuries?
2. What critical care lifts or transfers are the most difficult and present the highest risk?
3. What are the factors that make a lift or transfer a high-risk activity?
4. What types of critical care patient conditions contribute to high-risk situations?
5. What do you think can be done to reduce or minimize a high-risk situation?
6. What are the barriers to risk reduction? In other words, what are some of the reasons that you don't take precautionary steps?

Although the protocol recommends this step only for identifying high-risk tasks, other issues, such as staffing, emerged during the focus groups. The data were reduced to common themes. The most frequent or most intensely reported themes for MSD risks were

1. Patient characteristics: heavy (obese), dependent, resistant/combative
2. Hazardous tasks
   - Transporting patients and their extensive equipment (while manually ventilating them on occasion) in beds with balky wheels and IV poles that do not glide
   - Frequent turning and repositioning patients in bed

Describe Unit, including # beds, room configurations (private, semi-private, 4-bed, etc), and bathrooms:

Part I - Space/Maintenance/Storage

1. Describe current storage conditions and problems you have with storage. If new equipment is purchased, where would it be stored?

2. Identify anticipated changes in the physical layout of your unit, such as planned renovations.

3. Describe space constraints for patient care tasks; focus on patient rooms, bathrooms, shower/bathing areas.

4. Describe any routine equipment maintenance program or process for fixing broken equipment. What is the Reporting Mechanism/ procedure for identifying, marking, and getting broken equipment to shop for repair?

5. If potential for installation of overhead lifting equipment exists, describe any structural factors that may influence this installation, such as structural load limits, presence of asbestos, etc.

Part II - Patient Population/Staffing/Equipment Use

1. Describe the patients on your unit.

2. List your existing FTEE and also the typical number of filled positions.

   FTEE Assigned Ceiling: ____RN ____LPN ____NA ____Transport ____Other (list)

   Typical positions filled: ____RN ____LPN ____NA ____Transport ____Other (list)

3. Discuss projected plans or upcoming changes in staffing, patient population, or bed closures.

4. Discuss proposed changes in the average daily census over the next two years.

5. Identify typical distribution of patients by physical dependency level according to the definitions below. Note: This is not the same as patient acuity. The total for the 3 categories should equal your average daily census.

   ___ **Independent** – Patient performs task safely, with or without staff assistance, with or without assistive devices.

   ___ **Partial Assist** – Patient requires no more assist than stand-by cueing, or coaxing, or caregiver is required to lift no more than 35 lbs. of a patient's weight.

   ___ **Dependent** – Patient requires nurse to lift more than 35 lbs. of the patient's weight, or is unpredictable in the amount of assistance offered. In this case assistive devices should be used.

Fig. 1. Pre-site visit unit profile.

1. Provide inventory of all patient care equipment; describe working condition and how frequently equipment is used.

Patient Care Equipment	Manufacturer	Qty	In working order? Comment:	Describe whether it is used and why	Recommendations
Sample: Mechanical Lifts	ARJO	3	yes	Used frequently, but there are not enough slings for all patients	Need 1-2 additional lifts and 12 additional XL size slings.
Sample: Surfboard friction reducing device	Not sure	1	yes	Rarely used—inconvenient to obtain and too heavy to carry to bedside	Need easy to use friction reducing devices stored at bedside for patients who require assistance with lateral transfers.

7. Perception of Problem Areas – what do you think are your problem areas?

8. What patient handling equipment do you think you need?

Fig. 1 (*continued*)

- Reading body fluid levels 6 inches off the floor
- Emptying urine drainage every hour from 6 inches off the floor
- Having to maintain awkward postures for prolonged periods of time during procedures

3. Equipment
   - Lack of safe patient handling and lifting equipment, in particular self-propelled beds
   - Need to get help from other staff members for manual patient handling because of lack of equipment

4. Staff
   - Not enough staff to allow nurses to help other nurses reposition or transport their patients. Causes delays in patient care.
   - Large variation among caregivers in height and strength
   - 75% of staff complaining of current or recent musculoskeletal pain
   - Staff reluctance to report MSDs because of fear of management repercussions ("being blackballed")
5. Maintenance
   - Wheels on beds are not well maintained to ease push/pull stress of bed transports
   - IV poles broken
6. Shift length and scheduling
   - 12-hour shifts and frequent overtime contribute to fatigue and musculoskeletal pain
7. Unit layout
   - Extensive walking required
   - Limited opportunities to sit

Some of the participants had misconceptions; namely, that body mechanics are effective in preventing injury and that if a nurse was injured, it was because of his or her lack of fitness or technique. The facility perpetuates this belief by providing annual training in body mechanics. Staff members did not know that there was a recommended weight limit for patient handling or what that recommendation was, which is a maximum of 35 pounds [17].

