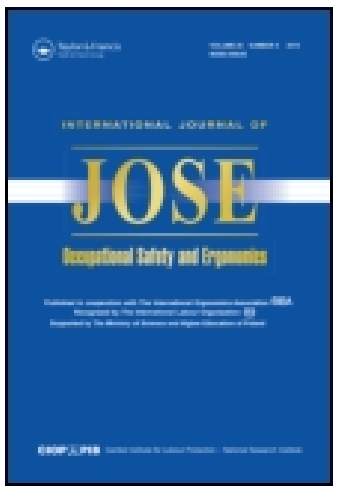

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Ergonomic Program Effectiveness: Ergonomic and Medical Intervention

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Ergonomic Program Effectiveness: Ergonomic and Medical Intervention

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The implementation of a successful ergonomic and medical intervention program designed to reduce the number and severity of injuries and illnesses and the associated levels of discomfort in the workplace is presented. Because of the recent activity concerning the on-again-off-again Occupational Safety and Health Administration (OSHA) Ergonomic Program Standard questions have been raised as to the value and effectiveness of an organization's ergonomics program. In light of these concerns, the immense cost associated with work-related injury and illness, and the related pain and

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suffering associated with such injuries and illnesses, it is important to present a workable and effective ergonomic and medical intervention program. The results of this applied study demonstrate that through the application of an ergonomic and medical intervention program, workplace-related injuries and illnesses can be reduced or eliminated.

ergonomic and medical intervention
cumulative trauma disorders
work-related musculoskeletal disorder
occupational injury and illness

1. INTRODUCTION

The Occupational Safety and Health Administration's (OSHA) Ergonomic Program Standard was put into effect on January 16, 2001. By March 8, 2001, the U.S. House and Senate had repealed the OSHA Ergonomic Program Standard. The Ergonomic Program Standard's stated purpose was to reduce the number and severity of musculoskeletal disorders (MSDs) caused by exposure to risk factors in the workplace (OSHA, 2000). Much debate has risen concerning the value of an ergonomics program as a means of effectively reducing or eliminating occupational injury and illness.

Overexertion injuries and other work-related musculoskeletal disorders (WMSDs), such as lower back pain, carpal tunnel syndrome (CTS), and tendonitis, are the leading cause of work-related disabilities and workers' compensation claims and costs in the USA (Tanaka et al., 1995). Currently, WMSDs account for one third of all occupational injuries and illnesses reported to the Bureau of Labor Statistics (1999) and have been the largest single job-related injury and illness issue in the USA for the last 10 years (OSHA, 2000). MSDs are injuries and illnesses that affect muscles, nerves, tendons, ligaments, joints, or spinal discs (OSHA, 2000). These injuries and illnesses can be caused or aggravated by exposure to ergonomic hazards in an occupational setting.

Total compensable costs associated with musculoskeletal disorders are estimated to be in excess of US $15 bn annually (OSHA, 2000). According to a national survey, 1.6 m workers reported symptoms of hand discomfort from CTS, one of the most serious disabling conditions associated with performing highly repetitive manual work (Tanaka et al., 1995). The lengthiest absence (median = 30 days) reported for any major type of

job-related injury or illness is associated with employees afflicted with CTS (Personick, 1997).

Occupational injuries and illnesses can be divided up into at least five different ergonomic risk categories found in a broad spectrum of occupations:

1. Repetitive motions,
2. Forceful exertions,
3. Awkward working postures,
4. Whole-body or segmental vibration,
5. Localized contact stresses.

Over the last few years, many industries have seen a notable increase in the reporting and diagnosis of WMSDs and other disorders associated with occupational and other injury, illness, and discomfort risk factors. The increase in the reporting of WMSDs did not go unnoticed by some of the chief decision makers at Baylor College of Medicine in Houston, TX, USA. The Director of the Occupational Health Program (OHP) and the Director of the Office of Environmental Safety (OES) solicited an ergonomic consulting contract with the Safety Engineering Program (currently the Health Science Center) at Texas A&M University, College Station, TX, USA. The goal of the consulting contract was to provide the technical expertise needed to establish an ergonomic intervention program that supplemented the medical intervention efforts of the OHP. This article will explain the ergonomic and medical intervention program now in place at Baylor College of Medicine and provide an ergonomic and medical intervention program model that is potentially applicable to any work setting in most any industry.

