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An Ergonomic Program: Implementing Elemental Steps and Employee Participation in the Workplace

Sharon Jeanine Dunning

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AN ERGONOMIC PROGRAM: IMPLEMENTING ELEMENTAL STEPS AND EMPLOYEE PARTICIPATION IN THE WORKPLACE

Sharon Jeanine Dunning

B.S., Boston College, 1982

A Thesis
Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Public Health
at the
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2002
APPROVAL PAGE

Master of Public Health Thesis

AN ERGONOMIC PROGRAM IMPLEMENTING ELEMENTAL STEPS AND
EMPLOYEE PARTICIPATION IN THE WORKPLACE

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2002
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I want to thank my mother, family and friends for their continued support as I work toward completion of this thesis. I want to thank my advisors for their contributions. It is with tremendous appreciation that I thank my primary advisor, Timothy Morse for his relentless patience and support as I reach the completion of my thesis project over the last few years and most recent months. His contributions to the success of this paper cannot be overstated. He is a knowledgeable professor and friend, who I value and respect. Thank You.

My thesis is dedicated to the memory of my greatest fan, advocate and mentor, my father, Kelly Dunning. You have my utmost appreciation and gratitude for the many sacrifices you made for our family.
Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Background</td>
<td>1</td>
</tr>
<tr>
<td>Methods</td>
<td>15</td>
</tr>
<tr>
<td>Results of the Case Study</td>
<td>19</td>
</tr>
<tr>
<td>Discussion and recommendations for successful ergonomic programs</td>
<td>33</td>
</tr>
<tr>
<td>Appendix A: Ergonomic Survey I.</td>
<td>42</td>
</tr>
<tr>
<td>Appendix B: Ergonomic Follow-up Survey II.</td>
<td>44</td>
</tr>
<tr>
<td>Appendix C: Psychosocial Work Environment Assessment</td>
<td>45</td>
</tr>
<tr>
<td>Appendix D: Ergonomic Work Plans (#4, #11)</td>
<td>46, 47</td>
</tr>
<tr>
<td>Appendix E: Requisition for Ergonomic Improvements</td>
<td>48, 49</td>
</tr>
<tr>
<td>References</td>
<td>50</td>
</tr>
</tbody>
</table>
List of Tables

1. Reports of Occupational Disease in CT .......... 2
2. Musculoskeletal Disorders by Type in CT, ODSS .... 4
3. Laboratory Worker’s Compensation OSHA 200 Form Logs .. 24
4. High Priority Health Issues ................. 26
INTRODUCTION:

Ergonomics is a science that addresses fitting of the workplace to the worker and evaluates the relationship of risk factors to musculoskeletal disorders (MSDs). The purpose of this paper is to describe an ergonomics program instituted in a laboratory setting, including an assessment of MSD risk factors, and to use that case study to make recommendations for implementing effective ergonomics programs elsewhere. The thesis will begin with background on ergonomics and MSD, followed by a description of the methods used. The description of the case study will be presented in the Results section, with discussion centering on the recommendations for practical methods of implementing successful ergonomics programs. The Occupational Safety and Health Act of 1970 have provided a guideline for employers to protect the health and safety of employees to their work environment. This law requires employers to furnish employees with employment and a place to work “free from recognized hazards that are causing or are likely to cause death or serious physical harm” (OSHA, 2000).

Background

In March of 1979, the Occupational Safety and Health Administration (OSHA) hired its first ergonomist to examine the health risks associated with musculoskeletal disorders. In the mid 1980s, the Bureau of Labor Statistics published data that indicated an increasing number of cumulative trauma disorders accounted for 48% of the reportable cases of disease. (BLS, 1995) In August of 1990, OSHA published the Ergonomic Program Management Guidelines for Meatpacking Plants as a result of the significant number of MSDs. Several employees reported problems due to lower back pain, which created
increased absenteeism from work. In November 1990, OSHA drafted a proposal for a standard for Ergonomics. In 1998, in the state of Connecticut, musculoskeletal disorders (MSDs) accounted for 3,398 cases reported by employers to the Bureau of Labor Statistics ConnOSHA (Morse et al., 2000); 1,634 cases (including 51 cases due to hearing loss) were reported by Employer First Reports of Injury to the Workers Compensation system and physicians reported 754 cases to the Occupational Disease Surveillance System (ODSS).

Table 1 indicates the number of documented cases for MSDs compared to the other occupational diseases in the State of Connecticut.

Table 1: Reports of Occupational Disease in Connecticut, 1998

<table>
<thead>
<tr>
<th>Type of Disease</th>
<th>BLS/ConnOSHA</th>
<th>WC</th>
<th>ODSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musculoskeletal Disorders (MSD)</td>
<td>3,398</td>
<td>1,634</td>
<td>754</td>
</tr>
<tr>
<td>Hearing loss</td>
<td>51</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Lung</td>
<td>469</td>
<td>563</td>
<td>176</td>
</tr>
<tr>
<td>Poison</td>
<td>45</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Lead</td>
<td></td>
<td></td>
<td>203</td>
</tr>
<tr>
<td>Skin</td>
<td>989</td>
<td>270</td>
<td>237</td>
</tr>
<tr>
<td>Physical Agents</td>
<td>92</td>
<td>21</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>517</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>Infectious</td>
<td></td>
<td>653</td>
<td>13</td>
</tr>
<tr>
<td>Mental</td>
<td></td>
<td>117</td>
<td>3</td>
</tr>
<tr>
<td>Heart</td>
<td></td>
<td>184</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5,510</td>
<td>3,556</td>
<td>1,444</td>
</tr>
</tbody>
</table>

Sources: BLS: Bureau of Labor Statistics/ Connecticut OSHA
WC: CT Workers’ Compensation Commission, First Report of Injury database
ODSS: Occupational Disease Surveillance System, Connecticut Departments of Public Health and Labor

The annual survey conducted by ConnOSHA focused on job-related injuries and illnesses and reported that musculoskeletal disorders accounted for 62% of reported illnesses. Reports for 1998 increased for both the BLS and workers’ compensation systems, but declined for the ODSS system. The increase was only 2% for the BLS system and this
was accounted for by a similar rise in employment levels, leaving the rate of occupational
disease unchanged (Morse, et al., 2000). The actual number of MSDs was estimated to be
higher than just reported cases, based on research using capture-recapture analysis
conducted by Morse and colleagues (Morse, et al., 2001).

MSDs have been associated with an increased cost of business operations in the
workplace. In 1996, U.S. workers experienced more than 647,000 lost workdays due to
MSDs. MSDs account for 34 percent of all lost workday injuries and illnesses. MSDs
account for $1 of every $3 spent for worker’s compensation. These injuries cost business
$15 to $20 billion in workers compensation costs each year. Indirect costs may run as high
as $45 to $60 billion (OSHA, 1999).

Ergonomics is the science of fitting workplace conditions and job demands to the
capabilities of the working population (NIOSH, 1997). Ergonomics is concerned with the
direct impact that work places on an employee and his/her performance toward carrying out
certain tasks. Ergonomists conduct studies at the place of work and observe the various
tasks that an employee may perform in order to determine whether there is a causal
relationship to the injuries that may occur over a period of time. These types of injuries are
often referred to as musculoskeletal disorders (MSDs), Cumulative Trauma Disorders
(CTDs), repetitive strain injuries (RSIs) and or repetitive motion disorders (RMDs) in the
literature. Musculoskeletal disorders (MSDs) may involve muscles, nerves, tendons,
ligaments, cartilage and spinal disc degeneration. Table 2 shows the number of reports by
CT physicians of different types of MSDs (Morse, et al., 2000).
Table 2: Musculoskeletal Disorders by Type in CT, ODSS, 1998

<table>
<thead>
<tr>
<th>Category</th>
<th>Cases</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tendonitis</td>
<td>180</td>
<td>23.9%</td>
</tr>
<tr>
<td>Carpal Tunnel Syndrome</td>
<td>166</td>
<td>22.0%</td>
</tr>
<tr>
<td>Epicondylitis</td>
<td>127</td>
<td>16.8%</td>
</tr>
<tr>
<td>DeQuervains Syndrome</td>
<td>58</td>
<td>7.7%</td>
</tr>
<tr>
<td>Tenosynovitis</td>
<td>57</td>
<td>7.6%</td>
</tr>
<tr>
<td>Bursitis</td>
<td>48</td>
<td>6.4%</td>
</tr>
<tr>
<td>Other MSD</td>
<td>38</td>
<td>5.0%</td>
</tr>
<tr>
<td>Ganglion Cyst</td>
<td>26</td>
<td>3.4%</td>
</tr>
<tr>
<td>Plantar Fascitis</td>
<td>11</td>
<td>1.5%</td>
</tr>
<tr>
<td>Trigger Finger</td>
<td>10</td>
<td>1.3%</td>
</tr>
<tr>
<td>Cubital Tunnel</td>
<td>8</td>
<td>1.1%</td>
</tr>
<tr>
<td>Costochondritis</td>
<td>6</td>
<td>0.8%</td>
</tr>
<tr>
<td>Thoracic Outlet Syndrome</td>
<td>6</td>
<td>0.8%</td>
</tr>
<tr>
<td>Arthritis</td>
<td>5</td>
<td>0.7%</td>
</tr>
<tr>
<td>Rotator Cuff Syndrome</td>
<td>4</td>
<td>0.5%</td>
</tr>
<tr>
<td>Hand Arm Vibration Syndrome</td>
<td>4</td>
<td>0.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>754</strong></td>
<td></td>
</tr>
</tbody>
</table>

