THE EFFECTIVENESS OF THE BACKROOM CONVERSION PROCESS ON REDUCING BACK INJURIES RELATED TO MANUAL MATERIAL HANDLING

By

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ABSTRACT

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ABC Company is a retailer operating retail stores throughout the United States. In any given week, a 100,000 square foot store will receive 2-3 trailers of freight 3-4 nights per week. Each trailer can hold 200-400 pieces of freight. The trailers are generally unloaded during the night, beginning at approximately 10:00 p.m. with a team of 8-10 unloaders and stockers. Some freight will be moved to the salesfloor in order to replenish store shelves while the remaining freight will be stored in the receiving area. Efficient freight flow from the receiving area and backroom to the salesfloor is essential in achieving sales goals and maintaining standards of productivity, associate moral, and associate safety. Consequently, the amount of freight being moved and the means by which it is handled has resulted in an increased occurrence of associate back injuries related to material handling. The most

predominant injuries are sprains and strains resulting from material handling activities including lifting, pushing, pulling and reaching.

In 1999, in an effort to improve the efficiency of the flow of freight and to address the aforementioned issues, ABC Company undertook redesigning its backrooms and inventory management process referred to as the "backroom conversion". Sixty stores underwent the conversion during what was referred to as "Phase One" with an additional three hundred and sixteen stores scheduled for the conversion later in the year. The conversion process included changes in the arrangement of steel bins (shelving) in the backroom; the material handling equipment used in the movement of freight; the amount of palletized versus non-palletized freight; and associate training.

Research studies support the implementation of several key components in developing a comprehensive program aimed at preventing and reducing back injuries resulting from manual material handling activities. These components include ergonomic job design or redesign, training, strength and fitness testing, and the use of back belts. Through extensive research, it has been proven that ergonomic design of a work station is significantly far more effective than traditional methods such as selecting the worker to fit the job or training the worker on proper lifting techniques in reducing back injuries.

The study's methodology involved analyzing the workers' compensation claims, specifically, back injuries which occurred in the backroom or receiving area of the store as a result of manual material handling. Furthermore, the training process was also reviewed to determine what changes were made to it as a result of the backroom conversion.

The results revealed that the sixty stores that went through the initial rollout of the backroom conversion process experienced 67 associate injuries caused by material handling

prior to the conversion compared to 48 after the conversion was completed, a reduction of 28%. Material handling injuries overall also decreased by 16%. A review of the training process showed that additional training was developed and implemented to provide associates with training on the proper use of the walkerstacker. All other components of training related to proper lifting and back injury prevention remained the same.

Several recommendations were made based on the results of the study. ABC Company should continue to work with suppliers in redesigning packaging to limit the weight of individual boxes or cartons and include handles to allow for easier handling by associates. The training program should also be expanded to include training aimed specifically at unloaders and stockers providing the basic ergonomic principles and specific work practices in the backroom which will reduce the potential for back injuries. Once the NIOSH back belt study is completed for ABC Company, the Company will need to re-evaluate its position on the continued use of back belts as part of their back injury prevention program. Recommendations for further study were also made, including the continued analysis of back injuries as it relates to an associate's length of employment as well as an analysis of injury data at points in time when inventory is at its highest and physical demands on associates is at its greatest.

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CHAPTER 1

Research Problem and Objective

Statement of the Problem

In the retail industry, a store's success lies in part in its ability to provide the customer with the merchandise the customer wants. This is done by managing and replenishing inventory. Because the majority of square footage space is dedicated as salesfloor space, less than 20% of the square footage is available for the storage of inventory. The receiving area, or backroom, as it is referred to in the retail industry, must be managed in such a way that merchandise can be moved from the backroom to the salesfloor in an efficient and timely manner.

In any given week, a 100,000 square foot store will receive 2-3 trailers of freight 3-4 nights per week. Each trailer can hold 200-400 pieces of freight. The trailers are generally unloaded during the night, beginning at approximately 10:00 p.m. with a team of 8-10 unloaders and stockers. Some freight will be moved to the salesfloor in order to replenish store shelves while the remaining freight will be stored in the receiving area. Efficient freight flow from the receiving area and backroom to the salesfloor is essential in achieving sales goals and maintaining standards of productivity, employee moral, and employee safety. Consequently, the amount of freight being moved and the means by which it is handled has resulted in an increased occurrence of employee back injuries related to material handling. The most predominant injuries are sprains and strains resulting from material handling activities including lifting, pushing, pulling and reaching.

In addition to the increased exposure for injury, there are additional challenges facing stores in regards to the traditional methods of receiving and stocking merchandise. They are:

1. Space:

   Seasonal events such as “back-to-school”, Christmas, advertised sales, promotions, etc., drive the availability of space in the backrooms. While it is necessary to get merchandise to the stores in advance of these events, the volume of merchandise quickly shuts down the receiving area and recovery is difficult. The amount of merchandise simply exceeds the space available to store the merchandise. Because of this “seasonal gridlock” the utilization of space is critical to prevent gridlock during heavy seasonal freight flow.

2. Time:

   The volume of incoming merchandise has increased but the size of the backroom has not. Stores have been expected to accomplish unloading and stocking goals within an 8-hour time frame.

3. Frequency of Delivery of Freight:

   The receiving process is driven by the frequency of truck deliveries. When the number of trailers received by the stores per night increases, so does the amount of freight that must be moved to the salesfloor or stocked in the backroom. In many cases, freight cannot be moved as efficiently as required in order to keep the salesfloor “in-stock” and keep the merchandise in the backroom organized.

4. Training of Employees:

   Effective training of each key group on the receiving team is essential for maximum in-stock, minimum overstock, maximum productivity, safety, and job

satisfaction. Employees need training to perform their jobs technically as well as to understand the roles of other team players and communicate with them throughout day. Employee turnover and personnel shortages can often lead to ineffective training.

5. Communication:

   Effective communication among employees is critical to effective inventory management. Plans must be communicated, issues addressed, and efforts coordinated on a daily basis among management, receiving employees, stockers, invoice clerks, and department managers.