2. METHODS

2.1. System Overview

Program objectives were laid out and an ergonomic action team, which consisted of a member of Baylor's industrial hygiene staff and a representative of Texas A&M, was established. The entire medical and ergonomic intervention process is depicted in flow charts in Figures 1 and 2. This intervention process is the product of many trial efforts resulting in

a workable and manageable system in response to employee reports of work-related injury or illness. Within each flow chart are different sections representing the diversified components of the intervention program.

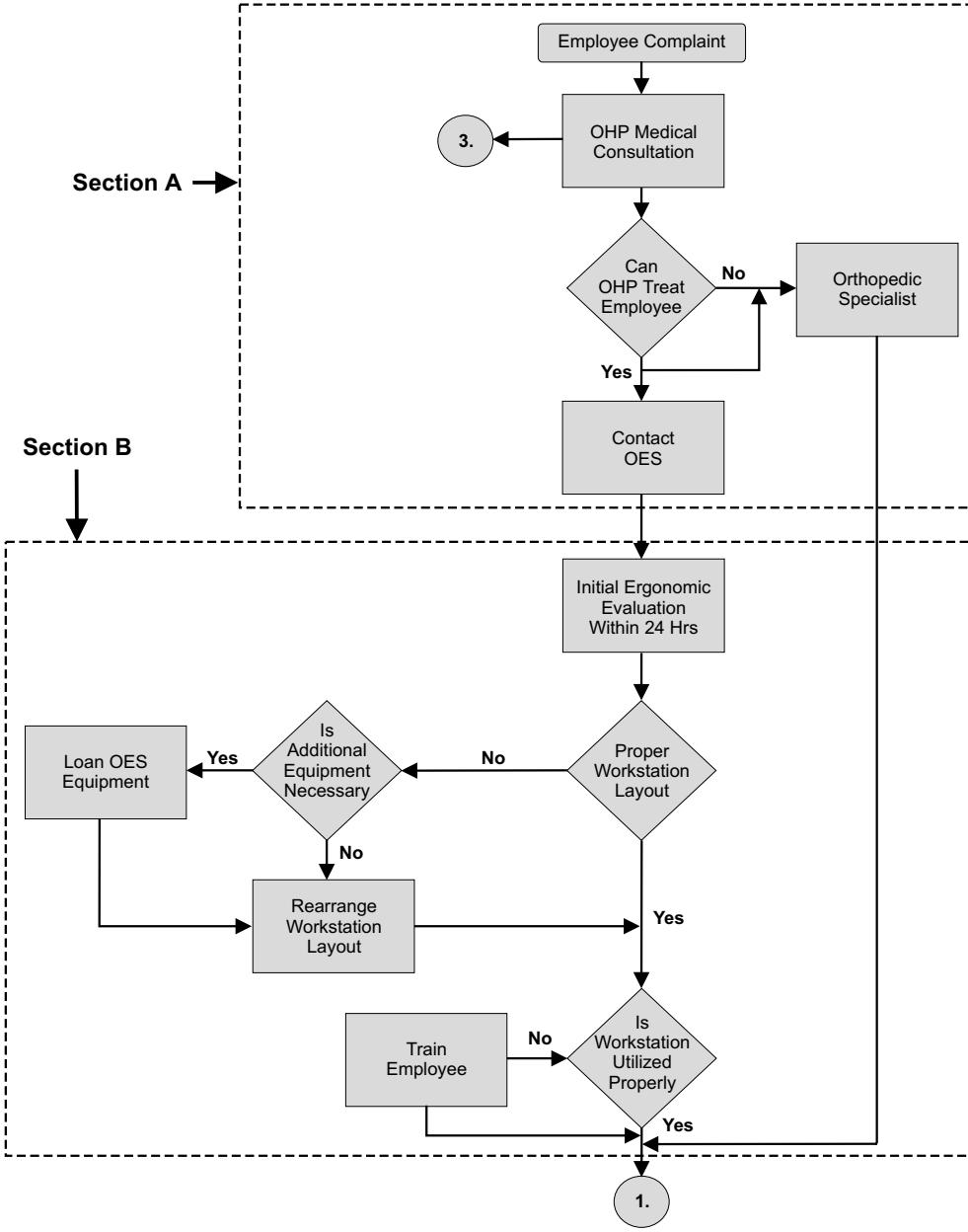


Figure 1. Ergonomic and medical intervention flow chart (part 1). *Notes.* OES—Office of Environmental Safety; OHP—Occupational Health Program.