The specific descriptions of these disorders include (adapted from Morse, 2000):

**Tendon Disorders**

- Tendonitis: swelling of the tendons
- Epicondylitis: tendon irritation in the elbow area, including “golfer’s elbow” and “tennis elbow”
- Rotator cuff syndrome: tendonitis in the shoulder area
- Tenosynovitis: inflammation of the tendon sheaths, lubricated covers that surround the tendons, particularly in the hand
- De Quervain’s syndrome: tendon sheath disorder of side of wrist and base of thumb
- Trigger finger: a bump on the tendon that catches on the tendon sheath that makes the finger or thumb difficult to move
- Ganglion cysts: swelling of the tendon sheaths from excess lubricating fluid
- Bursitis: inflammation of the fluid-filled sacs around ligaments and tendons

**Nerve Disorders**

- Carpal tunnel syndrome: pinching of the median nerve in the wrist, usually by swollen tendons that pass through the carpal tunnel (the median nerve can also be pinched in the elbow, shoulder, or neck areas)
Cubital tunnel syndrome: a pinching of the ulnar nerve in the elbow
Several others

Circulatory/Combined/Other

- Thoracic outlet syndrome: pinching of the nerves and blood vessels in the neck/shoulder area
- HAVS, or Hand Arm Vibration Syndrome: finger blanching from the cut off of blood flow due to vibration (also known as white finger or Raynaud’s)
- Plantar Fasciitis: swelling of the tissue under the skin in the bottom of the foot
- Raynaud’s Syndrome is a condition resulting in discoloration of the fingers and toes when a person is exposed to changes in temperature.
- Sciatica is a condition associated with pain along the course of the sciatic nerve, which runs from the lower back down the legs. Pain develops following an unusual movement or exertion that places a strain on the lumbar portion of the spine, where the nerve has its roots, either immediately or after an interval of several hours or a few days.
- Synovitis is an inflammation of a synovial membrane.

Musculoskeletal disorders (MSDs) are related to both biomechanical factors and psychosocial factors. These factors are created by everyday tasks that enable a worker to perform his/her duties.

NIOSH highlighted MSD risk factors based on investigations in different work settings in industry. Common examples were jobs requiring repetitive, forceful, or prolonged exertions of the hands; frequent or heavy lifting, pushing, pulling, or carrying of heavy objects; and prolonged awkward postures. Vibration, particularly in combination with cold is also a risk factor (Bernard, 1997).

In a review prepared by the NIOSH, hundreds of epidemiological studies were evaluated to identify the varying risk factors of MSDs associated in the workplace. The research examined the evidence of MSDs in the neck, upper extremity, arm, hand/wrist, and the lower back region. Many of the epidemiological studies reviewed found direct evidence linking MSDs to injuries due to repetitive work, forceful exertion and static postures (Bernard, 1997).
The epidemiological studies presented by NIOSH examined the evidence for causal relationships and the strength of association between exposure to workplace risk factors and MSDs. Studies were examined in order to determine consistency, which refer to the repeated observation of an association. Specificity of effect was observed to identify whether there was an association of a single risk factor with a specific health effect. Temporality was documented to determine if cause preceded the effect in time. Studies in the review included quantitative measures of association between risk factors and MSD, including relative risk, odds ratios and the 95% confidence intervals.

NIOSH examined the strength of association between exposure to workplace risk factors and MSDs, and came to the following conclusions:

<table>
<thead>
<tr>
<th></th>
<th>Neck problems:</th>
<th>Shoulder:</th>
<th>Elbow:</th>
<th>Hand/Wrist:</th>
<th>Back:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Repetitive Work</td>
<td>Repetitive Work</td>
<td>Repetitive Work</td>
<td>Lifting/Force</td>
<td></td>
</tr>
<tr>
<td>Force</td>
<td>(Reasonable evidence)</td>
<td>(Reasonable)</td>
<td>(Insufficient)</td>
<td>(Reasonable)</td>
<td></td>
</tr>
<tr>
<td>Posture</td>
<td>(Strong evidence)</td>
<td>(Reasonable)</td>
<td>(Reasonable)</td>
<td>(Reasonable)</td>
<td></td>
</tr>
<tr>
<td>Vibration</td>
<td>(Insufficient evidence)</td>
<td>(Insufficient)</td>
<td>(Reasonable)</td>
<td>(Reasonable)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Reasonable)</td>
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<tr>
<td></td>
<td>(Insufficient)</td>
<td>(Insufficient)</td>
<td>(Insufficient)</td>
<td>(Insufficient)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Strong evidence)</td>
<td>(Strong evidence)</td>
<td>(Strong evidence)</td>
<td>(Strong evidence)</td>
<td></td>
</tr>
</tbody>
</table>

[Bernard, 1997]

In cases involving days lost from work, the Bureau of Labor Statistics reported that
for the United States in 1994, approximately 705,800 cases (32%) were due to overexertion.

- 367,424 injuries due to overexertion in lifting (65% affected the back);
- 83,483 injuries or illnesses in other and unspecified overexertion events.
- 92,576 injuries or illnesses due to repetitive motion, including typing or key entry, repetitive use in tools, and repetitive placing, grasping, or moving of objects other than tools. Of these injuries or illnesses, 55% affected the wrist, 7% affected the shoulder and 6% affected the back. (Bernard, 1997)

Due to the increased number of musculoskeletal disorders and injuries in the workplace, ergonomic programs were recommended by OSHA to reduce the impact on health and costs in industry. (OSHA, 1990) The General Accounting Office report reviewed five companies and outlined six elements that were needed to identify and control ergonomic hazards in the workplace. The elements included (1) management commitment (2) employee involvement (3) identification of problem jobs (4) development of solutions for problem jobs (5) training and education for employees and (6) medical management. The five companies, which implemented the ergonomic programs, experienced a reduction of injuries and a reduction in worker’s compensation costs (GAO, 1997).

In the research published by NIOSH, seven similar steps to prevention were documented, focused on identifying, correcting and preventing MSDs. The following steps were recommended:

1. Identify signs of MSDs.
2. Secure management commitment and employee participation.
3. Provide training – such as an in house expertise.
4. Evaluate job risk factors/data collection and assessment.
5. Evaluate controls (determine controls to reduce risk factors).
(6) Include healthcare management of MSD.

(7) Proactive ergonomics. (NIOSH, 1997)

Both approaches have had successful outcomes and many corporations have incorporated these basic steps into their Ergonomic programs. (Falville, 1996; Haims et al., 1998; Halperin et al., 1997; Halperin et al., 1997; St.-Vincent et al 1998; Zalk, 2001) Many of the ergonomic programs that have been established to date incorporate “participatory ergonomics”. This concept suggests that the successful outcome of an ergonomic program requires the involvement of employees from the beginning of its implementation through the entire process.

*Elements of an Ergonomic Program*

The major components of an Ergonomic program include job evaluations, managerial support, medical management, training and education, and prevention strategies. (NIOSH 1997, GAO 1997) Each of these components is necessary for the success of an ergonomic program and requires careful thought and organization, if it is to be carried out correctly and receive managerial support and employee confidence.

The program can be designed for short term or long-term goals depending on the focus of the problems and the strategies to correct them, which have been outlined by the evaluator. Short-term goals might include improvements that can be easily and inexpensively accomplished but still be effective. Short-term success can provide the basis for support for further and more expensive investments in ergonomics. The following are elemental steps suggested by NIOSH that were utilized in the case study.

1. **Identifying a problem:**

Review Workers Compensation claims and discuss with employees cases of
carpal tunnel syndrome, tendinitis, lower back pain or other MSDs. Assess certain complaints of pain and work conditions. Evaluate the jobs that involve repetitive activities, awkward and static postures such as lifting heavy loads or vibrating equipment. Recognize activities involving compression of hands, arms and other body parts working with machinery, fast movements involving acceleration and velocity and gripping forces. Identify multiple jobs involving various issues, which may indicate the implementation of a larger program.

