LIFTING BEHAVIOR, BACK PAIN, AND BACK INJURY

AMONG REGISTERED NURSES IN THE HOSPITAL SETTING

BY

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THESIS

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In memory of my grandmothers,

Florence Esther Brown Hakes and Aura Margaret Cleghorn Thorpe,

and my daughter,

Kathryn Eileen Wachs.

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SUMMARY

Back injury among nursing personnel engaged in direct patient care in the hospital setting has been shown to be a primary occupational health concern. The primary agent of back injuries among nurses has been reported to be the moving of patients. A descriptive cross sectional survey was undertaken to examine the prevalence of prescribed lifting behavior among registered nurses in the hospital setting. Using Suchman's (1965) epidemiologic framework, factors influencing prescribed lifting behavior, specifically characteristics of the nurse, the patient, and the environment, were identified as well as determining the relationship between prescribed lifting behavior, occupational back pain, and occupational back injury. One hundred seventy-eight female registered nurses employed on critical care, stepdown, and general nursing units of four northern Illinois community hospitals were observed by the researcher and two research assistants moving adult patients in bed. Following the observation, each nurse completed a questionnaire which measured the nurse's attitudes toward safety and back injury prevention, her perception of teamwork on the unit, her knowledge of body mechanics, selected demographic characteristics, and her self reported history of occupational back pain and back injury.

The 155 completed questionnaires and observations were analyzed resulting in the following findings. The prevalence of prescribed lifting behavior among the nurses observed was low with only two percent of the sample nurses completing all thirteen behaviors as prescribed. A major culprit in lowering the prevalence rate was the

widespread problem of the bed being at a lower-than-optimal height (lower than waist height) during moving episodes. Other behaviors with low occurrence were lowering the siderail, using a rocking motion during the move, keeping the back and waist essentially straight, and flexing the hips and knees.

In examining the antecedents of prescribed lifting behavior, it was determined that the variance in total lifting score was best explained by the type of patient movement and by the nurses' age. Nurses who were observed pulling patients up in bed had higher total scores than nurses who were observed turning patients or moving patients to the side of the bed and younger nurses achieved higher total scores than older nurses.

The environment items (bedwheels, obstacles, bed height, head of the bed, and siderails) were best predicted by the type of unit (critical care having the highest score) and the nurse's age (younger nurses scoring higher than older nurses). The variance in the items which dealt with the actual movement of the nurse's body during lifting (stance, shoes, movement, posture, and patient position) was best explained by the type of patient movement (pulling a patient up in bed resulting in a higher score than the other two movements) and by the patient-staff ratio (a higher ratio, more patients per nurse, related to a higher score). The posture items (position of the back, waist, hips, and knees) were best predicted by patient assistance (scores were lower when the patient assisted during the move) and the

patient-staff ratio (the more patients per nurse, the higher the score).

Analysis of variance was used to determine if there were any significant relationships between lifting scores, self-report of back pain and self report of back injury. The only significant F value in the analyses was between the environment items and recall of back pain in the previous six month period. Those nurses who had recently experienced back pain also were more likely to lock the bed wheels, raise the bed height, lower the head of the bed and the siderails, and remove furniture and equipment from the bedside as the patient's condition allowed.

Finally, significant relationships were found between the recall of occupational back pain during the previous two week period and the previous six month period. Back injured nurses were significantly more likely to report back pain during the previous two week and the previous six month periods.

Several limitations in the areas of sampling, instrumentation, and design dictate caution in the conclusions that can be drawn from the study. The sample of hospitals, units, data collection days and shifts, and nurses were acquired by convenience. Instruments specific to the problem of back injury among nurses or specific to the hospital work environment were, for the most part, nonexistent. Thus, all but one of the instruments used in the study were researcher designed and used following pilot study testing. Inadequate interrater reliability for the observation data brings into question the comparability of the

data collected at the four hospitals. Finally, the cross sectional design did not allow for temporal ordering between lifting behavior, self reported occupational back pain, and self reported occupational back injury.

I. STATEMENT OF THE PROBLEM

Lord, either lighten my load
or strengthen my back.

Poster in Nurses' Lounge

Back injury and back pain are common and costly phenomena in occupational settings. Numerous ergonomic, biomechanical, and environmental strategies to reduce the incidence and severity of occupational back injuries have been tried, but the problem persists. Therefore, a new approach to the back injury problem seemed necessary in order for research findings to provide direction for effective preventive strategies. This study was undertaken to ascertain the prevalence of a primary determinant of back injury and back pain, lifting behavior, among members of a specific occupation, nurses. The emphasis in this study was health-related behavior (lifting behavior) rather than health outcomes (pain and injury) which were emphasized in earlier research. Further, antecedents and consequences of prescribed lifting behavior were studied in an effort to link possible preventive strategies to the reduction of back injuries and back pain.

A. Prevalence and etiology of back injuries among workers in various settings

In industry, the leading cause of injury has been posited to be overexertion, accounting for one third of all occupational injury and illness costs (Liles & Mahajan, 1985). The most common and serious type of injury are those to the low back (Liles & Mahajan, 1985). McGovern (1985) reported back injuries to be the number one source of

industrial absenteeism. She estimated the prevalence of industrial back injury to be between 35 percent and 82 percent. Low back injuries account for one of every five compensable injuries, resulting in $4.6 billion annually in compensation in the United States with a mean cost per back injury of $6000 (Morris, 1984). In the United Kingdom, Troup (1965) stated that 19 percent of reported accidents affect the spine and trunk, similar to Morris' (1984) findings in the United States. Yu et al. (1984) estimated that more than half of the working population suffer back pain sometime during their work life, a similar estimate to McGovern's (1985) prevalence rate.

Multiple factors are thought to be responsible for these accidents and resulting injuries. However, many researchers have focused on lifting behavior as a primary culprit in many back injury scenarios (Brown, 1973; 1975; Chaffin and Park, 1973; Dukes-Dubos, 1977; Jones, 1972; Liles and Mahajan, 1985; Nachemson, 1971; Snook et al., 1978; Troup, 1965; Yu et al., 1984; Klein et al., 1984). In a 1982 study of 900 back injured workers, the Bureau of Labor Statistics reported that 75 percent of the workers were lifting at the time of the injury (Preventing Illness and Injury in the Workplace, 1985). In an earlier investigation, Brown (1975) studied 509 workers in warehouses, hospitals, removal and storage, and light industries. His questionnaire revealed 49 percent of the back injuries were caused by lifting, 12 percent by slips and falls, and 39 percent fell in the 'other' category. "In the industrial environment, there is very strong personal correlation between low back pain and lifting - back

pain being attributed to trauma as a result of lifting" (Brown, 1975, p.28).

Chaffin and Park's (1973) study of 411 men and women working at 103 different jobs involving manual handling showed results of significantly higher rates of back injury when a job was rated as having a higher lifting strength rating (LSR).

$$\text{LSR(lifting strength rating)} = \frac{\text{LOAD(maximum)}}{\text{Strength of the worker}}$$

Further, workers who lifted less than 50 times per day or more than 150 times per day were at increased risk.

In an evaluation of the 1982 NIOSH lifting guidelines, Liles and Mahajan (1985) found a relationship between injury incidence, resulting disability, injury severity, and the ALR (action limit ratio). The ALR is calculated by the following formula:

$$ALR = \frac{W}{AL}$$

where W=the frequency and time weighted average of required lifting weights

AL=the action limit

$90(6/H)(1-.01|V-30|)(.7+3/D)(1-F/Fmax)$-US customary units

where H=horizontal location (in) forward of midpoint between ankles at origin of lift (6 inches to 32 inches)

V=vertical location (in) origin of lift (0 to 70 inches)

D=vertical travel distance (in) between origin and destination of lift (10 inches to (v-80) inches)

F=average frequency of lifts (lifts/minute)

(.2 (1 lift/5 minutes to Fmax)

Fmax=maximum frequency which can be sustained (12-18 depending on body position and time) (NIOSH, 1982)

A large ALR was correlated with an increased incidence and severity of back injury among workers in 101 different jobs which required lifting (Liles and Mahajan, 1985).

Another study divided the incidents resulting in back injury into two groups, true accidents and nonaccidental injuries (NAI). The researchers reported that true accidents are most often the result of slips, trips, and movements of floor surfaces (underfoot accidents) while NAI were most often associated with the handling of loads (bending, lifting, carrying, twisting) (Manning, 1985; Mitchell et al., 1983). This study provides an explanation as to the sometimes contradictory results regarding the 'causal' mechanisms in back injury research. Back injuries may well arise out of more than one circumstance. Those circumstances being 1) a more truly unintentional, unavoidable, and unexpected phenomenon or 2) a situation closer to the "not an accident" end of the continuum in which lifting plays a primary role.

In a study of compensable back injury claims, Liberty Mutual Loss Prevention representatives completed 192 questionnaires concerning the last back injury case with which they were involved. Seventy percent of the injuries were related to manual handling tasks including lifting, pushing, pulling, and carrying. Lifting, alone, however was responsible for 49 percent of the injuries (Snook et al., 1978).

Nachemson (1971), in discussing the etiology and treatment of low back pain, stated

> Thus, mechanical factors are of importance, and in larger studies it has been repeatedly demonstrated that more than 50 percent of our patients claim that the onset of their symptoms occurred in connection with lifting heavy objects or in performing similar mechanical tasks, and nearly all of them noted the increase of pain following mechanical stress (p. 20).

Troup (1965) found a somewhat smaller percentage in the United Kingdom where 25 percent of all reported industrial accidents were the result of manual handling. He acknowledged that the cause of many back injuries is unknown, but maintained manual handling was an important causative factor. "Though most of them arise without definable cause, heavy manual work is clearly a major contributory factor" (Troup, 1965, p. 858).

While there has been some controversy over whether workers employed in heavy physical labor have similar back injury incidence as sedentary workers, Hult (1954) found that degenerative changes of the spine were 1.5 times more likely in the heavy labor group compared to the sedentary workers.

These studies, while not limiting the 'cause' of back injury to heavy lifting, do point to lifting as a significant risk factor in back injury incidence. Are nurses at increased risk for back injury? Is lifting behavior a significant risk factor for back injury among hospital staff nurses? Studies of nurses who have suffered back injury have been reviewed to determine the primary risk factor(s) related to the injury.

B. Prevalence and etiology of back injuries among nurses in the hospital setting

Though hospitals are thought to be safe, healthy environments for patients, employees, and visitors, hospitals actually trail industry in work injury prevention (Seidlitz, 1981). According to National Safety Council estimates, the injury rate among hospital employees is twice the rate of other service industries (Stellman, 1982). When various departments within the hospital were compared in relation to injury rate, nursing personnel were found to have a disproportionately high number of accidents and resulting injuries (Lewy, 1981; Hoover, 1973; Stellman, 1982; Trascz and Rose, 1983). Lewy (1981), in a study at Columbia University Medical Center, found that nurses reported 60 percent of the incidents but accounted for only 33 percent of the workforce.

Injuries to nurses include punctures, contusions, abrasions, lacerations, burns, sprains and strains (Wilkinson, 1983; Hefferin and Hill, 1976; Douglass, 1971; Stellman, 1982). Many of these injuries are minor, often unreported. Strain injuries, however, may be serious, resulting in lost work time and sometimes permanent disability. The back is a primary site of strain injury for nurses (Hefferin and Hill, 1976; Hoover, 1973; Ferguson, 1970; Raistrick, 1981; Stubbs et al., 1983a; Stellman, 1982).

Several studies have examined the incidence and prevalence of strain injuries to the back among nurses. Hoover (1973), at the Wilmington Medical Center, found that, for nurses, 40 percent of time lost from all occupational injuries was due to back injury. Stellman

(1982) concurred with these findings saying, that for nurses, back injuries were the leading cause of time lost from work. Clever (1981), in a study of all hospital employees, reported that one half of all lost work time injuries to registered nurses were due to overexertion or strain. This accounted for 13 percent of the total injuries to all hospital employees. Forty percent of these injuries affected the back. In a study of acute and long term hospitals in British Columbia, Canada, 70 percent of the lost work days were attributed to nursing staff (Trascz and Rose, 1983). Sixty percent of these lost work days were due to back injury.

The major cause of back injury in nurses is thought to be the lifting of patients (Clever, 1981; James, 1983; Stellman, 1982; Hoover, 1973). Hoover (1973) reported that while nurses comprised 43 percent of the total medical center employee population, they experience 67 percent of the lifting injuries. Dehlin et al. (1976), in a study of 267 female nurse aides in a Swedish geriatric hospital, found the overall incidence of back symptoms to be 46.8 percent with a recurrence of symptoms in 82 percent of the affected staff. However, no relationship between lifting technique and incidence of back injury could be established though the lifting burden was found to exceed the maximum permissible limit.

Owen (1982) reported that 85 percent of accident report forms for low back pain filed over a three year period by nursing personnel at a university hospital indicated the lifting or transferring of patients as the trigger event. Ferguson (1970), in a study of Australian

hospital employees, reported that 52 percent of all injuries to nursing staff resulted from lifting. Forty-one percent of the injuries were to the back and the same percentage involved the patient as the agent of injury. "Strain injury of the trunk was incurred in lifting in over two thirds of the cases" (Ferguson, 1970, p. 378).

Howell and Knight (1981), in discussing hospital safety, concurred with Ferguson (1970) when they wrote

> Strain or overexertion usually suffered during patient handling accounts for the largest percentage of accidents to nurses in typical accident surveys (p. 29).

From these studies, as well as from those conducted in general industrial settings, it is clear that while lifting is not the only causal factor operating, it is a significant one.

To conclude, workers in general and nurses in particular have been studied in relation to their back injury experience and possible causative factors related to those injuries. While lifting appears to be an important etiologic factor, in many instances, hypothesized relationships between antecedent variables and back injury have either been absent or weak. There are several possible explanations for the inconsistent results in accident research, including the problems associated with the use of accident and injury data as criteria.

C. Limitations of accident/injury data as criterion variables

Occupational accident research has relied almost exclusively on reported accidents and resulting injuries as the basis for the determination of causal factors and the evaluation of preventive strategies. The research has been inconclusive in determining the cause of accidents, either in general or in specific accident

categories, or what preventive approaches are most effective in reducing the incidence of accidents and the severity of injuries. There are many shortcomings to the use of accident and injury data as criterion measures for these studies, including lack of an acceptable definition for the term accident, measurement issues, study sampling and design, and data analyses.

1. Defining accidents and related injuries

Webster defines an accident as

1) a happening that is not expected, foreseen, or intended;

2) an unpleasant and unintended happening, sometimes resulting from negligence that results in injury, loss, damage, etc.;

3) fortune; chance (to meet by accident) (Guralnik, 1978, p. 8).

It seems from the first two definitions, an accident is usually a negative experience which to some degree is unpredictable and unintended by the victim or others involved in the episode.

Turning to occupational literature, Bird (1983) described an accident process by delineating three stages, precontact, contact and postcontact. The contact is thought to be with a source of energy in excess of the body's tolerance or with a substance that interferes with the body's normal function. From an occupational standpoint, Bird defines an accident as "an undesired event resulting in personal physical harm, property damage, or business interruption" (p. 681). From this definition, it is clear that the outcome need not involve human loss. Destruction of property or shut down of the line could also result from an accident situation.

McCormick (1976) had a similar if more general view of accidents and stated that "accidents involve the release of some form of energy" (p. 442). Accidents may result from natural forces, man-made items or behaviors. No indication of predictability or intentionality was given.

A classic discussion of accidents was authored by Suchman (1961). He went beyond the definitions previously cited and dealt with accident parameters and process. Suchman (1961) stated that there was no accepted research or practice definition of accidents. He set forth parameters to be used to classify an event as an accident or as a nonaccident. The three major characteristics of accidents according to Suchman (1961) were:

1) Degree of expectedness,

2) Degree of avoidability,

3) Degree of intention (p. 30).

That is, an event is more likely to be termed an accident the more it is unexpected, unavoidable, and unintentional. Further, four corollaries were added:

4) Degree of warning,

5) Duration of occurrence,

6) Degree of negligence,

7) Degree of misjudgement.

The event occurs with little warning and is of short duration. True accidents involve little negligence or misjudgement on the part of those people involved. These parameters place the labeling of events on a continuum from "not an accident" to a "true accident". Because

of the multiple factors, a plane rather than a line might best depict the event in terms of its "accident" nature. Thus, a predictable situation in which participants have a good deal of control over the outcome is closer on the continuum to "not an accident" than is a situation of low predictability and little input by the victims.

Accident situations can then be thought of as (1) potential injury-producing events. These events can be separated from antecedent factors which are hypothesized to contribute to the occurrence of the accident as well as being separate from the resulting injury if one occurs. In other words, an accident is not labeled as such merely due to its cause or its effect. (2) Using Suchman's (1961) characteristics, accidents can be distinguished from other events by their low degree of predictability, avoidability, and intentionality. By defining accidents by their degree of these characteristics, accident events can be placed on a continuum from "not an accident" to "true accidents". (3) Occupational accidents, for the most part, are found somewhere between the extremes and thus are amenable to prevention strategies. Implied in these characteristics, the determination of an event being an accident is dependent on the situation which produced it. Multiple factors are involved in any accident situation. It is the combination of these factors which produce the accident and which give direction to prevention strategies. (5) Accountability for the resulting damage, be it personal or environmental, is less for those involved in a true

accident than for those who, due to carelessness or willfulness, contributed to an accident event.

These criteria include the ideas of several authors who have attempted to define and analyze the concept accident. Obviously, the definitions are as varied as the authors, reflecting the richness of the concept. Unfortunately, the variety of definitions has curtailed standard measurement and thus may be one explanation for conflicting research results. In many research studies, either no definition of 'accident' is provided or the definition is left to the employee filing the first report of injury or the employer who determines which accidents should be reported. This lack of standardization in definition limits the comparability of various studies which use accident incidence and resulting injury as the criterion variables.

2. Measurement issues

The measurement of accidents, and the resulting injuries, provides researchers with several problems. First, to be able to accurately compare accident and injury rates the researcher must establish exposure levels. If, for example, staff nurses exhibit ten times the incidence of puncture wounds compared to administrative nurses it would be erroneous to assume that staff nurses are more careless, less knowledgable, or under more stress than administrative nurses. Rather, the higher incidence may simply reflect the frequency to which staff nurses are exposed to potential injury situations (preparing, administering, and disposing of injections) compared to administrative nurses. Thus, knowing a worker's exposure is essential in preventing the researcher from attributing 'cause' to other

variables which may merely be associated with the difference in exposure levels.

Second, the aspect(s) of accidents and injuries measured may influence the results of the research. The most often measured aspects are accident and injury incidence (number of accidents or injuries per unit of time, number of hours worked, number of employees at risk, etc.) These statistics are subject to several sources of bias. The statistics are generated through report of employees and management. Therefore, the reporter must define the event or subsequent injury as reportable, know how to report the event or injury, have time to report, and perceive no sanctions against reporting. Thus, these statistics are thought to be of limited value because most likely they are indicative of only a portion of the actual accident and injury occurrence in an industry. Accidents which do not result in injury are not as likely to be reported as ones which result in injury. The more severe the injury, the more likely is the accident to be reported. These generalizations are of course subject to variation depending on the industry, the specific workplace and probably even the department or unit. Therefore, comparisons even within the same workplace may not be based on comparable data.

Injury severity may also be used as a criterion measure. Injury severity suffers from the same definition problems as does health status. Should injury severity be determined by the number of days lost from work, the number of doctor visits, the number of days in the hospital, the cost to the company, or the residual disability of the

worker? These measures are confounded by numerous other variables such as the type of work in which the injured employee is engaged, the personality of the worker, the age of the worker, the physician, the geographic location of the workplace and the health care services available. Therefore, it is questionable that severity of injury judged by these measures will lead the researcher to any conclusions which relate clearly to the causes of injury or the effectiveness of prevention programs. Other information which could be collected and compared related to accidents and injuries include accident type, agency of accident, unsafe act, hazardous condition, nature of the injury, part of the body affected, and source of the injury (Fraser, 1980). As discussed previously, the 'causes' of accidents and the 'causes' of injuries may not be the same. Therefore, even if these data were available, the complexity of the analysis in determining which variables were significant and the amounts and combinations of specific variables would be overwhelming. This problem is only accentuated by the limited reliability of the data.

3. Sampling and design considerations

In terms of the samples used in accident research, the workers who have reported injuries are thought to create a biased sample in that not only are they injured but the injury was reported. Because this group is only a subset of the population of interest (all injured employees) it is difficult to decipher if variables discriminate people who have suffered injuries or people who have reported them. Also, because injuries are the result of multiple factors coming together at a specified time, there is a probability aspect to

accidents and injuries. Thus, someone may be classified as having never suffered an accident or resulting injury today but tomorrow may join the accident/injury group due to an occupational mishap during that 24 hour period. Because of the unstable nature of accident/injury status, it is difficult to differentiate groups on the basis of certain variables as the variables which distinguish the groups today may be altered tomorrow based on different group membership. Similar problems plague epidemiologic research concerning disease etiology.

Using accident and injury data as criterion measures present some methodological dilemmas. If research is conducted in a retrospective fashion the researcher is faced with the problems of recall of data related to the accident as well as recall of factors which may be hypothesized to explain the occurrence of the accident. Further, temporal ordering cannot be easily established and thus one cannot be sure if the variables which distinguish injured from noninjured workers today were equally relevant prior to the accident or if the accident and resulting injury have affected these variables. If a prospective study is undertaken, a large sample of workers and a long study period are necessary to ensure adequate numbers of accidents and resulting injuries, and thus meaningful conclusions. A large sample and long time period have their own limitations. A large sample may require more than one workplace which will multiply the number of variables which could have causal influence. A long time period may alone influence accident and injury rates due to changes in processing

methods, machinery, or seasonal variation. Further, in a prospective study, it is important to have a firm handle on variables which are to be measured over time. It is not possible to measure everything that could possibly influence the incidence of accidents and injuries and due to the large outlay of money and time the researcher does not want to miss measuring the variable which best explains the phenonmenon. Neither approach, retrospective or prospective, is completely satisfactory in the study of accident and injury causation at this time.

4. Analysis

Typically, correlations between causal variables and accidents/injuries are low. There are numerous explanations for this. Accidents are a coarse measure according to Teel (1954) and as such variables which may come together to create an accident with a resulting severe injury for one worker may only result in an accident without an injury in another and thus would not even be reported. Further, correlations are affected by the accident rate and the length of the exposure period. The measures would be far more reliable given longer periods of time and higher rates. For this reason many authorities advocate the use of all accidents rather than only those which result in injury believing that accidents are much more prevalent than injuries (Teel, 1954; Heinrich, 1959; Suchman and Scherzer, 1960; McFarland, 1963; Peterson and Goodale, 1980). Finally, it may be that researchers are attempting to correlate causal variables with accidents and injuries which are not specific to the incident. An example might be measuring worker risk taking behavior

in relation to an accident in which the worker had no knowledge of the risk and therefore could not have taken a risk even if he were predisposed to do so. In this case, the correlation between risk-taking behavior and accident incidence might be very low.

For all of these reasons, the problematic definition of accidents, the measurement issues, sampling bias, and design and analysis considerations, the use of accident and injury statistics seems, at this time, to be of limited value. However, it may be valuable to assess the adequacy of accident and injury data in relation to research specific to prevention of back injury among nurses employed in the hospital setting.

D. Limitations of back injury data

Following the criteria presented previously for defining accidents, the events which result in occupational back injury could be classified as accidents. The event, moving patients, for example, has the potential to result in an injury. Based on what is known about spinal stress in relation to lifting, this relationship is plausible. At this time, it is difficult to predict when or how a back injury will occur. While it is thought that some back injuries are preventable, improper lifting techniques are by no means the only etiologic factor in back injury incidence. Thus, while the worker may be held accountable to some degree for the accident and resulting injury, other factors related to the environment or the work itself may also contribute to this costly problem.