In 1999, in an effort to improve the efficiency of the flow of freight and to address the aforementioned issues, ABC Company undertook redesigning its backrooms and inventory management process referred to as the "backroom conversion". Three hundred and seventy-six stores were selected to undergo the backroom conversion. Sixty stores completed during Phase One were the basis of this study. The conversion process included changes in the arrangement of steel bins (shelving) in the backroom; the material handling equipment used in the movement of freight; the amount of palletized versus non-palletized freight; and employee training.

Prior to the conversion of the backrooms and as part of the evaluation of what changes needed to be made, an ergonomic consultant conducted an ergonomic analysis for ABC Company that focused on the receiving process and the job of the stockers and unloaders. As a result of the study, the primary ergonomic stressors were identified and ergonomic recommendations were provided. Both engineering and administrative controls were recommended to reduce the frequency of lifting injuries associated with material handling. A

follow-up ergonomic study was completed in the fall of 1999 which illustrated the improvements made to the to the backroom and the manner in which manual material tasks were performed. The impact of the modifications made during the backroom conversion on the frequency of employee injuries was evaluated in order to determine if employee injuries relating to material handling had been reduced.

Purpose of the Study

The purpose of this study was to evaluate the effectiveness of the backroom conversion in reducing the frequency of employee back injuries (sprains and strains due to lifting, pushing, pulling, and reaching) related to material handling among unloaders and stockers. A comparison of workers' compensation data before and after the conversion would indicate whether or not the changes made have been effective in reducing such injuries. Additionally, by evaluating the training procedures related specifically to material handling, it can be determined if additional training or changes to the current training process should be made to enhance the training process in an effort to reduce manual material handling injuries.

Goals of the Study

The goals of the study were to:

1. Compare workers' compensation claims (back injuries related to manual material handling) which occurred prior to the backroom conversion to claims which occurred after the conversion was completed;
2. Determine whether changes made during the backroom conversion process resulted in a reduction of back injuries among unloaders and stockers;
3. Identify appropriate ergonomic controls that will effectively reduce and/or eliminate exposure to back injuries related to manual material handling.

Background and Significance

Employee injuries related to material handling account for the greatest number of Employee injuries at ABC Company. The sixty stores that went through the initial rollout of the backroom conversion process experienced 67 employee injuries caused by material handling prior to the conversion compared to 48 after the conversion was completed.

Changes made to the backroom and the receiving process alone will not prevent injuries relating to material handling. ABC Company's continued emphasis however has been, and continues to be, the integration of good risk control processes into every segment of the company's operation. Efforts to educate employees and prevent back injuries have included various measures that include training on proper lifting techniques; the development and implementation of a policy on the use of back belts for stockers and receiving employees; and the use of video and computer-based learning on proper lifting techniques. These measures have been effective to some degree but continued emphasis on injury prevention from material handling is necessary.

Limitations of the Study

1. Injury data collected reflect only reportable accidents and does not include "incidents" (i.e., injuries that were sustained but that did not require medical attention).
2. The changes made to the backroom considered only some of the recommendations made in the ergonomic analysis conducted by the ergonomic consultant in 1994.
3. Powered equipment (automated bike and softlines racks) which were to be installed as part of the backroom conversion were not ready for installation at the time of this study. Employees had to continue to manually raise and lower bikes from storage hooks suspended from the ceiling.

4. The time of year during which the conversions took place and the amount of inventory in stores at that time of the year may not be representative of the effectiveness of the conversion on inventory control as it would during a peak seasonal time.

Definitions

Backroom Conversion: The process undertaken by ABC Company to redesign the configuration of the backroom and receiving area, as well as processes relating to the receiving of freight.

In-Stock: The concept of having merchandise that is available for sale to the customer available in the backroom.

Unloaders: Employees responsible for unloading freight from trailers.

Stockers: Employees responsible for moving freight to the salesfloor to stock the salesfloor.

Summary

In 1999, in an effort to improve the efficiency of the flow of freight and to address employee productivity and safety, ABC Company redesigned its backrooms and inventory management process. Three hundred and seventy-six stores underwent what was referred to as the "backroom conversion". The conversion process included changes in the arrangement of steel bins (shelving) in the backroom; the material handling equipment used in the movement of freight; the amount of palletized versus non-palletized freight; and employee training. Employee injuries related to material handling account for the greatest number of employee injuries at ABC Company. Sixty stores that went through the initial rollout of the backroom conversion process experienced a reduction in back injuries caused by material handling. The purpose of this study was to evaluate the effectiveness of the backroom conversion in reducing the frequency of back injuries (sprains and strains due to lifting,

pushing, pulling, and reaching) related to material handling among stockers and receiving employees. A comparison of workers' compensation data before and after the conversion would indicate whether or not the changes made have been effective in reducing such injuries.

CHAPTER 2

Literature Review

Manual materials handling is defined as the unaided human acts of lifting, lowering, pushing, pulling, carrying, or holding and releasing an object (boxes, bags, barrels, etc.) (Asfour, Genaidy, and Mital, 1980, p. 150). Despite the tremendous technological advances in the workplace and increased automation of jobs, many workers are still required to handle objects manually, which creates significant potential for injuries (Khalaft, Parnianpour, Sparto, and Barin, 1999). By job function, manual material handling workers are at greatest risk of developing back injuries, according to statistics and the experience of experts (LaBar, 1992, p. 29). Workers' compensation claims associated with manual material handling represent the single largest source of claims and costs (Dempsey and Hashemi, 1999). In 1995, the Bureau of Labor Statistics (BLS) reported that in one year there were 705,800 cases of days away from work that resulted from over exertion or pain from repetitive motion associated with material handling. Estimated costs associated with lost workdays and compensable claims related to musculoskeletal disorders range from $13-$20 billion annually (National Academy of Sciences [NAS], 1998). To combat these losses, considerable activity is expended on developing manual material handling jobs to fit a high percentage of male and female workers. The purpose of this chapter is to provide a summary of the review of literature that identifies the most common controls used to reduce or prevent back injuries resulting from manual material handling. The controls on which a literature review was conducted included job design and re-design; pre-placement and selection of workers; the use of back support belts; and employee training on proper lifting techniques.