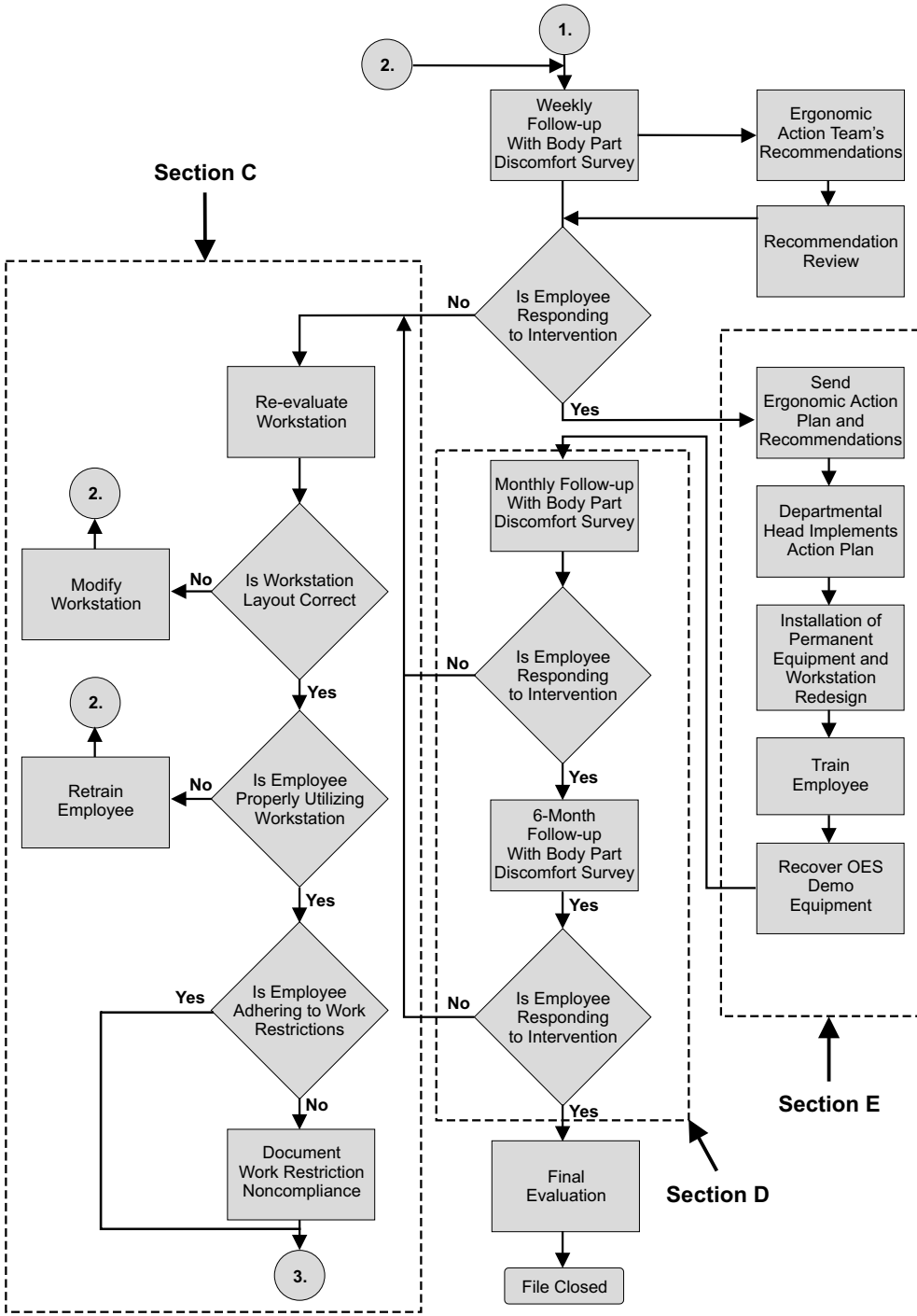


Figure 2. Ergonomic and medical intervention flow chart (part 2). *Notes.* OES—Office of Environmental Safety.

