Reducing Employee Back Injuries in the Perioperative Setting

ABSTRACT

An ergonomic consultant conducted an evaluation of a 14-room surgical suite that had a high rate of employee back injuries. The consultant made five specific recommendations regarding moving patients, maneuvering carts and equipment, using gallbladder boards, walking on wet floors, and accessing power outlets. Most of the recommendations were implemented and well received. Eighteen months after the implementation of the consultant's recommendations, there was a 25% reduction in the number of back injuries among the OR staff members. *AORN J* 61 (June 1995) 1046-1052.

Back injuries are a common cause of work-related disability among hospital employees.[1] Literature related to back injuries is limited, and despite the recent increased interest in ergonomics, nothing has been written about ergonomic measures to prevent injuries in OR personnel, with the exception of a few articles on ergonomic issues pertaining to anesthesia machines.[2]

There is one article that is specific to back injuries among OR personnel in which the authors identified lifting anesthetized or partially recovered patients as the common cause of disc injuries. They also identified slippery shoe covers and floors (ie, around scrub sinks and OR beds) as potential hazards.[3] Other risk factors identified included tripping hazards, sustained awkward postures,[1] and the need to move and lift heavy equipment.

Risk factors can be modified by using ergonomics to reduce musculoskeletal injuries among OR personnel. The objective of ergonomics is to adapt jobs and workplaces to employees by designing tasks that are within employees' physical capabilities and workstations, tools, and equipment that do not cause injury.

This article describes an ergonomic assessment that was conducted in a 14-room surgical suite, the recommendations that were made as a result of that assessment, and the subsequent impact of the changes on reducing back injury rates.

BACKGROUND

Baystate Medical Center, Springfield, Mass, is a large, tertiary care facility with 750 patient beds. It is the third largest acute care hospital in Massachusetts, and it serves a population base of 800,000. In 1992, more than 9,000 inpatient surgical procedures were performed at Baystate Medical Center.

From 1990 to the first half of 1992, the employee health service at the Center noted a high rate of back injuries among its OR personnel. Registered nurses sustained 79% of the back injuries, and surgical technologists and OR assistants sustained 21% of these injuries. Many of the injuries were serious and career threatening. As a result of this growing concern for employee safety, the Center contracted with an ergonomic consultant from Seattle, in June 1992 to conduct an assessment of the ORs. The firm provides ergonomic consulting to companies seeking to redesign workplaces and work procedures.

METHODOLOGY

The ergonomist toured the surgical suite before the actual assessment to determine the nature and scope of potential ergonomic deficiencies. The initial tour lasted approximately one hour and focused on the basic equipment and procedures commonly used in the ORs. After the tour, the ergonomist proposed spending one day observing on site and one and one-half days off site to evaluate his observations and to produce a report.

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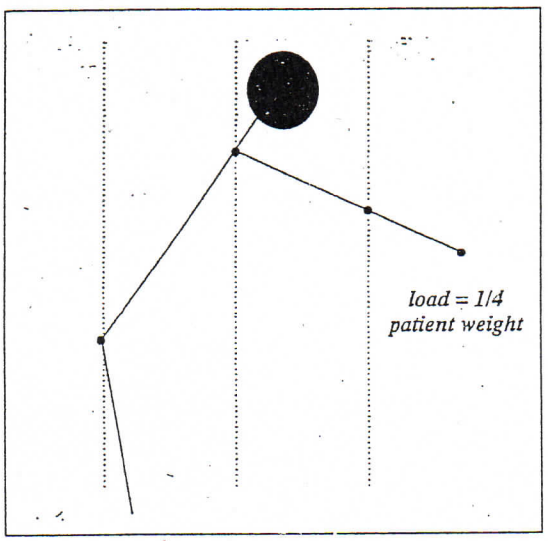

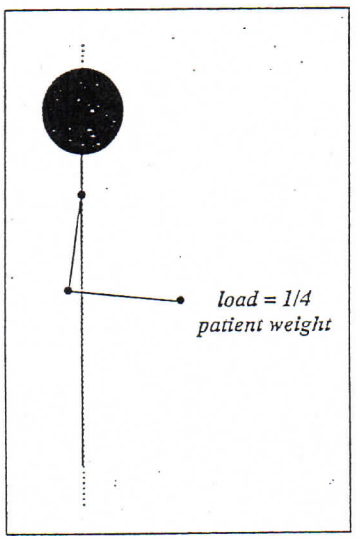

Figure 1 • *(Far left)* Original posture during patient lift from OR bed.