Improper lifting, a hypothesized etiologic factor, most likely

occurs numerous times during each working day. However, accidents, particularly those involving severe injury, are much less common. Therefore, the event which results in back injury among nurses can be classified according to Heinrich's (1959) scheme of many unsafe acts, some no injury accidents, a few minor injury accidents, and a rare major injury accident. The first report of injury forms from a midwestern university hospital would bear this out in that for fiscal year 1983, only one major back injury was reported among the nursing staff resulting in over 200 lost work days. Twenty-seven other injuries were reported with only a few or no lost time days. There were no records of the no injury accidents or of the numbers of times per day that nurses engaged in behaviors which increased their risk of back injury (Personal Communication, University of Illinois, Office of Risk Management, 1985).

When describing the event which results in a back injury, the characteristics of predictability, avoidability, and intentionality can be used to place the event on the "not an accident" to "true accident" continuum. For the most part, accidents have some degree of these attributes but are certainly not thought of as self-inflicted injury situations. Therefore, these events are amenable to prevention strategies. As in the case of many other occupational injuries, back injuries among nurses do have the connotation of carelessness by the victim. However, nurses who have suffered an injury-producing event say that the environment often makes it impossible to choose any other behavior but an unsafe one. Thus, the problem of multiple causation is foremost in the derivation of prevention strategies. In summary,

back injuries among nurses are the result of borderline accidents. That is, the events which result in the injury are on the continuum between "not an accident" and "true accidents", due to their degree of predictability, avoidability, and intentionality.

Manning (1985) reported that back injuries among Ford Motor Factory employees in Liverpool, England could be categorized as nonaccidental injuries or as arising from true accidents. Nonaccidental injuries were defined as "back pain arising without interruption of activity by an unforeseen event; pain occurs during a body movement, for example, lifting or bending without an unforeseen event such as a slip or unexpected load" (Manning, 1985; Troup, 1965). It is interesting to note that the primary causes of true accidents which resulted in back injury were underfoot events (slips, trips, and movements of floor surfaces). The primary causes of nonaccidental injuries, in contrast, were bending, lifting, carrying, and twisting (Manning, 1985). In this study, the definition of accident and resulting injury was critical to these results.

In relation to back pain and injury studies, the literature is divided between studies of 'back injury' and studies of 'back pain'. Often no definitions for these terms are offered and thus comparison of study results for these two groups of research studies is difficult.

Other limitations, besides definition, to the use of accident and injury data in studying nurses' back injuries include the difficulty in diagnosing the existence of back pain/injury, the lack of a known causal incident, and sample bias due to the loss of injured nurses

from the workforce. Stubbs et al. (1983a) pointed out the difficulties in establishing a medical diagnosis from objective data (x-rays, examination, etc.). Often pain is the only symptom and the physician bases the diagnosis on subjective data only. This may lead to increased error when the diagnosis is the criterion measure in the study as the diagnosis may be affected by the patient's ability to communicate the intensity, location, and duration of the pain and the physician's ability to interpret this subjective data in making an accurate diagnosis.

The lack of a specific incident which is known to have caused the back pain increases the difficulty in studying causal factors. With most injuries (loss of limbs, contusions, burns), the worker is aware of exactly the incident which resulted in injury. Back pain, however, may result only after several traumas which may have gone unnoticed.

Due to the traditionally heavy work expected of nurses, those with severe back injury may be forced to leave their positions if not the profession. These nurses are not studied due to their absence from the workplace. Only those nurses with less severe injury, or no injury become part of the study population and this limited sample may bias the results of causal and evaluation studies.

Back injury data from samples of nurses displayed many of the same limitations as accident and injury data in general. Definition of what constitutes a back injury, lack of a known causal event, and sample bias are all limitations in this data and may explain conflicting results among the many studies undertaken.

E. Advantages of behavior as a criterion variable

Accident and injury data have been shown to have numerous limitations including definitional problems, sampling bias, design considerations, and measurement and analysis limitations. Safety behavior has been linked to accidents and injuries theoretically, and through research concerning the etiology of occupational back injury. Within the nursing profession, educators and practitioners have provided guidelines for defining what constitutes safe and unsafe behavior. Therefore, it appears that using safe lifting behavior as the criterion variable in research aimed at delineating variables thought to influence the incidence of occupational back injury could result in more reliable and valid data thus giving more clear direction to prevention strategies.

Specific advantages to studying behavior over accident and injury data include:

1) Behaviors represent common events. As Heinrich (1959) hypothesized from the results of his study of accident and injury records, there are many more instances of unsafe behavior than of reportable injury. Therefore, it is likely safety performance will follow a normal curve rather than the Poisson distribution displayed by accident and injury data. This allows for a wider variety of appropriate analytic techniques which may result in more solid conclusions and subsequently improved prevention programs.

2) Worker behavior, for example lifting behavior, is observable. The researcher is no longer saddled with self reported or inaccurately

collected records of accidents and injuries. Further, missing data (such as unreported accidents and injuries) are not as likely or as serious a problem when safety behavior is being observed. Though observation has the drawback of influencing behavior, methods to counteract this can be employed thus improving the validity of the resulting data. Bias can be reduced by the use of observation rather than record data due in part to the ability of the researcher to randomly select a sample of workers and observe them in much the same way researchers collect data in other social science fields.

3) Methodologies can also be borrowed from other fields when behavior is the criterion variable rather than accident and injury data. Prospective and experimental designs become more feasible and the study of individuals as well as groups offer a more varied approach to the development of prevention strategies. These prevention strategies are more likely to show an impact on behavior than on accident and injury rates particularly in the short run. Due to the multiplicity of factors involved in accident and injury causation, it may not be practical to assume that the change in one factor will greatly lower the rates. However, separating these factors, unsafe behavior as an example, and studying them independently may then allow combinations of preventive strategies to be attempted in the future resulting in a major reduction in rates. Also, the study of behavior has the potential to draw environmental factors into the solution of this occupational problem by studying these factors as influencing the behavior. In other words, what factors in the workplace impinge on the worker and result in the

worker performing an unsafe act? This approach of using behavior as the criterion variable will move accident research from a solely epidemiologic and record audit approach to a study of human behavior and the factors which influence that behavior.

Recent studies of industrial safety have used behavior rather than accident and injury statistics as the dependent variable. Ramsey et al. (1983) correlated thermal conditions with the incidence of safe behavior among workers in a manufacturing plant and a foundry. Observations were collected randomly on behaviors and conditions which had been shown to correlate with injury risk. These researchers found 90 percent safe behavior among the workers and environmental temperature did influence the incidence of unsafe acts. The researchers concluded that the behavioral observation technique facilitated the collection of large amounts of data which were found to be more sensitive measures than accident and injury statistics.

Chhokar and Wallin (1984) also used behavior as the dependent variable to ascertain the effect of an applied behavior analysis (training, goal setting, feedback). The pertinent behaviors were defined through analysis of plant accident reports and supervisor and employee input. Thirty-five key behaviors were developed for this study. Safe behavior increased significantly after training and increased even more after feedback.

In a study of industrial lift truck operators, observations of behavior were compared between trained and control groups (Cohen and Jensen, 1984). Training resulted in a 61 percent improvement in

performance scores. Behavior was thought to have changed due to "continued practice in safe work procedures, coupled with a redefinition of group norms sustained through peer modeling and continued management support" (p. 135). These studies highlight the successful use of safety behavior as the criterion variable in occupational safety research.

F. Conceptual framework

Due to the numerous limitations of accident and injury data, including data related to occupational back injuries, a new approach to the problem was needed. Heinrich (1959) and Suchman (1961) both developed linear models to depict the accident process. Heinrich (1959) viewed the accident and resulting injury as the consequence of an unsafe act on the part of the worker in the face of a mechanical or physical hazard. The unsafe act was due to the fault of the worker whose behavior was influenced by his/her social environment and ancestry. Specifically, Heinrich (1959) stated that "improper attitude, lack of knowledge or skill, physical unsuitability, or improper mechanical/physical environment" (p. 38) were the antecedents of unsafe acts.

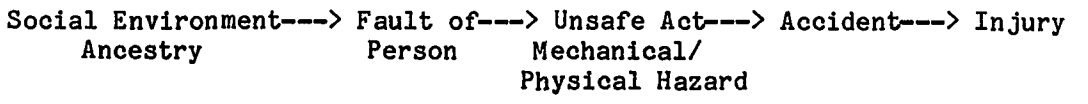


Figure 1. Accident and injury scheme (Heinrich, 1959, p. 16).

Not all unsafe acts result in accidents and not all accidents result in injury. In a study of safety records, for every 330 accidents, 300 were no injury accidents, 29 were minor injury accidents, and 1 was a major injury accident. Heinrich (1959) was not able to report, of course, the number of instances of unsafe practice in relation to each accident category.

This information, then, puts accidents into a different frame of reference, that is, separate from both the antecedent, or causal, factors and also separate from the resulting injury if one occurs. Rather, the accident seems to embody the union of multiple factors, both personal and environmental, which when triggered by an unsafe act result in a slip, a cut, a blow. Some of these accidents result in no injury while others require a band aid and others months of hospital care. The trigger, the unsafe act, may occur hundreds of times without an accident occurring because the other factors are not present. However, without the unsafe act the combination of other factors would not be of consequence and therefore decreasing the incidence of unsafe behavior is of primary importance.

Suchman (1961) developed a similar model.

Predisposing characteristics of the Individual ----->	Unsafe Behavior in the Face of a Hazard. ----->	Injury Producing Event

Figure 2. Injury scheme (Suchman, 1961).

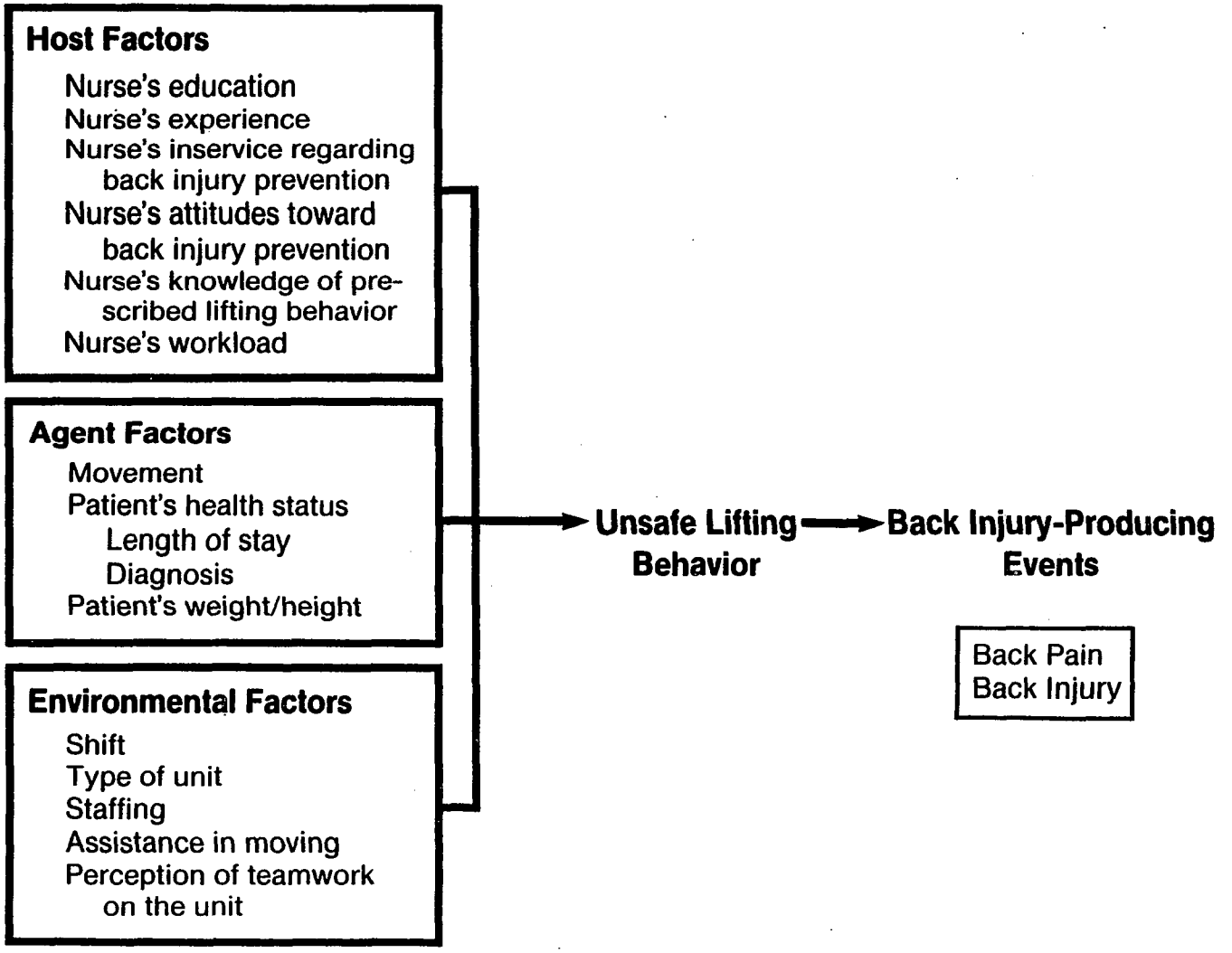
In this early model, however, only the characteristics of the individual were included as antecedents of the behavior. In later work, Suchman (1965) used behavior as the criterion in a study of Puerto Rican sugar cane cutters and their acceptance of a glove meant to decrease the incidence of hand lacerations. Using the epidemiologic triangle, Suchman (1965) elaborated on the antecedent component of his framework, categorizing the antecedents as host or worker factors, agent or glove factors, and environmental factors. He found specific variables in each category influenced whether or not workers wore the protective glove. He also found some relationships among the factors which taken together had an effect on worker acceptance of the glove.

Both Heinrich (1959) and Suchman (1961; 1965) suggested that preventive strategies should be aimed at reducing the incidence of the unsafe act thereby reducing the incidence of accidents and resulting injuries. The unsafe acts could be limited by aiming prevention strategies at host, agent, and environmental factors thought to influence the behavior.

This framework was applied to the problem of occupational back injury among nurses in the hospital setting. Lifting behavior was targeted as the "unsafe act" which preceeded many back injury-producing events. Host, agent, and environmental variables thought to influence lifting behavior were defined. Figure 3 displays the variables and their hypothesized relationships.

This investigation was concerned with identifying characteristics of the nurse, the environment and the patient which influenced the

Figure 3. Conceptual framework.


Host Factors
Nurse's education
Nurse's experience
Nurse's inservice regarding back injury prevention
Nurse's attitudes toward back injury prevention
Nurse's knowledge of prescribed lifting behavior
Nurse's workload
Agent Factors
Movement
Patient's health status
Length of stay
Diagnosis
Patient's weight/height
Environmental Factors
Shift
Type of unit
Staffing
Assistance in moving
Perception of teamwork on the unit
Unsafe Lifting Behavior
Back Injury-Producing Events
Back Pain
Back Injury

incidence of prescribed lifting behavior. Further, in an ex post facto manner, the relationship between prescribed lifting behavior and nurses' histories of back pain and back injury was explored.

G. Research questions

From the conceptual framework, three questions emerge. First, what is the prevalence of prescribed lifting behavior among registered nurses employed on specific hospital units? Second, do characteristics of the nurse, the patient, and the environment explain significant variance in actual lifting behavior performed by the nurse? Third, are there differences in actual lifting behavior between those nurses who have and those nurses who have not experienced occupational back pain and/or an occupational back injury?

II. REVIEW OF THE LITERATURE

Occupational back injuries among registered nurses in the hospital setting have been examined in relation to their incidence and prevalence, their identified 'cause', and hypothesized antecedent variables. Due to the numerous conceptual, measurement, and design problems which plague accident research, this study centered on a commonly identified behavioral 'cause' of back injury, lifting behavior. The purpose of the study was to determine the prevalence of prescribed lifting behavior among registered nurses in the hospital setting, the factors thought to influence the incidence of prescribed lifting behavior among registered nurses in the hospital setting, and the relationship between prescribed lifting behavior, reported back pain, and reported back injury among registered nurses in the hospital setting.

This literature review presents accepted guidelines for the determination of what behavior can be labeled 'safe' and 'unsafe'. Studies which include variables found to be significantly associated with back pain and back injury among nurses are highlighted. Finally, recent studies of back pain and back injury among nurses, particularly those with a prevention focus, are presented.

A. Lifting behavior

Ergonomic experts have debated for more than twenty years the 'correct' technique to use in lifting objects. The most commonly advocated technique has been the straight back-flexed knee technique but as Brown (1973) has pointed out, since the 1930's when the

straight back-flexed knee technique was first advocated there has actually been an increase in occupational back injury. This increase may be due to the fact that the technique is not used or that it actually is responsible for some back injuries (Brown, 1973; Yu et al., 1984; Jones, 1973). Snook et al. (1978) found no difference in back injury experience between those companies providing lifting training and those not offering such a program. The ineffectiveness of the training programs may have been due to the teaching strategies employed or the specific lifting techniques taught.

There are several possible explanations for the association between technique and back injury incidence. Troup (1965) found that, when lifting, untrained workers' hips rose faster than the shoulders and resulted in a stooped lift even though the movement may have begun as a flexed-knee lift. Jones (1973) states that while the straight back-flexed knee technique emphasizes the strength of the large leg muscles, the greater flexion of the knee results in less vertical force. In other words, the straight back-flexed knee technique requires greater physical effort. With repeated lifting, it is likely that muscle fatigue results and Brown (1973) believes that this fatigue predisposes the back to subsequent injury. The straight back-flexed knee technique also requires a small load which will fit between the knees or the load cannot be held close to the body. Chaffin (1975) stressed that bringing the load close to the body is the most important consideration in manual materials handling. The experts do agree that further research is needed to discover the relationships between lifting technique and lifting situation.

Therefore, nursing texts and media were reviewed to define criteria used by nurses to discriminate 'correct' from 'incorrect' lifting behavior. In moving patients in bed, either toward the head of the bed, to the side of the bed, or turning the patient to a lateral position, certain behaviors were listed repeatedly as important by several nurse authors (Brill and Kilts, 1980; DuGas, 1983; Ellis and Nowles, 1981; Kozier and Erb, 1983; Lewis, 1984; Rosdahl, 1981; Wolfe and Weitzel, 1979). Similarities between authors include:

1) The bedside environment must be altered to facilitate the movement of the patient. Obstacles such as overbed tables, night stands, patient's shoes or slippers, treatment equipment, and chairs should be moved from around the bed. The wheels of the bed should be locked to prevent bed movement during lifting. The bed should be raised to the nurse's waist height, the head of the bed should be lowered (if tolerated by the patient) and the side rail should be in the down position.

2) The nurse's body should be in proper alignment prior to initiating any movement. Proper alignment or posture means assuming a broad stance (4-8 inches) with one foot forward of the other. Shoes should be flat or low heeled. The knees and hips are flexed but not the waist or back. Thus, the line of gravity extends from the center of gravity to within the base of support, perpendicular to the floor. The nurse faces the direction of the force which decreases the chance of twisting the spine. Pivoting on the balls of the feet also decreases the twisting of the spine. The patient should be as close

to the nurse as possible, allowing for patient safety as in turning the patient to a lateral postion. In this case, if the patient were brought to the edge of the bed and then turned s/he would have a high probability of falling to the floor. When more than one nurse is lifting, either the patient is brought to one side and both nurses lift from that side or the nurses stand on either side of the bed and the patient is centered.

Prior to actually initiating the move, the nurse contracts the abdominal muscles upward and the gluteal muscles downward thus decreasing the impact of the movement itself. The major muscles of the legs and arms are used to actually move the patient rather than the weaker muscles of the back.

3) The actual movement of the patient should be pulling, sliding, or rolling rather than lifting due to the additional effort required in moving against gravity when one lifts. Pulling, sliding, or rolling the patient is accomplished by the nurse rocking from one foot to the other, using her weight as part of the moving force. Less energy is expended when this movement is smooth and rhythmic at a moderate speed rather than jerky with frequent stopping and starting. Moving patients in segments may be required if the nurse is working alone and/or the patient is heavy. This coordinated movement is made easier if friction is reduced, in this situation friction between the bed sheets and the patient's body. Friction can be reduced by pulling sheets taut, powdering to decrease the moisture on the patient's skin, or using a plastic back board.

These critical behaviors, categorized as pertaining to the

environment, the nurse, and the movement, are the basis for determining whether a movement episode is safe or unsafe.

B. Antecedent variables

1. Characteristics of the nurse

a. Demographic characteristics

Demographic characteristics, including age and experience of the worker have been cited by several authors as influencing injury incidence (Chilius, 1979; Ferguson, 1970; Frenkel et al., 1980; Knight and Howell, 1981; Michaels and Zoloth, 1982). These variables are, however, not as clear cut as they may first appear. It has been hypothesized that age alone, or considered in isolation from other factors, does not constitute an increased risk of occupational injury, but rather younger workers have a higher incidence of accident because of their inexperience on the job. Frenkel et al., (1980) found, using the Quality of Employment Survey, that workers who have been on the job one to three months experienced three times the injuries of workers with one to three years tenure and eight times the injuries of those with twenty years tenure. It is interesting to note that while older employees experience fewer injuries, they are more likely to be disabled should an injury occur (Michaels and Zoloth, 1982).

In studies of nurses, age was also a factor in relation to occupational back injury. In comparing nurses to teachers and industrial workers, nurses experienced back injury at an earlier age than the other two groups with a lesser incidence as nurses got older (Levy and Wegman, 1983; Cust et al., 1972). Also, years of service have been found to relate to low back injury among nurses. Cust et

al. (1972) reported that nurses with one to four years experience had the highest incidence of injury. This differs from the findings of Frenkel et al. (1980) who found the highest incidence to be among those workers with one to three months on the job. This discrepancy may be due to different occupational groups studied, or the difference in the meaning of experience. Cust et al. (1972) may mean years in the profession while Frenkel et al. (1980) measured years worked on a specific unit.

b. Education

Professional education may also relate to injury incidence in that an understanding of body mechanics and practice in using body mechanics may differ among graduates of the various types of basic nursing programs. The more limited practice opportunities in both collegiate (BSN) and community college (ADN) programs, compared to traditional diploma programs, may have an impact on the lifting behavior of BSN and ADN graduates. On the other hand, the knowledge the BSN graduate possesses relative to physiology and biomechanics as well as her/his problem-solving skills may allow her/him to adapt her/his lifting behavior in unusual situations.

Inservice has long been the treatment of choice for the already back injured as well as the primary prevention strategy for those workers at risk. A review of proper body mechanics via film or demonstration is a common format. Unfortunately, back injury rates among workers have not been reduced and thus the strategy has questionable utility. In a study concerning back injury prevention among nurses, Stubbs et al. (1983b) found that intraabdominal pressure

during lifting episodes (an indirect measure of spinal stress) was not significantly reduced following intensive individual training. A follow up fifteen weeks after training did not support retention of acquired skills. Several research studies have shown that knowledge does not necessarily lead to appropriate behavior (Falvo, 1982; Gordon and Haynes, 1983; Rawbone et al., 1978; Riggs and Nolan, 1983; Shute et al., 1981; Wilson et al., 1980).

c. Knowledge

Several sources have cited inadequate knowledge of proper lifting techniques and body mechanics as the main reason for the prevalence of back injury among nurses (Clever, 1981; Trascz and Rose, 1982; Ferguson, 1970; Raistrick, 1981). Yet, in a 1972 Hospital Occupational Health Services Study (NIOSH), 70 percent of the hospitals surveyed provided no training regarding proper lifting techniques and body mechanics. Knowledge of proper lifting techniques together with the skill to perform them is basic to back injury prevention among nurses.

According to Howells and Knight (1981), "Knowledge forms the basis for understanding and developing desirable attitudes concerning safe behavior" (p. 14). In order for a worker to recognize workplace hazards and avoid them when possible or react appropriately when confronted by them, the worker must know the hazards exist in the workplace, know how to remedy dangerous situations, and know how to report the existence of the hazard or the resulting accident and injury (Howells and Knight, 1981).

Cardinal principles of lifting patient loads include bringing the

load as close to the lifter as possible, a wide base of support, absence of twisting with smooth even motion, and the use of assistance, be it mechanical or human, as needed (Henifin, 1982; Troup, 1965; Wright, 1982). The use of mechanical lifts, assisting rather than lifting the patient, and the practice of muscle conditioning exercises by the nurse may all contribute to the prevention of back injury. Knowledge, in relation to safe workplace behavior, is a necessary but not sufficient, condition for accident prevention. That is, the worker must be informed about the hazard exposures in the workplace as well as the health-protecting behaviors to employ for each of the hazards in order to expect a reduction in the incidence of injuries sustained on-the-job. In Suchman's (1965) study of Puerto Rican sugar cane cutters, it was found that those workers who were aware of the efficacy of protective equipment in preventing occupational accidents were more likely to accept the glove (Suchman, 1965).