Job Design and Re-Design

Tasks that involve manual material handling exceeding the worker's physical capacity and a poor workplace layout are the most common causes of back injuries. How often a worker performs manual material handling tasks, and for how long, are important factors that contribute to such injuries. Frequently repeated and long-lasting tasks are the most tiring and therefore the most likely to cause back injury. Poor layout of the workplace also increases the risk for injury. For example, shelving that is too deep, too high or too low causes unnecessary bending or reaching. Lack of space to move freely increases the need for twisting and bending. Unsuitable dimensions of work surfaces force the worker to perform manual material tasks in awkward positions that add to stress to the musculoskeletal system. Similar stressful body movements occur where work areas are overcrowded with people or equipment (Canadian Centre for Occupational Health & Safety [CCOHS], 1997, p.2). Good job design reduces the worker's exposure to the risks of manual handling, and consequently reduces the medical and legal problems of selecting the worker for the job as well as finding replacements for absent workers. Good job design also places less reliance upon the worker's willingness to follow established training procedures, such as lifting properly (Snook, 1978, p.964).

There are several considerations that must be made when job re-design is considered as a means to reduce material handling injuries. Job analysis is completed as a step in the process toward job redesign and identifies those tasks that are the key stressors to the worker. The purpose of the analysis is to give a starting point for prioritizing interventions (Braun, 1990). The analysis breaks a job into its various elements or actions, describes them, measures and quantifies risk factors inherent in the elements and identifies conditions contributing to the risk factors (Putz-Anderson, 1988). The job analysis has several steps including obtaining a complete description of the job; interviewing employees who perform the job; breaking the

job down into discrete tasks and then studying each task to determine the specific risk factors that occur during the task. Each risk factor may be evaluated in terms of its magnitude, the number of times it occurs during the task, and how long the risk factor lasts each time it occurs (NIOSH, Elements of Ergonomics Programs, 1997, p. 23).

The tasks of most jobs can be described in terms of the tools, equipment, and materials used to perform the job, the workstation layout and physical environment, and the task demands and organizational climate in which the work is performed (NIOSH, 1997, p. 23). More detailed information can be gained by observing, videotaping or photographing the workers during performance of the task. Additionally, determining characteristics of the work surface such as slip resistance, hardness, and surface edges and the muscle force used to accomplish the task will also provide useful information. Lastly, the collection of subjective data through the use of worker interviews, surveys and questionnaires will identify psychological factors which influence worker performance (NIOSH, 1997).

In the 1994 study of the unloader and stocker positions in the backroom at ABC Company an ergonomic consultant identified several musculoskeletal stressors that could potentially contribute to the occurrence of material handling injuries. The study included observing, interviewing and videotaping ABC Company employees whose primary job function was that of unloader (unloading the freight from trailers) and stockers (stocking the merchandise on the salesfloor shelves). A typical work shift entailed the stacking of 22-25 pallets per truck, a two-hour truck unloading time, using 7 employees. Table 1 describes a summary of the findings and recommendations of the 1994 study.

Table 1

Summary of Musculoskeletal Stressors of Unloader/Stockers Positions and Recommendations

Muscloskeletal Stressors	Proposed Recommendations
Stacking height of merchandise on pallet was over 80 inches	Stabilize and balance load on pallet; no recommendation made on height
Load on trailer had tipped, fallen causing damage to merchandise	Provide training to warehouse on better loading techniques or palletize more of the freight
Stacking of heavy items caused employee complaints	Ensure that employees know how to balance a load
Placement and spacing of the pallets on floor as to avoid tight spacing and awkward postures/motions	Continue to rotate employees, setting up pallets so the heaviest and bulkiest products have the least amount of travel from the roller conveyor
Pulling of telescopic conveyor when wheels are bent or bowed	Maintain conveyor wheels
Pulling pallet jacks was reportedly difficult	Maintain pallet jacks
Carrying loads without handles	Assess break packs and their handles
Loading pallet, especially to the first layer	Ensure that employees understand how to lift/lower a load
Handling bulky items	Same as above

In the follow-up study that occurred in 1999, the ergonomic consultant observed several changes that had been made to the backroom unloading process, many of which were included in ABC Company's backroom conversion process. Most notable was the change in the configuration of the steel bins or shelving and the purchase of walker stackers for the handling of palletized freight. The steel bins were rearranged so as to allow the placement of palletized freight by a walker stacker. It also reduced the need for employees to manually carry merchandise up ladders to store the merchandise in upper shelves. Freight could be palletized by department and moved by the walker stacker more quickly and more safely. It also permitted more efficient movement and storage of freight that would not be moved to the salesfloor. The installation of automated softlines (apparel) and bike racks would also eliminate manual handling of the merchandise, thus reducing the potential for injury. Additionally, the time during which the unloading process of the trailers was changed from 10:00 p.m. to 4:00 p.m., with additional employees being added to the unloading process (from 7 employees to 10) allowing for the work to be spread out among several employees. Additional process changes and the impact on the unloaders and stockers are listed in Table 2.

Table 2

Summary of Job Changes and the Impact on the Job of the Unloaders and Stockers

Job Elements	Comparison of the Work Method/Human Interface Technique	Impact of the New Work Method/Human Interface Technique	Proposed Recommendations
Creation of pallet layout chart by	There was no direction for pallet	Quickens the unloading process;	Consider a corporate directive

department	placement in the past	provides direction for employees that may be inexperienced with the department codes	
Rollers on conveyor	In good working order with a maintenance schedule as needed	Reduced musculoskeletal stress when moving the conveyor; better positioning of the body when unloading the trailer	Continue with maintenance checks of the conveyor wheels for ease of movement
Packaging of product	Employees reported the worst packaging to be in Domestics	No changes since 1994 study	Work with vendor or warehouse in package redesign

Pre-Placement and Selection

Matching the worker and the job has been associated with reductions in work-related injuries and illnesses, and improvements in job performance and job satisfaction. There are two approaches: selecting and training the worker to fit the job, and designing the job to fit the worker. Although job design may be applicable to many manufacturing operations, there are other jobs that are difficult to design and control and require greater dependence upon pre-placement testing and selection of workers (Snook, 1987).