Figure 2 • *(Left)* Posture required to not exceed 250 kg disc-compressive force during patient lift from OR bed.

The ergonomist focused on the types and frequency of injuries that had occurred in the ORs in previous years and on activities identified by employees as being particularly awkward or stressful or as having injury potential. A significant proportion of the back injuries were found to be related to slipping and falling and to maneuvering heavy carts. Injury cost was not considered as important as injury frequency because the cost of given types of injuries varied considerably.

During the onsite day, the ergonomist observed five different surgical procedures recommended by the perioperative nurse manager that would allow him to see a broad spectrum of equipment and procedures. The primary focus was on preparatory and cleanup activities and maneuvering patients. The ergonomist interviewed the team members between surgeries and during the preparatory and cleanup phases.

The onsite assessment included several categories.

Measurements. The ergonomist recorded the physical dimensions of the equipment and the force required to operate and maneuver each piece of equipment.

Ergonomic checklists. The ergonomist evaluated employee tasks by using checklists to assess a broad spectrum of ergonomic-related factors and to provide a general risk rating for each task. The checklists assessed a series of workplace stressors on a scale of one to three. The score was given as a percentage of the maximum possible score and was used to categorize the task: 0% to 20% = low risk, 21% to 59% = medium risk, and 60% to 100% = high risk. An abbreviated version of the ergonomics checklist is shown in Table 1.

Video analysis. The ergonomist recorded employee lifting activities on videotape and analyzed the videotape to calculate the disc-compressive forces in the L5-S1 lumbar discs.

Solution identification. The ergonomist developed several potential solutions for each problem where possible.

RECOMMENDATIONS

After analyzing the back injury data and observing on site for a full day, the ergonomist made specific recommendations about five types of activities that he believed were responsible for most of the back injuries. These activities included moving patients, maneuvering carts and equipment, lifting gallbladder boards, walking on wet floors, and accessing power outlets.

Moving patients. Before the ergonomic assessment, patients were rolled on their sides and then rolled back onto short roller boards. One person reached over the stretcher and lifted and pulled patients from the OR bed to the stretcher. As many as three people pushed patients from the other side of the OR bed. The person reaching across the stretcher potentially could sustain a back injury because of the required lifting posture, which is shown in Figure 1. The estimated disc-compressive

Table 1

SAMPLE ERGONOMIC CHECKLIST

Analysis date: _____ Job/Task name: _____

Department/Location: _____ Analyst: _____

Part/Unit name: _____ Employee name: _____

Job/Task duration*: _____ # people exposed: _____

Job/Task description: _____

*continuous > 4 hours; frequent = 1 to 4 hours; occasional < 1 hour

Injury/Illness review

Record reviewed:	Type of injury	Number of injuries
Occupational Safety and Health Administration log		
Workers' compensation		
First aid log		

Checklist use

Industrial jobs:

Upper limb intensive: A, B Materials handling: D

Upper limb intensive with tool use: A, B, C

If video display terminal use is combined with any of the above, add E

Office/laboratory jobs:

Video display terminal use: E

If non-video display terminal-related tasks are also performed, use A, B, C, or D as appropriate

	Before			*After*		
	Never	Sometimes	Frequently	Never	Sometimes	Frequently
A. Task characteristics						
• Worker repeats the same movement pattern	—	—	—	—	—	—
The work requires:						
• Reaching in front of the body	—	—	—	—	—	—
• Reaching behind the body	—	—	—	—	—	—
• Reaching sideways	—	—	—	—	—	—
The operator applies or undergoes:						
• Pinch grips	—	—	—	—	—	—
• Forceful grips	—	—	—	—	—	—
• Static muscle loading	—	—	—	—	—	—
B. Workstation						
The work surface:						
• Is too high or too low	—	—	—	—	—	—