However, just because the worker knows about the hazard does not insure the practice of effective safety behaviors. Studies in many areas of health promotion behavior have found time and again that people do not always behave in a manner congruent with their knowledge of health hazards (Falvo, 1982; Gordon and Haynes, 1983; Rawbone et al., 1978; Riggs and Noland, 1983; Shute et al., 1981; Wilson et al., 1980). Miller (1976), reporting on studies carried out by Ring in New Zealand, stated that even when workers were taught and retaught "correct" lifting technique, they did not use it. In a study of nurse aides in a Swedish geriatric hospital, it was found that when workers

were given instruction regarding the straight back/flex knee technique every three months there was no reduction in reported low back symptoms (Dehlin et al, 1976). Dehlin et al. (1976) reported that the correct technique was used except when unfavorable lifting conditions, short staffing, or other less-than-optimal situations prevailed. These competing situations then may have more of an effect on behavior than does training, thus giving the appearance that training is not beneficial. Rather, prevention may simply be a matter of diminishing the effect of these competing variables. Dehlin et al. (1981) compared three nonrandom groups of female nurses' aides. One group received conditioning training twice a week for eight weeks, a second group received ergonomic counseling for eight weeks, and a third group acted as the control. The researcher found little difference in low back symptoms among the three groups. This, again, could be explained by competing variables rather than ineffectiveness of the treatments. However, it is clear that knowledge alone does not result in prescribed lifting behavior or a reduction if low back symptoms.

d. Attitudes

In Suchman's (1965) study of sugar cane workers, a significant relationship was established between attitudes of the workers in regard to accident prevention and whether or not they wore the protective glove. Specifically, the workers who reported that most accidents are preventable, that one can learn to prevent accidents, and that accidents result from carelessness were more likely to wear the glove. Those workers who believed that prevention is not worth the trouble, that accidents always occur regardless of prevention

strategies, and that accidents are somehow the result of destiny were unlikely to wear the glove. Further, workers who felt personally vulnerable to accidents and who worried about such an occurrence were more likely to wear the glove. Thus general attitudes toward safety and accident prevention were demonstrated through safety-related behavior, the use of the protective glove.

e. Workload

In a 1974 article, Lehmann (1974) made a case for the relationship between heavy workloads and dissatisfaction with one's job, job satisfaction and stress, and stress and increased incidence of accidents and resulting injuries. French and Caplan (1973), at the University of Michigan, found relationships between conflicting demands, unclear job roles, work overload, and stress. Craig (1966) concurred with the overload-stress-accident model.

> Under conditions of sensory overload, when a person is required to respond in an organized fashion important changes occur in his awareness and his behavior. For one thing, behavior becomes increasingly variable. Often there is a loss of control of movements. The ability to predict future outcomes of activity may be reduced. Behavior tends to become oriented toward immediate goals with little consideration of their long term implications. Habit patterns may regress to earlier levels. The rat under sufficient stress appears to forget all he knows about a maze; the child forgets his toilet training; and the industrial or business worker reverts to forms of behavior that he had been "trained out of". In addition, conscious awareness is often narrowed so that the individual loses his responsiveness to aspects of the environment to which he ordinarily reacts. It is plain that such behavior is the stuff of which accidents are made (p. 270).

Margolis and Kroes (1972) found that 9.7 percent of surveyed workers holding high stress jobs reported a work injury during the preceeding

year while only 4.8 percent of workers employed in low stress jobs reported an injury.

Magora (1973), in his study of low back pain in workers from eight occupations including nursing, found that those workers who reported job dissatisfaction, a perceived high degree of job responsibility and mental concentration, and tension and fatigue after work were more likely to have suffered low back pain. A study of nurses' aides working in a Swedish geriatric hospital revealed that nurses' aides with back symptoms reported a lower level of job satisfaction, greater perceived strain on the job, and a greater demand for physical and psychic strength than did those nurses' aides without reported back symptoms (Dehlin and Berg, 1977). Temporal ordering is not indicated in either of these studies, that is, the association between back symptoms and the other variables has not shown causal direction.

Nurses are often confronted with heavy workloads. Stubbs et al. (1983b), using radio pills, found that intraabdominal pressure, an indirect measure of spinal stress, was higher for those nurses working on units with a high degree of patient dependency and less experienced nurses, than on units with similar patient dependency and more experienced nurses. It is hypothesized that when nurses perceive they are extremely busy, they are less likely to take the time to secure assistance in moving a patient and they may not raise the bed height or use prescribed lifting technique. These behavioral shortcuts added to the patient's weight and the patient's dependency increase the nurse's risk of injury.

2. Characteristics of the patient

The weight and health of patients are thought to influence the technique nurses use in moving patients in bed and whether they secure assistance in moving these patients. Dehlin et al. (1976) found that nurse aides often exceed the recommended weight for single and repeated lifts.

> The lifting burden during nursing often equalled or exceeded the recommendations of various authors concerning permissable maximum weight loads during different types of lifts. The lifts were often performed under unfavorable conditions and seldom with an 'ideal' lifting technique (Dehlin and Lindberg, 1975, p. 65).

The weight of patients may simply be too great, meaning that no matter what lifting technique is employed, the risk of back injury is high. (This explanation would not necessarily hold for other workers where engineering controls have been used to redesign their jobs, perhaps decreasing the weight lifted.) In nursing, however, patients come in a variety of sizes and weights, of body compositions (muscle to fat ratios), and of health status. Therefore, every time the nurse lifts, pulls, pushes, or transfers a patient, the nurse must adjust to this variable, unpredictable load.

In determining the maximum permissible weight to be lifted by a worker, several authors have provided guidelines. The Factories Act of 1937 (United Kingdom) established 50 percent of the worker's body weight as a reasonable limit for occasional lifting by women and young people and 40 percent of the worker's body weight for continuous lifting (Troup, 1965). For a 125 pound nurse, the maximum weight to be lifted would be 62.5 pounds. This is in line with other

recommendations of 65 pounds for intermittent work, 50 pounds for continuous work (Troup, 1965). However, the lifting recommendations of the Factories Act were eliminated shortly after enactment due to the unacceptable load which heavier workers were expected to lift (Personal communication, T. Leamon, 1986).

Ayoub (1982) proposed the following formula for determining maximum acceptable weights:

$$W = (C_1 S + C_2) C_3$$

where W = predicted acceptable weight (lb)

S = back strength x leg strength (lb)

C_1, C_2, C_3 = constants derived from the frequency of lift, height of lift, and size of object.

To determine the acceptable weight to be lifted using this formula requires a knowledge of the worker and the job.

NIOSH guidelines published in 1982 also require more information than worker gender to determine both the action limit (AL), the weight most people can lift given certain job characteristics, and the maximum permissible limit (MPL), the limit for any lifting job. Jobs which require lifting materials above the MPL are unacceptable. To determine the AL and the MPL, the following formulas are used.

$$AL(lb)=90(6/H)(1-.01|V-30|)(.7+3/D)(1-F/Fmax)\text{-US customary units}$$

$$MPL(lb)=3(AL)$$

where H=horizontal location (in) forward of midpoint between ankles at origin of lift (6 inches to 32 inches)

V=vertical location (in) at origin of lift (0 inches to 70 inches)

D=vertical travel distance (in) between origin and destination of lift (10 inches to (80-v) inches)

F=average frequency of lifts (lifts/minute) (.2(1 lift/5 minutes to Fmax)

Fmax=maximum frequency which can be sustained (12-18 depending on body position, and time) (NIOSH, 1982).

In these formulas, the characteristics of the lifting task are taken into account but not the differences in workers. The formula is only applicable for episodes of 1) smooth lifting 2) two-handed, symmetric lifting in the saggital plane 3) moderate width 4) unrestricted lifting posture 5) good couplings and 6) favorable ambient environments (NIOSH, 1982).

These formulas were devised for industry and are valuable in designing job specifications when the weight and size of the object as well as the lifting movements are amenable to change. In nursing, the movement of patients occurs in bed, between bed and chair and from bed to carts. The size and strength of the nurse is as variable as the size and health of the patient. As the patient regains his/her health, the assistance of the nurse should diminish. However, even this assumption is variable as exemplified by the patient who at the end of the day requires more help than in the morning, a result of fatigue perhaps.

A random sample of units at a midwestern rehabilitation hospital was chosen on January 24, 1985 and fifty patients were weighed. These weights illustrate the variability in loads nurses deal with daily. The patients' weights ranged from 78.6 pounds to 306 pounds. The mean

weight was 151.8 pounds and the standard deviation 40.1 pounds. This variability of weight, if used in a formula, would severely limit the distance a nurse could lift a patient and the frequency of the lift. If the 50 percent of one's body weight recommendation was used as a criteria, most nurses could do no lifting alone. By the same token, the nurse is rarely attempting to lift the patient's entire body off the bed independently. Rather, she is more likely to be turning the patient on his/her side, pulling the patient up in bed, or assisting the person to transfer from bed to chair or back again.

Thus, it is apparent that the maximum permissible weight to be lifted is dependent on the person or object being lifted, characteristics of the worker, and environmental and situational variables.

3. Characteristics of the Workplace

Variables specific to the workplace may also impact on the incidence of occupational injury. These variables include the shift worked, the work area, and the staffing pattern.

a. Shift

Trascz and Rose (1982) reported that the day shift had the highest incidence of back injury to nursing personnel seemingly due to an increased exposure to the hazard. Though the evening and night shift nurses usually move patients less frequently, fatigue, boredom, and hunger may make these nurses more likely to be involved in an accident (Knight and Howell, 1981; Michaels and Zoloth, 1982; Finn, 1981).

b. Unit

The specialty unit to which the nurse is assigned may also be a significant factor in accident incidence. Medical, surgical, orthopedic, and geriatric units, those with adult patients often with mobility limitations, had the highest incidence of low back pain among nursing personnel in the study by Trascz and Rose (1982).

c. Staffing

Staffing patterns are also important in determining whether nurses lift safely and therby reduce their risk of back injury. In a study of Swedish nurse's aides in a geriatric hospital, Dehlin et al. (1976) found that, though the aides understood how to lift patients correctly, the instructions they had been given were not followed if there was inadequate staffing on the unit. Trascz and Rose (1982) reported a "marked reduction of time loss due to back injuries" following an increase in staff on the study unit and reorganization of work responsibilities (p. 22).

d.Teamwork

While the lifting of patients has been implicated as a primary cause of back injury among nurses, it may be that improper techique on the part of the nurses is not the underlying villian. Rather, it may well be that nurses often lift alone and, for most nurses, the weight of most patients is too great for them to bear. If this is the case, the nurse's perception of teamwork on the unit may well influence whether or not she chooses to move the patient alone or with coworker assistance. Dehlin and Berg (1977), in their study of Swedish nurses' aides in a geriatric hospital, found that those aides who reported

having experienced back symptoms also reported more negative relations with supervisors and workmates. Impaired relationships may translate into lower perceptions of teamwork on the unit. However, whether the impaired relationships or the back symptoms came first is unknown. Besides impaired coworker relationships, work group norms are also thought to influence a worker's safety-related behavior. Peterson (1982) stated that,

> "Regarding safety, work group pressures and group norms are perhaps the most important determinants of worker behavior. To reiterate: the group sets its own safety rules and its members live by their rules, not ours" (p. 114).

For example, sugar cane cutters in Puerto Rico were found to be more likely to wear a protective glove if they had discussed its use with other sugar cutters who felt favorably about the use of the glove (Suchman, 1965).

Zohar et al. (1980) reported the results of an intervention study aimed at increasing the use of hearing protection in a metal fabrication plant. An A-B-A design with control group was used to test the effectiveness of the feedback intervention. While the intervention increased the number of workers wearing hearing protection, the return to baseline following the treatment did not occur as expected. Rather, the positive effects (the high use of hearing protection) continued even given a 65 percent turnover rate. In other words, a 90 percent compliance rate remained after five months even though two thirds of the employees were new and had not been exposed to the intervention. Zohar et al. (1980) concluded

> . . . at the departmental level, demonstrated acceptance of earplugs by a sufficiently large number of workers in a given group, in effect, creates new norms and behavior standards favoring their use (p. 78).

Cohen and Jensen (1984) reached much the same conclusion in their study of the safety behavior exhibited by industrial lift truck operators.

> The explanation for the enduring effects of the program appears to be that habits were changed due to continued practice in safe work procedures, coupled with a redefinition of group norms sustained through peer modeling and continued management support (p. 134).

Though these researchers concluded that a change in group norms was responsible for prolonged intervention effects on safe behavior, rival hypotheses exist in both studies. For example, might the treatment have actually been ineffective, with some other factor responsible for the initial change in behavior? If this were the case, that factor might still be exerting an effect on worker behavior, thus explaining the prolonged effect. Controlling for rival hypotheses in these studies as well as establishing the relationship between safe work behaviors and work group norms would have strengthened this explanation of the prolonged treatment effect.

e. Assistance

The determination of what constitutes a "safe" lift is based on nurses' judgements. The nurse must make judgements based on the characteristics of the patient, the environment, and the situation as to whether assistance, human and/or mechanical, is needed. Unfortunately, nursing authors are vague as to what criteria should lead the nurse to seek assistance.

> Use other persons or mechanical aids as required. Some objects are too heavy to be moved without assistance. Mechanical devices can assist nurses to move patients, thereby avoiding muscle strain (Kozier and Erb, 1983, p. 558).
>
> Get help from another person if the patient is heavy or if you are not sure that you will be able to move him alone. No matter how difficult it is to get help, it is always better to wait than to risk injury to yourself or the patient (Rosdahl, 1981, p. 226).
>
> When a patient is to be moved or lifted, his comfort and safety and that of the persons involved should be considered equally important. First of all, those who lift patients must be realistic about the effort involved. Two small-statured, 100 pound nurses must realize immediately that they are physically incapable of lifting a 250 pound patient. He may be rolled, pushed, pulled, or slid in bed, but lifting him from one area to another is another matter. By using good body mechanics and the principles of mechanical law, moving and lifting helpless patients can be made relatively easy. It is essential that the nurse understand such procedures so that she is not entirely dependent on assistance from others. Waiting for assistance which may not be necessary often means that patients cannot be moved as often as they should or when they would like to be. . . Children and light-weight adults are relatively easy to slide toward the head of the bed without the assistance of a second person. Average-weight adults of about 140 to 150 pounds begin to pose a problem. Many nurses have devised ways of moving heavy patients up in bed without assistance, but these methods are usually at great risk to the nurse. When moving a heavy, helpless patient up in bed, two people should be available (Wolfe and Weitzel, 1979).

The variety of opinion and lack of clarity in these guidelines make it difficult for the nurse to make a sound, safe judgement in regard to securing assistance. Further, nurses are cautioned to be particularly careful in the use of mechanical lifts. DuGas (1983), for example, warns that mechanical lifts can tip easily and it is important to have sufficient help to monitor both the lift and the patient's movements to avoid patient injury. A combination, then, of a lack of criteria

upon which to base judgements and hesitance in using mechanical devices may result in choosing to lift alone when assistance is indicated.

C. Back pain among nurses

Just as back injury has been shown to be an occupational hazard for nurses, so, according to Stubbs et al. (1981), is back pain. Stubbs et al. (1981) estimated that in England, ". . . in one year, one out of every six nurses is likely to suffer back pain as a result of lifting or moving a patient" (p. 857). Their study revealed that back pain accounted for 16.2 percent of the sick leave incurred by the sample of nurses studied.

Cust et al. (1972) compared questionnaires completed by 911 nurses and 949 teachers in Scotland and found that the incidence of occupational low back pain was significantly more frequent in female nurses (19.9%) than in female teachers (12.8%) while the incidence of nonoccupational low back pain was similar for the two groups (14% and 17%, respectively). The precipitating cause for 46 percent of the nurses was the lifting of patients while the most frequently reported cause among the teachers was bending (21%).

Magora (1970) studied Israeli workers in eight occupations (bank clerks, post office clerks, bus drivers, police, farmers, light industry, nurses, heavy industry) ranging on a continuum from sedentary to physically demanding. The two groups exhibiting the largest percentages of workers with low back pain were the heavy industrial workers with 21.6 percent and the nurses with 16.8 percent.

> The highest low back pain incidence was found in heavy industry workers and nurses. If all other factors are disregarded, it may be assumed that stressful physical activity, a common denominator in these two occupations, certainly plays an important role in the appearance of the low back pain syndrome (p. 36).

(Magora and Taustein (1969) defined low back pain as complaints of pain from the low thoracic spine (T-10) downward to the lumbar and sacral spine.) Magora (1972) comments that low back pain in nurses is likely to be related to the distance of the load from the body during lifting, the moderate to hard physical effort and the variability of the patients' weights. Twenty-seven percent of nurses listed lifting as the cause of their back pain but in this sample 52 percent of the nurses listed the cause of their back pain as unknown (Magora, 1974). The nurses who did not know the cause of their back pain may actually have fallen in the 'lifting' group if the hypothesis of microfractures from repeated compressive stresses (such as lifting) with time leading to spinal degeneration is accurate (Chaffin and Park, 1973). Sudden maximal physical effort, as might occur when a patient suddenly goes limp during a bed to chair transfer, was also found to be highly related to low back pain among nurses in this study (Magora, 1973).

Of the 116 women in Magora and Taustein's (1969) study with low back pain, only approximately 25 percent required sick leave, with only 5 percent needing more than eleven days. In comparison, of the 313 men with low back pain, 48 percent required sick leave and 15 percent needed more than eleven days. This discrepancy may relate to the differences in jobs held by members of either sex (no women

employed in heavy industry, for example) or it may be related to characteristics of each gender.

Harber et al. (1985) conducted a survey of 550 nurses and 37 unit clerks employed in a 600 bed tertiary care center to ascertain the prevalence of low back pain among staff nurses, and possible etiologic factors related to nurses' reported back pain. Back pain was defined as "pain or discomfort in the low back which is not due to menses" (Personal communication, P. Harber, 1985). Fifty-two percent of the nurses reported occupational back pain during the previous six months compared to 20 percent of the unit clerks. Nine percent of the nurses missed work due to back pain. However, of the 21 back pain claims submitted by nurses in the previous year, only 5 claims resulted in lost work time.

> Most nurses probably continue their tasks despite discomfort, but the distraction and limitation of motion may markedly decrease efficiency. A critically important, but difficult to quantitate, aspect of nursing is the psychological support provided to patients and social interaction fostering smooth staff relationships. It is not difficult to suspect that a nurse with significant personal discomfort is impaired in these important areas, particularly if the nurse feels that the job caused the pain. Furthermore, certain analgesics impair alertness; although it was not specifically determined which drugs were used, it is possible that at least some who reported having used medications (29% during a six month period) used analgesics outside the aspirin-acetominophen class. Thus, even back pain that does not lead to lost work time can have significant adverse effects on patient care efficiency (p. 522).

Lifting patients in bed was most commonly reported as the etiologic factor in their back pain. Moving beds and helping patients out of bed were also cited as associated activities. These researchers stress that for many reasons, including the variable, unpredictable

load, the unconventional movements, and the irregular nature of the work, worksite design to prevent low back pain is difficult. Therefore, they recommend a basic understanding of ergonomics on the part of the nurse and a commitment to low back pain prevention on the part of administration together with adequate staff and mechanical assistance to decrease low back pain among nurses.

These studies point to a relationship between lifting behavior and low back pain. Harber and SooHoo (1984) allude to a relationship between low back pain and back injury.

> . . . there has been no validation of the underlying assumption that there is a definite relationship between pain and risk of subsequent injury. However, it is reasonable to assume that those workers who develop pain when working are more likely than pain-free individuals to develop injuries. This seems particularly likely since pain is a common manifestation of overexertion, strain, and sprain (p. 882).

D. Back injury among nurses

It has been established by numerous researchers that back injury is a primary occupational health problem among nurses (Hefferin and Hill, 1976; Hoover, 1973; Ferguson, 1970; Raistrick, 1981; Stubbs et al., 1983; Stellman, 1982; Clever, 1982; Trascz and Rose, 1983). A primary causative factor for back injuries among nurses is reported to be the lifting of patients (Clever, 1982; James, 1983; Stellman, 1982; Hoover, 1973; Ferguson, 1970; Howell and Knight, 1981).

Recent research has focused on factors thought to influence the incidence of back injury or factors directly related to lifting. Owen and Damron (1984) compared groups of back injured and nonback injured nurses and nursing assistants relative to demographic, physical,

lifestyle, and knowledge/skill characteristics. Demographic data supported the findings of previous studies showing that nurses tend to injure their backs at an earlier age than workers in other occupations. Further, nurses with a familial history of back injury were more likely to be back injured than those without such a history. Three physical characteristics significantly discriminated the back injured group from the nonback injured group and included differences in leg length, muscle flexibility, and proprioception. Five lifestyle variables were significant discriminators, vulnerability to the stressors of frustration and overload, number of hours of high energy activity, perception of physical condition, and number of cigarettes smoked per day. The knowledge/skill characteristics focused on subjects selecting pictures of workers lifting a box using correct body mechanics and an evaluation of subjects lifting a fifteen pound box on videotape. The back injured and nonback injured groups did not differ significantly on the knowledge measure (Owen, 1982). However, in actual practice the nonback injured subjects were more likely to have a broader stance and hold the box closer to the body during the move (Owen, 1985).

While this study possesses all the limitations of research using accident data including its ex post facto design, it is interesting to note the relationships, such as back injury and work overload, and back injury and lifting technique, which support previous research findings.

E. Summary

The studies undertaken thus far have not attempted to sort out the relationships among antecedent variables, lifting behavior, back pain, and back injury. In order to truly understand the problem, it was felt that nurses must be observed in their own work environments moving patients. While history of back injury would remain "out of order" in verifying the conceptual framework, back pain, occurring in the present or near past, could more likely be attributed to the lifting behavior observed. Finally, the variables influencing lifting behavior could be separated from those variables which influence back pain and back injury incidence directly. Therefore, a descriptive, cross sectional survey using both observational and questionnaire strategies was undertaken.

III. RESEARCH DESIGN AND METHODS

The purpose of the study was to ascertain the prevalence of prescribed lifting behavior among registered nurses in the hospital setting, the factors thought to influence the incidence of prescribed lifting behavior among registered nurses in the hospital setting, and the relationship between prescribed lifting behavior, reported back pain and reported back injury among registered nurses in the hospital setting. To provide preliminary information related to the above areas a descriptive, cross sectional survey was undertaken using both observational and questionnaire strategies.

A. Sample

1. Pilot Study

Sampling for both the pilot study and the main study was undertaken in four phases. For the pilot study, a community hospital, closest in geographic proximity to the researcher, was contacted and agreement to participate secured. Three units within the pilot hospital met the following criteria for inclusion in the study.

1. The predominate population of the unit consisted of adult patients.
2. Large numbers of patients on the unit were unable to move themselves without the assistance of nursing personnel.
3. The majority of nursing personnel on the unit were licensed.

Shift and day to observe on each selected unit were chosen in conjunction with the nurse manager to maximize the number of nurses available. Her schedule and the scheduled events on the units were

taken into account. Individual nurses on the unit working during the selected day and shift were all invited to participate and all agreed. However, not all nurses who agreed to participate were actually observed. Only those nurses who had an opportunity to move a patient in bed and notified the researcher of the impending move were observed. In order to collect 40+ observations for the pilot study, it was necessary to return to units to observe one or two nurses who had not been on the unit during the originally scheduled day and shift.

2. Actual Study

Based on the researcher's experience in the pilot study, hospitals for actual study were selected by the following criteria.

1) The hospital was geographically located within a 45 mile radius of the researcher.
2) The hospital could be categorized as a community hospital in contrast to university hospitals or medical centers.
3) Each hospital had at least 150 beds.
4) Staffing for each hospital was provided primarily by registered nurses.

The third and fourth criteria were added to decrease the collection time required per hospital. It was found in the pilot study that lack of patients and low numbers of registered nurses extended the collection time by several days.