2.2. Medical Consultation

Employees report known or suspected work-related injuries or illnesses to Baylor's OHP. An employee with symptoms or signs of a cumulative trauma disorder (CTD) is initially evaluated in Baylor's Occupational Health Clinic. The occupational medicine physician does not provide an opinion to the third party administrator about the work-relatedness of an injury. While potentially increasing the administrative cost to Baylor, the physician and employee can develop a relationship not altered by the physician being the doctor and also the judge about payment.

At the initial employee evaluation, the employee completes an incident report that is sent to Baylor's Department of Risk Management as well as a brief Occupational/Environmental History (developed during the medical consultation). These documents provide the physician with a summary of the present situation, previous employment, hours worked per week, job requirements, health hazards, personal protective equipment used, hobbies, and previous health-related issues. This information assists the physician in the identification of other sources of cumulative trauma. If the employee's injury or illness appears to be work-related an Ergonomic Hazard Evaluation Data Sheet is completed by the employee and forwarded to Baylor's Office of Environmental Safety (OES). (See section A in Figure 1.)

The occupational medicine physician reviews the completed information and interviews the employee. The employee's symptoms, possible causative factors, previous history of joint or soft tissue injury or disease, and medical problems that could contribute to the injury are reviewed. The examination focuses on the injured body part. The initial visit takes approximately 45 min.

2.3. Medical Intervention

If the occupational health physician concludes that the employee's symptoms can be resolved with brief symptomatic treatment, such as a non-sterodial anti-inflammatory agent or alteration in the workstation or surrounding environment, no referral is made. If the physician believes that longer follow-ups will be necessary or invasive treatment will be required, referral to an appropriate specialist is made. Most referrals are to orthopedists. Possible cervical spine disc herniations are referred to neurosurgery specialists.

Although the employee is referred under workers' compensation, there is no guarantee made to the employee that the claim will be accepted as

work-related. All Baylor College of Medicine employees have insurance, which pays 80% of the cost after the deductible has been met.

If not referred, the employee is given a follow-up appointment with the occupational physician. This is generally the time when brief therapy, such as anti-inflammatory medication, has been completed or the workplace or job duties have been reviewed or modified by the OES. If the employee is without symptoms, no further evaluation may be recommended. If the employee continues to have difficulty further treatment may be prescribed or referral to a specialist may be made. The OHP refers to a specialist when specialized care will be helpful. This Baylor specialist then becomes the treating physician. Although the employee may select a different physician, most accept the referral. Great care is taken to place the referred employee into the care of the new physician within 48 hrs.

2.4. Ergonomic Intervention

The ergonomic intervention process is initiated upon the recommendation of the Occupational Health Program (OHP). This recommendation comes from the occupational physician who performs the medical consultation and determines that the employee's injury or illness may be related to his or her workstation or work area. At this point the Office of Environmental Safety (OES) is contacted and an initial ergonomic evaluation is conducted by the ergonomic action team.

Initially, the scope of the ergonomic intervention program was restricted to only those cases that were referred to the OES by the OHP. This allowed for an opportunity to establish workable policies and procedures and to evaluate the program's effectiveness on a small scale before starting a college-wide ergonomic intervention program.

2.4.1. Initial evaluation

Once the OES has been contacted by the OHP (see section B in Figure 1), the ergonomic action team visits the employee's work area. First, the employee's supervisor is contacted to discuss the purpose of the visit, to explain the ergonomic intervention program's goals, and to invite the supervisor to attend the initial ergonomic evaluation. This method provides the supervisor with an understanding of the employee's injury or illness, possible causation factors, and corrective procedures. This information can