The work area:						
• Restricts movement of the body	—	—	—	—	—	—
• Has lighting/glare that makes seeing difficult	—	—	—	—	—	—
• Has foot pedals that cause awkward position	—	—	—	—	—	—
C. Hand tool						
Tool use requires that:						
• The wrist be in a nonneutral position	—	—	—	—	—	—
The worker experiences:						
• Vibration and/or torque	—	—	—	—	—	—
• Unevenly balanced weight	—	—	—	—	—	—
The controls on power tools cause:						
• Hyperextension of the thumb	—	—	—	—	—	—
D. Materials handling						
The task requires:						
• Heavy lifting	—	—	—	—	—	—
The handling process required includes:						
• Movement of object(s) above shoulder level	—	—	—	—	—	—
• Movement of object(s) below knee level	—	—	—	—	—	—
Material handling equipment:						
• Is needed but unavailable	—	—	—	—	—	—
E. Video display terminal						
Visual						
Monitor/documents:						
• Are positioned too high or too low	—	—	—	—	—	—
• Are difficult to see/read	—	—	—	—	—	—
Lighting:						
• Is needed but unavailable	—	—	—	—	—	—
Musculoskeletal						
• Keyboard/work surface is too high or too low	—	—	—	—	—	—
• Hand/wrist rests on hard/sharp edge	—	—	—	—	—	—

Recommendations

force in this position varied between 375 kg and 795 kg. This exceeds the recommended limit of 250 kg.[4]

In response to these observations, the ergonomist recommended that at least four people should be required to move a patient from the OR bed to the stretcher and back, that lighter weight plastic slider boards nearly the entire length of the patient's body be used to reduce friction between the patient and the stretcher, and that wider draw sheets be used so that the person pulling the patient would not have to reach so far across the stretcher to grasp the sheet.[5] The recommended lifting posture results in a disc-compression force just below the 250 kg limit when lifting a large (ie, more than 200 pound) patient (Figure 2).

Maneuvering carts and equipment. Heavy carts and equipment weighing between 225 kg and 455 kg were pushed or pulled to different areas as needed. Significant effort was necessary to maneuver these carts because of the types of fitted wheels. Some carts had four independently pivoting wheels, which made them difficult to control, and other carts had excessively wide or soft wheels, which made them difficult to roll.

The ergonomist recommended that not more than 28 kg of force be required to start a cart load rolling and that not more than 36 kg of force be required to stop the cart load in less than one meter. Carts with these capabilities exist but often are not in use because the recommended performance criteria usually are not specified to the hospital's purchasing department.

Lifting gallbladder boards. The gallbladder board is composed of two layers of plywood covered in plastic laminate and separated by 5-cm spacers. The board was placed on top of the OR bed and under the patient, which allowed x-ray film plates to be placed under the patient. The ergonomist determined that the stresses imposed on an employee's back when lifting and placing the gallbladder board were excessive and recommended that the gallbladder board be permanently fixed to one table. This table could be used for all procedures requiring the board and would not adversely affect other procedures.

Walking on wet floors. Serious back injuries often result from trying to catch one's balance when slipping. Slips on wet floors had occurred in the past in the surgical suite and were more likely to occur around scrub sinks and in ORs after floors were mopped or waxed. Soap on the floor also tended to act as a lubricant. To reduce the risk of slipping, the ergonomist recommended replacing cloth shoe covers with rubber-soled sneakers to be used solely in the ORs and discontinuing the use of wax on linoleum floors in the surgical suite.

Accessing power outlets. The power outlets in the ORs each consisted of a heavy cord, metal box, and face plate that sat directly on the floor. Employees had to bend over to floor level to plug or unplug each piece of equipment. The ergonomist recommended placing the power outlets on movable stands or suspending them from the ceiling at elbow height to reduce excessive bending. Four new ORs subsequently have been built in the suite, and their power outlets are suspended from the ceiling approximately 30 inches above the floor.