In selecting hospitals for the actual study, six hospitals were recommended to the researcher by colleagues as meeting the criteria. Two of the hospitals were reported to have low census at the time of

the study thus the other four hospitals were contacted first regarding their interest in participating in the study. All four hospitals contacted intially agreed to participate, thus no further contacts were made.

Following agreement by the hospitals to participate in the study, various mechanisms were used to select units, days, shifts, and nurses. In Hospitals 1, 3, and 4 access to nursing units was gained through the nursing education/resources departments. In Hospital 2, the Vice President for Nursing was the contact person. Tours were conducted of each facility and appropriate units for study were chosen based on the criteria listed previously. These units included medical, oncology, rehabilitation, surgical, orthopedic, medical and surgical stepdown, intensive care, and coronary care. Not all units listed were available at all the study hospitals. The only units which met the criteria but were not open to the researcher were critical care units at Hospital 1. When asked, the contact person at Hospital 1 stated that she preferred that the researcher not collect data in the Intensive Care or Coronary Care Units of the hospital.

The nurse managers in each of the hospitals were contacted regarding the study and asked for their participation. In all of the hospitals except Hospital 4 the contact person initially approached nurse managers as to their interest in the study. Follow up contacts by the researcher or the research assistants were completed to schedule convenient times for the data collection to occur. In Hospital 3, the researcher and a research assistant met with the Vice

President for Nursing, the Safety Officer, nurse managers, medical staff representatives and other administrative personnel to explain the study and enlist their support. In Hospital 4, the research assistant contacted each nurse manager directly.

Procedures for explaining the study to subjects and securing consents also varied by hospital. Upon agreement of the nurse managers, staff nurses working the day and evening shifts on scheduled data collection days were asked to participate in the study. In Hospital 1, the researcher explained the study to the staff nurses and secured signed consent forms during each unit's report time at the beginning of each shift. In Hospital 2, nurse managers escorted the researcher about the unit and introduced the researcher to each registered nurse. After an explanation of the study by the researcher, each nurse was asked to sign a consent form. In Hospital 3, the research assistant sought out each registered nurse on the unit and asked for her consent to participate following an explanation of the study. In Hospital 4, a research assistant attended unit meetings to explain the study and secure consents prior to the day scheduled for data collection. For units which were not having unit meetings during the study period, letters were placed in the mailboxes of registered nurses employed on study units prior to the day of data collection explaining the study and asking for their cooperation in gathering data. On the day of data collection for these units, the research assistant in Hospital 4 sought out each registered nurse on the unit, reminded her of the study, and obtained consent.

All nurses who were asked to participate in the study did agree

and signed the consent form. However, only those nurses who had an opportunity to move a patient in bed during the selected shift and who contacted the researcher prior to the move were actually observed.

B. Instrumentation

Several of the instruments used in this study were developed by the researcher and used initially in the small pilot study (n=44). Based on pilot study data, the instruments were revised prior to use in the actual study. In this section, the development of each instrument as well as the content of the instument is described. Reliability estimates based on pilot study data are presented and revisions based on the data discussed. Finally, reliability estimates based on the data from the actual study are given.

1. Observation of nurse's lifting behavior

The observation guide for recording nurses' lifting behavior was developed based on current nursing textbooks and input from nurse experts (Brill and Kilts, 1980; DuGas, 1983; Ellis and Nowles, 1981; Harris, 1982; Kozier and Erb, 1983; Lewis, 1984; Rosdahl, 1981; Wolfe et al., 1979; personnal communication Marilyn Rantz, RN, MS). The observation was divided into two parts, an environmental observation and a nurse observation (Appendix A). The environmental portion of the observation guide consisted of items focusing on the height of the bed, the position of the siderails, the position of the head of the bed, the locks on bed wheels and obstacles around the bed. The nurse portion of the guide focused on the movement and posture of the nurse. Specifically, the nurses' shoes, her stance, the actual movement of

her body during the lift, and the position of her back, waist, hips, and knees were included in this section. These observations were coded as (1) for a prescribed behavior such as flexed knees or a 4-12 inch stance and (0) for a nonprescribed behavior such as wearing clogs or leaving the bed in the low position. A total score was then computed by adding all thirteen behaviors together with no weighting of items. Items were not weighted due to a lack of theory as to which nurse and environmental factors had the greatest impact on spinal stress. However, it was hypothesized that the environmental factors and the nurse factors would be related. For example, a low bed height would be related to a flexed back. While it is questionable whether the use of the techniques prescribed by nursing textbooks would result in reduced incidence of back pain and back injury among registered nurses, the guidelines found in these textbooks did provide a standard against which to describe the behavior observed in the four study hospitals. Further, at the present time, there is no universal standard for lifting which has been shown to reduce the incidence of pain and injury.

The pilot study data yielded a total scale (13 items) alpha coefficient of 0.36 (n=44). The data from the environmental items (bedwheels locked, position of the siderails, bed height, position of the head of the bed, and obstacles around the bed) produced an alpha coefficient of -0.23 (n=44). The nurse items (stance, her distance from the patient, her movement, and the posture of her back, waist, hips, and knees) resulted in an alpha coefficient of 0.54 (n=44). When the posture of the nurse's back, waist, hips, and knees (4 items)

was taken separately from the nurse subscale, the alpha coefficient was 0.68 (n=44). No revisions in the observation guide were made following the pilot study. However, the researcher did attempt to define the behaviors which should be scored 1 and which should be scored 0 (Appendix B).

The actual study yielded similar alpha coefficients. For the total scale (13 items) the alpha coefficient was 0.33 (n=178). The environmental subscale (5 items) yielded an alpha coefficient of 0.25 (n=178). The nurse subscale (7 items) resulted in a 0.63 coefficient (n=178). The four items analyzed separately from the nurse subscale had a 0.62 coefficient (n=178).

The low alpha coefficients for the total scale and the environmental subscale point to the fact that one behavior such as locking the bedwheels does not predict another behavior such as lowering the siderails or raising the bed height. The higher alpha coefficients for the nurse subscale and the four posture-item scale, in contrast, give evidence of the relationships among the scale items and provide confidence in using the scale in analysis.

2. Attitudes regarding safety and back injury prevention

A twelve item Likert-type scale was developed to determine each nurse's attitudes regarding her susceptibility for experiencing a back injury, her ability to prevent back injuries, and her perception of the importance of prescribed lifting behavior in the prevention of back injury. The items on this instrument closely resembled the items used by Suchman (1965) in his study of sugar cane cutters in Puerto

Rico and their acceptance of the cutting glove to prevent severe lacerations. The content of the twelve items discriminated between those workers who wore the protective glove and those who did not.

Using pilot study data, the attitude scale had an alpha coefficient of 0.64. When item #8 "I worry about suffering a back injury due to my work" was deleted, the alpha coefficient increased to 0.67. Based on comments pertaining to item clarity and relevance from subjects, five items were modified. In the actual study, this modified scale (Appendix A) had an alpha coefficient of 0.51 (n=155). Reasons for this lower alpha coefficient might be the presence of subscales within the instrument or items which do not adequately represent the nurses' attitudes regarding safety and back injury prevention.

3. Perception of unit teamwork

This scale consisted of ten Likert-type items dealing with the nurses' perceptions of teamwork on the unit. The nurses were asked to respond to items dealing with the type of patients on the unit in regard to the need for more than one nurse in moving them, the difficulty in securing assistance, and the quality of coworker assistance. These items were developed based on journal articles, pilot study observations and informal interviews, and the researcher's experience.

In the pilot study, the teamwork scale had an alpha coefficient of 0.38. The removal of items did not increase the alpha. The researcher hypothesized that 1) the items may represent two or more dimensions within the scale 2) the items were not measures of self

reported teamwork behavior. .Therefore, comprehensive revision was undertaken, rewriting seven of the ten items (Appendix A). The alpha coefficient for this scale, using data from the actual study, was .80 (n=155).

4. Knowledge of prescribed lifting behavior

Six four-option multiple choice items were devised to test the nurses' knowledge of prescribed lifting behavior. These items were formulated in tandem with the observation guide, that is, the behaviors recorded on the observation guide were then tested cognitively on the knowledge questionnaire. These items were developed based on items used to test the knowledge of baccalaureate nursing students at a large midwestern university. They were reviewed by nurse experts for content validity.

The knowledge scale, which measured an understanding of the principles of correct body mechanics, had an alpha coefficient of .06 based on pilot study data. These coefficients were based on only five items as all respondents answered one of the questions correctly. The low alpha coefficients resulted in two items being discarded and two new items being developed (Appendix A). The new scale had an alpha coefficient of .06 (n=154) in the actual study. This extremely low alpha coefficient indicates that the items do not constitute a single scale, but rather are multiple aspects of what nurses need to know to move a patient as prescribed.

Test-retest reliabilty was established by giving the six-item knowledge test to 39 graduate nursing students at a midwestern

university. The test was repeated three weeks later with 27 students completing both tests. It was felt these graduate students were an appropriate sample as most of the nurses were involved in patient care practice during their course of study. The stability coefficient for the instrument was .40.

5. Recall of back pain

Fourteen items, taken from a questionnaire developed by Harber et al. (1985), were used with permission to assess the self-report of back pain among nurse respondents. Back pain was defined as pain or discomfort in the low back which was not due to menses. Eight items dealt with the nurses' incidence of back pain and its severity during the past two weeks while four items focused on the nurses' experience of back pain during the last six months. The nurses were also asked to estimate the percentage of their coworkers who experience occupational back pain. The final item listed fourteen activities which the nurses could choose as causative factors in the incidence of low back pain, such as lifting a patient in bed or bending to lift an item from floor level.

6. Back injury history

The back injury history form was developed based on journal article review and input from two occupational health experts (Appendix A). This questionnaire was designed to discover how many back injuries each nurse had experienced and specific information related to the last injury including when and where the injury occurred, whether the injury was reported, if lifting was involved in

the etiology of the injury and the cost of the injury in terms of lost work time and hospitalization.

C. Procedure

1. Pilot study

As previously indicated, a pilot study was undertaken to ascertain the utility of the study design and procedures. The Vice President for Nursing at Hospital P was contacted in June, 1985 and a meeting with the researcher was held to discuss the project. Following approval for the research by the hospital and the university Institutional Review Board, the researcher met with the Nurse Managers of the medical, surgical, and critical care units to enlist their support as well as to develop the data collection schedule. All registered nurses on selected units during selected shifts agreed to participate.

Forty-four registered nurses and licensed practical nurses were observed at Hospital P between August 27, 1985 and September 3, 1985. Eighty-one percent of the nurses observed completed the questionnaire.

a. Sample

1) Characteristics of the nurse

The nurses ranged in age from 23 to 62 years. One nurse was male. Over one half (57%) were ADN graduates and for 49 percent of the respondents the associate degree was their highest degree. Four of the nurses (11%) were licensed practical nurse, 9 of the nurses (26%) held bachelor's degrees and one nurse (3%) a master's degree.

Experience in nursing ranged from one to 34 years ($\bar{x}$=10 years) while experience on the unit ranged from 6 months to 16 years

($\bar{x}$=5 years). The majority of the nurses (62%) had attended an inservice which had focused on back injury prevention in the past two years. Twenty-seven percent of the nurses reported one or more back injuries. However, 81 percent of the nurses reported experiencing back pain and 45 percent reported back pain at least once a month.

2) Characteristics of the patients

The patients ranged in weight from 72 pounds to 252 pounds. Sixteen had dermatologic diagnoses, 14 neurologic, 13 musculoskeletal, 8 hepatic/biliary, 7 gastrointestinal, 6 renal/urological, 5 pulmonary, 4 cardiovascular, and 3 hematologic. The patients had been in the hospital from 1 to 21 days ($\bar{x}$=5.5 days). Fourteen had undergone surgery and were 1 to 11 days ($\bar{x}$=3.5 days) post op at the time of the observation. Twenty-nine of the patients were pulled up in bed for the observation, 2 were moved to the side of the bed, 10 were turned onto their sides and 4 were transferred between bed and chair. Thirteen of the patients were able to assist the nurse during the move while 30 were unable to assist and one patient was comatose. Over 90 percent of the observations showed a coworker assisting the nurse.

3) Characteristics of the environment

Observations were conducted every day of the week with 24 on the day shift and 20 on the evening shift. Twelve observations were collected in the critical care unit, 17 on the medical unit and 15 on the surgical unit. Seventy-seven percent of the observations occurred at a time when staffing was at the usual level. Of the nurses

observed, 55 percent felt their patient assignments were at the usual level, 26 percent felt their assignments were lighter than usual and 18 percent reported their assignments were heavier than usual.

b. Instruments

Five instruments were developed by the researcher for this study. The attitude scale, teamwork scale, knowledge scale, observation of lifting behavior guide, and back injury history were discussed previously under B. Instrumentation. One instrument, the Safety Climate Questionnaire, was used in the pilot study but for several reasons was not used in the actual study. The instrument had been used previously in occupational research and reported by Zohar (1980). With permission, an English translation of the instrument was used in the pilot study.

Organizational safety climate is the perception of an aggregate of workers regarding the commitment of the organization to their safety at work. These perceptions are thought to influence the workers' safety behavior and thus accident and injury rates. The measurement of safety climate involves establishing a unit of analysis, such as a work group or a department, in which workers engage in frequent, selective interaction concerning a variety of issues over a significant time period.

Zohar (1980) developed a 40-item Likert-type scale composed of eight subscales. The subscales originated from a literature review and were validated by a principal components factor analysis of data from a sample of workers from twenty factories. Management commitment to safety was a major factor in that study.

Using pilot study data, alpha coefficients for the safety climate questionnaire were 0.80 for the total scale and 0.60 (training), .75 (management attitudes), .72 (relation to promotion), -1.38 (risk of job), -.42 (workpace), .67 (safety officer), -.34 (social status) and .53 (safety committee).

While some of the alpha coefficients were respectable, the scale was deleted from the questionnaire for two reasons. First, the respondents complained about the safety climate section saying it was boring to answer and they could see no point in answering the questionnaire. Two CCU nurses commented "These questions were repetitive and not specific. I found myself uninterested in your questionnaire after about twenty questions." "I'm a very opinionated person, yet I answered most of your questions 'not sure'. I think the questions are too vague and left one uninterested in answering." Two other nurses began the questionnaire but quit in the safety climate section.

A second reason for deleting the section was 12 of the 40 safety climate items showed the largest frequency assigned to "not sure" and "not relevant" categories. The reasons for this could include: 1) the items were not particularly clear probably due to the translation 2) the instrument was not developed for the hospital workplace and thus many of the items were not relevant 3) the items were blatantly repetitious which may improve the scales internal consistency but may also result in respondent fatigue and irritation and thus neutral responses. The researcher questioned whether the instrument's

validity in its present form, the additional time required of subjects, and the loss of respondents was worth the data generated and thus deleted this section from the actual study.

c. Results

Based on the pilot study results, several modifications were made in the study methods. First, only female registered nurses were included in the study sample. The pilot study revealed the small number of male nurses employed in area hospitals. It was felt that without adequate numbers of male nurses, separate analyses could not be undertaken and because of obvious differences in strength and body size between the sexes, combined analyses might result in invalid findings. The sample was also limited to registered nurses, again due to the small number of licensed practical nurses employed in area hospitals. Analyzing the two groups of nurses, registered nurses and licensed practical nurses, together would require similar work responsibilities and knowledge. It was felt that those nurses holding a license as a registered nurse were more likely to be similar in regard to work responsibilities and knowledge while licensed practical nurses, having less education and a less independent practice, were more likely to differ on significant variables.

A second modification concerned the movements to be observed. The researcher attempted to adapt the observation instrument to record transfer behavior. However, the researcher found these observations to be very difficult to track with accuracy. Often the nurse would begin the transfer in an accepted posture but end the transfer, after pivoting for example, in an unacceptable posture. The observation

guide did not allow for the recording of these changes. Further, the researcher was often unable to see the nurse adequately as the patient moved from bed to chair, for example, and was placed between the nurse and the researcher. Therefore, the movements included in the study were limited to "in bed" movements such as pulling a patient up in bed, moving a patient to the side of the bed, and turning a patient on his/her side.

A third modification was the expansion of the back pain segment of the questionnaire which became feasible with the deletion of the safety climate portion of the questionnaire. When 81 percent of the nurses in the pilot study reported experiencing back pain, it was decided to gather more information concerning the etiology and consequences of nurse's back pain. The use of a new tool developed by Harber et al. (1985) allowed for the gathering of more detailed information as well as comparison between reported back pain in the two studies.

2. Research assistant training

Research assistants were hired to assist with data collection due to their residence in a particular community and upon recommendation of colleagues. One research assistant had recently completed a masters degree in psychiatric nursing and had several years of experience on many types of hospital units. The other research assistant was currently engaged in a BSN completion program and had worked on an orthopedic unit for nine years, since becoming a registered nurse. Though both research assistants lived in the

community where study hospitals were located, neither was employed by the hospital in which she collected data.

The researcher and the two research assistants met in the cafeteria of Hospital 3 on October 22, 1985. The researcher provided the research assistants with precoded observation guides, precoded questionnaires, envelopes, consent forms, collection envelopes, and a training manual outlining data collection procedures (Appendix B). The manual was reviewed item by item, prescribed lifting movements were demonstrated and questions were answered.

Following this initial training session, both research assistants collected data with the researcher. Research Assistant 1 conducted observations on two consecutive mornings with the researcher prior to collecting data on her own. Eleven observations were jointly collected. The researcher also joined Research Assistant 1 at the end of the two week data collection period at Hospital 3. Nine additional observations were completed during that evening shift.

Joint data collection for Research Assistant 2 and the researcher took place on two separate occasions one month apart. Seven observations were collected during these two collection periods. Joint data collection between the research assistants was not possible due to unforeseen personal restrictions on the research assistants' time.

Percent agreement, phi coefficients, and Kappa statistics were computed for each of the observation items using the data collected by the researcher and each of the research assistants. It was expected that these measures of association would be greater than 0.80. Table

1 shows the unexpectedly low agreement between the data recorded by the different observers. Some of the lowest agreement surprisingly involved the items related to the environment. It had been assumed that because the items which focused on the nurse required more judgement on the part of the observer, those items would have lower agreement in general than the items regarding the environment. Therefore, more time had been spent in training the observers in regard to the nurse observations than for the environment observations.

Percent agreement has been used in several occupational safety studies incorporating observational data conducted in recent years (Komaki et al., 1978; Komaki et al., 1980; Komaki et al., 1982; Ramsey et al., 1983; Chhokar and Wallin, 1984). These studies reported percent agreement between 78 and 96 percent with frequent interobserver data collection. Percent agreement does not, however, take into account the effect of chance, a particular problem with dichotomous data. To address this problem, Cohen and Jensen (1984) computed Cohen's (1960) Kappa statistic for each observation item in a study regarding the safety behavior of industrial lift truck operators. The Kappa statistic is used to determine the interrater reliability among dichotomous items taking into account the element of chance. Thus, the Kappa statistic is usually lower than the phi coefficient which does not control for chance.

Kappa statistics for the items dealing with bedwheel locks, bedside obstacles, bed height, distance between the nurse and patient,

TABLE I

INTERRATER RELIABILITY OF OBSERVATION ITEMS

	Research Assistant 1			Research Assistant 2		
ITEM	Percent Agreement	Phi	Kappa	Percent Agreement	Phi	Kappa
Environment						
Bedwheels	11/20	.38*	.25	5/7	.47	.36
Obstacles	13/20	.23	.17	6/7	.00	.00
Bed Height	10/20	.27	.14	4/7	.00	.22
Head of Bed	17/20	.74**	.70	5/7	.47	.36
Siderail	17/20	.68**	.68	5/7	-.15	.44
Nurse						
Stance	19/20	.69**	.64	7/7	.00	.00
Shoes	19/20	.00	.00	7/7	.00	.00
P/N Distance[a]	14/20	.31	.18	6/7	.00	.00
Rocking	10/20	-.01	-.01	6/7	-.19	.72
Back	14/20	.53**	.34	6/7	.73*	.71
Waist	16/20	.65**	.60	2/7	.17	.08
Hips	13/20	.35	.22	5/7	.47	.36
Knees	14/20	.41*	.33	4/7	.40	.22

[a] P/N Distance = distance between the patient and the nurse.

* $p < .05$.
** $p < .01$.

motion of the nurse and the posture of the nurse's back, waist, hips, and knees were unacceptably low for the data collected by Research Assistant 1 and the researcher. The phi coefficients based on the same data, though higher than the Kappa statistics, were still lower than the percent agreement with bed height, distance between the nurse and patient, motion of the nurse, and posture of the hips not even reaching a significance level of 0.05. It is important to note that lack of variability will result in zero or near zero Kappa statistics and phi coefficients. Since nearly all of the nurses wore proper shoes, that item had low variability and thus, though percent agreement was high, the Kappa statistic and phi coefficient were low.

Based on the percent agreement among the intial eleven observations collected with Research Assistant 1, it was felt that training of the research assistants had been successful and that discrepancies between the researcher and the research assistant would dissipate as the research assistant gained experience. However, as can be seen in Table II, the percent agreement, phi coefficients, and Kappa statistics in most cases decreased over the two weeks of data collection. It is interesting to note that the researcher, based on the inital percent agreement on the motion of the nurse and posture of the back items, discussed these items with Research Assistant 1 and repeated the demonstrations. The interrater reliability of those items, based on percent agreement, the phi coefficients, and the Kappa statistics actually improved for the data collected during the final shift. The interrater reliability of all other items, with the exception of the posture of the waist, decreased during the two weeks.

TABLE II

INTERRATER RELIABILITY OF OBSERVATION ITEMS
AT THE BEGINNING AND END OF A TWO WEEK DATA COLLECTION PERIOD
(RESEARCH ASSISTANT 1 AND RESEARCHER)

ITEM	Initial Data Collected Percent Agreement	Phi	Kappa	Final Data Collected Percent Agreement	Phi	Kappa
Bedwheels	8/11	.56*	.48	3/9	.19	.06
Obstacles	8/11	.24	.23	5/9	.32	.20
Bed Height	8/11	.52*	.43	2/9	.00	.00
Head of Bed	10/11	.81**	.79	7/9	.60*	.53
Siderail	10/11	.83**	.82	7/9	.36	.27
Stance	10/11	.67**	.42	9/9	.00	.00
Shoes	10/11	.00	.00	9/9	.00	.00
P/N Distance	9/11	.52*	.61	5/9	.00	.00
Rocking	5/11	-.10	-.10	5/9	.10	.12
Back	7/11	.35	.22	7/9	.50	.39
Waist	8/11	.00	.00	8/9	.76**	.73
Hips	9/11	.39	.40	4/9	.25	.14
Knees	9/11	.39	.40	5/9	.38	.25

* $p<.05$.
** $p<.01$.

In other words, the researcher and Research Assistant 1 were recording more similar observations at the beginning of the two week data collection period than at the end of the period.

The second research assistant and the researcher also did not have high interrater agreement. Because of the low number of observations (n=7), it is difficult to draw conclusions relative to the data. For example, bedside obstacles, bed height, stance, shoes, and the distance between the patient and the nurse items showed no variability and resulted in zero reliability coefficients. While the interrater reliability of the back posture was acceptable, it is questionnable whether this reliability coefficient would hold given a larger number of observations.

Pearson product moment correlations were computed for the total lift score and each of the subscale scores by research assistant (Table III). In regard to the data collected by the researcher and Research Assistant 1, the environment score decreased from a significant 0.91 initially to a low 0.29 by the end of the data collection period resulting in an interrater reliability of 0.56. Both the nurse subscale and the posture items increased from one time to the other as did the total scale.

The correlations between the data collected by the researcher and Research Assistant 2 revealed three negative correlations indicating that the two raters frequently recorded opposite data pertaining to the observations. None of the correlations were significant due in part to the small number of observations (n=7).

TABLE III

CORRELATIONS BETWEEN RESEARCHER AND RESEARCH ASSISTANT ON DEPENDENT VARIABLES

SCALE	Research Assistant 1			Research Assistant 2
	Total Data (n=20)	Initial Data (n=11)	Final Data (n=9)	Total Data (n=7)
Total	.36	.29	.34	-.34
Environment	.56*	.91**	.29	.18
Nurse	.42*	.41	.51	-.50
Posture	.42*	.31	.67*	-.19

* $p<.05$.
** $p<.01$.