BODY PART DISCOMFORT SURVEY

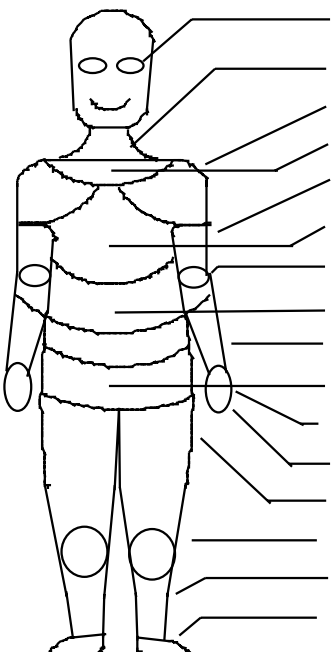
Department Name: Human Resources

Name (Optional): Your Employee **Height (Optional):** 5' 9" **Weight (Optional):** 170 pounds

Job Title: Receptionist II **Job Description:** Data Entry and Phone Duties

Hours on Task: 40 Hours per week **Gender:** (M) F **Date:** January 19, 1999

For each body part on the figure below, place an X in the area that best describes any discomfort you feel. If you have no pain or discomfort for any one of the body parts on the figure, mark an X in the NONE column.



	(None) No Pain	(Just Noticeable) Pain Does Not Restrict Activity	(Some Pain) Restricts Some Activity	(Moderate Pain) Restricts Most Activity	(Intolerable Pain) Restricts All Activity	COMMENTS IF YOU KNOW WHY
EYES	☐	☐	☒	☐	☐	Monitor too far away
NECK	☐	☐	☐	☒	☐	Monitor too high
SHOULDERS	☐	☐	☒	☐	☐	Extended reaching
UPPER BACK	☐	☐	☒	☐	☐	Improper workstation height
UPPER ARM	☐	☒	☐	☐	☐	Extended reaching
MID BACK	☐	☒	☐	☐	☐	Unable to use back rest
ELBOW	☐	☐	☒	☐	☐	Sharp edges on desk
LOWER BACK	☐	☐	☒	☐	☐	No lumber support/adjustment
LOWER ARM	☐	☐	☐	☒	☐	No lower arm support
BUTTOCKS	☐	☒	☐	☐	☐	Uncomfortable seat pan
WRISTS	☐	☐	☐	☐	☒	No wristrest
HANDS	☐	☐	☐	☐	☒	No arm supports
THIGHS	☐	☒	☐	☐	☐	No thigh clearance under desk
KNEES	☐	☒	☐	☐	☐	Sharp edge on chair
LEGS	☐	☒	☐	☐	☐	Seat pan too high
FEET	☐	☒	☐	☐	☐	No foot rest

Figure 3. Example of completed body part discomfort survey.

then be utilized to correct deficiencies with other workstations and educate employees who may not yet be feeling the effects of CTDs.

The initial ergonomic evaluation begins with an interview with the employee. At this time the employee is supplied with a packet of information, which includes a body part discomfort survey, a general environment checklist, a workstation checklist, and a chair feature checklist.

Symptoms of musculoskeletal disorders include localized pain, numbness, tingling, burning, cramping, and stiffness (OSHA, 2000). Body part discomfort surveys have been shown to be beneficial in the analysis of various workstations (Harber et al., 1993; Ryan, 1989). This body part discomfort survey (see Figure 3) allows the employee to indicate areas and levels of pain ranging from none to intolerable pain. The general environment checklist (see Figure 4) provides information concerning the employee's work area, such as temperature, air quality, and noise levels. The workstation checklist (see Figure 4) generates information concerning the employee's desk and computer station. The chair feature checklists (see Figure 5) provide information regarding chair comfort and adjustability.

During the interview, the employee is asked what the injury or illness is and what daily activities cause pain. This is an important part in the process because this interaction allows the action team to develop a rapport with the employee and the supervisor. By establishing a sincere caring attitude, the action team will be able to gain support and commitment from the employee and his or her supervisor for the action team's ergonomic recommendations.

The next step is to observe and videotape the employees at their workstation. The purpose of the videotape is to document the workstation's existing layout, equipment usage, work methods, and procedures. If the layout is improper, the ergonomic action team will rearrange the workstation within the constraints of available equipment. Examples include moving the CPU from a computer workstation to the floor to provide more usable workspace, lowering or raising the VDT to bring the VDT to the proper viewing height, or removing the pencil drawer from the desk to provide more thigh clearance.