A symptoms survey can provide a medical history, which can be developed to evaluate and assist in identifying the conditions that contributed to the health problem. This tool is useful when conducting individual analysis because the evaluator can attempt to locate the source of the health problem and use this information in combination with the questionnaire to design interventions to prevent further injury and/or improve the workplace.

2. Managerial support and employee participation:

Efforts should be made to assist management/administration in understanding the dynamics of an ergonomic program and the impact on employees. Attempt to gain support from both the union/labor and management in order to help secure the implementation of the program. Develop a joint labor/management ergonomic team who can assist in the recognizing of ergonomic hazards and reduce or eliminate them. The team should work with employees in order to create a proactive approach toward achieving prevention strategies for success. Employers should encourage employees to report symptoms and injuries and provide an environment wherein confidentiality is assured. Education and training opportunities should be provided in order to
encourage employees to participate in identifying a problem and being a part of prevention strategies. Employee participation provides a platform for the evaluator to launch the program, make observations and gather feedback, which will assist in the assessment of the problems and the implementation of potential solutions at the worker level.

3. **Designing a job evaluation:**

A job analysis requires the evaluator to explore a series of questions regarding the work environment of the employee and their responses. These questions should be written in such a way that there is minimal bias or indication of the evaluator’s thoughts and perceptions on the topic, which may influence the responses of the employee. The job evaluation is a tool used to examine whether there is a need for an ergonomic intervention or a need to provide information on prevention strategies to solve the problems. The questions should identify the primary location, and layout of the workstation of the employee and should delve into social, physical (biomechanical), and mental stressors that may impact the employee’s health. A thorough evaluation should also consider other influences and/or interests outside the workplace, which may impact an employee’s health.

4. **Medical management:**

An employer should seek health care providers who subscribe to the best current practices. Health care providers should recommend interventions, which inform the employer on current issues and ergonomic solutions. (Kuorinka I, 1995) According to OSHA, early reporting of signs and symptoms is optimal. Prompt evaluation, treatment and follow-up by Health Care Professionals (HCPs) are recommended. A
conservative approach using stretching exercises or replacing outdated equipment with ergonomically engineered equipment may correct the problem. Early recognition can sometimes head off a more serious condition that may require a more comprehensive approach such as surgery. There are cases of advanced carpal tunnel injuries where patients have undergone surgery and experienced recurrences of the injury and opted for additional surgeries. In some of these cases surgery did not improve or correct the problem. Early detection of symptoms and incorporating prevention strategies seems to be the most effective way to avoid a serious injury.

5. Training and Education:

Developing in-house expertise can be an effective way to utilize employees and obtain participation in the program. It is most effective if the employees selected for a representative sampling are believed to experience the same risk factors/exposures and work shift as the group they will attempt to evaluate. Employees will be more receptive to participation in surveys or assist in fact finding efforts, if they are trained to understand the mechanics of the program, which they are involved in. The training should be current and provide opportunities for team building an in-house ergonomics program. The advantage to an in-house program is that the expertise would be available on site to address safety issues regarding ergonomics.

6. Prevention Strategies:

The objective is to provide a healthier environment than what the employee may have experienced before the ergonomic program was implemented. It is expected that the outcomes of the program may lead to continuous/ongoing improvements and involve the surveillance of employee health, welfare and satisfaction. A follow-up survey
should be conducted to evaluate the reduction or elimination of risks and measure any new risk factors that were created. The follow-up should use a similar tool to the initial survey in order to analyze whether the interventions were successful. The ergonomic team should quantify costs and benefits of the intervention in order to make recommendations to the company to continue or expand the program. It is hoped that the strategies outlined by the evaluator will be implemented and followed at the workplace and become a permanent health and safety practice.

Ergonomics addresses the MSDs that may be due to occupational exposures over a period of time. The exposures that place an employee at risk in many cases tend to be chronic and repetitive. Education and awareness is thought to be a way to reduce the number of injuries that occur. (NIOSH, 1997) Ergonomic programs in the workplace can be both primary prevention of MSD as well as secondary prevention through early reporting systems. (NIOSH, 1997) Passive surveillance is provided by records of injuries and reported by the worker and defined and maintained by the employer. OSHA regulations require all employers with over 10 employees to keep records of all injuries reported on the job. Active surveillance asking workers through questionnaires or other means to report all injuries including those that may have not been formally reported, and often conditions (such as early symptoms) that are less serious than would normally result in reports. The information provided by the worker gives the evaluator a closer look at the chain of events, which led to the injury and how the injury may be prevented or eliminated. Ergonomic evaluations provide documentation of MSD symptoms to direct analysis of the problem and design solutions.

The focus of this paper is to describe elemental methods (strategies) that are
necessary in order to develop an ergonomic program in the workplace. Many musculoskeletal injuries that may occur in the workplace are documented by claims submitted by an employee to the employer and then reported to the workers' compensation insurance company. However, due to the various symptoms associated with MSDs and many other factors, cases that are not reported to the employer, may be reported to an employee's personal physician or in some cases have never been reported. (NIOSH, 1997; Morse, 2000; Morse, et al., 2001) It is possible that the injury may not be directly linked to employment until an evaluation of the work and the injury have been reviewed by the employer or that an employee has filed a complaint. The research suggests that a prevention program, which educates workers and designs ergonomically correct procedures may lead to lower absenteeism among employees, reduced claims for workers' compensation, and improve injury prevention both in and away from work. Such an intervention may directly and indirectly contribute to reducing the number of overall injuries that may occur at the workplace. The literature supports the idea that simple education and awareness practices of employees can reduce the number of ergonomic injuries in the workplace. (NIOSH, 1997; GAO, 1997; King et. al., 1997)

Ergonomics to a large extent involves changes of behavior for both employers and employees. Management support is critical to the success of any intervention steps toward reducing the stressors in the workplace. (NIOSH, 1997; GAO, 1997; Haims, et al., 1998; Zalk, 2001) In addition to implementing improvements, resources must be made available to educate and motivate the employee to change their behavior. Given the opportunities for education and awareness, employees may begin to understand how over time daily tasks may contribute to aches and pain, which may leave a negative
physical impact on their health, and become more receptive to preventive programs.

Studies indicate that some MSDs are acute, but most are chronic and can be aggravated by carrying out strenuous and stressful daily routine tasks. The most common risk factors are repetition, force, static and awkward posture, vibration, and stress. (Bernard, 1997) Research suggests that if certain preventive steps are taken, one may be able to reduce or eliminate further injury.
METHODS:

Background/Timeline

In July of 1995, the DPH agency's new administration began a comprehensive reorganization, which included an in-depth study of the Connecticut Department of Public Health State Laboratory. In the spring of 1996, the DPH agency initiated the reorganization of the Laboratory and coordinated efforts with the New England Health Care Employee Union, District 1199 and reviewed the impact on members. The Centers for Disease Control (CDC) conducted a site review and an Ergonomic survey was launched. The findings were summarized in a grant proposal. In August of 1997 the grant proposal for the continuation of funding for the Quality Work Life project was approved. Management support for the continuation of the efforts indicated in the survey was achieved.

A simple analysis was conducted to compare the Worker Compensation (WC) 200 Logs for 1996 at the laboratory prior to the implementation of the Ergonomic project and post WC 200 Logs for calendar years 1999, 2000 and 2001. The comparison of the types of injuries associated with MSDs was consistent with the findings in the literature (Morse, 2000). The number of days workers were absent from work in the laboratory as a result of these types of injuries indicated the impact of MSDs on the workforce.

The goal of this project was to examine whether MSDs did exist in the laboratory and to what magnitude. Steps were taken to determine the need for changes based on the outcome of the survey and the participants' responses. The core elements outlined by NIOSH in the Introduction section were used to guide the project. Risk factors were identified based on the questionnaire given to employees. Joint labor-management
committees were established to initiate and provide guidelines for the project. Employee involvement and management support were an integral part of the initiation, implementation and final outcome. The project is ongoing and will be guided based on the outcome of a follow-up survey.

This project was conducted at the State of Connecticut Department of Public Health (CTDPH)- Division of Laboratories, located in Hartford, Connecticut. The State Laboratory is a public health service facility comprised of administrators/managers and unionized employees who serve as microbiologists, chemists, laboratory assistants and clerical support. At the time this study was conducted, the State Laboratory employed approximately 163 employees.

A case study approach with participant observation was used for the study design. No control group was used. Participants in the study included unionized employees of the state laboratory, management and the union. Committee members involved in the project were New England Health Care Union District 1199 labor union members and management, and arose from broader statewide union-management projects on quality improvement (termed "Quality of Work Life" or QWL projects). Costs for implementation of the project (e.g. consultants, new furniture and other interventions) were partially covered by a grant from the state QWL committee. Employees who were members of other unions were also encouraged to participate. Involvement of all employees in the program provided a more inclusive approach and could lend useful information as to the various types of problems experienced by different employees representing different unions. Despite the encouragement, it should be noted that very
few employees outside of the 1199 union actively participated. The percentage of participation by union was not measured.