Due to the apparent lack of interrater reliability for the observation items, measures of central tendency for the total lift score and subscale scores (environment, nurse and posture items) between the observers were compared (Table IV). Basically, Hospital 1 and Hospital 2 (researcher collected) had similar ranges and means for the total lift score and each of the subscale scores. Hospital 3 (Research Assistant 1 collected) had higher mean scores for the total lift scale and the environmental scale but lower mean scores for the nurse scale and the posture items than in Hospital 1 and Hospital 2. The mean scores for the total lifting scale and all subscales

TABLE IV

RANGE AND MEAN FOR TOTAL LIFT SCORE AND SUBSCALE SCORES BY HOSPITAL

SCALE	Hospital 1 n=52	Hospital 2 n=48	Hospital 3 n=47	Hospital 4 n=31
Total				
Range	3-11	5-13	5-13	5-12
Mean	8.0	8.1	8.4	9.0
Environment				
Range	1-5	1-5	1-5	1-5
Mean	2.7	3.0	3.7	3.5
Nurse				
Range	0-7	1-7	1-7	0-6
Mean	4.3	4.1	3.8	4.4
Posture				
Range	0-4	0-4	0-4	0-4
Mean	2.3	2.0	1.4	2.3

collected at Hospital 4 (Research Assistant 2 collected) were higher than those same scale scores collected at Hospital 1 and Hospital 2.

Analysis of variance (Table V) revealed that the mean environment score differed signficantly ($p<.01$) between research assistant-collected hospitals (Hospitals 3 and 4) and researcher-collected hospitals (Hospitals 1 and 2) with the mean scores of Hospitals 3 and 4 being significantly higher than the mean scores of Hospitals 1 and 2. The other significant difference found between hospitals was relative to the posture items with Hospitals 1, 2, and 4 (researcher and Research Assistant 2-collected, respectively) having a significantly higher mean posture score ($p<.01$) than Hospital 3 (Research Assistant 1-collected). While it has been shown that there is low interrater reliability between the researcher and the research assistants, it is also possible that the significant difference between mean scale scores may be a real difference between nurses' behaviors in different hospitals.

3. Data collection

On scheduled days, the researcher or a research assistant stationed herself centrally on the unit. When a nurse was ready to move a patient in bed, the nurse sought out the observer and notified her of the impending move. Some movement situations were discovered by the researcher or research assistants while walking about the unit. The observer was positioned at the foot of the bed, and the movement was recorded using the observation guide. Movements included in the study were pulling a patient up in bed, moving the patient to the side of the bed and turning a patient onto his/her side. One observation

TABLE V

ANALYSIS OF VARIANCE SUMMARIES OF TOTAL AND SUBSCALE LIFTING SCORES BY HOSPITAL

Scale	SS	df	MS	F
Total Score				
Between	20.7	3	6.9	1.95
Within	614.6	174	3.5	
Environment Score				
Between	26.3	3	8.8	7.9**
Within	194.4	174	1.1	
Nurse Score				
Between	9.3	3	3.1	0.95
Within	568.5	174	3.3	
Posture Score				
Between	25.5	3	8.5	4.8*
Within	310.5	174	1.8	

* $p<.05$.
** $p<.01$.

was recorded for each nurse. Following the observation, the nurse was asked whether her assignment that day was light, heavy, or average and a precoded questionnaire was given to her in an envelope with a return date printed on it. Patient data were then gleaned from the kardex and the chart and included the patient's age, diagnosis, weight, height, date of admission, post operative day, and any other pertinent information related to the movement (amputations, casts, etc.).

The researcher or a research assistant returned to the units within a few days after the observations were completed to retrieve the questionnaires from the large envelopes posted on each unit. Missing questionnaires were sought by contacting the nurses face-to-face and asking them to complete the questionnaire. Blank questionnaires were supplied in the event of loss. In all four hospitals data collection was completed within one month.

The data were coded onto fortran sheets, entered into a microcomputer, and then transferred to a mainframe. The data were cleaned through visual inspection of computer printouts of the raw data and frequency tables with three errors identified and corrected.

D. Data analysis

1. Research question 1: What is the prevalence of prescribed lifting behavior among registered nurses employed on specific hospital units?

This research question was answered using the data recorded on the observation guide. To calculate a prevalence rate, the number of prescribed lifts observed was divided by the total lifts observed and multipled by 100. The definition of a prescribed lift was a lift

recorded as having a perfect score of thirteen on the observation guide. While this rate may not reflect the population rate, it gives some evidence of the importance of this behavior to back injury. For example, if the prevalence rate for prescribed lifting behavior is high but so is the incidence of back injury, the researcher would question whether prescribed lifting behavior is a significant factor in back injury incidence. However, if the prevalence of prescribed lifting behavior is low and back injury incidence is high, then the case for the relationship is strengthened.

2. Research question 2: Do characteristics of the nurse, patient, and environment explain significant variance in prescribed lifting behavior?

Pearson product moment correlations, analysis of variance, and regression analysis were utilized to answer this research question. Continuous predictor variables were correlated with criterion variables to determine significant relationships. Relationships between categorical predictor variables and criterion variables were examined using analysis of variance. The least squares comparison test was used to discern the exact differences between groups in the analysis. Predictor variables found to be significantly related to nurses' lifting scores were entered into regression equations to determine the variance in the total and subscale lifting scores explained by the predictor variables.

3. Research question 3: Are their differences in actual lifting behavior between those nurses who have and those nurses who have not experienced occupational back pain and/or an occupational back injury?

Analysis of variance was used to detect differences in mean lift scores of nurses with and without back pain as well as those who had and had not experienced back injury. Least squares comparison tests were used to detect exact differences between the groups in the analyses.

E. Limitations

This study had several limitations related to the sample selection, the instrumentation, and the design. The samples of hospitals, unit, shifts, and nurses were gained by convenience. Hospitals were chosen by the researcher based solely on geographic proximity and numbers of nurses employed. The units were chosen based on administrative recommendation and the shifts were chosen by agreement between nurse managers, the hospital contact person, and the researcher. The nurses were essentially volunteers in that, though the researcher approached all nurses working on selected units on each data collection day, the nurse could choose not to sign the consent form or not tell the researcher when she planned to move a patient. This might have resulted in an exceptionally high rate of nonparticipation by nurses who perceive they lift 'incorrectly'. Further, regarding the nurse sample, those nurses who have suffered severe back injuries are most likely not in the workforce and

therefore have no chance of being included in the study.

Due to the exploratory nature of this research, tested instruments were not available to measure the specific constructs of interest. Therefore, five new instruments were developed for this study. While the pilot study allowed for instrument modification, the reliability and validity of the instruments had not been firmly established. The observation of the nurses' lifting behavior by the researcher or her assistants may have influenced that behavior. Only one movement was observed for each subject and it is unknown if each movement observed was indicative of the nurses' usual behavior.

Finally, the cross sectional design of the study did not allow for temporal ordering of the antecedent variables and lift score in relation to back injury incidence. Truly, a longitudinal design would be necessary to gain evidence of cause-and-effect relationships among the antecedents and back injury incidence.

IV. FINDINGS

This study was undertaken to ascertain the prevalence of prescribed lifting behavior among nurses in the hospital setting, the nurse, patient, and environmental factors which influence the incidence of prescribed lifting behavior among registered nurses in the hospital setting, and the relationship between prescribed lifting behavior, reported back pain, and reported back injury among registered nurses in the hospital setting. Prevalence estimates were computed for the total lifting behavior scale and each of the three subscales. Pearson product moment correlation and analysis of variance were used to establish significant relationships among the predictor and the criterion variables. Those predictor variables, nurse, patient, and environment factors, exhibiting significant relationship to the criterion variable, lifting behavior, were placed in regression equations together to determine the variance in lifting behavior which was explained by the variance in selected predictor variables. Analysis of variance was used to determine whether lifting scores differed significantly between back injured and nonback injured nurses as well as between those nurses who did and those who did not report occupationally-related back pain.

A. Description of the sample

1. Description of the hospitals

Four northern Illinois community hospitals were selected based on geographic location, similar size, and mission. A summary of each hospital's total open beds, occupancy rates, total number of

registered nurses employed, and full time equivalents is presented in Table VI.

TABLE VI

STUDY HOSPITAL'S OCCUPANCY AND REGISTERED NURSE STAFF

Hospitals	Open Beds	Occupancy Rate	Registered Nurses Employed	Fulltime Eqivalents
Hospital 1	370	60%	600	500
Hospital 2	265	70%	236	170
Hospital 3	460	70%	350	339
Hospital 4	400	62%	384	245

The employee health nurse or risk manager in each institution provided data to the researcher regarding the number of back injuries among registered nurses reported during the previous two years, the number of work days lost due to back injuries among registered nurses, and the dollars paid for those injuries during the past two years (Table VII). Interestingly, lost work time and dollar costs were higher in Hospital 3 than Hospitals 1 and 2. Compensation costs for the back injuries experienced by registered nurses in Hospital 4 were not available.

The low numbers of reported back injuries among registered nurses as well as the relatively few days of lost work time due to back injuries among registered nurses in Hospital 4 lead the researcher to question the accuracy of the reporting system or the extreme

effectiveness of Hospital 4's safety programs. Another factor in the low lost work time at Hospital 4 may have been the number of back injured employees who did not lose work time because they were on restricted work activity. Nurses on restricted work activity return to work earlier because they are involved in work activities with less physical demands and thus lost work time for the hospital appears less. In 1984, five employees who reported occupational back injuries at Hospital 4 were on restricted work activity for a total of 31 days.

TABLE VII

BACK INJURIES, LOST WORK TIME, AND COMPENSATION PAID BY HOSPITAL

Hospitals	Total Number of Back Injuries Reported by Registered Nurses		Lost Work Time		Cost in Dollars Paid to Date	
	1984	1985	1984	1985	1984	1985
Hospital 1	21	13	90	78	2550	3878
Hospital 2	8	3	180	53	7546	4247
Hospital 3	36	36	208	305	10047	17102
Hospital 4	12	10	34	28	--	--

To compare the hospitals in regard to back injury incidence, an injury rate was computed by dividing the total number of back injuries reported by the total number of registered nurses employed and

multiplying by 100 (Table VIII). Using the total number of registered nurses employed as the denominator takes into account the number of nurses exposed to the hazard. Hospital 3 had more than double the rate of injury of Hospitals 1, 2 and 4. However, in order to control for hours of exposure, back injury rates were also computed using full time equivalents as the denominator (Table VIII).

TABLE VIII

BACK INJURY RATES BY HOSPITAL.

Hospitals	Back Injury Rate (Total number of nurses)		Back Injury Rate (Full time equivalents)	
	1984	1985	1984	1985
Hospital 1	3.5	2.2	4.2	2.6
Hospital 2	3.4	1.3	4.7	1.8
Hospital 3	10.3	10.3	10.6	10.6
Hospital 4	3.1	2.6	4.9	4.1

2. Predictor variables

a. Nurse variables

A total of 178 nurses in the four hospitals were observed. One hundred fifty-five nurses completed the questionnaire for a response rate of 89 percent. A breakdown of observations and responses by hospital is displayed in Table IX. It is interesting to note the high

response rate in Hospital 4 where the research assistant did extensive follow up. The lowest response rate, in Hospital 1, may have been due in part to a less vigorous follow up regime.

TABLE IX

OBSERVATIONS AND QUESTIONNAIRE RESPONSES BY HOSPITAL

Hospitals	Observations	Questionnaire Responses	Response Rates
Hospital 1	52	42	.81
Hospital 2	48	42	.88
Hospital 3	47	40	.85
Hospital 4	31	31	1.00
Total	178	155	.87

The registered nurses in the study sample, all female, ranged in age from 22 to 64 years with a mean age of 34 years. Forty-one percent of the 155 nurses who responded to the questionnaire held the associate degree as their basic nursing degree. Another 45 percent of the respondents possessed a diploma and 14 percent held a baccalaureate degree. Regarding the highest degree held by the sample nurses, 40 percent had an associate degree, 39 percent a diploma, 20 percent a bachelor's degree and 1 percent a master's degree (Table X). Sample nurses had been employed as registered nurses from three months to 42 years with a mean of over 9 years. The nurses had worked

on their respective units from one month to twenty years with a mean of nearly five years.

TABLE X

SAMPLE NURSES' BASIC NURSING DEGREE AND HIGHEST DEGREE

Educational Degree	Basic Degree	Highest Degree
Associate Degree	64 (41%)	62 (40%)
Diploma	69 (45%)	61 (39%)
Bachelor's Degree	22 (14%)	31 (20%)
Master's Degree	0	1 (1%)
	155 (100%)	155 (100%)

Seventy percent of the nurses reported they had attended an inservice program which had focused on back injury prevention during the previous three year period (1983-1985). Seven percent had attended an inservice designed to prevent back injury prior to 1983. Thirty-seven nurses (23%) had either never attended or could not remember attending an inservice related to the prevention of back injuries. It is interesting to note that in two of the four participating hospitals back injury prevention inservices were offered once a year. The other two hospitals did not have scheduled inservices. Rather one hospital had available a slide-tape

presentation developed by the physical therapy department and the other hospital provided inservice as requested by specific units, during orientation, and following the report of an injury.

Nurses were asked following the observation portion of the data collection whether their patient assignments that day were average, heavier than usual, or lighter than usual. Forty-nine percent reported their patient care assignments to be average on the day they were observed, 31 percent felt their assignment was lighter than usual, and 20 percent felt their assignment was heavier than usual.

1) Attitude and knowledge scores for nurses

Two of the instruments developed by the researcher for this study measured nurses' attitudes toward safety and back injury prevention and nurses' knowledge of body mechanics. The attitude scale (Appendix A) had a possible score range of 12 (felt injuries could not be prevented) to 60 (felt a personal responsibility to prevent injuries). The actual scores ranged from 32 to 53 with a mean score of 43.

The six-item "knowledge of body mechanics" instrument (Appendix A) had a possible score range of 0 to 6. The respondents' scores ranged from 2 to 6 with a mean score of 4.5. Fourteen percent of the nurses answered all six questions correctly. Only one item was answered incorrectly by over half of the respondents. Sixty-six percent of the nurses did not choose lifting as the movement to avoid whenever possible. Instead they chose to avoid rolling (5%), pushing (33%), or pulling (27%). The percent of respondents answering incorrectly on the other five items ranged from 7 to 26 percent.

b. Patient variables

The unit of measurement in this study was the individual nurse with one observation of lifting being recorded for each nurse. However, several different nurses may have been observed moving the same patient. Therefore, the data included in this section does not represent 178 individual patients.

The patients who were moved by registered nurses observed during the course of the study ranged in age from 17 to 98+ years with a mean of 67 years. Seventy-six (43%) of the patients were men, 102 (57%) were women. Patient weights ranged from 65 to 450 pounds with a mean of 153 pounds. According to data obtained from patient charts, these patients ranged in height from 4 feet 8 inches to 6 feet 3 inches with a mean of 5 feet 5 inches. The ratio of weight to height ranged from 1:1 to 6:1 with a mean of 2:1.

Patient diagnoses were categorized using the medical categories of the Merck Manual (1980). Table XI displays the number of patients who were moved by a nurse in this study with diagnoses in each category. Seventy-one percent of the patients fell in the following three diagnostic categories: musculoskeletal diagnoses (30%), neurologic diagnoses (22%), and cardiovascular diagnoses (19%). There were no patients moved in the study who were diagnosed with allergic, pediatric/genetic, endocrine, otorhinolaryngology, dental/oral, physical agents, or sexually-related health problems.

Patients involved in the study had been hospitalized from 1 to 46 days with a mean of 9 days, a median of 6 days, and a mode of 3

days. This discrepancy among measures of central tendency points to the relatively few people who are hospitalized for lengthy periods. Three quarters of the patients had been in the hospital less than two weeks.

TABLE XI

DIAGNOSTIC CATEGORIES FOR PATIENTS MOVED BY SAMPLE NURSES

Diagnostic Category	Frequency
Infectious/Parasitic	2
Hematologic	8
Cardiovascular	34
Pulmonary	6
Renal/Urological	16
Gastrointestinal	3
Hepatic/Biliary	8
Gynecologic/Obstetric	2
Nutrition/Metabolic	3
Musculoskeletal	54
Neurological	39
Psychiatric	1
Dermatologic	2

Forty-six percent (n=178) of the patients observed had undergone a surgical procedure. The observed movement of these patients with nursing assistance occurred from the day of surgery to 37 days post operatively with a mean of 6 days post operative, a median of 3 days post operative, and a mode of 1 day post operative. The majority of surgical patients requiring assistance (59%) had undergone surgery between one and five days earlier. Again, three fourths of the surgical patients were less than two weeks post operative.

Nurses were observed pulling patients up in bed (45%), moving patients to the side of the bed (32%), or turning patients onto their sides (23%). During these moves, 20 percent of the patients assisted the nurse, 75 percent did not assist the nurse, and 5 percent of the patients were recorded as comatose and thus unable to assist in their move.

c. Environment variables

Data were collected at four hospitals on eight types of units (Table XII). The unit type with the most observations was critical care while the least observations were made on rehabilitation units. When units were grouped into three categories, namely critical care, stepdown, and general nursing units (GNU), the largest number of observations were made on general nursing units (67%) while stepdown (11%) and critical care units (23%) contributed the other third of the observations.

TABLE XII

PATIENTS BY UNIT BY HOSPITAL

Units	Hospital 1	Hospital 2	Hospital 3	Hospital 4	Total
ICU/CCU	0	6	19	15	40
Stepdown	9	8	1	1	19
GNU					
Oncology	12	21	5	0	38
Ortho	20	0	10	7	37
Surgical	7	9	7	0	23
Medical	4	4	0	6	14
Rehab	0	0	5	2	7
	52	48	47	31	178

Observations were conducted every day of the week (Table XIII) with the largest number being made on Thursday (23%) and the smallest number on the weekend (7%). The shifts on which observations were made were evenly divided with 52 percent of the observations being collected on the day shift and 48 percent being collected on the evening shift.

TABLE XIII

OBSERVATIONS BY DAY OF THE WEEK

Day of the Week	Observations
Sunday/Saturday	12
Monday	20
Tuesday	37
Wednesday	40
Thursday	41
Friday	28
	178

In regard to staffing, head or charge nurses reported staffing patterns to be at the usual level during 74 percent of the shifts used for observation. Eighteen percent of the observations were made when units were staffed below the usual level and 31 percent of the

observations were made when staffing on the unit was above normal. These results are comparable to the nurses' perceptions of whether their patient assignments were average, heavy, or light during the observation shift (Table XXIV, Appendix C). The patient-staff ratio, calculated by dividing the number of patients on the unit by the number of direct care nursing personnel, ranged from 1:1 to 6.5:1 with a mean of 3.4:1.

The vast majority (92%) of the observations collected showed at least one coworker assisting the study nurse in moving the patient. Only one nurse used a mechanical device to assist in the movement and three nurses had the assistance of a nonnurse such as a physical therapy aide. (Mechanical devices were not visible on the units however all hospitals did own such equipment.) All told, only three percent of the nurses observed moved their patients without either coworker or patient assistance.

1) Teamwork scores

The ten item teamwork instrument developed by the researcher asked nurses about the cooperation on the unit in terms of moving patients. There was a possible score range of 10 (low teamwork) to 50 (high teamwork) (Appendix A). The actual scores ranged from 22 to 50 with a mean of 35, indicating an overall tendency to report perceived teamwork on units in contrast to more isolated practice.

3. Criterion variables

a. Lifting behavior

The total liftscore was computed based on thirteen unweighted behaviors that were scored as having occurred as prescribed (1) or not

having occurred as prescribed (0) (Appendix A). Scores for the full instrument could range from 0 to 13. Actual scores ranged from 3 to 13 with a mean of 8.3 and a standard deviation of 1.9.

Three subscales of the lifting scale were devised by the researcher. The environment subscale included five items (bedwheels, obstacles, bed height, head of the bed, and siderails) with the scores ranging from 1 to 5 ($\bar{x}$=3). The nurse subscale consisted of seven items which had to do with the nurses' posture and behavior. The nurse scores ranged from 0 to 7 with a mean of 4.1 and a standard deviation of 1.8. A posture subscale of the nurse subscale was also computed in an effort to focus on only the posture of the nurse's body. The posture subscale consisted of four items (position of the back, waist, hips, and knees) and had a range of 0 to 4 with a mean of 2 and a standard deviation of 1.4.

Beyond looking at absolute posture scores, configuration frequencies were computed (Table XIV). Nearly three quarters of the observations were categorized into only four configurations. These configurations were 1) Back and waist flexed, hips and knees straight (0000), 2) Back and waist straight, hips and knees straight (1100), 3) Back and waist flexed, hips and knees flexed (0011), 4) Back and waist straight, hips and knees flexed (1111).

In looking at each of the thirteen items on the observation guide independently (Table XV), it is interesting to note that over one third of the beds involved in observations did not have locked bedwheels. Environmental obstacles were not a significant problem in

TABLE XIV

POSTURE CONFIGURATIONS

POSTURE				FREQUENCIES
1[a]	2[b]	3[c]	4[d]	
0	0	0	0	41 (23%)[e]
1	1	1	1	31 (17%)
1	1	0	0	31 (17%)
0	0	1	1	24 (13%)

[a] Body position 1: Back straight (1) flexed (0).

[b] Body position 2: Waist straight (1) flexed (0).

[c] Body position 3: Hips flexed (1) straight (0).

[d] Body position 4: Knees flexed (1) straight (0).

[e] Percentage based on total number of observations (178).

TABLE XV

NURSE BEHAVIOR BY LIFTING ITEM

LIFT BEHAVIOR ITEM	NUMBER AS PRESCRIBED
Environment	
No obstacles	154 (87%)[a]
Head of bed flat	144 (81%)
Bedwheels locked	109 (61%)
Siderail down	96 (54%)
Bed height raised	67 (38%)
Nurse	
Flat, low heeled shoes	175 (98%)
Stance 4-8 inches apart	165 (93%)
Patient within 8 inches of nurse	140 (79%)
Flexed hips	95 (53%)
Flexed knees	91 (51%)
Straight waist	86 (48%)
Straight back	82 (46%)
Rocking motion by nurse	73 (41%)

[a] n=178.

the four study hospitals. The position of the bed however was in a lower-then-optimum position in 62 percent of the observations, the head of the bed was raised in nearly one fifth of the observations, and the side rail was raised in nearly half the cases. Regarding the nurse, 60 percent did not use a rocking motion when moving the patient. The back, waist, hips, and knees were flexed during approximately 50% of the observed moves.

b. Back pain

Nurses were asked to recall episodes of back pain during the previous two weeks and the previous six months. Table XVI displays the percent of nurses who report back pain and related activities at both time periods. One fourth of the nurses complained of back pain during the previous two week period, with 77 percent of these afflicted nurses attributing their back pain to work. At the six month recall, the percent of nurses complaining of occupational back pain climbed from 21 percent to 38 percent. Forty-one percent of the nurses also complained of back discomfort at the end of the workday during the previous two week period that had not been present at the beginning of the shift. It is interesting to note that while nurses report a significant problem with occupationally-related back pain, they do not miss work because of it. Only two percent of the sample nurses had missed work during the previous two weeks due to back pain and only six percent of the nurses reported missing work due to back pain during the previous six months.