The purpose of such tests has been to identify candidates who possess the physical attributes needed to perform the required range of tasks effectively and also to continue to do the job without accidental injury or the onset of any cumulative disorder (David & Hoffman, 1992). The challenge in developing pre-placement testing is finding effective selection criteria and using these criteria without discriminating against handicapped, older, and female workers (Snook, 1987).

The first step in an assessment of an individual's capabilities for and risks of employment involves a detailed review of job demands and exposures. The data required would include job descriptions, industrial hygiene data, physical measurements, reports from workers and supervisors, direct observations, manual dexterity, flexibility, and coordination (Pransky, Frumkin, and Himmelstein, 1988; David & Hoffman, 1992). The analysis of this data will allow the attributes needed to perform the work to be identified. In addition, the level of these attributes, either singly or in combination, that are required by workers in order to sustain the intensity of the work involved or to perform specific critical tasks, should be defined (David & Hoffman, 1992).

Preplacement medical examinations have also been used in many industries to determine a person's ability to carry out the tasks of a given job. There are, however, various opinions in the medical literature regarding the effectiveness of preplacement medical examinations in preventing injuries. Some investigators believe medical examinations should be used only for older workers (Schussler, Kaminer, Power, and Pomper, 1975). Others believe medical examinations are necessary and most beneficial for hazardous jobs (Alexander, Maida, and Walker, 1975). Two studies were unable to demonstrate the effectiveness of preplacement

medical examinations in identifying workers who are susceptible to low back pain (Chaffin, Harrin, and Keyserling, 1978).

Several studies have demonstrated the relationship between strength and fitness and the incidence of low back pain. In a series of four studies, Chaffin and his associates investigated isometric strength testing as a technique for selecting workers for strenuous job. Workers were tested from various industries and monitored for medical incidents. These studies are consistent in finding that the probability of a musculoskeletal disorder is up to three times greater when job lifting requirements approach or exceed the worker's isometric strength capability (Snook, 1987).

Cady and his associates used a five-component scale to evaluate the fitness of 1,652 fire fighters. The five components were: (a) endurance work measured at the end of twenty minutes of heart-rate-controlled exercise; (b) total isometric strength of selected muscle groups; (c) total of spine flexibility measurements; (d) diastolic blood pressure during exercise at a heart rate of 160 beats per minute; and (e) heart rate two minutes after standardized bicycle exercise (Snook, 1987). The fire fighters were placed into three groups (most fit, middle fit, and least fit) and monitored for compensable low back injury over a period of four years. Approximately 7% of the least fit group experienced low back pain, compared to 3% of the middle fit group and less than 1% for the most fit group (Snook, 1987). The study showed reduced compensation costs for the most fit individuals. It was concluded that physical fitness and conditioning prevent back injuries (Snook, 1987).

Although preplacement testing and selection of workers will not solve the entire musculoskeletal problem in industry, it can contribute significantly to the overall solutions,

especially for jobs that are difficult to design and control. Training, ergonomics, appropriate treatment, and management commitment must supplement it.

Back Support Belts

Extensive research has also been conducted regarding the use of back support belts as a loss control tool. The term "back belt" refers to those belts used as a support device to prevent potential back injury and does not address those devices issued by medical personnel as part of a treatment protocol. The use of back belts in industry is a topic of repeated debate. The available scientific data to date neither completely supports nor condemns the wearing of back belts to control low back injuries. NIOSH does not recommend the use of back belts to prevent injuries among uninjured workers and emphasizes that back belts do not mitigate the hazards to workers posed by repeated pushing, pulling, twisting or bending (National Safety Council [NSC], 1996). On the basis of a review of the scientific literature completed in 1994, NIOSH concluded that insufficient evidence existed to prove effectiveness of back belts in preventing back injuries related to manual handling job tasks (NSC, 1996).

NIOSH is presently evaluating the data collected from a study conducted for ABC Company from August 1996 to August 1998. The study included 160 stores. Employee job classifications included were stocker, unloader, and selected department managers. Eighty stores in the study instituted a back belt usage policy and the remaining eighty stores did not. Employees participating in the study underwent strength and endurance tests administered by a contracted health care provider. The results of the study are not expected to be complete until January 2000.

In a similar study, researchers from the UCLA School of Public Health studied the workplace injury history of 36,000 workers of the Home Depot, a national home center chain,

over a six-year period. They found that low-back injuries fell by about one-third after the company imposed a consistent policy on back support use. The researchers examined the effectiveness of back supports by analyzing worker injury data collected on approximately 36,000 people who worked at its 77 California stores from 1989-1994. The company imposed a consistent back support use policy that was phased in between 1990 and 1992. Analyzing injury reports and other worker information, the researchers found that Home Depot workers sustained about 31 back injuries per 1 million work hours without the supports, compared to about 20 injuries per 1 million work hours after a consistent back support use policy was imposed (Kraus, Brown, McArthur, Peek-Asa, Samaniego, Krause, and Zhou, 1996).

Controlled studies conducted by Reddell, Congleton, Huchington and Montgomery have found belts to be of little or no value in back injury prevention (Mahone, 1994, p. 19). Different belts have been tested using various data collection techniques, ranging from pyschophysical, biomechanical, electromyography, external abdominal pressure measurements, subjective surveys, injury rates and injury costs. None of these studies have found belts recommendable. However, some evidence does suggest, however, that belts may reduce twisting in some jobs or that belts increase intra-abdominal counter movements in lifting tasks involving 150-200 lbs. (Mahone, 1994, p.17). The literature review did not reveal any studies that suggest the use of back belts in and of themselves would prevent back injuries. However, back belt usage as part of a comprehensive ergonomics program and used in conjunction with, or as part of employee training, was found to be acceptable.