A literature review for this paper was made by use of internet-based search engine resources such as Pub Med, Google, Yahoo and Medline in addition to a review of current medical, occupational health and public health journals.

Survey

The case study included an employee survey. The survey was constructed by the ergonomic team, reviewed and approved by the Quality Work Life (QWL) Steering Committee and Health and Safety Committee. The initial survey shown in Appendix A was short and simple to answer, and was based on self-report. The survey/questionnaire was designed as a tool to measure ergonomic risks and determine the needs of employees.

The survey was based on a 1997 NIOSH questionnaire and adapted to reflect the workforce in the laboratory setting. The questions on the survey focused on whether employees experienced risks, how employees felt about their workstations, whether employees were satisfied and what types of improvements they felt should be made. Employees were given an opportunity to express their concerns about their work environment. The survey provided the team with the opportunity to analyze the extent of a problem, if any. Questions referred to a large range of physical risk factors such as repetition of similar movements, force demands involving pulling, pushing, lifting and gripping; awkward or static postures and compression of hands, arms and other body parts. In addition, questions referring to psychosocial factors involving issues of stress, including work demands, job control, social support and their perceived association with
various types of symptoms were asked. The survey was hand-distributed by the team to participants and completed within a week. Participation in the survey was voluntary and the names of workers were optional to try to increase response rate and promote honest opinions. The team was available during distribution of the survey, but limited their direct assistance to individuals to reduce potential biases. Careful attention to the design of the survey (i.e., simple wording) was employed so that employees of varying educational backgrounds felt comfortable answering the questions.

Appendix B contains the follow-up survey, which was designed to evaluate the implementation and improvements made to the facility and to identify the employee's perception of the changes to date. The follow-up survey/questionnaire would have been used to determine if the changes were maintained and to measure the expected level of employee satisfaction. However, due to the tragic events of September 11, 2001, this survey was not administered to the employees since the lab was extraordinarily busy responding to potential anthrax exposures and other issues. It is expected that at some point in the future the survey will be administered.

This case study did not assess individual factors which may be associated with MSDs such as age, gender, smoking and physical activity. The factors associated with the job and work environment and their impact on the worker as an individual or group were examined.

Success of the program was measured by the participation of employees; the establishment of an in-house expertise; the improvements to workstations and purchases of updated equipment and the positive collaboration between the DPH management, the ergonomic team, and the QWL joint committee that was created.
RESULTS:

Introduction

The Health and Safety Committee and Labor-Management launched an effort to reorganize the State Laboratory in 1996. The effort was designed in order to provide a salary savings to the State personnel budget. Part of the agreement led to the installation of the Quality of Work Life (QWL) Program (a District 1199 union based program) intended to create improvements throughout the laboratory, improve employee morale and save jobs. The QWL Steering Committee was comprised of four managers and four 1199 union employees. The mission of the QWL steering committee was to collaborate on a number of issues concerning the laboratory’s present way of conducting business and the future. The QWL steering committee and the ergonomic team were established to oversee the inclusion of new technology, the accommodation of increased workspace, and the implementation of ergonomic engineering for each area. The grant proposal was written by members of the Steering Committee based on the results of the survey, and justified the need for ergonomic improvements in the laboratory. Initial funding for the ergonomics grant was $20,000, which was increased to approximately $40,000 once the initiatives recommended under the original proposal had been implemented.

Three laboratories (Virology, Environmental Chemistry, and Biochemistry) were identified as having the greatest need for improvements and were designated as a pilot project based on a CDC site review. The work site was selected based on the potential to improve worker safety/comfort and address ergonomic considerations. These laboratories were subsequently redesigned by professional engineers and updated based
on a modernized design, which can increase productivity and improve safety among employees.

*Joint Committee*

The Health and Safety Committee used funding from the grant to hire two ergonomic consultants to assist in the implementation of improvements. The consultants provided training workshops to all laboratory staff. An ergonomic team was created comprised of laboratory employees on site with the expertise to recognize ergonomic problems and create improvements. Request for volunteers to serve on the team were made by electronic mail. Ten individuals were chosen by the QWL Steering Committee to be on the ergonomic team. The ergonomic team was trained at the state laboratory in order to develop an in-house expertise at the facility. Training sessions took place over two days and included intense interactive discussion, role-playing, reviewing the current ergonomic technology, and conducting visits and analyses of individual workstations.

Committee members represented a broad range of positions with varied skills and responsibilities such as secretaries, biologists, chemists, lab aides and a safety manager. The facilitator was an 1199 union coordinator of QWL projects, who did not work for the Department of Public Health. The diversity of the team provided an understanding of differing health issues experienced by staff in the laboratory setting. The charge of the committee was to focus on health problems and identify risk factors attributed to work and evaluate the worksites. The team chose a team leader amongst the group and met weekly with the facilitator, who directed the project by utilizing work plans shown in Appendix D and defined the short-term goals and gave some consideration to long-term goals. The project was expected to be for 3 to 6 months in duration, but required a
minimum of a year commitment to the process with ongoing recommendations for follow-up.

The ergonomic team reported to the Health and Safety Steering Committee on the problems employees experienced resulting from repetitive motions and musculoskeletal disorders (MSDs). The ergonomic team leader met weekly throughout the project to update the QWL Steering Committee on the progress. The Steering Committee and ergonomic team both met regularly and posted all dates on the calendar and conference room where meetings would be held. Once a month an update was given to the Health and Safety Committee.

Communication

It was determined that several levels of communication were required in the process of the project. The team reviewed the methods available to inform workers about the progress of the project and found that electronic mail, memorandums and informal discussions with employees worked best. Details regarding meetings were openly posted on calendars to provide additional access to information about the project. A newsletter was created to inform 1199 members and other staff about updates on the effort and information about obtaining prevention and new ergonomic technologies.

The QWL sponsor of the team was a manager, who had a dual responsibility to communicate information to the team and QWL Steering Committee. The sponsor attended regular meetings and informed the team leader on scheduling an update or proposal to present to the Committee. The union encouraged members to become an integral part of the QWL effort and contribute ideas to assist in the changes that would
take place. This forum worked to the advantage of the team due to improved feedback and suggestions from other workers.

**Brainstorm sessions**

The team developed a good working relationship with one another based on respect and trust established in the initial session. It was important to establish these ground rules in order to maintain a positive and productive climate and respect for all opinions. Each week the team met and was free to exchange a constructive critique of the pros and cons regarding the direction the project would take. There was a learning curve as the team members became more experienced and skilled in their abilities to work together and share ideas in order to produce a final product that reflected their professional integrity.

Discussions in the early stages of the project were difficult. Initially the team members felt limited in their ability to make decisions and meet obligations since many decisions had to be approved by the QWL Steering Committee. As the project advanced communication between parties improved.

**Tools utilized**

The team designed various forms to aid in the organization of the project. A requisition form for ordering equipment and documenting and tracking purchases was created. The team learned the importance of the purchasing system of the organization and the limitation of the process with the state contractors on account. Work plans (samples shown in Appendix D), were designed to aid in the facilitation of the meetings and to indicate the assignment of each team member from session to session and the priority of the actions to be taken. The team drafted cover letters for all requests to the
committees and lab employees. The Internet was one tool that was used to obtain
catalogues for the team. The team worked with the purchasing section of the laboratory
to assist in communication with vendors contracted by the state. One of team members
worked in that section of the laboratory and played an active role in assisting the team in
the steps to take.

The requisitions shown in Appendix E were distributed to lab personnel and a
return receipt was given to each team member based on the floor they were assigned to.
All personnel could fill out the form for a request for equipment and submit it to the
supervisor of the section for approval. The supervisor was required to collect the
requisitions for their staff, sign and date each for their section and return to the
Ergonomic team member. A similar system is used for all orders within the laboratory.
A running total was kept of all costs and pared down in order to stay within the budget.
The team reviewed every request and submitted orders to purchasing if the request was
within the guidelines based on the ergonomic justifications detailed in the cover letter.
No reasonable request was denied.