If additional equipment is required to remedy ergonomic deficiencies, the OES will loan demo equipment to determine if these interventions will relieve the CTD symptoms. The demo equipment is made available until arrangements are made by the employee's supervisor to purchase the necessary equipment. The demo equipment usually consists of ergonomically designed chairs, foot rests, wrist rests, and document holders.

Name: Your Employee Location: Main Office
Telephone #: 555-1212 Supervisor: Jane Jones

Workstation Checklist

Instructions: Please evaluate your workstation.
Please include a brief description, and possible cause/solution if not satisfactory

Please Return To Dr. Jerome J. Congleton (Mail Stop 3133) When Complete.

THANK YOU !!!

Desk:	Satisfactory ? Circle One		Description
1. Height	Yes	(No)	Too low
2. Thigh Clearance	Yes	(No)	No clearance
3. Wrist Rest	Yes	(No)	Not Provided
4. Organizability (Shelf space, drawer space,	(Yes)	No	
5. Size	(Yes)	No	
6. Foot Rest	Yes	(No)	Not Provided
Terminal:			
1. Screen Glare	(Yes)	No	
2. Screen Angle	(Yes)	No	
3. Screen Height	Yes	(No)	Too High
4. Screen Position	Yes	(No)	Too Far Away
5. Keyboard Height	Yes	(No)	Too Low
6.. Keyboard Position	(Yes)	No	
7. Document Holder	Yes	(No)	Not Provided

Name: Your Employee Location: Main Office
Telephone #: 555-1212 Supervisor: Jane Jones

General Environment

Instructions: Please evaluate your workstation.
Please include a brief description, and possible cause/solution if not satisfactory

Please Return To Dr. Jerome J. Congleton (Mail Stop 3133) When Complete.

THANK YOU !!!

Temperature:	Satisfactory ? Circle One		Description
1. Too Warm	Yes	(No)	AC does not work
2. Too Cool	(Yes)	No	
Air Quality:			
1. Stale or Musty Odor	(Yes)	No	
2. Too Much Cigarette/Cigar/ Pipe smoke	(Yes)	No	No Smoking Allowed
3. Too Dry/Too Humid	(Yes)	No	Just Right
Noise:			
1. Much Too Noisy	(Yes)	No	
2. Tolerable but Distracting	Yes	(No)	Time Stamp
Lighting:			
1. Too Bright	(Yes)	No	
2. Too Dim	Yes	(No)	Bad Lighting

Figure 4. Example of completed general environment and workstation checklists.

Name: Your Employee Location: Main Office
Telephone #: 555-1212 Supervisor: Jane Jones

Chair Feature Checklist II

Instructions: Please evaluate the chair(s) that you use most of the day. Please include a brief description of the type of adjustment mechanism (i.e. knob, lever, twist, pneumatic, etc.).

Please Return To Dr. Jerome J. Congleton (Mail Stop 3133)When Complete

THANK YOU !!!

Adjustability:

	Circle One	Description
1. Seat Pan Height	Yes (No)	Type: Fixed Height
2. Seat Pan Angle	(Yes) No	Type: Lever
3. Backrest Angle	Yes (No)	Type: None
4. Backrest Height	Yes (No)	Type: None
5. Backrest Depth	(Yes) No	Type: Knob
6. Tension Knob	Yes (No)	Type: None
7. Armrest Width	Yes (No)	Type: None
8. Height and Swivel	Yes (No)	Type: None
9. Lumbar Support	Yes (No)	Type: None

Name: Your Employee Location: Main Office
Telephone #: 555-1212 Supervisor: Jane Jones

Chair Feature Checklist II

Instructions: Please evaluate the chair(s) that you use most of the day. Please include a brief description of the type of adjustment mechanism (i.e. knob, lever, twist, pneumatic, etc.).

Please Return To Dr. Jerome J. Congleton (Mail Stop 3133)When Complete

THANK YOU !!!

Adjustability:

	Circle One	Description
1. Seat Pan Height	Yes (No)	Type: Fixed Height
2. Seat Pan Angle	(Yes) No	Type: Lever
3. Backrest Angle	Yes (No)	Type: None
4. Backrest Height	Yes (No)	Type: None
5. Backrest Depth	(Yes) No	Type: Knob
6. Tension Knob	Yes (No)	Type: None
7. Armrest Width	Yes (No)	Type: None
8. Height and Swivel	Yes (No)	Type: None
9. Lumbar Support	Yes (No)	Type: None

Figure 5. Example of completed chair feature checklists.