TABLE XVI

NURSES REPORTING BACK PAIN AND RELATED ACTIVITIES

QUESTIONNAIRE ITEM	FREQUENCY
Two Week Recall	
Back pain > 30 minutes at least one day	42 (27%) (n=154)
Back pain > 30 minutes due to work at least one day	32 (21%) (n=154)
Severe back pain, stopped activity, at least one day	19 (12%) (n=155)
Go home with sore back although came to work without discomfort at least one day	63 (41%) (n=155)
Take medication for back discomfort at least one day	32 (21%) (n=154)
Miss work due to back pain at least one day	3 (2%) (n=155)
Change nonwork plans due to back pain at least one day	8 (5%) (n=155)
Six Month Recall	
Miss work due to back pain at least one day	9 (6%) (n=155)
Remain in house due to back pain at least one day	17 (11%) (n=155)
Use medications for back pain at least one day	51 (33%) (n=154)
Develop back pain due to work at least one day	56 (38%) (n=148)
Percentage of coworkers thought to have occupational back pain	
None	8 (6%)
>10%	52 (37%) (n=136)

c. Back injury

Sixty nurses (39%) reported they had suffered at least one back injury during their lifetime. The total number of reported back injuries per nurse ranged from one to ten injuries (Table XVII). The most recent injury had occurred between 1960 and 1985. The majority of most recent injuries had occurred since 1983 (76%). Sixty-six percent of these injuries had occurred at the hospital where the nurse was currently employed. Thirty-four nurses stated they had reported their back injuries to the hospital. This figure is close to the total number of occupational back injuries reported on the questionnaire (41). Over three quarters of the nurses stated they were lifting patients or objects at the time the injury occurred. However, only one third of the nurses were lifting alone at the time of the injury.

TABLE XVII

TOTAL BACK INJURIES EXPERIENCED BY SAMPLE NURSES

NUMBER OF INJURIES	NUMBER OF NURSES
1	35
2	18
3	3
5	1
10	1
	58

Forty-five percent of the 41 injured nurses reported losing one to 75 days of work (mean=9.6, median=4.0, mode=2.0) as a result of the back injury. Only three nurses required hospitalization for care of their back injuries. One nurse reported being hospitalized for one day, one for 30 days, and one nurse did not provide the data.

B. Prevalence of prescribed lifting behavior

Prevalence estimates for prescribed lifting behavior using the full thirteen observation items as well as the three subscales (environment, nurse, and posture) were calculated. The number of perfect scores was divided by the number of nurses observed (178) and the result was multiplied by 100. Table XVIII shows the number of perfect scores for the entire thirteen items and the three subscales as well as the prevalence estimates for each.

TABLE XVIII

PREVALENCE OF PRESCRIBED LIFTING BEHAVIOR

Scale	Cases with Perfect Scores	Prevalence
Total	3	2 per 100
Environment	25	14 per 100
Nurse	17	10 per 100
Posture	31	17 per 100

C. Nurse, patient, and environment variables related to prescribed lifting behavior

1. Pearson product moment correlations

Table XIX presents the Pearson product moment correlations computed between each of the continuous predictor variables and lifting score/subscale scores. Significant correlations were found between the age of the nurse and the nurse's total lift score, the score being higher for younger nurses.

Age of the nurse was also correlated with environment score, again the score being higher for younger nurses. The type of unit (critical care, stepdown, floor), assignment level (heavy, average, light), the patient/staff ratio, and the weight/height ratio of the patient were significantly related to the environment score. Critical care units, light assignment levels, low patient/staff ratios, and high weight/height ratios were correlated with higher environment scores. The nurse score was related to only one predictor variable, patient/staff ratio, as was the posture score. Interestingly, the higher the ratio (more patients per nurse) the higher the score.

2. Analysis of variance

To determine if any of the categorical predictor variables were related to the nurses' total lifting scores or any of the subscores, oneway analysis of variance was used. Tables XXV to XXVIII (Appendix D) consist of the sums of squares, degrees of freedom, mean squares, and the F value for each analysis.

The total lift score was shown to be related to the specific

TABLE XIX

CORRELATIONS AMONG THE CONTINUOUS PREDICTOR VARIABLES AND TOTAL LIFTING SCORE/SUBSCALE SCORES

Predictor Variables	Total Lift Score	Environment Score	Nurse Score	Posture Score
Nurse Variables				
Age of Nurse (n=154)	-.17*	-.24*	-.04	-.06
Assignment level (n=178)	.06	.17*	-.04	-.02
Months employed as a professional nurse (n=154)	-.08	-.14	.005	-.05
Months employed on present unit (n=152)	.03	-.03	.04	-.03
Attitude score (n=155)	.10	.03	.07	.10
Knowledge score (n=155)	-.04	-.13	.04	.02
Patient Variables				
Weight/height ratio (n=178)	-.01	.18*	-.08	-.07
Post operative day (n=82)	-.01	-.01	.05	-.003
Length of stay (n=177)	-.09	-.05	-.06	-.06
Age of the patient (n=176)	-.0007	-.08	.04	-.001

* $p<.05$.
** $p<.01$.

TABLE XIX

CORRELATIONS AMONG CONTINUOUS PREDICTOR VARIABLES AND TOTAL LIFTING SCORE/SUBSCALE SCORES

Predictor Variables	Total Lift Score	Environment Score	Nurse Score	Posture Score
Environment Variables				
Unit type (n=178)	.12	.29**	-.04	-.06
Patient/staff ratio (n=178)	.01	-.25**	.16*	.19*
Staffing level (n=178)	.05	-.05	.08	.11
Teamwork score (n=155)	-.03	-.06	.0007	.01

* $p<.05$.
** $p<.01$.

movement of the patient. The least squares comparison test showed that the nurses involved in pulling patients up in bed had significantly higher ($p<.05$) total lifting scores than those nurses who were observed moving patients to the side of the bed or turning patients onto their sides. The least squares difference comparison test, though liberal, was chosen due to the exploratory nature of the study.

The movement of the patient was found to be related to the nurse score. Again, nurses who were observed pulling patients up in bed had higher scores than those nurses who were observed turning patients or moving them toward the side of the bed.

Finally, the posture score was also related to whether or not the patient provided assistance during the move. Assistance by the patient resulted in lower posture scores for the nurse.

3. Multiple regression analysis

Total lifting score was regressed on the predictor variables, nurse's age, and movement of the patient. Table XX displays the multiple correlation, the cumulative squared multiple correlation, the change in the squared multiple correlation with the addition of each predictor variable, the degrees of freedom, the standardized Beta value, the F ratio, the significance level of the F ratio, and the number of cases used in the computation. The stepwise method of regression analysis was used with this data. This method enters and removes variables from the equation based on probability levels (F-to-enter=.05, probability of F-to-remove=.10, and tolerance=.01) (Nie, 1983) until the best fit of the data is acheived. This method

TABLE XX

STEPWISE REGRESSION ANALYSIS OF THE NURSE, PATIENT, AND ENVIRONMENT VARIABLES ON TOTAL LIFTING SCORE AND SUBSCALE SCORES

Scale	Multiple R	Cumulative R	Change	df	Beta	F	p	n
Total								
Movement	.21	.05	.05	1	.22	7.2	.008	152
Nurses Age	.27	.07	.02	2	-.17	7.2	.004	
Environment								
Unit type	.28	.08	.08	1	.28	12.6	.001	153
Nurse's age	.34	.12	.04	2	-.20	9.8	.0001	
Nurse								
Movement	.27	.07	.07	1	.27	14.1	.0002	153
P/S Ratio[a]	.32	.10	.03	2	.16	9.7	.0001	
Posture								
Pt Assist	.20	.04	.04	1	-.20	7.3	.008	152
P/S Ratio	.26	.07	.03	2	-.18	6.6	.002	

[a] P/S Ratio (Patient/staff ratio).

capitalizes on chance and is therefore not often recommended for use in analysis. However, due to the exploratory nature of this study and the lack of a mathematical model, the reseacher felt justified in using the technique with caution applied to the significance of the results.

Patient movement explained five percent of the variance in total lifting score. The addition of nurse's age to the equation increased the squared multiple correlation by two percent, resulting in seven percent of the variance in total lifting score explained by the two predictor variables.

The environment score was found to be significantly related to unit type, nurses' age, assignment level, patient/staff ratio, and weight/height ratio. However, when environment score was regressed on these predictor variables, only two, unit type and nurses' age, explained significant variance in the environment score. Unit type, critical care, stepdown, or floor units, explained 8 percent of the variance in environment score. The age of the nurse added another 4 percent to the variance explained with a total of 12 percent of the subscale's variance explained by the two variables. The nurses' assignment levels, patient/staff ratio, and weight/height ratio did not meet the criteria for inclusion in the equation.

Movement of the patient, and the patient/staff ratio were shown to be related to the nurse score and met the criteria for inclusion in the regression equation. The movement of the patient explained 7 percent of the variance, and the patient/staff ratio added an

additional 3 percent for a total of 10 percent of the variance in nurse score explained by the two variables.

The posture scale, a subscale of the nurse scale, was shown to be related to patient assistance during the move, and the patient/staff ratio. Together, these variables explained 8 percent of the variance in posture score with patient assistance contributing 4 percent and patient/staff ratio contributing an additional 3 percent.

Histograms of the standardized residuals, normal probability plots of the standardized residuals and the standardized scatterplots of the predicted against the residual scores were examined. No violations of the assumptions of normality, linearity, or homoscedasticity were found.

D. Relationship among lifting behavior, back injury and back pain

Analysis of variance showed no significant relationships between two week recall of occupational back pain and total or subscale lifting scores (Table XXI). Similarly, analysis of variance revealed no significant relationships between reported back injury and total or subscale lifting scores. However, there was a signficant relationship between six month recall of back pain and the environment score. Those nurses who recalled experiencing occupational back pain in the previous six months had significantly higher mean environment scores than nurses who did not report such pain.

Cross tabulations were computed between back injury and recall of back pain during the previous two week period as well as back injury and recall of back pain during the previous six months.

TABLE XXI

ANALYSIS OF VARIANCE SUMMARIES FOR BACK PAIN AND BACK INJURY BY TOTAL LIFTING SCORE AND SUBSCALE SCORES

Scale	SS	df	MS	F
Total				
Back pain (Two week)				
Between Ss	.19	1	.19	.05
Within Ss	545	152	3.6	
Back pain (Six months)				
Between Ss	.90	1	.90	.25
Within Ss	525.8	146	3.6	
Back injury				
Between Ss	2.0	1	2.1	.57
Within Ss	557	153	3.6	
Environment				
Back pain (Two week)				
Between Ss	3.3	1	3.3	2.6
Within Ss	193	152	1.3	
Back pain (Six months)				
Between Ss	5.9	1	5.9	4.8*
Within Ss	179.3	146	1.2	
Back injury				
Between Ss	3.6	1	3.6	2.8
Within Ss	196	153	1.3	

* $p<.05$.
** $p<.01$.

TABLE XXI

ANALYSIS OF VARIANCE SUMMARIES FOR BACK PAIN AND BACK INJURY BY TOTAL LIFTING SCORE AND SUBSCALE SCORES

Scale	SS	df	MS	F
Nurse				
Back pain (Two week)				
Between Ss	4.7	1	4.7	1.5
Within Ss	482	152	3.2	
Back pain (Six months)				
Between Ss	10.5	1	10.5	3.3
Within Ss	462.3	146	3.2	
Back injury				
Between Ss	.22	1	.22	.07
Within Ss	491	153	3.2	
Posture				
Back pain (Two week)				
Between Ss	2.5	1	2.5	1.4
Within Ss	275	152	1.8	
Back pain (Six months)				
Between Ss	4.5	1	4.5	2.5
Within Ss	266.5	146	1.8	
Back injury				
Between Ss	.85	1	.85	.47
Within Ss	278	153	1.8	

* $p<.05$.
** $p<.01$.

Significant Chi square statistics were computed for both associations (X^2 =6.0, df=1, p=.01; X^2 =10.6, df=1, p=.001, respectively.)

E. Qualitative analysis of nurses' self-report of back injury etiology and prevention

Nurses were asked 1) In your opinion, what are the most important factors affecting the incidence of back injuries/back pain among registered nurses on your unit? 2) In your opinion, what strategies could be used to decrease the incidence of back injuries/back pain among registered nurses on your unit? The largest number of "cause" responses provided by the study nurses were categorized by the researcher as "nurse-related" and included such causes as moving patients without adequate assistance and the use of improper body mechanics (Table XXII). Patient-related causes, patient weight, behavior, and health, composed the second largest group of cause responses. The third group, environment-related causes, included decreasing staffing levels and increasing workloads for nurses.

In relation to preventive strategies, the two most commonly listed nurse-related strategies focused on instruction and feedback regarding body mechanics and requesting assistance in lifting (Table XXIII). Only one patient-related strategy was listed, teaching patients to assist during the movement. The environment-related strategies focused on the availability of adequate assistance, the use of assistive devices, and teamwork.

Forty-five percent of the cause responses were nurse-related and 53 percent of the preventive strategy responses were nurse-related. Thirty-three percent of the cause responses were patient-related while

TABLE XXII

SUMMARY OF NURSES' RESPONSES REGARDING CAUSES OF OCCUPATIONAL BACK INJURY IN THE HOSPITAL SETTING

Reported Cause	Frequency Listed
Nurse-related	
Moving patients without enough help	60
Improper body mechanics	33
Frequency/distance of lifting	7
Stress	2
Carelessness	2
Prior injury	1
Unknown congenital defect	1
	106 responses
Patient-related	
Weight of the patient	30
Combative, uncooperative, impatient patients	25
Condition of the patient	18
	73 responses
Environment-related	
Decreased staffing/heavy workload	27
Furniture/equipment factors	8
Limited skill of coworkers	5
Lack of assistive devices	1
	41

TABLE XXIII

SUMMARY OF NURSES' RESPONSES REGARDING STRATEGIES TO PREVENT OCCUPATIONAL BACK INJURIES IN THE HOSPITAL SETTING

Suggested Prevention Strategies	Frequency Listed
Nurse-related	
Instruction, feedback regarding body mechanics	47
Requesting assistance in lifting	27
Fitness of the nurse	3
Common sense	1
Quit job	1
Good assessment of the patient	1
Decreased stress level	1
Improved attitude	1
Weight loss program	1
Less haste	1
	84 responses
Patient-related	
Teach patients to assist, remain calm	6 responses
Environment-related	
Adequate assistance available	34
Use assistive devices	15
Teamwork	15
Raise bed height	3
Organization of patients on unit	1
Larger rooms	1
	69 responses

only four percent of the preventive strategies were patient-related. Environment-related responses comprised 22 percent of the cause responses but 43 percent of the preventive strategies were environment-related.

V. SUMMARY, DISCUSSION, AND RECOMMENDATIONS

This study was designed to determine the prevalence of prescribed lifting behavior among registered nurses employed in the hospital setting, the antecedent nurse, patient, and environment factors which influence prescribed lifting behavior among registered nurses in the hospital setting, and the relationship between prescribed lifting behavior, reported back pain, and reported back injury among registered nurses practicing in the hospital setting. In this chapter, the research study will be summarized, implications of the findings will be discussed, and recommendations for education, practice, and research will be presented.

A. Summary

Back injury among nursing personnel engaged in direct patient care in the hospital setting has been shown to be a primary occupational health concern. The primary agent of back injuries among nurses has been reported to be the moving of patients. A descriptive cross sectional survey was undertaken to examine the prevalence of prescribed lifting behavior among registered nurses in the hospital setting. Using Suchman's (1965) epidemiologic framework, factors influencing prescribed lifting behavior, specifically characteristics of the nurse, the patient, and the environment, were identified as well as determining the relationship between prescribed lifting behavior, occupational back pain, and occupational back injury. One hundred seventy-eight female registered nurses employed on critical care, stepdown, and general nursing units of four northern Illinois community hospitals were observed by the researcher and two research

assistants moving adult patients in bed. Following the observation, each nurse completed a questionnaire which measured the nurse's attitudes toward safety and back injury prevention, her perception of teamwork on the unit, her knowledge of body mechanics, selected demographic characteristics, and her self reported history of occupational back pain and back injury.

The 155 completed questionnaires and observations were analyzed resulting in the following findings. The prevalence of prescribed lifting behavior among the nurses observed was low with only two percent of the sample nurses completing all thirteen behaviors as prescribed. A major culprit in lowering the prevalence rate was the widespread problem of the bed being at a lower-than-optimal height (below waist level) during moving episodes. Other behaviors with low occurrence were lowering the siderail, using a rocking motion during the move, keeping the back and waist essentially straight, and flexing the hips and knees.

In examining the antecedents of prescribed lifting behavior, it was determined that the variance in total lifting score was best explained by the type of patient movement and by the nurses' age. Nurses who were observed pulling patients up in bed had higher total scores than nurses who were observed turning patients or moving patients to the side of the bed and younger nurses achieved higher total scores than older nurses.

The three subscales of the lifting behavior scale (environment, nurse, and posture) were analyzed separately. The environment items were best predicted by the type of unit (critical care having the

highest score) and the nurse's age (younger nurses scoring higher than older nurses). The variance in the items which dealt with the actual movement of the nurse's body during lifting was best explained by the type of patient movement (pulling a patient up in bed resulting in a higher score than the other two movements) and by the patient-staff ratio (a higher ratio, more patients per nurse, related to a higher nurse score). The posture subscale, actually a subscale of the nurse subscale, was best predicted by patient assistance (scores were lower when the patient assisted during the move) and the patient-staff ratio (the more patients per nurse, the higher the score).

Analysis of variance was used to determine if there were any significant relationships between lifting scores, self-report of back pain, and self report of back injury. The only significant F value in the analysis was between the environment score and recall of back pain in the previous six month period. Those nurses who had recently experienced back pain were more likely to lock the bed wheels, raise the bed height, lower the head of the bed and the siderails, and remove furniture and equipment from the bedside as patient condition allowed.

Finally, significant relationships were found between the recall of occupational back pain during the previous two week period and the previous six month period. Back injured nurses were significantly more likely to report back pain during the previous two week and the previous six month periods.

Several limitations in the areas of sampling, instrumentation,

and design dictate caution in the conclusions that can be drawn from the study. The sample of hospitals, units, data collection days and shifts, and nurses was acquired by convenience. Instruments specific to the problem of back injury among nurses or specific to the hospital work environment were, for the most part, nonexistent. Thus, all but one of the instruments used in the study were researcher designed and used following pilot study testing. Inadequate interrater reliability for the observation data brings into question the comparability of the data collected at the four hospitals. Finally, the cross sectional design did not allow for temporal ordering between lifting behavior, self reported occupational back pain, and self reported occupational back injury.

B. Discussion

1. Sample description

a. Nurse-related variables

The nurses in this sample tended to be young ($\bar{x}$=34 years) although the full range of ages in the working population were represented. Studies have shown younger nurses to be at increased risk for occupational back injury due in part to inexperience but perhaps also due to increased exposure. As nurses age, they either leave staff nurse positions for administrative posts or they seek positions in other areas of nursing (clinic, public health, etc.) perhaps because they have suffered a back injury and are unable or unwilling to continue in bedside hospital nursing. Older, more experienced nurses still caring for hospitalized patients may be either genetically-endowed with strong backs or have learned to

protect themselves from harm by using prescribed lifting behaviors or avoiding potentially-hazardous situations.

Regarding the educational level of the sample nurse, nearly 80 percent of the nurses were educated in associate degree or diploma programs, with no further educational degrees attained. Nurses who had recently graduated from nursing education programs were likely to report attending a recent inservice program regarding back injury prevention probably as part of orientation to the hospital. However, thirty percent of nurses reported they had not attended an inservice program focused on back injury prevention since 1983. Recent updating of moving skills had not occurred for at least a third of the nurses theoretically putting them at increased risk for back injury.

Nurses were asked to categorize their workload on the day of observation as heavy, average, or light. Only 20 percent of the nurses categorized their workload as heavy. With hospitalized patients being more acutely ill and current cost containment measures resulting in less staff on the units, the researcher had hypothesized a larger percentage of nurses categorizing their workload as heavy. The criteria the nurses were using to determine appropriate workload is unknown. Numbers of patients, severity of the patients' illnesses, or tasks to be completed by the nurse are all criteria which nurses could use in making the determination. Further, it is unclear to what standard nurses compared the observation days' workload; the past week, the past year, or some ideal?

The knowledge test was originally included in the study to

control for the effect of information regarding body mechanics on behavior with the expectation that all of the study nurses would have the same basic knowledge. If indeed the nurses all had similar levels of knowledge concerning methods of moving patients, then inservice programs which focused on cognitive learning would no longer be needed. To the contrary, the knowledge test implied a lack of correct information particularly regarding the notion of avoiding actual lifting whenever possible. It seems important, then, to continue with the cognitive aspects of inservice programs and add a motor skills portion to allow for practice with supervision of the actual behaviors. Attitudes regarding safety and back injury prevention tended to support a theme of self responsibility rather than other-directedness. However, sample nurses may simply have answered in ways they perceived as correct, reporting what they thought they should believe rather than reporting what they actually did believe in relation to back injury prevention.

b. Patient-related variables

Patients observed in this study as needing assistance in moving tended to be older ($\bar{x}$=67 years) and more often women then men. Taking into account the longer lifespan of women compared to men and the age of the patients this was to be expected. The majority of patients in this study were admitted to the hospital with diagnoses that could be grouped into one of three categories, cardiovascular, muculoskeletal, or neurological. The diagnostic categories were indicative of the common health problems experienced by those hospitalized people in need of near total nursing care. While the

health problems of hospitalized patients are often complex and life threatening, most patients are in the hospital for a surprisingly short time. (A 1982 National Center for Health Statistics publication provided data showing the average length of stay for patients under age 65 in short-stay, non-Federal general and specialty hospitals to be six days. For those patients over age 65, the average length of stay was ten days.) This paradox of life-threatening illness and short hospital stay may be the result of economic constraints on reimbursement to hospitals for services rendered.

The concept of self care has led to a philosophy among nurses of assisting patients in activities of daily living while they are ill but at the same time encouraging patients to take on more and more of their own care as they recover. This idea has also been applied to the moving of patients with an expectation that patients will assist as they are able during repositioning and transferring activities. Interestingly, in this study, in only 20 percent of the observed moves did the patient assist the nurse. Two reasons may explain this low percentage of assistance. The patients moved during the observations may have simply been too ill to assist the nurse or the nurse may not have enlisted the patient's assistance by explaining the behaviors expected of the patient during the move (pushing with the feet, pulling on the trapeze, etc.)

c. Environment-related variables

Adequacy of staffing patterns was assessed by asking the nurse in charge of the unit if the staffing during the observation day was at

the usual level or if there were more or less staff than usual. The usual staffing levels were determined by formulas devised to take into account the tasks required to care for each patient on the unit. The formulas differed somewhat by hospital and even by unit within the hospital. There appeared to be some problems with these formulas in respect to nursing tasks that are difficult to quantify such as the time involved in providing affective support to patients and families, in implementing teaching programs, or in assisting patients in developing self-directed plans of care. Given the inconsistency among units' staffing formulas, it is important to note that the charge nurses' report of staffing level, the nurses' report of workload level, and the patient to staff ratio were significantly correlated, giving some credibility to the measures (Table XXIV, Appendix C). Only three of the 178 nurses observed moved their patients without the assistance of a coworker or the patient. While there was an expectation on the part of the researcher that bias might be a factor in relation to nurses' actual behavior, the type of movement situations presented the researcher and research assistants created a more obvious bias in that only those moves involving more than one nurse were recorded. This may have been due to the nurses' perceptions of what constituted a move worthy of observation or it may have been for the very reasons the nurse moves patients alone (time, patient's condition, etc.), she was unable to notify the researcher of the move.

The fact that mechanical devices were not visible on the nursing units suggests three possible problems - a lack of knowledge on the

part of the staff regarding the use of these machines, disrepair of the machines, or a perception of Hoyer lifts and other mechanical devices being more trouble than they are worth in terms of patient safety and available coworker assistance.

d. Lifting behavior, back pain, and back injury

It was hypothesized by the researcher that observation bias would play a large role in "reminding" nurses to raise the bed height, lower the siderail, and lock the bedwheels. The fact that the patients' beds were seldom raised to the optimal height prior to a lifting episode was thus surprising. However, it is important to note that only the position of the bed was recorded, not whether the nurse had raised the bed. Therefore, the problem here may not have been with the nurse and her behavior but rather with the beds and the maximum height which could be attained. Further, when the bed was in a low position reaching over the raised siderail to lift patients did not appear to be a problem, thus the position of the bed most likely influenced other observations such as the position of the siderail.

While posture scores gave some indication of the use of correct body postures, the configuration of postures also appeared to be important. In relation to the four most frequently observed postures, only 17 percent were recorded as being prescribed. Twenty-three percent were labeled at risk for low back pain and injury based on flexion of the back and waist coupled with straight hips and knees resulting in inordinate stress on the low back. Seventeen percent of the nurses appeared at risk for upper back pain and injury in that all

four areas, back, waist, hips, and knees, were kept straight during the patient move with increased strain on the upper arms and across the shoulders and upper back. The fourth configuration category included those nurses who flexed their back and waist but also flexed their hips and knees. It is hypothesized that the bending of the knees would decrease the risk of low back pain and injury because the muscles of the thighs would accept some of the strain involved in moving the patient. This posture is probably related to the high incidence of low bed height.