Training

Lifting is the most common event associated with the onset of lower back pain and back injury. Most efforts in back injury prevention training has traditionally focused on proper

lifting techniques. Training courses to teach workers how to lift properly have been a commonly used approach in reducing workers' compensation costs and preventing back injury. According to NIOSH, the value of training programs on safe lifting is open to question. Although the concept of training to lift safely appears valid, results have been poor. Uninjured workers are unmotivated, training quality varies, and compliance is inconsistent. In addition, training is often applied as a panacea, while needed job modifications are avoided or considered too expensive or too difficult to implement (Mahone, 1994, p. 17). Training has failed to significantly reduce back injury because in part, "safe" lifting is not natural. NIOSH recommends that safe lifting programs should include site specific examples of safe lifting, as well as the minimization of hard and fast rules (such as always bend the knees). Instead, they recommend that training focus on providing the following information: (1) the risks of poor lifting; (2) the basic physics of lifting; (3) the effects of lifting on the body; (4) awareness of individual strengths and weaknesses; (5) how to avoid factors that might contribute to problem postures; and (6) the development and use of handling aids (Shaw, 1994). It's essential that employees understand that safe lifting requires them to apply basic knowledge to each situation individually and that they have options in how they perform individual tasks.

Nordin, Critis-Battie, Pope, and Snook (1991) reviewed a number of studies that attempted to evaluate the effectiveness of training programs. They report that the results of safe lifting programs are mixed with about half of the programs reporting decreased injury rates with the other half reporting no benefit. However, they did report that supervisor involvement in the form of feedback has led to the best results to date. This indicates that periodic reinforcement may be necessary for long term behavior change.

Training programs have traditionally focused on teaching employees specific work practices for their safety. Though most experts support such training, the actual effectiveness of such programs has been difficult to evaluate. The concept of training has been extended to include elements of recognition and problem solving. Moreover, it is now recognized that training is needed at all levels of management (Putz-Anderson, 1988).

Conclusion

Researchers believe that ergonomic solutions may be the key factor in resolving some of the problems relating to manual material handling. The past fifteen years of research on lifting-related lower back pain, injury and manual lifting have produced three findings with substantial scientific support. They are: (1) manual lifting poses a risk of lower back pain and injury to many workers; (2) lower back pain and injury is more likely to occur when workers lift loads that exceed their physical capabilities; and (3) the physical capacities of workers vary substantially (Waters, Putz-Anderson, Garg, Arun, & Fine, 1993, pp. 750-751).

Each of the aforementioned controls will have little effect if used alone in reducing or eliminating back injuries. An overall ergonomic approach would be far more effective, as applied not only to training, but also to selection and job placement, and to the redesign of manual handling tasks. Studies support that the best approach is an integration of all of these components. The total approach that includes a combination of ergonomic and medical controls together with training programs for both workers and management may help to provide the ultimate answer for solving the back injury problem (Benson, 1984, p. 36).

CHAPTER 3

Methodology

The methods and procedures used in this study of the effectiveness of changes made during the backroom conversion in the reduction of back injuries related to manual material handling are explained in this chapter under the headings (1) method of the study, (2) sample selection, (3) instrumentation, (4) procedures followed, and (5) method of analysis.

I. Method of Study

A. Back injuries related to manual material handling were identified as the leading cause of injuries to unloaders and stockers in the backroom (receiving) area of ABC Company, Inc. This was determined through an analysis of workers' compensation claim data.

B. ABC Company initiated the backroom conversion process, designed to improve operational effectiveness of the backrooms, and in part, to address opportunities identified in an ergonomic study of the receiving process.

C. The effectiveness on the backroom conversion was studied to determine if it contributed to the reduction of back injuries among loaders and stockers.

D. A review of literature was conducted to determine what related research has been conducted on reducing manual material handling injuries.

1. Statistics on the frequency and severity of back injuries resulting from material handling was researched.
2. Data was cited from the Bureau of Labor Statistics stating the frequency and severity of back injuries related to manual material handling.
3. Methods used to reduce the occurrence of manual material handling injuries were researched. Two ergonomic studies conducted in 1994 and

1999 for ABC Company were also reviewed to determine the problems identified in the backroom and recommended controls.

4. Four controls were selected from the review of literature for further research. They were: job design and re-design; selection and strength testing of employees; the use of back belts; and employee training.
5. Studies that were conducted involving each of the aforementioned controls were reviewed. Some research findings comparable to warehouse operations were identified and then compared and contrasted to existing practices in place at ABC Company, Inc. The pros and cons of each control were also identified in order to include or eliminate the control in the recommendations made to ABC Company.

II. Sample Selection

A. Sixty stores were selected as the sample of this study. These were stores that underwent the conversion during "phase one" (the first group of stores to undergo the conversion). The Project Coordinator and senior management in Operations determined the stores chosen for the conversion.

B. This sample included approximately six hundred employees who were considered unloaders and stockers and whose primary job function was to unload and move freight from the trailers to the appropriate area in the receiving room for storage or to the salesfloor.

1. The majority of the employees were hourly and non-management.
2. Age and gender of employees was not considered in data evaluation.

C. Workers' compensation data was analyzed to determine what percentage of injuries

were back injuries that occurred during the unloading and stocking process in the backroom before the conversion and after the conversion in the same stores.

III. Instrumentation

A. All claims involving a back injury related to manual material handling in the backroom were retrieved from the J & H STARS system for fiscal years '98 and '99.

B. The J & H STARS system database was used as the primary source of data collection. It contains a historical record of workers' compensation claims and excludes "incidences", i.e., injuries that may have occurred but did not require medical treatment. It provides a statistically accurate means of measuring injury frequency and allows the user to sort data by location (store), date of loss or injury, department, body part and cause (lifting, pushing, pulling, etc.).