The principle of loaning demo equipment serves three functions. First, it allows the OES to provide the employee with the necessary equipment immediately. Secondly, it provides an opportunity to determine the effectiveness of the ergonomic interventions. The third function is to allow the employee to try products from several different manufacturers to determine preference.

With the demo equipment in place and a proper workstation layout, the employee training begins. The training consists of explaining the basic concepts and theories behind ergonomics, stress management, proper equipment set-up and usage, proper methods, and procedures for daily activities.

2.4.2. Follow-up

The employee is requested to fill out a body part discomfort survey (BPDS) biweekly and send it to the OES. This provides the ergonomic action team with three pieces of information:

1. Is the employee responding to the medical and ergonomic intervention?
2. Does the employee's condition remain the same?
3. Is the employee's condition worsening? (See section D in Figure 2.)

If the employee's condition does not show improvement, the action team will revisit the employee (see section C in Figure 2) to determine if there is a need for additional training or workstation layout changes. The action team will also investigate to see if the employee is adhering to any work restrictions prescribed by the occupational physician. If not, the employee will be reminded of those restrictions and will be further interviewed to determine why he or she is not adhering to them. Reasons for not adhering to the restrictions may include

1. The employee may not fully understand the restrictions;
2. The employee's normal job duties make the restrictions impossible to obey.

If the action team cannot remedy this situation the immediate supervisor will be notified and corrective action taken.

This process is repeated until the employee shows signs of improvement. If the employee does not respond to the medical and ergonomic interventions, the employee will be requested to visit the OHP for further evaluation.

2.4.3. Recommendations

When the employee begins to demonstrate improvement through the ergonomic interventions, the action team prepares formal recommendations to be reviewed by the OHP. The recommendations usually take the form of training (conducted by OES), purchasing equipment (performed by supervisor), such as an ergonomically designed chair, wrist rest, footrest, or a document holder, and ensuring that the employee returns the body part discomfort surveys to the OES. The approved recommendation along with an Action Plan is forwarded to the employee's supervisor. The Action Plan (example in Figure 6) is a form that lists the recommendations for the employee, a signature box, and a date box. Each Action Plan is generated specifically for each employee and the "Action Required" is tailored to the needs of each employee. The signature box represents accountability to the supervisor for taking the appropriate steps

Name: Your Employee Location: Main Office
Telephone #: 555-1212 Supervisor: Jane Jones

Ergonomic Action Plan

Action Required	Person Assigned	Date	Signature
1) Ensure the employee is trained on how to manage stress and equipment usage	Department Head	1/12/99	John Smith
2) Ensure the employee completes and returns body part discomfort surveys to OES as prescribed.	Department Head	1/12/99	John Smith
3) Obtain one ergonomic chair from the approved ergonomic catalog from the purchasing department.	Department Head	1/12/99	John Smith
4) Obtain one wristrest from the approved ergonomic catalog from the purchasing department.	Department Head	1/12/99	John Smith

Figure 6. Example of completed ergonomic action plan.

necessary to fulfill the recommendations. The date box is an indicator of when this action took place. When all the Action Plan recommendations are complete, a copy is forwarded to the OES to be kept in the employee's file.

When new equipment arrives a member of the ergonomic action team will help install the equipment and train the employee on proper use and adjustment (see section E in Figure 2).

2.4.4. Final evaluation

The follow-up process changes at this point (see section D in Figure 2). The biweekly BPDS are changed to monthly for a period of 3 or 4 months. If the employee continually shows improvement or if the employee completely recovers, a 6-month follow-up and final evaluation will be conducted by the action team and then the file will be closed.

3. RESULTS

3.1. Ergonomic Intervention

Baylor College of Medicine consists of many different departments that range from research laboratories to administrative support centers. This combination provided many different instances where action was requested to provide ergonomic assistance. Due to the variety of job descriptions and employee tasks, the ergonomic intervention effort was not restricted to office ergonomics. Many of the cases referred to the OES were employees involved in research activities. Tables 1 and 2 display the number and severity of the referrals to the OES during the first year.