From the preliminary questionnaire and focus group data, the authors prioritized high-risk patient handling tasks according to the protocol (Table 1). The researchers did not include all of the tasks in the Guide, as many were not applicable or uncommon in this MICU (eg, lifting a patient from the floor or bathing a patient on a shower trolley). Instead, the researchers added tasks to the list that were more common in the MICU.

Step 5: conduct team site visit for ergonomic assessment

After meeting with the acting supervisor and the head nurse, the researchers toured the MICU to evaluate observable risks. The unit seemed to have been converted from a standard semiprivate medical-surgical floor by removing one bed from each room to create single rooms. This layout reduced or eliminated visibility of patients from the nurses' station, however, so staff nurses established makeshift substations near their assigned patients. The medication carts were not height adjustable. The hallways were crowded with furniture and medical equipment, making navigating an occupied bed to or from the elevator difficult. The staff reported that the doors to the CT scan room are opened manually, requiring nurses to hold an awkward posture with hips and feet to keep the door open until the bed is pushed through.

Based on information from the supervisor, focus groups, and the site visit, the researchers completed a unit summary sheet (Table 2).

Step 6: risk analysis

After reviewing the baseline injury, presite visit, focus group, observational data, and the identification of high-risk tasks, MSD risk factors were identified. These include

1. Lifting/moving heavy loads
2. Reaching and lifting with loads far from the body
3. Pushing a load a significant distance
4. Squatting
5. Maintaining awkward postures

Environmental hazards included cluttered hallways, broken bed wheels, monitors not adjustable to accommodate the gaze of the shortest nurses, and a physical layout that required nurses to walk long distances for medications, supplies, and charting. Walking more than 3.5 miles per shift is considered a risk factor for musculoskeletal discomfort [21].

Step 7: formulate recommendations

The Guide suggests that recommendations should be achievable and simple and includes two categories: engineering design and administrative solutions. Engineering controls involve external changes to the way a job is performed, for example, the use of a mechanical lift to move a patient from a bed to a stretcher. Administrative controls affect the way work is done or the hours of exposure to risk. For example, if a hospital offers 8-hour shifts instead of 12-hour, each caregiver's exposure to hazardous MSD risks is reduced by 4 hours per day, allowing adequate recovery time between work periods.

The researchers made the following recommendations. Because ergonomic concepts are new to this facility, the first step is for the supervisor to bring her concerns about staff safety and risks to hospital management for further discussion.

Table 1
Prioritization of high-risk patient handling tasks

Patient description	Unit description	Miscellaneous information	Equipment	Problems identified	Solutions
Medical patients with multiorgan system failure, 80%–85% dependent, many on ventilators and all attached to monitors, IVs, and other equipment	23-bed medical ICU, all private rooms with private baths	Recent change in unit manager For profit hospital Staff is unionized	2 slide/surf boards; 4 specialty beds on order for trial	High risk from transporting patients in beds	Self-propelled beds or ERGOtug Medical Mover. Clear halls of extra equipment. Put electric doors on CT scan room
				Turning side to side in bed or pulling up in bed a problem	Explore value of friction-reducing devices
				No preventive maintenance on bed wheels	Institute routine maintenance program
				Large proportion of obese patients	On admission for patients over 250 lb, rent bariatric beds or consider purchase if percentage of bariatric patients exceeds 30% in a 3-month period
				Transferring patients from stretcher to bed	Powered lateral assist device or AirPal
				Fatigue from long shifts	Limit overtime; provide seating and break opportunities
				Reading urinary output bags or chest tube drainage when stooped	Provide mirrors on poles to visualize levels without stooping. Change emptying frequency to every 3 hours once level is read and recorded.
				Extensive walking	Redesign unit layout with mini–nurse stations. Provide chairs reserved for nurses in recessed hall areas and in nurses station, where chairs often are taken by medical residents
				High reported prevalence of MSD pain but zero injury reporting for 2.5 years	Encourage early reporting and intervention for MSDs
				Awkward postures from applying femoral pressure manually	Rearrange standing medical order form to list Femstop first to encourage this choice over manual pressure
				Awkward postures from using medicine cart	Obtain height adjustable cart
				Awkward postures from reading cardiac and other monitors	Increase downward height adjustability of monitors or provide short staff with step stools

Table 2
Unit summary sheet

Patient handling task	Frequency of task	Stress of task	Rank[a]
Transporting patient off unit	H	H	1
Repositioning patient from side to side	H	H	1
Lifting patient to head of bed	H	H	1
Bathing a patient in bed	M	H	1
Transferring patient: bed to stretcher	M	H	1
Transferring patient: bed to chair	L	H	1
Making an occupied bed	H	H	1
Weighing a patient	M	L	10 (beds have built-in scales)
Emptying catheter drainage[b]	H	H	1
Reading chest tube drainage[b]	L	H	1
Applying pressure on femoral artery[b]	M	H	1

Abbreviations: H, high; L, low; M, moderate.
[a] 1 indicates high risk; 10 indicates low risk.
[b] Indicates high-risk task added to list in the Guide under "Other."