C. Additional data was collected to compare back injuries that occurred in the backroom during the first quarter of the previous fiscal year (February through August) to the same time frame in the current fiscal year.

IV. Procedures Followed

A. Three hundred and seventy six stores underwent the Backroom Conversion during the first quarter of the fiscal year. Of those, sixty were chosen as the focus of this study.

B. Reports were run using J & H STARS, a database containing historical workers' compensation claim data for ABC Company, to determine loss history before the conversion. This data was then compared to losses that occurred after the conversion was completed.

C. In order to understand the changes made to the backroom during the conversion process, including changes to the physical environment and work practices, the receiving and processing procedures were reviewed. This included reviewing operational guidelines regarding the purpose of the conversion process, how the conversion process would be carried out, responsibilities of selected store personnel responsible for coordinating the conversion; safe work practices; operational changes relating to freight delivery, storage of merchandise, and inventory control.

D. Having determined that a reduction in back injuries relating to material handling did in fact occur following the conversion, goals of the study were identified to determine how the reduction in injuries was related to the changes to the work environment and work practices introduced through the backroom conversion. A secondary goal of the study was to identify ergonomic controls and recommendations that could potentially assist in controlling back injuries.

E. A literature review was conducted to identify controls used to reduce back injuries due to manual material handling. Numerous studies confirmed that job redesign was the most effective control. Two ergonomic studies conducted specifically for ABC Company were studied to determine what controls had been recommended in 1994, what recommendations were implemented following the study, and what additional recommendations could be made to further enhance ABC Company's efforts in reducing back injuries due to manual material handling injuries.

F. Based on the findings of the literature review (i.e., the most effective controls), and the analysis of the injury data, additional recommendations were developed. These included:

1. Developing training tools and a means of measuring the effectiveness of such training (ergonomic observation checklist, best practices for material handling, distance education on material handling;
2. Re-evaluation of the use of back belts;
3. Continued refinement of the work environment and work tools;
4. Development of a report for senior management with data regarding the number of claims and the cost of back injuries due to manual material handling injuries.

IV. Method of Analysis

A. In a comparison of back injuries in the sixty stores that underwent the backroom conversion it was found that there were 67 back injuries reported during the time frame 2/1/98-8/31/98 (pre-conversion). During the time frame 2/1/99-8/31/99 (post-conversion) 48 back injuries were reported representing a 28% reduction.

B. A cost analysis showed that the average cost of a back injury occurring as a result of manual material handling in the backroom prior to the conversion averaged $3,861.00. The average cost of a back injury occurring as a result of manual material handling in the backroom where the conversion had been completed averaged $2,638.00, representing a reduction of 32%.

C. The training process in stores prior to the conversion related to manual material handling compared to that which was in place following the completion of the

conversion process was found to include expanded training on the use of powered equipment, specifically, the walker stacker. No other changes in the training process were found.

V. Conclusions and Recommendations

A. Having reviewed the injury data and ABC Company's training program, as well as considering the information obtained through the literature review, recommendations were formulated which addressed the continued effort to reduce back injuries related to manual material handling in the backroom.

CHAPTER 4

Results and Discussion

The purpose of this study was to evaluate the effectiveness of the backroom conversion (i.e., changes made to the work environment and work practices) on reducing back injuries related to manual material handling sustained by stockers and unloaders. The following results and discussion are presented as they relate to each goal stated in Chapter 1.

Compare Workers' Compensation Claims (Back Injuries Related to Manual Material Handling) Which Occurred Prior to the Backroom Conversion to Claims that Occurred After the Conversion was Completed

Workers' compensation claims data was used as the basis for analysis. Four data samples were included as part of the study. They included:

A. all claims related to manual material handling in the 376 stores that went through the conversion process;

B. only back injuries related to manual material handling extrapolated from the first sample;

C. only back injuries related to manual material handling that occurred in the sixty stores included in Phase One.

The data in the first sample included all material handling claims wherein medical treatment was required or sought and excluded all claims referred to as "incidences" wherein no medical treatment was required or sought. The selection criteria included body part codes consisting of the lower, mid and upper back, shoulder, and neck. Specific injury codes included strain from lifting, strain from pulling/pushing, strain from reaching, strain from bending, disc injury, herniation, and other (not otherwise defined). Location of injury (i.e.,

department) was limited to the backroom or receiving area. It was found that the frequency of material handling injuries was reduced by 16% in the stores that underwent the backroom conversion and back injuries were reduced by 15%. Prior to the conversion, back injuries accounted for 43.1% of all material handling injuries and for 43.8% of material handling injuries in stores after the conversion process was completed. The second data sample included only back injuries related to manual material handling in the 376 stores. A comparison of the number of all injuries related to material handling and only back injuries prior to and after the conversion is shown in Table 3.

Table 3

Comparison of the Total Number All Material Handling Injuries to the Number of Back Injuries Only Pre- and Post-Conversion

Accident Type	Pre-Conversion	Post-Conversion	% Change
All injuries caused by material handling	213	178	-16%
Only back injuries caused by material handling	92	78	-15%

The third sample included only back injuries related to manual material handling that occurred in the initial sixty stores. The data included only those claims wherein medical treatment was required or sought and excluded all others, that is, all claims referred to as "incidences" wherein no medical treatment was sought or required. Body part codes consisted of the lower, mid and upper back. Shoulder and neck injuries were not included. Specific injury codes included strain from lifting, strain from pulling/pushing, strain from reaching, strain from bending, disc injury, herniation, and other (not otherwise defined). It excluded

injuries that may have resulted in injury during material handling such as slips, trips, and falls, struck by, struck against, or fall from elevation. Location of injury (i.e., department) was limited to the backroom or receiving area. Two loss dates (the date of injury) were used to compare loss history between the same two periods of time (February-August) in the current fiscal year and the prior fiscal year. By using data from the previous fiscal year, a comparison could be made between the number of back injuries which occurred prior to the backroom conversion and the number which occurred after the backroom conversion was completed and operational. The data, presented in Table 4, shows a 28% reduction in the total number of claims involving back injuries resulting from manual material handling. The cost per claim of back injuries post-conversion was not considered due to the fact that claims occurring in stores after the conversion was completed would not have the same maturity as those compared to from the previous year.