A significant number of study nurses reported having experienced occupational back pain during the previous two week period (21%) with the number of nurses with low back pain increasing when the recall period was extended to six months. This finding pointed to the intermittent nature of back pain for some nurses and the need to assess longer recall periods than two weeks in order to gather accurate information regarding back pain incidence. Although 32 of the study nurses complained of back pain only 3 nurses missed work for this reason. While it is admirable that nurses are reluctant to miss work, one questions if working when one is experiencing back pain may contribute to the later incidence of severe back injury which may result in long periods of lost work time, hospitalization, and perhaps total disability. In the long run, remaining at home with back pain to rest the back muscles and reevaluating one's behavior in relation to the back pain might save the hospital and the nurses substantial cost and suffering.

Back injuries were reported by nearly 40 percent of the nurses.

Interestingly, the majority of these injuries occurred at the hospital where they were employed at the time of the study. Most of the injuries were reported to have occurred while the nurse was moving a patient but relatively few nurses were moving patients alone at the time of the injury. These data substantiate other studies reported in the literature in that the moving of patients does appear to be a primary cause of occupational back injury among registered nurses in the hospital setting. The lack of relationship between lifting scores and back injury may indicate that other factors such as unexpected behavior on the part of the patient may truly be the causative factor or that, due to the measurement error inherent in the observations of lifting behavior, the relationship has been obscured. Again, only 27 of the 60 back injured nurses missed work due to the back injury. Does this "self-care" behavior actually contribute to more severe injury later in the nurses' careers and cost the hospital increased amounts of money in workers' compensation claims and in the loss of highly skilled professional nurses?

2. Prevalence of prescribed lifting behavior

It is evident from the observation data that registered nurses do not move patients in bed as they have been taught. Beds are not raised to near waist height, siderails are not lowered, the nurse does not use the motion of her body in moving patients nor does she flex her knees allowing her legs rather than her back to take the bulk of the strain. While back injury is believed to result from multiple factors, nurses in this study as well as in other studies have cited

the moving of patients as a primary determinant of back injury (Owen, 1982; Clever, 1981; James, 1983; Stellman, 1982; Hoover, 1973; Ferguson, 1970). It would seem prudent then to ascertain why prescribed lifting behaviors are not used and to develop strategies to increase the prevalence of prescribed lifting behavior.

3. Nurse, patient, and environment antecedents of prescribed lifting behavior

Five variables were helpful in explaining significant variance in total lifting score and subscale scores. However, less than fifteen percent of the variance in total lifting score or any of the subscale scores was explained by virtue of the inclusion of these predictor variables. One obvious reason for this may be the absence of significant predictor variables. Measurement error may also be obscuring relationships which actually exist. Two variables, type of patient movement and the nurses' age, explained significant variance in total lifting score. Those nurses who were observed pulling patients up in bed, for example, scored higher on the total observation guide than did those nurses who were observed moving patients to the side of the bed or turning the patients onto their sides. This may be explained by the greater reaching distance and thus the greater back and waist flexion involved in turning patients or moving them to the side of the bed prior to either turning or transferring. When a patient is pulled up in bed, the nurse is usually within eight inches of the patient and with the use of lift sheets even a low bed need not result in great flexion of the nurse's back.

In regard to the relationship between nurse's age and lift score, younger nurses were found to have higher lift scores. It is hypothesized that over time nurses develop their own techniques for moving patients based on personal experience and unit or hospital norms. These techniques may not follow the principles of prescribed body mechanics taught in nursing schools today. It is also important to note the relationship between age of the nurse and other variables such as type of unit and weight-height ratio of patients (Table XXVI, Appendix C). Younger nurses were more likely to work in critical care units than were older nurses and patients on critical care units were more likely to weigh more per inch of height than patients on the general nursing units (Table XXIV, Appendix C). Thus, younger nurses were in an environment where patients were very ill and very heavy. In the critical care units, beds were often left in the high position because of the patient's need for numerous, frequent procedures as well as the patient's usual confinement to bed. The patients were often unable to assist in a move which, along with the weight of these patients, necessitated prescribed body mechanics to 1) protect the nurse from back injury and also 2) to have the leverage to move the patient.

Similar reasoning could be used to explain the relationship found between age of the nurse, type of unit, and environment score. Since critical care beds are often left in the raised position at all time, nurses working in critical care units may be more likely to lower the siderail prior to moving a patient resulting in a higher environment

score. Again, age of the nurse in relation to environment score may be explained by years of faulty habit acquisition or more simply by the age of the nurses who staff different types of units. As an aside, it is interesting that nurses with the most experience are not caring for the patients who are most seriously ill. While this phenomenon may be a reflection of rapid technologic change, it would be expected that those nurses with the most experience would be best suited to caring for patients with complex nursing needs.

The nurse score, computed by adding together items related to the movement of the nurse and her posture, was explained by the type of patient movement and the patient-staff ratio. Again, those nurses observed pulling patients up in bed scored higher on the nurse items than did nurses who were observed turning patients or moving patients to the side of the bed. As discussed previously, this may be explained by the difference in the patient's position relative to the nurse in each type of movement and in the use of lift sheets when pulling patients up in bed which may negate the usual strain on the nurse when the bed is left in the low position. The nurse score was also influenced by the patient-staff ratio on the unit at the time of data collection. The more patients per staff member on the unit, the higher the nurse score. It had been hypothesized that the opposite relationship would be the case, namely that a high patient-staff ratio would be related to lower nurse scores. This speculation was based on the idea that the patient-staff ratio would be related to the nurses' perception of her workload (assignment level) which it was (Table XXIV, Appendix C) and that heavy workloads translate into higher levels of

stress and less careful behavior. The data in this study do not support this contention. However, an alternative explanation may be that units with low patient-staff ratios, critical care units, are high stress areas by virture of the illness levels of the patients on these units. Therefore, the heavy physical workloads on the general nursing units may be overshadowed by the heavy physical and emotional workloads in critical care units.

Regarding the posture score, patient assistance and patient-staff ratio were significant predictor variables. Those nurses who secured patient assistance in the move had lower posture scores than those nurses who moved patients who could not/did not assist or those who were comatose. This may reflect the nurse's assessment of the situation in that when the patient is well enough to assist and the resulting workload is thus diminished, the nurse is not as particular in using prescribed lifting behavior as she is when the workload is heavier. However, it may well be that this thinking is at the root of the back injury problem. If nurses decide, based on their assessment of the patient, not to use prescribed lifting behavior, they may substantially increase their risk of injury should that assessment be faulty or should the patient or the environment create an unexpected, unpredictable situation. While it is unlikely that using prescribed lifting behavior would eliminate all injuries, prescribed behavior may significantly decrease a nurse's risk of injury should an unexpected situation arise. Again, the explanation for the relationship between posture score and patient-staff ratio is unclear.

4. Prescribed lifting behavior, recall of occupational back pain, and self reported occupational back injury

Recall of back pain by nurses in this study was similar to the back pain experience reported by nurses in the study conducted by Harber et al. (1985). Interestingly, the phenomenon of not missing work due to back pain was constant between studies (Table XXIX, Appendix E).

Recall of back pain during the previous six months was related to the nurse's environment score. It may be that back pain occurring over a significant time period reminds nurses to raise the bed, lower the siderail and the head of the bed, and remove obstacles from around the bed prior to moving patients. The lack of back pain effect on the movement and posture of the nurse in lifting may be related to the lack of repertoire possessed by most American nurses relative to various lifting methods. Compared to nurses practicing in Great Britain and Australia, for example, American nurses have a limited number of techniques they use to move patients and regardless of cues such as back pain may be unable to make significant changes in the method of lifting (Raistrick, 1981).

The significant relationship between the two week and six month recall of back pain as well as the significant relationship between back pain and back injury may have important implications. Nurses appear to suffer back pain over long periods, suggesting an inability on the part of the nurses to independently eliminate its cause. The relationship between back pain and back injury was not as clear, in that temporal ordering was absent. That is, the design of this study

did not allow the researcher to determine if back pain were both an antecedent and a consequence of back injury or solely a consequence. If back pain is indeed an antecedent, this significant risk factor could be used in identifying nurses likely to suffer a back injury. When back pain is viewed as a consequence, it is interesting to note that hospitals most likely continue to pay for back injuries in long term intermittent absenteeism and lowered productivity of nurses. These costs are not currently included in computing the total expense of back injuries to hospitals.

5. Qualitative Findings

Nurses were asked to list "causes" and prevention strategies relative to occupational back injury and back pain. These responses were categorized by the researcher into nurse, patient, and environment-related categories. Nurse-related causes and prevention strategies composed the largest groups of responses. In particular, prescribed body mechanics and assistance in moving were the most common substance of cause and prevention responses. However, it appears from the results of this study that the prevention of back pain and back injury is much more complex than merely providing inservice related to proper body mechanics. Rather, the three groups of strategies listed by the nurses must somehow be combined to counteract the numerous "causes" that the nurses listed. For example, the weight of the patients must be dealt with through garnering the assistance of the patient if possible, staffing patterns which take the weight of patients as well as the health status of the patients

into account, and the use of assistive devices such as bed scales, Hoyer lifts, and slide boards. The question to be answered in relation to prevention is not so much how to combine these strategies but rather how to create an environment where these preventive behaviors become the norm rather than simply listings of how the staff ought to behave. An example of this was the use of slide boards on all study units in Hospital 2.

The nurses were verbally supportive of the use of the boards in transferring patients from bed to cardiac chair or guerney and back. The widespread use of the plastic apparatus and the observation of nurses declining to move patients until the board became available were evidence of a norm in relation to the use of these slide boards. It was obvious that the nurses believed in the preventive worth of the slide board and felt the device was beneficial to both themselves and their patients. This type of situation needs to be duplicated relative to other aspects of prescribed lifting behavior such as raising bed height and flexing the hips and knees.

C. Recommendations

1. Education

With the low prevalence of prescribed lifting behavior observed in this study, it would appear beneficial to review nursing curricula in relation to content and teaching strategies used in National League for Nursing accredited programs. Specifically, content related to body mechanics and the moving of patients needs to be scrutinized. For example, are body mechanics being taught in relation to the proper method of lifting a box from the floor and carrying it across the room

or in relation to pulling, pushing, and rolling patients? Are students receiving classroom, laboratory, and clinical instruction regarding the moving of patients? Do faculty share a commitment to safe nursing practice and do their actions exemplify that commitment? And finally, are prescribed lifting behaviors taught not only as foundational to quality nursing care but also in relation to occupational health concerns of the registered nurse?

Historically, nurses have allowed harm to come to themselves in the process of caring for their patients. Today nurses are aware of the health hazards in their workplaces and are seeking courses of preventive action to maintain their health as they assist their patients in regaining, maintaining, or attaining optimal health status.

2. Practice

In relation to practice settings, what strategies could be instituted to increase the prevalence of prescribed lifting behavior and decrease the incidence of back pain and back injury? Based on the knowledge portion of the study questionnaire, it would seem advisable to assess the understanding of body mechanics by nurses engaged in clinical practice. Demonstration and return demonstration of moving situations in a laboratory setting may also be beneficial.

However, as Zohar (1980) found in general industry, when workers perceive a commitment to safety on the part of management, safe behavior increases. In regard to this study, that commitment could be translated into nurse manager instruction and feedback regarding prescribed lifting behavior on the unit. Including safety behavior,

in particular prescribed lifting behavior, in the yearly evaluation and rewarding nurses in monetary terms for their efforts could be entertained as intervention strategies.

In an effort to impress nurse managers and staff nurses with the serious nature of occupational back injuries, billing each unit for the cost of each back injury which occurs on that unit could be undertaken. This awareness strategy would hopefully encourage nurse managers to engage in staff nurse evaluation and in prevention programs which would not only lower the risk of injury to their staff members but also would lower the cost to their units. Another feedback mechanism which could be utilized is the coworker approach where staff nurse are responsible for providing feedback to other nursing personnel regarding their body mechanics and preparations for moving and transporting patients.

It is evident that prescribed lifting behavior alone will not eradicate the back injury problem among nurses. Providing an exercise program to strengthen back, leg, and abdominal muscles in an effort to reduce the nurse's risk of pain and injury regardless of the situations she may encounter might also indicate the institutional concern for and readiness to deal with the back injury problem.

On an administrative level, it is important for nurse executives and occupational health professionals to look at the changing patient population and current cost containment measures. Though the numbers of patients may be declining, the health status of hospitalized patients may actually demand more staff than before. Without adequate staffing, does the hospital actually pay out more money - not for

nurse salaries but in payments to nurses disabled by back injury? Could nonprofessional staff be utilized, not in patient care as was done ten years ago, but rather as truly assistive in running errands (securing assistive devices) and assisting in the moving and transporting of patients?

The development of unit communication systems which could reduce the time and energy nurses spend in securing assistance seems imperative. Many of the communication systems observed during the course of the study were disruptive, ineffective, or extremely complicated to operate, all resulting in nurses returning to the time-consuming search for a coworker to assist with the move.

Staff nurses and nurse managers need to identify back pain and back injury as significant occupational concerns, be willing to design and participate in programs aimed at reducing the incidence of back pain and back injury, and practice prescribed lifting behavior both at the workplace and in the community.

3. Research

The implications for research based on this study are many and varied. In relation to the sample, studies in various types and sizes of hospitals in several geographic locations are needed to ascertain the universality of the problem and its hypothesized antecedents. Nurses on various units, those new to the profession, those back injured and nonback injured, and those out of the profession or in positions which do not require direct care of hospitalized patients need to be interviewed regarding their perceptions of how back injury

occurs and what strategies would be beneficial in prevention programs. Observing nurses for several hours, several shifts, or several moves might provide data regarding the frequency of assisted versus nonassisted moves and the consistency of lifting behavior during the course of a workday or specified time period.

Regarding measurement issues, all researcher devised tools require further modification to improve reliability estimates. Validity studies must also be undertaken. The observation tool, in its present form, requires more specificity in its criteria for scoring each item. Further, observers obviously need indepth instruction, probably with the aid of videotaped episodes of nurses moving patients in bed, to be adequately trained. Subsequent review of this instruction at weekly intervals to decrease the possibility of interrater disagreement is essential. This observation tool may also require modification if it is to be used by nurse managers as the basis for feedback to staff nurses in intervention studies.

While a longitudinal study is still needed, more must be learned relative to both the predictor and criterion variables prior to such a study being undertaken. Single case experimental designs hold promise in testing various intervention strategies designed to increase the incidence of prescribed lifting behavior. Several occupational safety concerns in industry have been successfully studied using single case designs (Komaki et al., 1978; Komaki et al., 1980; Komaki et al., 1982; Ramsey et al., 1983; Zohar et al., 1980; Chhokar and Wallin, 1984; Cohen and Jensen, 1984). A behavior, such as prescribed lifting, is ideally suited to the methods used in these research

designs. The behavior can be observed and changes in behavior recorded. Intervention strategies can be instituted and then altered or withdrawn to test the efficacy of each intervention strategy. Finally, smaller samples are required. For example, the nurses working on a single unit can constitute the sample rather than needing several hospitals. This reduction in sample not only reduces the cost of the study but also reduces the number of extraneous variables which come into play when numerous units within several hospitals are required to secure sufficient numbers of subjects for experimental and control groups.

This study provided a starting point for safety research in a nonindustrial occupational setting using behavior as the criterion measure. Hospital occupational health practice has the dual concern of patient safety as well as employee safety which often complicates the identification of safety problems and their solutions. However, in the case of back injury prevention, it is clear that strategies aimed at reducing the incidence of back injury among registered nurses also promise to improve patient safety. It is anticipated that future research will not only provide direction for "lightening the load" and "strengthening the back" but ultimately in reducing the cost of occupational injuries to both worker and employer through the identification of risk factors and the development of effective prevention strategies.

IV. APPENDICES

Appendix A

OBSERVATION GUIDE

DATE _____ TIME _____ NURSE _____ MOVEMENT: UP SIDE TURN

HOSPITAL _____ UNIT _____ ROOM _____ DIAGNOSIS _____

STAFFING: BELOW AT ABOVE PATIENT HEIGHT _____ WEIGHT _____

ASSIGNMENT: HEAVY AV LIGHT LIMITATIONS (POD) _____

UNIT PT TOTAL ___ STAFF ___ LENGTH OF STAY _____

PATIENT AGE _____ SEX _____

1. Bed Wheels
   1. Locked
   0. Unlocked

2. Obstacles
   1. None
   2. Furniture
      _____
   3. Equipment
      _____
   4. Other
      _____

3. Bed Height
   1. Raised
   0. Low position

4. Head of bed
   1. Flat
   0. Elevated

5. Siderails
   1. Down
   0. Up

6. Stance
   1. 4-8 inches/ shoulder width
   0. Other _____

7. Shoes
   1. Flat, low heeled
   0. Other _____

8. Patient Position
   1. Within 8 inche of the nurse
   0. More than 8 inches from the nurse

9. Movement
   1. Rocking
   0. Other

10. Assistance
    1. None
    2. Coworker
    3. Mechanical
    4. Other
       _____

11. Back
    1. Straight
    0. Flexed

12. Waist
    1. Straight
    0. Flexed

13. Hips
    1. Flexed
    0. Straight

14. Knees
    1. Flexed
    0. Straight

15. Patient
    1. Assisted
    2. No assist
    3. Comatose

TOTAL SCORE _____

COMMENTS:

Appendix A (continued)

Attitude Scale

Nurses have various views regarding accident causation and prevention in general and back injury causation and prevention in particular. Please indicate, by circling the appropriate number, how much you agree or disagree with the following statements. There are no right answers.

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
1. Being a nurse makes me more susceptible to back injury than people in other occupations.	1	2	3	4	5
2. There is little that can be done to prevent most back injuries among nurses.	1	2	3	4	5
3. Moving patients as I have been taught is less efficient than other methods I have used.	1	2	3	4	5
4. Nurses can learn specific techniques which will substantially decrease their incidence of back injury.	1	2	3	4	5
5. Back injuries occur even if one tries to prevent them.	1	2	3	4	5
6. Most back injuries are caused by the carelessness of nurses themselves.	1	2	3	4	5
7. I am less likely to suffer a back injury when I'm moving patients as I've been taught rather than when I'm using some other technique.	1	2	3	4	5

Appendix A (continued)

	STRONGLY DISAGREE	DISAGREE	NOT SURE	AGREE	STRONGLY AGREE
8. I worry about suffering a back injury due to my work.	1	2	3	4	5
9. Most back injuries among nurses can be prevented.	1	2	3	4	5
10. Accidents and resulting back injuries are the result of destiny or fate.	1	2	3	4	5
11. I am particularly careful of my back whenever I move a patient.	1	2	3	4	5
12. Part of giving good nursing care is moving patients as I've been taught.	1	2	3	4	5

Appendix A (continued)

Teamwork Scale

In an effort to describe the way in which nurses on your unit go about caring for patients, please indicate how much you agree or disagree that the statements reflect the situation on your unit. Circle the appropriate number as you did in the previous section.

	STRONGLY DISAGREE	DISAGREE	NOT SURE	AGREE	STRONGLY AGREE
1. I can move the majority of patients on our unit alone without any difficulty.	1	2	3	4	5
2. For a variety of reasons, I end up moving patients alone more often than I would like.	1	2	3	4	5
3. Often I just do not have the time to find another nurse to help me move a patient in bed.	1	2	3	4	5
4. I rarely move a patient without assistance from coworkers.	1	2	3	4	5
5. It is difficult to find coworkers to help me move patients when I need assistance.	1	2	3	4	5
6. When it comes to moving patients, there are some staff on this unit that I really prefer not to lift with.	1	2	3	4	5
7. When patients on our unit need assistance moving in bed, usually more than one nurse is required.	1	2	3	4	5

Appendix A (continued)

	STRONGLY DISAGREE	DISAGREE	NOT SURE	AGREE	STRONGLY AGREE
8. I help coworkers more times than they help me when it comes to moving patients.	1	2	3	4	5
9. I know that some staff on this unit would rather not help me move a patient in bed.	1	2	3	4	5
10. When I am busy, I more often move patients without help from coworkers than when I feel my assignment is lighter.	1	2	3	4	5

Appendix A (continued)
Knowledge Scale

This section focuses on correct body mechanics which nurses use when they move patients. Please circle the number of the BEST answer to each question.

1. Which of the following behaviors will maintain proper spinal alignment for the nurse?

1. HOLDING OBJECTS AWAY FROM THE BODY.
2. BENDING AT THE WAIST TO LIFT OBJECTS.
3. FLEXING THE KNEES AND HIPS TO LIFT OBJECTS.
4. STRETCHING AND THEN TWISTING TO REACH AN OBJECT.

2. The large groups of muscles used in lifting are those of

1. THE THIGHS AND UPPER ARMS.
2. THE BACK AND ABDOMEN.
3. THE BACK AND THIGHS.
4. THE CHEST AND ABDOMEN.

3. The correct stance to assume prior to lifting is

1. FEET TOGETHER.
2. FEET LESS THAN 2 INCHES APART AND PARALLEL.
3. FEET 4-12 INCHES APART AND ONE IN FRONT OF THE OTHER.
4. FEET MORE THAN 24 INCHES APART AND ONE IN FRONT OF THE OTHER.

4. Because of the additional stress on the nurse, whenever possible, avoid moving patients by

1. ROLLING
2. PUSHING
3. LIFTING
4. PULLING

5. Prior to pulling a patient up in bed, the nurse, keeping in mind the condition of the patient,

1. REMOVES ALL OBSTACLES FROM AROUND THE BED, RAISES THE HEAD OF THE BED, LOWERS THE BED HEIGHT AND THE SIDERAIL.
2. REMOVES ALL OBSTACLES FROM AROUND THE BED, LOWERS THE HEAD OF THE BED AS WELL AS THE BED HEIGHT, AND RAISES THE SIDERAIL.
3. REMOVES ALL OBSTACLES FROM AROUND THE BED, RAISES THE HEAD OF THE BED AS WELL AS THE BED HEIGHT, AND LOWERS THE SIDERAIL.
4. REMOVES ALL OBSTACLES FROM AROUND THE BED, LOWERS THE HEAD OF THE BED, RAISES THE BED HEIGHT, AND LOWERS THE SIDERAIL.

Appendix A (continued)

6. Correct posture for the nurse when moving a patient includes

   1. FLEXED BACK, FLEXED WAIST, STRAIGHT HIPS, STRAIGHT KNEES.
   2. FLEXED BACK, STRAIGHT WAIST, FLEXED HIPS, STRAIGHT KNEES.
   3. STRAIGHT BACK, STRAIGHT WAIST, FLEXED HIPS, FLEXED KNEES.
   4. STRAIGHT BACK, FLEXED WAIST, STRAIGHT HIPS, FLEXED KNEES.

Appendix A (continued)

Qualitative Questions

1. In your opinion, what are the most important factors affecting the incidence of back injuries/back pain among registered nurses on your unit?

_____

_____

2. In your opinion, what strategies could be used to decrease the incidence of back injuries/back pain among registered nurses on your unit?

_____

_____

Appendix A (continued)

Demographic Information

Your age, education, and professional nursing experience are also important to us. Please complete these questions.

1. What is your age?

_____ YEARS

2. What is your basic nursing degree?

1. ADN
2. DIPLOMA
3. BSN
4. MSN
5. ND

3. What is the highest degree you have earned?

1. ASSOCIATE DEGREE
2. DIPLOMA
3. BACHELOR'S DEGREE
4. MASTER'S DEGREE
5. DOCTORAL DEGREE

4. How many months/years have you been employed as a nurse?

_____MONTHS _____YEARS

5. How many months/years have you worked on your present unit?

_____MONTHS _____YEARS

6. Circle the number of the most recent year in which you attended an inservice regarding back injury prevention.

1. 1985
2. 1984
3. 1983
4. 1982 OR EARLIER
5. I HAVE NEVER ATTENDED AN INSERVICE REGARDING BACK INJURY PREVENTION
6. I DON'T REMEMBER WHEN I'VE ATTENDED AN INSERVICE REGARDING BACK INJURY PREVENTION

Appendix A (continued)

Back Pain History

This section is composed of questions dealing with occupational and nonoccupational back pain. Please circle the answer which best describes your experience of back pain. BACK PAIN REFERS TO PAIN OR DISCOMFORT IN THE LOW BACK WHICH IS NOT DUE TO MENSES.