Problem assessment

The 1st goal was to recognize signs of problems experienced by employees.
OSHA 200 Form logs (an OSHA-mandated injury and illness record keeping system)
were reviewed. The OSHA 200 form logs in the laboratory for calendar years 1996,
1999, 2000 and 2001 are as follows. It should be noted that no Ergonomic Standard was
or is in place. Year 1996 denotes data prior to the implementation of the ergonomic
project and the years 1999, 2000 and 2001 show data after the project was complete.
### Table 3: Laboratory Worker's Compensation OSHA 200 Form Logs

<table>
<thead>
<tr>
<th>Year</th>
<th>Type of Injury</th>
<th># of Cases Reported</th>
<th>Average Days Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996*</td>
<td>Carpel Tunnel Syndrome (CTS)</td>
<td>6 cases reported</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Epicondylitis/Tendinitis</td>
<td>Not available</td>
<td>126</td>
</tr>
<tr>
<td>1999</td>
<td>Repetitive motion (hand)</td>
<td>2 cases reported</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Lifting (lower back pain)</td>
<td>2 cases reported</td>
<td>0</td>
</tr>
<tr>
<td>2000</td>
<td>CTS</td>
<td>6 cases reported</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Lifting</td>
<td>2 cases reported</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Back Pain</td>
<td>2 cases reported</td>
<td>15</td>
</tr>
<tr>
<td>2001</td>
<td>CTS</td>
<td>4 cases reported</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Computer use</td>
<td>1 case reported</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Lower back pain</td>
<td>1 case reported</td>
<td>½</td>
</tr>
</tbody>
</table>

Based on the review, there were discussions with workers regarding complaints about their physical pain in relation to specific job tasks. Individual team members and in some instances two members interviewed individual workers about the problems at their work site and observed their jobs. Team members were assigned weekly tasks in order to meet the deadlines of the goals outlined by the facilitator. The team leader reported updates to the QWL Steering committee for approval.

Workstations were videotaped to assist the team in reviewing and understanding the level of difficulties experienced by workers. The workstations that were videotaped were selected based on individual requests by participants as indicated on the initial survey.

**Survey results:**

A survey of employee perceptions about their work environment was performed. The survey was distributed to all (163) employees in the laboratory; approximately 80% of the employees were members of the 1199 union. Sixty-six (66) of the surveys were returned, a 40% response rate. Approximately 95% of the responses were from members of the 1199 union.
The response rate of the survey was considered to be somewhat low. However, the participants did provide useful information regarding the experiences of many employees. No determination was made as to whether people who did not participate may have experienced different health outcomes than those who participated. It is possible that the fear of management could have influenced the other employees. It could be argued that employees felt that there may be reprisals if they participated in the survey. The reason for the low number of participants could not be determined by this project. The team made a concerted effort to limit their involvement once the survey was delivered to employees in order to avoid influencing the responses. Confidentiality and anonymity were maintained in order to protect individual identities.

The responses to the survey in Table 4 indicated that many employees experienced physical and or psychosocial risk factors. The most common physical risk factors (also referred to as biomechanical risk factors) reported were heavy physical work, static postures, frequent bending or twisting in awkward postures, lifting, pulling, vibration, and repetitive work. Many of the above factors mentioned were reported to be associated with lower back pain and shoulder and neck pain. Psychosocial risk factors reported included poor work satisfaction, heavy job demands, low social support, and in some cases monotony as a result of doing the same task over and over without taking breaks. Appendix C shows the modified Psychosocial Work Assessment that was used for new cases of site evaluations that were performed.
### TABLE 4: Responses to the Survey by Participants

<table>
<thead>
<tr>
<th>High priority Health Issues</th>
<th>Yes</th>
<th>Percent</th>
<th>No</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do you stand for long periods? (1a.) If yes, do you have a cushioned mat or footrest?</td>
<td>47</td>
<td>71%</td>
<td>19</td>
<td>29%</td>
</tr>
<tr>
<td>2. Do you keyboard regularly?</td>
<td>47</td>
<td>71%</td>
<td>19</td>
<td>29%</td>
</tr>
<tr>
<td>3. Is the lighting at your workstation inadequate?</td>
<td>44</td>
<td>66%</td>
<td>17</td>
<td>26%</td>
</tr>
<tr>
<td>4. Do you experience eyestrain? *</td>
<td>21</td>
<td>53%</td>
<td>12</td>
<td>18%</td>
</tr>
<tr>
<td>5. Is your job stressful?</td>
<td>35</td>
<td>53%</td>
<td>28</td>
<td>42%</td>
</tr>
<tr>
<td>6. Does your job involve repetitive motions? Describe.</td>
<td>32</td>
<td>48%</td>
<td>28</td>
<td>42%</td>
</tr>
<tr>
<td>7. Do you lift more than 5 lbs?</td>
<td>32</td>
<td>48%</td>
<td>32</td>
<td>48%</td>
</tr>
<tr>
<td>8. Is your pain job related? Do you experience any symptoms, at least partly related to work, such as aching, tingling, numbness, burning or stiffness? Describe.</td>
<td>40</td>
<td>32%</td>
<td>25</td>
<td>38%</td>
</tr>
<tr>
<td>9. Do you have an adjustable chair? *</td>
<td>41</td>
<td>62%</td>
<td>22</td>
<td>33%</td>
</tr>
<tr>
<td>10. Do you feel that the size of your workstation is adequate for your needs?</td>
<td>41</td>
<td>62%</td>
<td>22</td>
<td>33%</td>
</tr>
<tr>
<td>11. Are you satisfied with the comfort and layout of your workstation? If no, what are some of the problems you can identify?</td>
<td>31</td>
<td>50%</td>
<td>31</td>
<td>50%</td>
</tr>
<tr>
<td>12. Do you hold the same position for long periods of time?</td>
<td>28</td>
<td>42%</td>
<td>36</td>
<td>55%</td>
</tr>
<tr>
<td>13. Does your job require you to reach above shoulder height frequently?</td>
<td>16</td>
<td>24%</td>
<td>48</td>
<td>73%</td>
</tr>
<tr>
<td>14. If improvements were made to your area, would you place more effort in your work?</td>
<td>42</td>
<td>64%</td>
<td>18</td>
<td>27%</td>
</tr>
<tr>
<td>15. Would you like a personal site evaluation of your workstation?</td>
<td>35</td>
<td>53%</td>
<td>26</td>
<td>38%</td>
</tr>
</tbody>
</table>

* Sixty-six employees participated in the survey. There are some questions that did not receive a yes or no response. Some questions had a brief explanation in addition to the response addressed in the Results section.

A large majority of the employee responses indicated that their work routinely
involved standing for long periods of time followed by key boarding and lighting
difficulties. Seventy-one percent of participants complained of standing for long periods,
with the same percentage reporting heavy keyboard usage. When asked whether the
work area provided a cushioned mat or footrest, thirty-one percent said they did not. Of
the employees who performed keyboard duties daily, the responses indicated that activity
could involve from 1 to 7 hours in an average day.

Sixty-seven percent indicated inadequate lighting at the worksite. Almost half
reported repetitive work as a problem, as well as lifting more than 5 pounds. Some of the
types of repetitive work that employees mentioned on the survey included pipetting,
shaking, stuffing envelopes, using scalpels, keyboarding and weighing various materials
including chemicals and heavier items. A few employees mentioned that they
experienced pain as a result of vibrations and forceful motions when using the autopsy
saw daily. Employees indicated that lifting shipments and supplies weighing more than 5
pounds and in some cases more than 20 pounds were a required daily task.

In relation to health complaints, pain was identified as the most important factor
which impacted health and work performance, and stress was next in importance. Sixty-
one percent of participants reported experiencing pain, and fifty percent identified
eyestrain and stress. Employees described symptoms of pain in the hand and wrist,
numbness in the thumb, stiffness in the neck, and back pain. Other problem areas
included leg, heel, arm, elbow, shoulder, and lower back pain.

More than sixty percent of employees said that they had an adjustable chair,
which did not work. The walk-around by the ergonomic team determined that several of
the chairs, which were originally designed to be adjustable, were broken or faulty and did
not provide support or comfort for sitting in a neutral posture. Adjustable chairs, which were donated from another department in the DPH agency to the laboratory, prior to the project, were found to be adequate and therefore not replaced. Seventy-seven additional chairs were purchased in February and March of 1998 based on the analysis performed by the team.

Some of the problems that laboratory employees faced were due to static postures. Forty-two percent of the employees' responses to the survey stated that they held the same position for long periods of time. Twenty four percent said their job required them to reach above shoulder height frequently.

Often awkward postures were involved in the lifting of materials off shelves overhead and moving equipment around or rearranging equipment due to space limitations. Awkward postures included twisting and bending while sitting for long periods of time. Working on the microscope was also found to contribute to lower back pain injuries. These unsupported positions tended to stretch the physical limits of the body and created an irritation of the tendons and other muscles and restricted blood flow.

When asked about issues concerning the workstation, sixty two percent of employees agreed that the size of the work area was adequate. Fifty percent were satisfied and comfortable with the layout of the workstation. Employees who were not satisfied with the workstation indicated problems with chair height, uncomfortable chairs, monitor level, printer location on bench, and bench surfaces. The responses to questions referring to job performance indicated that over sixty percent of employees responding to the survey felt that their work would improve if workstations were modified.