Without management support, no program in ergonomics will succeed.

Prior to meeting with hospital management, the supervisor should prepare a business case (cost-benefit analysis) for intervening by compiling information on the direct and indirect costs of MSDs in the facility's staff for the past 2 years. Direct costs usually include workers' compensation medical care and wage replacement (data available from insurer), whereas indirect costs include the cost of hiring replacement nurses to cover absences, among many other considerations. Indirect costs are estimated as equal to direct costs [22]. In this facility, with a nearly 3-year record of no reported injuries, the supervisor must recognize that there has been suppression of reporting, based on the prevalence of MSDs the staff described during the focus groups and their fear of reporting. A better indication of the direct cost of MSDs in this facility is the number of unscheduled absences (ie, the number of days when nurses call in sick or take a personal day with no prior notice). These absences translate into costs for overtime and agency nurses. An additional cost is turnover; when a nurse feels her health is at risk, she may move to an area with less perceived MSD risk. This is a phenomenon called the "healthy worker effect." A management approach based on ergonomics is to encourage early reporting, when intervention can be more effective, rather than waiting until pain and disability are severe. In addition, the supervisor should have a cost estimate for engineering and administrative controls recommended.

The supervisor also should come prepared with evidence that ergonomic interventions actually reduce injuries, absenteeism, and turnover [5,23]. The supervisor can find resources at the Patient Safety Center's Web site [24].

Once hospital management is convinced that there is a costly problem that can be prevented or lessened, the facility can embark on a participatory ergonomics program involving staff nurses in all areas. Staff nurses' participation is vital to the success of any program because they must have a say in engineering and administrative controls to ensure they will be accepted.

Discussion

The researchers found challenges in following the Guide's protocol; some steps seemed out of sequence or redundant. In particular, the unit summary sheet in step 5 calls for a list of solutions before risk analysis is completed or

recommendations formulated. In addition, step 4 calls for identifying high-risk tasks by "job observation, questionnaires to employees or brainstorming sessions with patient handlers" before the site visit occurs in step 5, which implies two site visits. The protocol's list of high-risk tasks in step 4 seems most appropriate for a nursing home setting, not critical care. Judging from missing or inappropriate responses, some questions on the Pre-site Visit Unit Profile form were difficult for the supervisor to understand. The protocol should be edited to make it more generic and easier to follow. Finally, it should be expanded to include gathering information on other risks that affect MSD incidence, such as the average number of hours a nurse works, the facility's climate for reporting work-related injuries and other signs that lifting burdens may be too great, such as staff turnover.

The researchers noted the following differences between MSD risks in this MICU and nursing homes.

1. In this MICU, almost all patients were completely dependent. In nursing homes, some proportion of residents can assist at least partially.
2. Nursing home patients almost always are ambulated or transferred to wheelchairs daily. In this MICU, patients are not transferred out of bed as frequently.
3. Bed transport is frequent in MICU, infrequent in nursing homes.
4. Staff are all RNs in MICU; the majority are certified nursing assistants in nursing homes.
5. Medical procedures are performed more frequently at bedside in MICU.
6. MICU patients have much more equipment attached to them than those in nursing homes.
7. Nurse-to-patient ratio is 1:2 in MICU; it may be 1:12 or more in nursing home.
8. MICU patients do not require feeding very often; caregivers often must feed nursing home patients (awkward postures).

The data were obtained from one CCU in one hospital during one shift in one city, so the findings are of limited generalizability. They do indicate, however, that MSD risks are present in critical care environments. To preserve the valuable resource of highly skilled practitioners safe and at the bedside, hospital administrators must begin to pay attention to the special risks they face and provide effective interventions. The nurses who work in these areas also should demand these protections. A major nurse union, United American Nurses, is a cosponsor with the American Nurses Association for the Handle with Care campaign to eliminate manual patient handling. It also passed a resolution to take political action to seek federal and state legislation to protect nurses from the hazards of manual patient handling [25].