RECENT BACK PAIN HISTORY

In the past two weeks, how many days did you:

1. Have back pain lasting more than thirty minutes?	NO DAYS	ONE DAY	2-4 DAYS	5-8 DAYS	9-12 DAYS	13-14 DAYS
2. Have back pain lasting more than thirty minutes which was due to work?	NO DAYS	ONE DAY	2-4 DAYS	5-8 DAYS	9-12 DAYS	13-14 DAYS
3. Have any <u>severe</u> back pain (no matter how brief) while working, which made you stop what you were doing?	NO DAYS	ONE DAY	2-4 DAYS	5-8 DAYS	9-12 DAYS	13-14 DAYS
4. Go home with a sore back although you came to work that day without this discomfort?	NO DAYS	ONE DAY	2-4 DAYS	5-8 DAYS	9-12 DAYS	13-14 DAYS
5. Take medication (including aspirin) for back discomfort?	NO DAYS	ONE DAY	2-4 DAYS	5-8 DAYS	9-12 DAYS	13-14 DAYS
6. Miss work due to back pain?	NO DAYS	ONE DAY	2-4 DAYS	5-8 DAYS	9-12 DAYS	13-14 DAYS
7. Change your non-work plans because of back pain?	NO DAYS	ONE DAY	2-4 DAYS	5-8 DAYS	9-12 DAYS	13-14 DAYS

Appendix A (continued)

8. In the past two weeks, how many days did you work at the hospital?	NO DAYS	ONE DAY	2-4 DAYS	5-8 DAYS	9-12 DAYS	13-14 DAYS	

SYMPTOMS OVER THE PAST SIX MONTHS

In the past six months, how many days did you:

9. Miss work of low back pain?	NO DAYS	1-2 DAY	3-6 DAYS	7-14 DAYS	15-30 DAYS	31-60 DAYS	61-120 DAYS	120+ DAYS
10. Have to remain in your house because of back pain (including work and non work days)?	NO DAYS	1-2 DAY	3-6 DAYS	7-14 DAYS	15-30 DAYS	31-60 DAYS	61-120 DAYS	120+ DAYS
11. Need to use any medicine (including aspirin) of back pain?	NO DAYS	1-2 DAY	3-6 DAYS	7-14 DAYS	15-30 DAYS	31-60 DAYS	61-120 DAYS	120+ DAYS
12. Develop back pain because of work?	NO DAYS	1-2 DAY	3-6 DAYS	7-14 DAYS	15-30 DAYS	31-60 DAYS	61-120 DAYS	120+ DAYS

13. What percentage of the RN's you work with, have back pain which is due to their work. NONE	1-10%	11-20%	21-40%	41-60%	61-80%	81-90%	91-100%

Appendix A (continued)

14. Have any of the following work-related tasks ever caused you to have back pain? (You may circle any that apply.)

1. MOVE FURNITURE
2. MOVE BEDS
3. MOVE EQUIPMENT
4. HOLD A PATIENT WHILE AMBULATING
5. ASSIST A PATIENT WITH MEALS
6. HELP A PATIENT GET OUT OF BED
7. LIFT A PATIENT IN BED
8. LIFT A PATIENT TO A GUERNEY
9. LIFT A PATIENT TO A WHEELCHAIR
10. ASSIST A PATIENT ON/OFF A TOILET
11. MOVE HEAVY EQUIPMENT OR A PATIENT IN BED ON AN ELEVATOR
12. CARRY A PIECE OF EQUIPMENT WEIGHING AT LEAST FIVE POUNDS
13. CARRY A PIECE OF EQUIPMENT WEIGHING THIRTY POUNDS OR MORE
14. BEND TO LIFT AN ITEM FROM FLOOR LEVEL
15. NONE OF THESE ACTIVITIES HAVE CAUSED ME TO HAVE BACK PAIN.

Appendix A (continued)

Back Injury History

The questions in this section deal with previous occupational and nonoccupational back injuries you may have experienced.

1. Have you ever injured your back?

    1. YES (GO ON TO # 32)
    2. NO (SKIP TO #40)

2. How many total back injuries have you experienced?

    _____ BACK INJURIES

Please circle the numbers of the answers which best describe your MOST RECENT BACK INJURY.

3. In what year did your most recent back injury occur?

    19 ____

4. Where did your most recent back injury occur?

    1. THIS HOSPITAL
    2. ANOTHER HOSPITAL
    3. ANOTHER WORKPLACE _____
    4. HOME
    5. OTHER _____

5. Did you report your back injury to your employer?

    1. YES
    2. NO

6. Were you lifting a patient or object when the back injury occurred?

    1. YES (GO TO #37)
    2. NO (SKIP TO #38)

7. If you were lifting a patient or object at the time of the injury, were you lifting alone or did you have assistance?

    1. ALONE
    2. ASSISTANCE

Appendix A (continued)

8. Did you lose time from work due to your back injury?

    1. YES (_____DAYS)
    2. NO

9. Were you hospitalized due to your back injury?

    1. YES (_____DAYS)
    2. NO

Appendix B

Training Manual

I. Sample

Female registered nurses regularly assigned to a medical, surgical, orthopedic, or critical care unit will be included in the sample. The participants will be chosen by virture of being scheduled on a shift chosen by the researcher. The nurse will be observed only once no matter how many chosen shifts she may work.

II. Procedure

A. Prior to data collection

1. Meet with hospital contact person

a. Determine schedule

Choose two days for both the day and evening shifts for all units (medical, surgical, orthopedics, and critical care). Any day of the week may be used. Choose the days so that there is the least duplication of nurses on the shifts.

b. Determine a central location on the unit for the RA to use during data collection.

c. Determine when you will be allowed to present the study to prospective participants and obtain their consent (i.e., after report).

B. Data Collection

1. Arrive on the unit prior to the beginning of report.

2. Introduce yourself to the staff.

3. At the appointed time (i.e., after report) briefly explain the study to the female RN's who are assigned to the unit and ask them to sign the consent form. Always acts as though you assume all will participate. Rather then saying "If you participate, etc.", say "when you participate, etc".

Appendix B (continued)

4. Collect the consent form, witness and date them and store them in the appropriate envelope.

5. From the consent forms, make a list of participants. After observing each participant, it is easy to match the questionnaire code number with each name.

6. While waiting for a patient to be moved,

   a. Tour the halls, get a feel for the tone of the unit (hectic, slow) and your presence will remind people you are on the unit.

   b. Obtain a count of all patients on the unit and all staff (RN's, LPN's, nursing assistants, and orderly's - NOT WARD SECRETARIES)

   c. Ask the unit manager, head nurse, or charge nurse if the staffing today is at the usual level, below or above the standard.

7. When a patient is to be moved

   a. Position yourself at the foot of the bed so that you can see the entire body of the nurse you are observing.

   b. Introduce yourself to the patient if s/he is alert and not terribly ill. However, you want to be as unobtrusive as possible.

   c. Unless the patient or staff are in a potential injury-producing situation, YOU ARE NOT TO GIVE ANY ASSISTANCE. Consider yourself the invisible woman.

   d. If possible, prior to the move, record the date, time, unit, room number, any patient limitations (amputee, cast, traction, trach, wounds, etc.), movement (up, side, turn), patient's sex, bed wheels, obstacles, nurse's shoes, assistance of coworker or mechanical device.

   e. Just before the move, record bed height, head of bed, siderails, patient position.

   f. During the move, record stance, movement (rocking), back, waist, hips, knees, and patient assistance.

Appendix B (continued)

g. After the move, make a quick drawing of the layout of the room. Also, ask the nurse if her patient assignment is about usual, or heavier or lighter than usual. I would expect that this determination has to do with the number of patients the nurse is caring for as well as their illness level.

h. Finally, go to the nurse's station and gather patient information such as age, diagnosis, height, weight, post op day, and length of stay.

i. You have now completed an observation.

j. Give the questionnaire to the nurse which has the same code number as the observation guide you just used. The questionnaire should be in an unsealed envelope. Ask her to complete the questionnaire as soon as she has a minute and return it to you. If you have already left for the day, ask her to return the questionnaire to the unit manager or head nurse. Stop on the unit the next time you are in the hospital to pick up these questionnaires.

k. When you have both the observation and questionnaire in your possession we have a complete case. Staple them together with the observation guide the last sheet.

BE SURE TO DOUBLE CHECK ALL FORMS FOR COMPLETENESS. MISSING DATA IS THE PITS!

III. Observation Guide

A. Date

The date of the observation
Example: 12/1

B. Time

Time of the observation in military time
Example: 800 or 1600 (8 AM or 4 PM)

C. Hospital

Precoded

D. Unit

M=Medical	C=Critical care (or use ICU, CCU, etc)
S=Surgical	R=Rehabilitation
O=Orthopedics	Step=Stepdown units

Appendix B (continued)

E. Staffing

AT the usual level BELOW the usual level ABOVE the usual level	According to the unit manager, head nurse, charge nurse.

F. Assignment

Heavy Average Light	According to the nurse being observed.

G. Unit Patient Total

Total number of patients on the unit.

H. Staff

Total number of RN's, LPN's, nursing assistants, and orderlies on the unit during the current shift.

I. Nurse

Code number for identification
Precoded

J. Movement

Up - pulling the patient up in bed
Side - moving the patient to the side of the bed. For example, prior to turning a patient.
Turn - turning the patient as during repositioning or linen change.

K. Room

Number of the room plus position of the bed
Example: 309A

L. Diagnosis

Primary diagnosis on chart/Kardex
If you are unsure, record all diagnoses.

Appendix B (continued)

M. Patient Height (Feet', Inches")

Use: 1) Admission height (may be reported by patient)
2) Estimated by nurse

N. Patient Weight (pounds)

Use: 1) Current weight
2) Admission weight
3) Patient reported weight
4) Estimated by nurse

O. Limitations (POD)

If a surgical patient, record date of surgery
Example: 11/2 or 12/1

Other limitations might include amputation, cast, traction, incisional pain, etc.

P. Length of stay

Record the date of admission

Q. Patient's Age

Record either the patient's age or birthdate
If birthdate, take care that the year is accurate (NOT 1985)

R. Patient's Sex

M=male
F=Female

S. Bed Wheels

Check bed wheels to see if they are locked. If they are locked, no matter who locked them, record as "locked".

Appendix B (continued)

T. Obstacles

Furniture: Were chairs, overbed tables, bedside tables, wheelchairs, commodes, etc. in the way?

Equipment: Were IV poles, respirators, monitors, suction, etc. in the way?

Other: Were "other" obstacles present? (Visitors, etc.)

Be sure to write in specifically what the obstacle was.

U. Bed Height

Raised - the bed is just short of waist height for the nurse being observed so that when she bends her knees the bed is approximately waist height.

Low position - if the bed is below hip height, circle this response. If the bed should happen to be higher than waist height, mark low position and write in "HIGH".

V. Head of Bed

Flat - lowest position

Elevated - any position other than flat
If the patient's condition warrants elevation, make a note to that effect but still mark elevated.

W. Siderails

Down - in the down position, out of the way

Up - in the operative position as patient safeguards. When turning patients, the siderail "should" be up on the side of the bed to which patient will be turned. However, still mark this as "up".

X. Stance

4-8 inches/shoulder width - may be from 4-12 inches apart

Other - "Feet together" or "Stance over 12 inches"

Appendix B (continued)

Y. Shoes

Flat, low heeled - standard nurses' shoes
Other - "clogs", etc.

Z. Patient Position

Is the patient

Within 8 inches of the nurse or

More than 8 inches from the nurse?
When nurses lift in pairs or teams, it is more likely that the patient will be more than 8 inches from the nurse. When the patient is being moved from one side of the bed to the other it if more likely that the patient will be more than 8 inches from the nurse.

AA. Movement

Rocking - the nurse rocks from her back foot to her forward foot as she moves the patient thus using the force of her body weight to assist in counteracting the inertia of the patient's weight.

Other - any other kind of movement
(i.e., top half of the nurse's body moves but not lower half)

BB. Assistance

None: Nurse moved the patient alone

Coworker: Was the nurse assisted by one or more coworkers?

Mechanical: Was a heyer lift, roll bars, etc, used to move the patient?

Other: Did a visitor, housekeeper, physician, etc. assist in moving the patient?

Appendix B (continued)

CC. Back

Straight: Basically, was the low back straight and free of heavy work?

Flexed: Was the low back bearing the load?

This piece of the observation is tricky. The back is flexible and this ability should be used - appropriately. For example, to turn a patient the back will be flexed somewhat. However, the question is whether the back is bearing the load or the upper legs and arms?

DD. Waist

Straight: The waist is straight.

Flexed: The nurse is bent at the waist which means the low back is flexed and the back muscles are at risk for injury.

EE. Hips

Flexed: The hips can be flexed in two ways -

1-The body is in a sitting position
2-The trunk is bent forward from the hips

*When the knees are bent (feet flat on the floor) the hips must be flexed.

Straight: The hips are relatively straight when the waist is flexed.

FF. Knees

Flexed: Knees bend to absorb some of the shock of the patient's weight during the move. This piece should correlate with a rocking motion.

Straight: The knees are locked.

Appendix B (continued)

GG. Patient Assistance

Assisted: The patient may push with his/her feet, pull by hanging onto the siderail, etc.

No assist: The patient is conscious but is too ill to follow the nurses' directions.

Comatose: The patient appears unaware of the environment.

HH. Total score

DO NOT COMPLETE

LEAVE BLANK

II. Interrater Reliability

Interrater reliability is established by correlating the scores of two or more observers for the same observation. The researcher will observe with each of the RA's on at least two occasions to establish this type of reliability.

Each observer will complete the blue form independently for each nurse during a shift. Comparisons will then be made and discrepancies noted and corrected.

Appendix C

TABLE XXIV

CORRELATIONS AMONG CONTINUOUS PREDICTOR VARIABLES

Variables	Nurse's Age	Experience as Nurse	Experience on Unit	Year of Inservice	Unit Type	Staffing	Assignment
Nurse's Age	1.0						
Experience as Nurse	.72**	1.0					
Experience on Unit	.39**	.54*	1.0				
Year of Inservice	.10	.19*	.29**	1.0			
Unit	-.16*	.00	-.03	.11	1.0		
Staffing	-.06	-.04	.00	.07	.03	1.0	
Assignment	.09	.02	-.05	.01	.18*	.32**	1.0

* p<.05.
** p<.01.

Appendix C (continued)

TABLE XXIV

CORRELATIONS AMONG CONTINUOUS PREDICTOR VARIABLES

Variables	Nurse's Age	Experience as Nurse	Experience on Unit	Year of Inservice	Unit Type	Staffing	Assignment
P/S Ratio[a]	.00	-.08	-.05	-.14	-.80**	-.06	-.30**
Post op Day	-.19*	-.11	.04	.23	-.21*	-.11	-.11
Length of Stay	-.15	-.12	-.08	.16*	-.17*	-.16*	-.09
Patient's Age	-.07	-.02	.08	.09	-.08	.05	.00
Attitude	-.01	-.12	-.18*	-.06	-.15	.05	.07
Teamwork	.07	-.02	-.07	.13	.06	.06	.01
Knowledge	-.00	.02	-.02	-.09	-.11	.16*	-.02
W/H Ratio[b]	-.17*	-.13	-.11	.02	.21**	-.07	.09

[a] P/S Ratio: Patient/Staff Ratio.
[b] W/H Ratio: Weight/Height Ratio.

* $p<.05$.
** $p<.01$.

Appendix C (continued)

TABLE XXIV

CORRELATIONS AMONG CONTINUOUS PREDICTOR VARIABLES

Variables	Patient/Staff Ratio	Postop Day	Length of Stay	Patient's Age	Attitude	Teamwork	Knowledge	Weight/Height Ratio
P/S Ratio[a]	1.0							
Postop Day	.22	1.0						
Length of Stay	.09	.87**	1.0					
Patient's Age	.06	.47**	.09	1.0				
Attitude	.13	.06	.01	.11	1.0			
Teamwork	-.02	-.15	-.11	-.05	-.07	1.0		
Knowledge	.09	.11	.03	.02	-.02	-.03	1.0	
W/H Ratio[b]	-.21*	-.03	.19**	-.17*	-.10	.02	.02	1.0

[a] P/S Ratio: Patient/Staff Ratio.
[b] W/H Ratio: Weight/Height Ratio.

* $p<.05$.
** $p<.01$.

Appendix D

TABLE XXV

ANALYSIS OF VARIANCE SUMMARIES FOR CATEGORICAL PREDICTOR VARIABLES BY TOTAL LIFTING SCORE

Predictor Variables	SS	df	MS	F
Nurse Variables				
Basic nursing education				
Between Ss	9.3	2	4.7	1.3
Within Ss	550.2	152	3.6	
Highest degree				
Between Ss	1.6	2	.8	.22
Within Ss	557.9	151	3.7	
Date of most recent back injury prevention inservice				
Between Ss	10.6	3	3.5	.96
Within Ss	549.0	151	3.6	
Patient Variables				
Movement				
Between Ss	26.3	1	13.2	3.8*
Within Ss	606.0	153	3.5	
Gender of patient				
Between Ss	3.0	1	3.0	.83
Within Ss	632.3	176	3.6	
Assistance of patient				
Between Ss	4.9	2	2.5	.68
Within Ss	630.3	175	3.6	

* $p<.05$.
** $p<.01$.

Appendix D (continued)

TABLE XXV

ANALYSIS OF VARIANCE SUMMARIES FOR CATEGORICAL PREDICTOR VARIABLES BY TOTAL LIFT SCORE

Predictor Variables	SS	df	MS	F
Environment Variables				
Day of the week				
Between Ss	7.3	5	1.5	.40
Within Ss	628.0	172	3.7	
Shift				
Between Ss	1.0	1	1.0	.28
Within Ss	634.2	176	3.6	
Assistance of coworkers or devices				
Between Ss	5.1	3	1.7	.47
Within Ss	630.1	174	3.6	

* $p<.05$.
** $p<.01$.

Appendix D (continued)

TABLE XXVI

ANALYSIS OF VARIANCE SUMMARIES FOR CATEGORICAL PREDICTOR VARIABLES BY ENVIRONMENT SUBSCALE SCORE

Predictor Variables	SS	df	MS	F
Nurse Variables				
Basic nursing education				
Between Ss	5.0	2	2.5	2.0
Within Ss	194.1	152	1.3	
Highest degree				
Between Ss	2.5	2	1.2	.96
Within Ss	195.1	151	1.3	
Date of most recent back injury prevention inservice				
Between Ss	4.6	3	1.5	1.2
Within Ss	194.5	151	1.3	
Patient Variables				
Movement				
Between Ss	2.2	2	1.1	.88
Within Ss	217.9	174	1.3	
Gender of patient				
Between Ss	4.3	1	4.3	3.5
Within Ss	216.5	176	1.2	
Assistance of patient				
Between Ss	.9	2	.45	.36
Within Ss	219.8	175	1.3	

* $p<.05$.
** $p<.01$.

Appendix D (continued)

TABLE XXVI

ANALYSIS OF VARIANCE SUMMARIES FOR CATEGORICAL PREDICTOR VARIABLES BY ENVIRONMENT SUBSCALE SCORE

Predictor Variables	SS	df	MS	F
Environment Variables				
Day of the week				
Between Ss	10.4	5	2.1	1.7
Within Ss	210.3	172	1.2	
Shift				
Between Ss	.52	1	.52	.42
Within Ss	220.2	176	1.3	
Assistance of coworkers or devices				
Between Ss	1.7	3	.57	.46
Within Ss	219.0	174	1.3	

* $p<.05$.
** $p<.01$.

Appendix D (continued)

TABLE XXVII

ANALYSIS OF VARIANCE SUMMARIES FOR CATEGORICAL PREDICTOR VARIABLES BY NURSE SUBSCALE SCORE

Predictor Variables	SS	df	MS	F
Nurse Variables				
Basic nursing education				
Between Ss	1.0	2	.52	.16
Within Ss	489.9	152	3.2	
Highest degree				
Between Ss	2.5	2	1.2	.39
Within Ss	487.4	151	3.2	
Date of most recent back injury prevention inservice				
Between Ss	4.0	3	1.3	.42
Within Ss	486.9	151	3.2	
Patient Variables				
Movement				
Between Ss	43.1	2	21.6	7.0**
Within Ss	533.8	174	3.1	
Gender of patient				
Between Ss	.05	1	.05	.02
Within Ss	577.7	176	3.3	
Assistance of patient				
Between Ss	8.1	2	4.1	1.2
Within Ss	569.6	175	3.3	

* $p<.05$.
** $p<.01$.

Appendix D (continued)

TABLE XXVII

ANALYSIS OF VARIANCE SUMMARIES FOR CATEGORICAL PREDICTOR VARIABLES BY NURSE SUBSCALE SCORE

Predictor Variables	SS	df	MS	F
Environment Variables				
Day of the week				
Between Ss	11.9	5	2.4	.72
Within Ss	565.9	172	3.3	
Shift				
Between Ss	.14	1	.14	.04
Within Ss	577.6	176	3.3	
Assistance of coworkers or devices				
Between Ss	6.4	3	2.1	.65
Within Ss	571.3	174	3.3	

* $p<.05$.
** $p<.01$.

Appendix D (continued)

TABLE XXVIII

ANALYSIS OF VARIANCE SUMMARIES FOR CATEGORICAL PREDICTOR VARIABLES BY POSTURE SUBSCALE SCORE

Predictor Variables	SS	df	MS	F
Nurse Variables				
Basic nursing education				
Between Ss	.10	2	.05	.03
Within Ss	578.6	152	1.8	
Highest degree				
Between Ss	.56	2	.28	.15
Within Ss	277.0	151	1.8	
Date of most recent back injury prevention inservice				
Between Ss	4.4	3	1.5	.80
Within Ss	274.4	151	1.8	
Patient Variables				
Movement				
Between Ss	3.5	2	1.7	.92
Within Ss	332.5	174	1.9	
Gender of patient				
Between Ss	.23	1	.23	.12
Within Ss	335.8	176	1.9	
Assistance of patient				
Between Ss	13.9	2	6.9	3.8*
Within Ss	322.1	175	1.8	

* $p<.05$.
** $p<.01$.

Appendix D (continued)

TABLE XXVIII

ANALYSIS OF VARIANCE SUMMARIES FOR CATEGORICAL PREDICTOR VARIABLES BY POSTURE SUBSCALE SCORE

Predictor Variables	SS	df	MS	F
Environment Variables				
Day of the week				
Between Ss	17.8	5	3.6	1.9
Within Ss	318.2	172	1.9	
Shift				
Between Ss	.57	1	.57	.30
Within Ss	335.4	176	1.9	
Assistance of coworkers or devices				
Between Ss	9.4	3	3.1	1.7
Within Ss	326.6	174	1.9	

* $p<.05$.
** $p<.01$.

Appendix E

TABLE XXIX

PERCENTAGE OF NURSES REPORTING BACK PAIN AND RELATED ACTIVITIES: COMPARISON OF TWO STUDIES

QUESTIONNAIRE ITEM	Harber et al. Percentage	Wachs Percentage
Two Week Recall		
Back pain > 30 minutes due to work at least one day	37% (n=520)	21% (n=154)
Severe back pain stopped activity at least one day	11% (n=520)	12% (n=155)
Go home with sore back although came to work without discomfort at least one day	43% (n=520)	41% (n=155)
Take medication for back discomfort at least one day	21% (n=520)	21% (n=154)
Miss work due to back pain at least one day	4% (n=520)	2% (n=155)
Six Month Recall		
Miss work due to back pain at least one day	9% (n=550)	6% (n=155)
Use medications for back pain at least one day	29% (n=550)	33% (n=154)
Develop back pain due to work at least one day	52% (n=550)	38% (n=148)
Percentage of coworkers thought to have occupational back pain		
None	6%	6%
>10%	50%	37% (n=138)

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