IMPACT OF ERGONOMIC ASSESSMENT

The ergonomic assessment was well received by perioperative nurse managers and staff members and was reviewed in detail at all administrative levels. As a result of this report, the following interventions were implemented in the surgical suite.

- Employees attended an inservice program about patient lifting and transferring techniques and were urged to attempt lifting only with the support of three other staff members (ie, one on each side of the patient, one at the head, one at the feet).
- We provided longer roller boards because staff members believed them to be more practical transferring aids than the recommended plastic slider boards and larger draw sheets.
- The staff members were urged to move heavy pieces of equipment with the help of another employee.
- We decided to eliminate the use of gallbladder boards entirely. To do this, we purchased fluoroscopic OR beds and budgeted money to purchase more of these beds next year.
- To minimize slips on wet floors, environmental services personnel began waxing floors with a sealant that provides better traction than the previously used product. Employees also were encouraged to wear rubber-soled, water-repellent shoes in the ORs.

We evaluated the wheels of all heavy equipment and replaced them with ergonomically efficient wheels where necessary. The guidelines we followed for selecting the wheels follow.

- Equipment should have swiveling wheels at the midpoint of each end and fixed wheels at the midpoint along the sides.

- Swiveling wheels' pivot points should be appreciably offset from the point at which the downward load is placed (Figure 3).
- Soft wheels deform and form flat spots, making them difficult to roll.
- Hard wheels are obstructed easily by small imperfections in the floor.
- Flat wheels are more difficult to roll than wheels with a radius.
- Wheels with narrow contact surfaces deform easily and form flat spots unless they are made of a hard material.
- Large-diameter wheels overcome small obstacles better than smaller wheels and are easier to roll.
- Wide wheels (ie, >1.5 inches) are more difficult to roll, especially in arcs.
- Small bearings near the center of the wheel are easier to roll but can support less load than wide rings of bearings.
- Ball bearings are easier to roll and last longer than sleeve bearings.
- A fifth wheel in the center of the load that extends slightly below the other wheels can greatly increase mobility and controllability of equipment.

The equipment that required replacement wheels included operating microscopes, endoscopic carts, irrigation units, and laparoscopic carts.

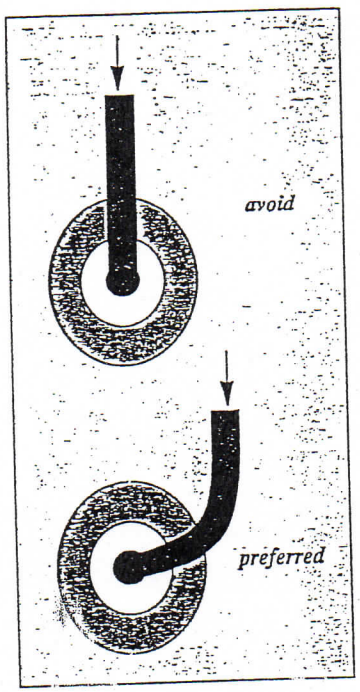

Figure 3 • Offset trailing wheels will align themselves to the direction of motion.

RESULTS

A survey of the OR staff members approximately six months after the implementation of these changes showed that fewer than half of the staff members were aware of the ergonomic changes, which suggested the need for further inservice programs. Of those who were aware of the changes, 94% believed they were somewhat helpful or very helpful and only 6% believed they were not very helpful or not at all helpful.

There has been a 25% reduction in the rate of OR personnel back injuries during the 18 months since the ergonomic changes were implemented. From Jan 1, 1990, through Sept 30, 1992, there were 27 back injuries among the OR staff members, an average of 0.8 injuries per month.

In the 18 months since the ergonomic interventions, there were 11 injuries, an average of 0.6 per month. Six of these were repeat injuries. Two of these repeat injuries occurred in one person. Further analysis of these 11 injuries showed that six were due to moving patients, two were due to lifting linen bags, and one was due to slipping on a wet floor. Two resulted from unusual incidents: one employee tried to catch a student who had fainted, and another employee slipped on a needle cap.