Recommendations

Judging from this small study and a search of the articles published in critical care nursing journals, critical care nurses are only minimally aware of the MSD risks they are exposed to during their shift. During the focus group interviews in the MICU, nurses were able to articulate the importance of properly arranging patients and necessary equipment before procedures are performed to prevent awkward positioning of their bodies. Most nurses were unaware, however, of the special equipment available to assist them in preventing musculoskeletal injuries, when transferring patients, for instance. Critical care nurses must be educated about the urgent need for assistive equipment in their specialty areas, so they can demand this equipment and safer work practices. Nurses seeking to change employers should inquire about ergonomic protections available in their potential new workplaces and refuse to work where they do not exist.

It is necessary for critical care nurses to change their paradigm from patient focus to the nurse/patient safety dyad. Nurses need to be aware that although they need to provide safe care to their patients, they also need to protect their own safety and that of their peers. The men in the study reported that they were asked more frequently than female staff members to help with patient movement, thereby increasing their exposure to hazardous tasks. With the current nursing shortage, retention of critical care nurses is vital, especially with the elderly population growing at such a fast rate. Two younger nurses in the focus groups recognized they are at risk for musculoskeletal injuries by stating they currently do not have back pain but realize they probably will in the next few years. This resigned way of thinking must change to one of optimism for a long career, given proper workplace protection from the hazards of manual patient handling, awkward postures, and repetitive motion leading to cumulative trauma.

Even with the safe patient handling initiatives that have been introduced during the past few years, critical care nurses still are unaware of the alarming statistics regarding MSDs in health care. Dissemination of new knowledge is presented to the nursing community at conferences through poster presentations and oral presentations. Many nurses may not attend conferences and, therefore, miss the information presented. Another method for distribution of new knowledge is through articles published in clinical and research journals. When nurses read professional journals, it usually is a journal in their field of practice and expertise; therefore, publishing articles related to musculoskeletal injuries (such as this one) in critical care journals (such as this one) is one way to reach this specialty. Some nurses may not read journal articles, however—a dissemination dead end.

Another way to distribute information to critical care nurses is through their professional organizations. Local chapters of professional organizations, such as the American Association of Critical Care nurses, are a good venue for disseminating information to nurses who specialize in critical care. For instance, chapters have meetings and educational offerings at local facilities that are more convenient for nurses to attend than national conferences, especially if continuing education credits are offered.

A change in paradigm may create some resistance, especially when the change involves something that has been accepted and done the same way for many years. Lewin's model of planned change describes a three-step framework for instituting change. The initial step is the unfreezing stage or preparation for change [26]. During this step, unions and professional organizations inform nurses about MSD statistics in health care, MSD hazards from manual patient handling, critical care tasks and environmental factors that have the highest risks, actions they can take to prevent injuring themselves, and modern technologic assistance available to reduce the risks that lead to MSDs. This is the step where nurses are influenced and become interested in engaging in change to improve their current practices.

The second step in Lewin's model of planned change is movement or changing. During this step, nurses shift their behavior to a new level. They can speak with their nurse managers regarding the necessary changes needed to initiate a comprehensive ergonomic program in their facility, including trying out available assistive devices to determine what equipment is most beneficial for high-risk critical care tasks. Feedback from end users is crucial, because they are the nurses who use the equipment every day. Equipment that requires distant storage or that slows down the time it takes to deliver care is destined to be abandoned. If staff nurses are not comfortable or satisfied with the equipment, then the equipment goes unused and the nurses revert to manual patient handling.

The final step in Lewin's model of planned change is the refreezing stage. During this step, nurses have implemented the new changes in their practice with the equipment they have chosen to be most beneficial for them. Because the nurses actively were involved with this change from the beginning and should be experiencing the benefits of reduced pain and fatigue, they are more likely to accept and continue the new safe patient handling practices.

Summary

Although the ergonomic assessment tool provided a good foundation for assessing a CCU, it should be revised to improve its clarity, sequencing, and applicability in a range of settings. This qualitative study indicates that even in a critical care area where there are no reported injuries, MSDs can be prevalent. The critical care work environment may involve risks in addition to those present in all nursing workplaces by virtue of the preponderance of dependent, obese patients; the challenge of delivering multiple, concurrent interventions to patients surrounded by a collection of modern technology inserted into an architectural space not designed to accommodate it; the need for bed transports to centralized technology or services; expenditures for high-tech equipment for patient care and not worker safety receiving budget priority; and the frequency of repetitive tasks involving awkward postures. Hospital administrators, professional organizations, unions, researchers, and equipment vendors should turn their attention to protecting critical care nurses from manual patient handling, an antiquated work practice unable to meet the demands of a twenty-first century work environment.

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