Workstation Evaluations
The next task was to look at the potential ergonomic exposures and determine how to approach the problem. The workplace analysis identified several problem areas in different sections of the laboratory that needed modifications. Additional requests from employees were indicated on the survey. The team analyzed a total of 40 workstations of employees and performed individual site evaluations. Site evaluations were set up as one-on-one evaluations with individual employees, where the evaluator could observe the worker completing routine tasks and make recommendations for changes in attempts to improve the worker's environment. The in-house team evaluated individual workstations, reviewed videotapes and brainstormed about possible solutions. Problems identified resulted in modifications to individual worksites.

In Phase 1, each team member conducted site evaluations and reported back to the team, initially. In Phase II the process was changed and two team members conducted the analysis in order to facilitate the time needed complete the evaluations. On average the evaluation in Phase I took at least an hour to perform and in phase 2 only 30 minutes was needed in most situations.

Workstations were assigned to a team by floor and based on the requests indicated on the survey. The team prioritized the needs of the area based on the assessment taken and reported their findings back to the team for further analyses. The walk-thru was conducted over a two-week period approximately and then the data was reviewed and prioritized according to needs of each area and the budget constraints. The team later distributed requisitions to the entire lab in order to receive orders for equipment.
Resources

Consultants continued to provide their expertise and were accessible to the team during the course of the program initiation, implementation and ongoing development. To keep the expenses low and within the budget, the ergonomic team attempted to find additional resources. Free seminars and literature were obtained through organizations such as ConnOSHA, NIOSH, private consulting firms with physical and occupational therapists, and chiropractors. A local chiropractor serving the neighboring community provided a free seminar on lower back and neck/shoulder pain prevention. Employees were receptive to the presentation and participated in the stretching exercises that were demonstrated by the chiropractor. Brochures and posters with illustrations from organizations were given to the team and distributed through the laboratory in order to provide quick reference guides for employees. The Health and Safety Committee obtained videos on office ergonomics to further assist employees in their understanding about ergonomic issues. The team created a library of current catalogs from numerous vendors to assist in the purchasing of furniture and equipment to update workstations. The team collected additional information from medical libraries, collaborating institutions and the Internet.

One of the advantages of working with a budget was that the department found the efforts of the project to be mutually beneficial and contributed additional state funds. The project provided a savings and created improvements that were ongoing and did not adversely impact the workflow of the staff. Once the limits of the budget were exhausted, the team leader and sponsor approached the QWL Steering Committee. The Committee reviewed the success and validity of the project and was able to provide
additional funds. No reasonable request for equipment was denied. If the purchase was a high-end item, the Committee had to approve it.

**Workstation Modifications and Upgrades**

Based on review of the video tapings and one on one interviews, the team determined that the workstations did not fit employees correctly. The laboratory was designed more than 30 years ago and the physical layout of the individual laboratories did not provide areas with flexibility or adjustable work areas. Most of the stations in the laboratory were permanently mounted (fixed) and the bench tops were made of concrete and/or steel. Cabinets under the counter prevented employees from sitting close to some work surfaces. The cabinets forced employees to sit in awkward working positions and their feet did not rest comfortably underneath on the floor. Many sections of the lab were designed to provide safety from chemical and biohazards, stain resistant and flame-retardants. Modifications were made to areas that were considered “clean areas” for paperwork and computer tasks. Adjustments were made to fit these areas to accommodate employees that worked at these stations on a regular basis. One new workstation was purchased for the 3rd floor and the other workstations had minor adjustments at no cost.

Overall, the ergonomic team upgraded over 40 workstations. The team made modifications to workstations such as adjustments to monitors, realignment of the physical lay out, replacement of height adjustable chairs, anti-fatigue mats and footrests. Ergonomic accessories such as headsets, keyboards, document holders, light fixtures, screens to cut glare on the computer, writing instruments and other hand accessories, adjustable work shelves, arm rests, belts for lifting heavy items, etc., were purchased at a
minimal cost. Due to limited funds, every attempt was made to keep down cost and/or modify existing equipment. Two phases were created to prioritize the improvements.

1. Phase I (February 1998): No cost and low cost items, which could be easily implemented, received immediate attention. ($6,100)

2. Phase II (March 1998): Improvements that could be completed in 2-3 months, which included a higher cost, were addressed. (Remaining budget of $13,600)

3. Finally, the short-term successes were defined to build credibility for long-term goals.

Worksites that required more extensive corrections and additional equipment expenditures were identified and submitted by the team to the Steering Committee and Health and Safety Committee for consideration for funding.

Other improvements included creating a central room/library for documents such as pamphlets, literature materials for reference information and catalogs. Some information was kept in the Health and Safety office on site.
DISCUSSION:

The main purpose of this project was to implement elemental principles of an ergonomic program in a laboratory services facility to improve ergonomics and reduce musculoskeletal disorders. The laboratory has implemented improvements and made several changes since the Quality Work Life Effort (QWL) made the recommendations in 1997.

It should be noted that due to the relatively small number of participants in the survey, it might be difficult to draw strong associations or inferences. One limitation of the study findings was the inability to distribute the second survey and compare pre and post responses due to the September 11, 2001 events. The observations were descriptive and no control or comparison groups were involved. The initial survey indicated a number of musculoskeletal risk factors, which appeared to contribute to the health issues experienced by workers in the laboratory. The research supported the conclusion by other researchers that ergonomic risk factors in the workplace can contribute to MSDs (Moore, et. al., 1998; St. Vincent, et. al., 1998; Halperin, et. al., 1997; King, et. al., 1997; Moir, et. al., 1996; Feurstein, et. al., 1998; NIOSH, 1997). However, the results of the survey were cross-sectional and no direct cause can be linked to the risk factors, which were observed.

Research by Melhorn considered the causation of cumulative trauma disorders as multi-factorial. He suggested that “cumulative trauma disorder” was not a medical diagnosis but perhaps a perception of pain (Melhorn, 1998). This point may be considered irrelevant since many studies have been conducted that indicate that MSDs do interfere with the work environment and tend to place an impact on the
well-being of individuals. (NIOSH, 1997) In his work he defined CTDs to involve individual, social and cultural factors, which impact individuals, employers and society. Melhorn stated that current research would have difficulty establishing a diagnosis for every person who experiences pain associated with the workplace. (Melhorn, 1998)

The research conducted by Szabo suggested that carpal tunnel syndrome may be attributed to other factors outside of the workplace such as obesity and age and should not be directly linked to occupational risk factors (Szabo, 1998). He summarized that there may be various causal factors, which contribute to CTS and no single technique is used to diagnose the problem definitively; therefore, more studies should be done. The results of the study conducted at the laboratory did not address the findings of these two researchers. While both researchers suggest there are many causes for MSDs and a large percentage are due to work, other problems may be created due to non-work environments such as sports and household activities which may play a larger role in contributing to the disorders. These are valid points, which demonstrate the need for more research on the emergence of MSDs and the impact of work and non-work related activities.

The analysis performed in this paper did not address the impact of non-work activities on the health of employees. There are no statistical data to measure the strength of the observations and successful outcomes suggested in this program. There was an examination of Worker Compensation claims prior to the intervention, but no analysis was reviewed after the program was completed to measure the impact on disease. 

Employee participation

The problems experienced by employees in the laboratory were unique to the
individual and to the type of work performed by each worker; and interventions need to be tailored to those specific issues. Employee participation was considered to be an essential element of the project as a way of identifying and responding to these issues. Employees provided feedback on the written and oral evaluations that enabled the team to assess the problems experienced. The employee had “first hand” knowledge of their work environment and an ability to provide the best information about the threshold of pain or stress they experienced as it related to their individual work. The involvement of the employees provided feedback to the team and created a sense of empowerment among them.

Ninety five percent of the employees in the laboratory were members of the District 1199 State Employees Union. The high representation of 1199 employees in the project may be due to (1) the statewide Quality Work Life (QWL) initiatives which were instituted and fully supported by the union to save jobs and avoid potential layoffs (2) the encouragement of the inclusion of members throughout the process and (3) the opportunity for the union to attempt to improve the morale its employees. Other unions may not have participated because they were reluctant or intimidated by management. The perception of this fear cannot be confirmed. It is suggested that some employees were apprehensive even when they were informed of the confidentiality and anonymity of the survey. Some employees were skeptical about the outcome. It should be noted that some employees became involved later in the project once they observed the actual changes and improvements taking place in the laboratory.