Although the trend toward fewer back injuries is certainly encouraging, the numbers are too small to determine whether the 25% reduction is statistically significant. It also is difficult to determine how much of this apparent reduction in injury rate is directly attributable to the ergonomic interventions; however, there has been no reduction in case volume or complexity, and there have been no changes in staffing patterns or other changes that would be expected to lower the rate of back injuries.

Further analysis of the postintervention injury pattern over 18 months shows that the back injury rate dropped to 0.44 per month for nine months and rose to 0.78 per month for the succeeding nine months. This suggests the need to periodically review ergonomic principles with the staff members to maintain their awareness of the importance of these principles in performing their work.

SUMMARY

The use of ergonomic strategies can lower the rate of back injuries in OR personnel and represents a win/win situation for staff members and nurse

managers. For staff members, it means less risk of being disabled and possibly having a painful back injury end their career. For nurse managers, the result is increased employee productivity and improved employee morale, both of which are crucial to the successful management of today's highly demanding OR environment. ▲

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NOTES

1. J Agnew, "Back pain in hospital workers," *Occupational Medicine* 2 (July-September 1987) 609-616; National Institute for Occupational Safety and Health, *Guidelines for Protecting the Safety and Health of Health Care Workers*, publ no 88-119 (Cincinnati: US Department of Health and Human Services, September 1988) 3.1–3.5; W B Patterson et al, "Occupational hazards to hospital personnel," *Annals of Internal Medicine* 102 (May 1985) 658-680.

2. L L Blum, "Equipment design and 'human' limitations," *Anesthesiology* 35 (July 1971) 101-102; M B Weinger, C E Englund, "Ergonomic and human factors affecting anesthetic vigilance and monitoring performance in the operating room environment," *Anesthesiology* 73 (November 1990) 995-1021.

3. M V DePaolis, J E Cottrell, "Miscellaneous hazards: Radiation, infectious diseases, chemical and physical hazards," *International Anesthesiology Clinics* 19 (Winter 1981) 131-148.

4. D B Chaffin, K S Park, "A longitudinal study of low-back pain as associated with occupational weight lifting factors," *American Industrial Hygiene Association* 34 (December 1973) 513-525.

5. National Institute for Occupational Safety and Health, *Applications Manual for the Revised NIOSH Lifting Equation*, publ no 94-110 (Cincinnati: US Department of Health and Human Services, January 1994) 4-12.

Using an Alias System to Ensure Patient Safety

Because of the increasing number of victims of violent crime admitted to the hospital, patient safety in the hospital setting is becoming a concern. One way to ensure that victims of violent crime are safe during hospitalization is to use an alias system for such patients. According to an article in the January-March 1995 issue of the *Journal of Trauma Nursing*, an alias system for victims of violent crime and other high-risk patients should consist of the following important aspects.

Patient definition. High-risk patients (eg, victims of violent crime, patients who are under arrest, celebrities) should be categorized and receive a risk level from security services personnel.

Patient identification. When high-risk patients are admitted to the hospital, staff members should call security personnel. A security officer can interview high-risk patients to determine their risk levels. Patients' risk levels should be listed in the emergency department (ED) log so ED personnel know to take precautions when providing information about these patients.

Alias generation. Hospitals should have predetermined lists of aliases that sound like real names. When high-risk patients are admitted to the hospital, their aliases should be entered into the patient tracking system. Admitting personnel should be informed when high-risk patients have been admitted, and they should know the aliases the patients have been assigned.

Registration, medical records, and patient care. High-risk patients are registered solely by aliases. Asterisks or numeric codes alert staff members that the names listed in hospital records are aliases. Additionally, all medications, transfusion products, and supplies should be labeled with patients' aliases.

Visitation. If possible, hospital exits should have access-controlled doors to allow staff members to monitor visitors. Each high-risk patient, if able, can complete a "visitation authorization" form that designates a certain number of "safe" visitors (eg, family members). Safe visitors also receive code numbers that allow them to access information about a patient's condition via telephone.

J Neff, "Innovations in care: The cutting edge—developing an alias system for patient security," Journal of Trauma Nursing 2 (January-March 1995) 25-26.