Table 4

Number of Back Injuries Prior to Conversion (1998) and After Conversion (1999) in Sixty Stores in Phase One of the Conversion

Loss Date	Number of Back Injuries
2/1/98-8/31/98	67
2/1/99-8/31/99	48

Determine Whether Changes Made During the Backroom Conversion Process Resulted in a Reduction of Back Injuries Among Unloaders and Stockers

Several changes were made to the physical design of the backroom as well as to the work practices of the unloaders and stockers as a result of the backroom conversion. One of the

most significant changes made to the physical design of the backroom was the reconfiguration of the steel shelving. The new configuration now accommodated pallets of freight to be stored up on shelves with the walker stacker without having to de-palletize and manually lift and carry the merchandise up into the shelves. Prior to the conversion, most freight that was delivered palletized to the store could not be stored in the steel without the freight having to be carried up into the shelves manually by employees piece by piece. Some palletized freight could be stored at ground level. Upon completion of the conversion, the steel shelves had been arranged in such a way as to allow for palletized freight to be stored on the shelves, being raised by the use of the walker stacker. This significantly reduced the amount of manual handling of freight, thus reducing the potential for injury.

Additionally, the creation of a pallet layout chart by department promoted increased space for greater ease of movement of employees and of equipment. The chart provided a guide to employees of how the freight would be sorted and placed on pallets by department. Furthermore, it provided direction for employees who may be inexperienced with department codes and quickened the unloading process. Use of the walker stacker reduced the amount of repetitive material handling and the amount of weight handled by each employee, thus reducing the potential for injury from lifting. The use of the walker stacker also improved the work process and flow of freight.

The handling of bulky bagged goods such as dog and cat food, soil, and fertilizer presented challenges to unloaders and stockers. Not all of these goods are delivered palletized to the store and therefore require considerable manual handling. ABC Company continues to work with suppliers to have the merchandise palletized upon delivery, floor-ready. Additionally, the Company has worked with suppliers to provide pull-tab price tickets that would eliminate

some of the handling of the product by cashiers. While this does little to reduce the amount of handling by stockers, it does address an exposure presented to both the cashiers and the consumer.

Changes were also made to the work practices as a result of the backroom conversion. These changes included changing the unloading time of the trailers from 10:00 p.m. to 4:00 p.m. and increasing the number of employees involved in the unloading of the trailers and stocking the salesfloor. This allowed for the work to be spread out among more employees, and again, reduced the employees' exposure to injury.

Identify Ergonomic Controls that will Effectively Reduce and/or Eliminate Exposure to Back Injuries

Several ergonomic controls were identified through the literature review that would reduce the injuries incurred due to manual material handling. These included job design and re-design; proper selection and strength testing; and training for employees, including training on the use of back belts. Additionally, ergonomic controls that ABC Company incorporated into their work design and work practices were also identified. These included the use of material handling equipment, ergonomics training including proper lifting techniques, team lifts for heavy merchandise, and the use of back belts.

Job design and re-sign, as discussed in the aforementioned paragraph, is one of the most effective means by which to control back injuries related to manual material handling. Proper selection and strength testing of employees has been extensively researched, but research results are inconclusive as to the benefits. ABC Company does not do any type of pre-employment strength testing.

The training process, including training plans and job descriptions for stockers and unloaders, prior to the conversion was compared to the training process in place following the completion of the conversion. The results of the comparative analysis showed that the training before and after the conversion included training on proper lifting techniques; pre-work stretching and warm-up exercises; and instruction on the proper fit and use of back support belts while lifting for stockers and at all times for unloaders. The completion of a computer-based learning (CBL) module on employee safety, with a passing score of at least 80%, is required within the employee's first seven days of employment. The module includes instruction on proper lifting techniques, stretching and warm-up exercises, the proper use, fit and wearing of a back support belt, and safe handling and use of ladders. A training video which emphasizes basic ergonomic principles and proper lifting techniques is also available as an additional training tool but is not part of the required training.

Instruction on use of powered equipment including pallet jacks, baler and compactor is also achieved through computer-based learning, on-the-job training, and performance testing and is expected to be completed within the employee's first 14 days of employment. No follow-up or refresher training is required. No preventative maintenance program is in place to ensure maximum performance of the equipment.

The primary difference in the training process in place before the conversion and after the conversion was the training on the operation of the walker stacker, a battery-powered unit designed to transport, elevate and slot palletized freight. Training requirements included watching a training video; taking a test (computer-based) and achieving a score of at least 80%; and a performance test on the proper operation of the stacker.

Execution and implementation of practices such as pre-work stretching and the wearing of back belts was inconsistent upon observation. The practice of stretching before their work began was often not part of the employee's daily routine unless prompted by management. The success of both elements appeared to be dependent upon the level of management support and follow-through and employee willingness.

Summary

The results of the study showed that back injuries due to manual material handling decreased by 28% after the completion of the backroom conversion. Material handling injuries overall also decreased by 16%. Additional training was developed and implemented to provide employees with training on the proper use of the walkie stacker. All other components of training related to proper lifting and back injury prevention remained the same. Several conclusions can be drawn from the results that will be discussed in the following chapter along with recommendations designed to enhance the current training process.

CHAPTER 5

Summary, Conclusions, and Recommendations

This chapter includes a summary of the study, conclusions drawn from the results of the study, and recommendations related to the study.

Summary

This study was designed to determine the effectiveness of the backroom conversion in reducing back injuries sustained by unloaders and stockers as a result of manual material handling. The summary includes a restatement of the problem, the methods and procedures used to conduct the study and the major findings.