The purchasing of ergonomically engineered equipment and the modification of workstations strengthened employee confidence and created a sense of credibility and
reality to the goals that the ergonomic team attempted to achieve. The visibility of
posters throughout the building, the accessibility to videos on Ergonomic issues, the
appearances of guest lecturers and a quarterly newsletter reminded employees of the
prevention strategies highlighted in the initial trainings and contributed to their
knowledge and awareness of the risk factors associated with musculoskeletal disorders.
Though not objectively measured, employee morale seemed to improve as a result of the
modifications and the expectation is that work performance may also improve.

In-House expertise

Success of the project was also measured by the establishment of an in-house
ewertise comprised of volunteers who worked at the laboratory. The team was trained
by ergonomic consultants, worked together on work plans, defined the goals of the
project and implemented solutions. The team, guided by a facilitator, strategically
performed the job analyses and carried out the recommendations, which were tracked
throughout the project. The team communicated regularly with the Quality of Work Life
Steering Committee, and served an important role in establishing the improvements that
were made to the laboratory. Building an in-house team of experts at the facility was
convenient and saved money. The team benefited from training and increased knowledge
about ergonomic hazards at their workplace.

The ergonomic team was established as a subcommittee of the Health and Safety
Committee. As a member of the 1199 Health and Safety Committee, I was asked to
organize a team that would examine and analyze the ergonomic issues that employees
experienced. Once the team was established I was nominated as team leader.

The advantage of having team members volunteer to serve and represent different
job assignments is that they are able to bring an expertise to the team that can be utilized in the construction of the project. Volunteers tend to work well because there is a willingness to see the mission realized and become a part of that process. Tapping into the skills of various talents on the team provided an advantage in the ability to broaden the scope of the project and benefit from their field experience, which they have in common with employees.

Team members worked well with one another throughout the course of the project. A key advantage to working with a team from within the facility was the ability to work closely with an employee onsite and to gather information for the research and analysis. Employees provided details regarding their personal experience as it related to ergonomics without hesitation to team members. Employees on the team knew each other from the laboratory, but had never worked together on a project. The QWL effort was responsible for bringing employees together to work on a project for the first time. During the brainstorming sessions, issues were discussed openly among the team members and approved at each meeting. Compromise was the key to the decision-making success.

Efficiency and organization skills were strengthened by trial and error. The team was able to recognize efforts that were hampered by inexperience in Phase 1. In Phase 2 the team learned by example and was able to adapt a different model for success. Time was utilized more efficiently. The advantage of a team comprised of 10 or less people allows the team to brainstorm around certain issues, identify negative and positive outcomes of the project and change strategy within the time frame. If efforts become stagnant the facilitator or team leader was able to recharge the team and recapture the
focus of the project.

As a result of the Ergonomic program and improvements in the laboratory, there has been a spin off to broaden the project to the rest of the Department of Public Health, which is another indication of success. Employees outside of the laboratory, but part of the DPH agency, have requested individual site evaluations. Management has responded positively to the requests and has granted individual evaluations based on recognition and observation of a potential problem by supervisors or managers. Ergonomics issues are considered an important part of the broader Health and Safety Committee.

*Health factors*

Research suggests that the physical and psychosocial factors are associated with musculoskeletal disorders. In the case study questionnaire, we found that employees experienced pain and stress at work on a regular basis. Employees stood for long periods of time and carried out keyboard tasks without taking breaks. Table 3 shows activities involving repetition and lifting were contributors to health problems at work. The findings were consistent with the scientific literature analyzed by NIOSH and others who reviewed the physical and psychological factors that impact the health of employees in the workplace. (NIOSH, 1997; GAO, 1997, NORA (USDHHS), 2001) More studies need to be conducted to further understand and interpret the relationship of MSDs and their impact on health and cost to public and private industry.

*Workstations and other improvements*

Updating workstations was one of the major outcomes as a result of the project. Employees seemed satisfied with the modest improvements that were made to the laboratory. Other employees observed the improvements and became interested in
receiving site evaluations. Management was also satisfied with the changes. It is
difficult to determine if the physical changes once in place had a measurable effect on
work performance. The follow-up questionnaire was not available to address this issue.
It is my observation that the improvements to the laboratory had a positive effect on
employees and their perceptions about their work environment.

To date the laboratory is continuing to expand its technology and management is
considering relocation of the laboratory. The ergonomic technology that was designed
and incorporated in the three laboratories (Virology, Environmental Chemistry and
Biochemistry) as a result of the grant were successful as a pilot project and will be used
as a guideline in the future plans to design or build a new laboratory. The relocation of
the laboratory is considered a strong possibility. It is hoped that management has been
made aware of the importance of ergonomic issues and will incorporate prevention
strategies as part of their future health and safety goals.

*Joint-committee and Labor Management*

The efforts of the joint committee comprised of labor and union employees had a
large impact on the success of the study. Management’s commitment to the efforts made
by the team was an integral part of the success of the project. The balanced composition
of the QWL Steering Committee included managers and union members, who worked
together in the decision making process and achieved positive results. The union was
supportive in the effort and maintained that the interest of the employee should be most
important. The union wanted the project to focus on methods to educate employees
about health and safety issues regarding ergonomics and to provide resources and access
to current information.
It should be mentioned that in 1997, lab employees and other state workforce were targeted for lay offs mandated by the governor and it was the strategic efforts of the 1199 State Employee Union recommending a Quality of Work Life Effort (QWL) that were key in minimizing the loss of jobs in the laboratory. Both sides compromised on some issues regarding the QWL expansion in order to reach the goals of the project.

Difficulties arise when management is not willing to provide enough time for the implementation of reductions of MSDs and prevention strategies. Resolutions for ergonomic improvements are not immediate and take time to develop. The efforts made by the joint committee improved communication and awareness of an important issue to all parties involved and provided a way to achieve success by working together and sharing ideas.

The Ergonomic Standard issued by OSHA under the Clinton administration (and then revoked by Congress under the Bush administration) was a step in the right direction towards providing a policy, which requires employers to be held accountable for the emergence of MSDs that have been associated with the workplace. If a federal standard were in place, the results of this project may have been different. The outcome may have improved the number of participants in the project. Possibly more employees from other unions would have participated and may have presented a different work experience regarding risk exposure due to different job classification and duties. A mandated policy could lead to conformity by employers to establish a healthier and safer environment with ergonomic guidelines in place. In time, if prevention/intervention strategies were in place, worker compensation claims related to MSDs may be reduced and thus lower expenses. The absence of the standard in public service has allowed the issue to continue
to be a low priority in many workplaces. Until the government establishes a policy and mandates basic guidelines for employers, it is likely that cases of MSDs will increase and the cost to eliminate them will continue to rise.

A voluntary approach works well for a small facility, but may limit the number of people that benefit from the improvements initially. This was the experience in the laboratory. The lower rates of disease measured in the BLS reports may be due to underreporting or no claims submitted. Employers continue to address the problem on an as needed individual basis as opposed to making facility-wide improvements that benefit the well being of all employees.

The outcomes of this project were positive and informative. Employees and management were made aware of the impact of risk factors on health outcomes experienced by the workforce. These observations are being considered in future decisions that will be made regarding the laboratory by management. The elemental steps that have been outlined by NIOSH and others were helpful in the process. This case study is a beginning and more can be done to ensure the safety of employees in the laboratory. It is recommended that an on-going approach to ergonomics be established to monitor the health of employees and reduce cost to industry. There are various approaches toward creating an Ergonomic program, which can lead to prevention or the elimination of musculoskeletal disorders. No one approach is the sole solution to the problem. The fact that MSDs are not fully understood and there are multiple risk factors that contribute to the cause of disease warrant the need for more research.
Appendix A: Ergonomic Survey I.

Several risk factors have been identified for cumulative trauma disorders. Some of them are listed below. Please keep these in mind as you complete your survey. Please circle a yes or no response and provide explanations, when necessary.

- Repetition rate for similar movements
- Force demands for pulling, pushing, lifting and gripping
- Awkward postures: postures that are far from the natural resting position
- Static postures: positions held without moving
- Compression of hands, arms and other body parts against handles, edges, etc.
- Fast movements: rapid acceleration of parts of the body
- Vibration, particularly when combined with cold
- Psychological stress, often related to high work demands, low control, and social support
- Fatigue or lack of recovery time

Y  N  Do you do keyboard work at a video display terminal daily?  
   If “Yes”, how many hours?

Y  N  Do you stand for long periods of time at your job?  
   If “Yes”, Do you have a cushioned floor mat or footrest?

Y  N  Does your job involve a lot of repetitive work? (For example, shaking)  
   If “Yes”, please describe:

Y  N  Do you have to hold the same position for long periods of time?

Y  N  Does your job require you to reach above shoulder height frequently?