Restatement of the Problem

Retail stores are faced with the challenge of managing and maintaining inventory in order to provide their customers with the desired merchandise. Efficient freight flow from the receiving area and backroom to the salesfloor is essential in achieving sales goals and maintaining standards of productivity, employee moral, and employee safety. Consequently, the amount of freight being moved and the means by which it is handled has resulted in an increased occurrence of employee back injuries related to material handling. The most predominant injuries are sprains and strains resulting from material handling activities including lifting, pushing, pulling and reaching.

Methods and Procedures

Through an analysis of workers' compensation data, manual material handling was identified as the leading cause of back injury among employees in the unloader and stocker positions. The backroom conversion process was reviewed to identify changes made to the work environment and work practices that may or may not have contributed to a reduction in

these injuries. Three hundred and seventy six stores underwent the conversion. Of those, the sixty stores that went through the first phase of the backroom conversion were selected as the basis for this study. A comparative analysis of back injuries in the sixty stores was conducted, comparing the number of back injuries reported among stockers and unloaders before the conversion to the number of back injuries reported after the conversion was completed.

A literature review was also conducted to determine what controls have been most commonly used to reduce the occurrence of manual material handling injuries. Included in this review were the results of two ergonomic studies conducted for ABC Company on their backroom/receiving area. Four primary controls were identified in the literature review. They were job design and re-design; selection and strength testing of employees; the use of back belts; and employee training.

Major Findings

The analysis of the workers' compensation data showed that a 28% reduction occurred in back injuries related to manual material handling among unloaders and stockers occurred. The average cost per claim was also reduced. The average cost per claim of back injuries reported in the sixty stores prior to the backroom conversion between the dates of 2/1/98 through 8/31/98 was $3,861.00. The average cost per back injury claim in the same sixty stores reported from 2/1/99 through 8/31/99 (post-conversion) was $2,638.00, a reduction of 32%. However, one must consider that the post conversion cost per claim does not allow for the same maturity of the claim and so the cost is not a true comparison.

Changes made to the physical layout of the backroom and work practices of the unloaders and stockers reduced the amount of manual handling of materials and thus reduced the exposure of employees to back injuries and other injuries related to manual material handling.

The training process in place before and after the conversion revealed one significant change, that being the training of employees on the use of powered equipment, specifically, the walker stacker. All other training, including training on proper lifting techniques, pre-work stretching exercises, the proper fit and use of back belts, and safe work practices specific to unloaders and stockers remained the same. ABC Company does not conduct pre-employment strength testing.

Conclusions

As a result of the findings, the following conclusions can be made from this study:

1. The physical changes made to the work environment as part of the backroom conversion contributed to the reduction in manual material handling and therefore contributed to the reduction in back injuries. These changes included:
    a) Reconfiguration of the steel which allowed for the pallets of freight to be stored as is with the walkie stacker without de-palletizing and manually lifting and carrying the merchandise up into the shelves;
    b) Creation of a pallet layout chart, by department, which promoted spacing for movement, direction for employees that may be inexperienced with department codes (freight is coded and must be placed with like merchandise by department), and quickens the unloading process;
2. Changes made to work practices as part of the backroom conversion contributed to the reduction in manual material handling and therefore contributed to the reduction in back injuries. These changes included:

a) Changing the unloading time from 10:00 p.m. to 4:00 p.m. and increasing the number of Employees involved in the unloading of the trailers and stocking the salesfloor which allows for the work to be spread out among more employees;

b) Use of the walker stacker reduced the amount of repetitive material handling and the amount of weight handled by each employee, thus reducing the potential for injury from lifting. It also improves the work process and flow of freight.

Recommendations

After analyzing the results and reaching several conclusions, the following recommendations were developed related to this study as well as those for further study.

Recommendations Related to This Study

1. The Company should continue to work with suppliers on re-designing packaging to include handles on boxed freight and limit the weight of each box. Bulky items such as bagged dog and cat food, soil, and bird seed should be shipped to the stores floor ready, that is, already palletized and wrapped in shrink wrap, to reduce the amount of manual handling of the freight by employees.
2. Develop and incorporate an equipment maintenance checklist for material handling equipment (walker stacker, conveyors push carts, etc.,) which would provide for regularly scheduled and preventative maintenance procedures to ensure material handling equipment is maintained to ensure peak performance.
3. The training video on basic ergonomic principles and proper lifting should be incorporated into the required training for stockers and unloaders. The video provides good ergonomic training and would be particularly suited for these tow job classifications. It is currently

available for stores to use but not required as part of the unloader or stocker training process.

4. The Risk Control Department should develop and provide a report for senior management that shows the number of back injuries and the associated costs to unloaders and stockers. Additionally, the report should provide management with solutions or controls which will help reduce the occurrence of injuries, specifically back injuries, related to manual material handling. The report should be generated at least weekly and compare current data to injury data from the previous year.
5. Pre-employment physical examinations should be provided to potential new-hires applying for unloader and stocker positions to identify if the candidate is physically capable of handling the physical requirements of the job. This should include strength testing.
6. A material handling training program should be developed specifically for unloaders and stockers that would be incorporated into their required training. The training could be video-based or computer-based and require a post-test which could be taken by the employee on the store's computer and the test results electronically submitted to the Training and Development Department. The Training and Development Department could assist in tracking to determine that the training is being executed as intended.
7. Management should enforce the implementation of the Pre-Work Stretch Program to ensure associates are participating. A member of management leading the stretches each day could accomplish this.

Recommendations for Further Study

1. Additional studies should be conducted to determine the impact the automated bike racks and softlines racks have on reducing manual material handling injuries. Neither rack was operational during the time this study was conducted.
2. Additional studies should be conducted to determine if the occurrence of injury to unloaders and stockers is related to length of employment. This may assist in determining if the training process for newer employees is effective in preventing injuries during the employee's first 90 days of employment.
3. Additional analysis of workers' compensation data should be completed when inventory levels are at their highest point and physical demands on employees are greatest (September through December). By doing so, one can determine if the physical changes made during the backroom conversion accommodate increased levels of freight and if work practices introduced with the backroom conversion continued to be executed.

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