Y  N  Does your job require you to lift daily?
If "Yes", please check:  
- 5-10 pounds
- 10-15 pounds
- 15-20 pounds
- Over 20 pounds

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>Question</th>
</tr>
</thead>
</table>
|   |   | Do you feel that the lighting in your workstation is adequate?  
   | Y | If "No", do you experience eyestrain, burning, etc.? |

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Do you find your job to be stressful?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Do you have an adjustable chair?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>Question</th>
</tr>
</thead>
</table>
|   |   | Do you experience any of the following symptoms, at least partly related to work: pain, aching, tingling, numbness, burning and/or stiffness?  
   | Y | If "Yes", please describe the symptoms (type, location, etc.) |

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Do you feel that the size of your workstation is adequate for your needs?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>Question</th>
</tr>
</thead>
</table>
|   |   | Are you satisfied with the layout and comfort of your workstation?  
   | Y | If "No", what are some of the problems? |

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Do you feel that you would be better able to perform your job duties if improvements were made to your workstation?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Would you like a personal evaluation of your workstation?</td>
</tr>
</tbody>
</table>

Additional Comments:

Optional: Name ____________________________ Floor __________________
Appendix B: Ergonomic Survey II.

Please circle Yes or No to responses and provide an explanation, when necessary.

Y   N   Were you employed at the laboratory in July, 1996? If not, have you been employed at the laboratory for more than one year?  Y   N

Y   N   Do you stand for long periods? If so, how much time do you stand at your workstation?

Y   N   Does your job involve keyboarding for long periods of time with few breaks? If so, how long? Do you take any break? (Please approximate the number of minutes or hours involved keying.)

Y   N   Do you experience repetitive motions such as vibration or shaking that may be created when doing routine task? If so, what types of motions? Please describe briefly.

Y   N   Do you lift items weighing five or more pounds? Do you use any safety equipment to assist you? Explain.

Y   N   Did you have a site evaluation in the last three years? Were any changes made to your workstation? (Briefly explain.)

Y   N   Have you missed days of work as a result of a muscular disorder such as a backache, neck or joint pain? Was the injury work-related? If so, what explain the type of injury and the approximate time (days) absent related to injury?

Y   N   Have you made changes in the way that you conduct your daily tasks in order to avoid potential injuries or muscle aches? If so, explain briefly.

Y   N   Have you consulted with a medical professional regarding muscle aches and strains such as to the back, neck, joints or carpel tunnel in the last three years? If so, what was the nature of the injury and are there other interventions needed such as services provided by chiropractor or surgery? Please explain:

Additional Comments:

Name_________________________ Floor/Room#________________________ Date______________
Appendix C: Psychosocial Work Environment Assessment  
(Adapted from NIOSH, 1997)

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>S</th>
<th>SD</th>
<th>DK</th>
</tr>
</thead>
<tbody>
<tr>
<td>My job requires that I learn new things.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>My job involves repetitive work.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>My job requires creativity.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>My job requires working very hard.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I have say in decisions.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>My supervisor is concerned about the welfare of those under him/her.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>People I work with take a personal interest in me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>People I work with are helpful in getting the job done.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>My job is secure.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Management cares about me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I am sufficiently informed about developments within the company.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I can easily leave my workplace for a brief period (breaks).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Please circle the number response that accurately describes your feeling about the statement. Strongly Agree (SA) Somewhat Agree (S) Strongly Disagree (SD) Don’t know (DK)/Not Applicable

Additional Comments:
# Appendix D: Ergonomic Work plans

## Work plan #4

**Project site:** DPH State Laboratory  
**Date Prepared:** Dec. 15, 1997

**Goal:** Disbursement of Ergonomic Grant Funds

Prime Responsibility of Team Leaders – S D and L C*

---

## Steps (start with action verb) | Who is responsible? | Target Dates Beg. 1997 | End 1997
---|---|---|---
#1 Contact Mildred and Zelda. Find out if they are still on team? | JC  
SD | 12/15 | 12/22
#2 Develop a cover letter to be sent to all sections with req. form | LH, TB & LH | 12/15 | Ongoing
#3 Create an application for requisitions | LC | 12/15 | Ongoing
#4 Order NIOSH pub 97-117 for team | Team | As soon as possible | 12/22
#5 Check to see if posters are up | SD | 12/15 | 12/22
#6 Discuss possibility of having a 30 minute seminar on back pain | DR | 12/15 | 12/22
#7 Obtain a calendar program and schedule events for Jan and Feb. | SK | 12/15 | 12/22
#8 Prepare newsletter for Jan and Feb. Locate articles on Internet | Team | Ongoing | Ongoing

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* Abbreviation of names in project.

**Next meeting time and Place:** Monday, Dec. 22, 1997, 2-3pm, 2nd Floor Conference Rm.
Appendix D: Ergonomic Work plans

Work plan #11

Project site: DPH State Laboratory  
Date Prepared: April 6, 1998

Goal: Disbursement of Ergonomic Grant Funds

Prime Responsibility of Team Leader – S D *

<table>
<thead>
<tr>
<th>#</th>
<th>Steps (start with action verb)</th>
<th>Who is responsible?</th>
<th>Target Dates Beg. 1998</th>
<th>End 1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Complete count on # of chairs for each room.</td>
<td>Team</td>
<td>4/10</td>
<td>4/13</td>
</tr>
<tr>
<td>#2</td>
<td>Finalize newsletter # 4.</td>
<td>SD and Team</td>
<td>4/10</td>
<td>4/17</td>
</tr>
<tr>
<td>#3</td>
<td>Review Phase 2 of Requisitions with Business Office.</td>
<td>LH</td>
<td>4/13</td>
<td>4/17</td>
</tr>
<tr>
<td>#4</td>
<td>Prepare Educational Project for Lab – Seminar/Speaker</td>
<td>Team</td>
<td>4/6</td>
<td>4/27</td>
</tr>
<tr>
<td>#5</td>
<td>Write Memo to Sections for Requisitions that were not approved</td>
<td>SD</td>
<td>3/1</td>
<td>3/30</td>
</tr>
<tr>
<td>#6</td>
<td>Review and edit Newsletter – Draft (Quarterly)</td>
<td>JC and TB</td>
<td>4/13</td>
<td>Ongoing</td>
</tr>
<tr>
<td>#7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#8</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

* Abbreviation of names in project.

Next meeting time and Place:  
April 13, 1998 (canceled), 1:30 pm, 2nd Floor  
Conference Room.  
April 20, 1998 (rescheduled date)
Appendix E: Requisition for Ergonomic Improvements

MEMORANDUM

Date: January 5, 1998

To: All Laboratory Employees

From: The QWL Ergonomic Team

Subject: Ergonomic Improvements

The Ergonomic Team Committee has been granted funds to upgrade 40 or more workstations. These upgrades can include but not be bounded by improvements that reduce stress from lengthy standing, keyboarding, and other repetitive work activities. We would like your ideas/suggestions for ways to get the highest impact from these funds.

All reasonable recommendations will be seriously considered.

The following criteria are to be used to determine which recommendations are accepted for implementation:

1. Does the equipment improve one or more workstations?
2. In general, does this achieve the QWL goals? Our goals include improving sales, turnaround time, productivity as well as improving the quality of life in the laboratory.
3. How great is the need for improvement being addressed by this request? (low, medium, high)
4. What is the measurable improvement likely to be?
5. Will this require ongoing costs as part of the department budget to maintain once installed?

Your written submission should be on the attached form with the following information:

Describe the recommendation and fill out the attached form. Describe the criteria items #1-5 above mentioned. Please submit your recommendation to:

Present a copy of your recommendations to your immediate supervisor. Your supervisor must know about the recommendations of your area and initial. The deadline for all submissions is January 15, 1998.

Submit form to one of the following Ergonomic Team members:
SD, TB SK (Biosciences)
JC (Chemistry)
LC, MO Toxicology
ZW (Data Processing)
LH, DR (Administration and Support Services)
Appendix E: Requisition for Ergonomic Improvements

Name: __________________________  Date: __________________________
Room: __________________________  Phone: __________________________

Item Description: __________________________

Quantity Requested

Cost Per Item __________  Total Cost: __________

From whom will the item(s) be purchased? (Vendor’s name, address and phone number)

Catalog number: ________________

Justification:
Why do you feel this item should be purchased? (Refer to question 1-5 on the previous page.)

You must give a copy of this form to your supervisor.

Copy given to: ______________________ (Supervisor name) on ______ (date).

Submit form to one of the following Ergonomic Team members:
SD, TB SK (Biosciences)
JC (Chemistry)
LC, MO Toxicology
ZW (Data Processing)
LH, DR (Administration and Support Services)

Deadline for submission is January 15, 1998.

Manager’s Approval: Approved __________  Not approved _________

Date ________________

49
REFERENCES