TABLE 1. Overview of All Laboratory-Related Survey Cases

	Laboratory Survey Cases				
Initial Pain Level	**Cases Closed**	**Condition Improved**	**Condition Stable**	**Condition Worsened**	**Totals**
Intolerable pain	0	0	0	0	**0**
Severe pain	2	1	0	0	**3**
Some pain	3	3	3	0	**9**
Just noticeable pain	0	1	2	0	**3**
TOTALS	**5**	**5**	**5**	**0**	**15**

TABLE 2. Overview of All Office-Related Survey Cases

	Office Survey Cases				
Initial Pain Level	**Cases Closed**	**Condition Improved**	**Condition Stable**	**Condition Worsened**	**Totals**
Intolerable pain	2	1	3* (2)	0	**3* (5)**
Severe pain	0	4	0* (1)	1	**0* (5)**
Some pain	6	6	7* (3)	0	**7* (15)**
Just noticeable pain	0	1	2* (1)	0	**2* (2)**
TOTALS	**8**	**12**	**12* (7)**	**1**	**12* (27)**

Notes. *—new referral.

These tables include all the referred employees to the OES. Some of the entries include employees who were recently referred to the OES and in the intervention process for 2 weeks or less. Many of the employees in the "condition stable" category are employees recently entering the process who have not had sufficient time to respond to the ergonomic or medical interventions. These new referrals are marked with an asterisk and are not included in the descriptive statistics.

The initial pain level indicates the pain level reported by the employee at the first interview by the ergonomic action team. The second column represents the number of referred cases closed. The term "closed" indicates that the ergonomic and medical intervention efforts have completely eliminated the employee's injury, illness, or discomfort associated with his or her job or tasks. The last three columns indicate the effectiveness of the ergonomic intervention efforts by the OES. If an employee is marked as "condition improved," he or she has indicated a reduction of discomfort as measured by the body part discomfort survey. The results of the intervention program as well as the overall program effectiveness are displayed in Table 3.

TABLE 3. Tabular Results in Percentages of Laboratory and Office Personnel

	Results of Intervention Program (%)				
Case Types	**Cases Closed**	**Condition Improved**	**Condition Stable**	**Condition Worsened**	**Sum of Closed Cases and Improved Cases**
Laboratory cases	33	33	33	0	66
Office cases	29	43	25	3	72
Overall Effectiveness	**30**	**40**	**28**	**2**	**70**

3.2. Reduction and Elimination of Symptoms

Table 1 shows the results of the laboratory staff employees in the intervention. Five of the fifteen laboratory cases entered into the program were "closed" (symptoms eliminated), five cases were "improved" (symptoms reduced), and five cases were "stable" (symptoms remain the same at the time of the manuscript preparation and further ergonomic and medical interventions will be conducted), and there were no cases that had "worsened." Table 2 illustrates the same information for the office staff employees in the intervention. Of the 28 office employees involved in the medical and ergonomics intervention (not including the "new referrals"), eight cases were "closed," twelve had "improved," seven remained "stable," and one had "worsened." Overall (Table 3), 30% of the cases had been "closed," 40% of the cases were showing "improvement," 28% were "stable," and 2% had "worsened." "Closed" and "improved" cases accounted for 70% of all the cases.

4. DISCUSSION

The current research demonstrates the potential success of ergonomic and medical intervention programs in reducing and even eliminating work-related injury, illness, and discomfort. Seventy percent of the employees involved in the intervention were either symptom-free, or were becoming symptom-free. The remaining 30% will have increasing levels of ergonomic and medical assistance, as illustrated in the ergonomic and medical flow chart (Figures 1 and 2), until their symptoms have been completely relieved.

The initial purpose of the ergonomic intervention program was to fulfill the OHP requests for workstation evaluations. But as the program grew and policies and procedures were established, it began to take a pro-active approach to the elimination of CTDs. The ergonomic intervention program expanded its initial goal and now includes Professional Development seminars presented to senior department members concerning ergonomics in the workplace and managing stress at computer workstations. These seminars are also presented to middle management supervisors and to employees. With the success of the ergonomic intervention program the Director of the OES incorporated ergonomic training into new employee orientation.

The ergonomic and medical intervention program described in this study includes rapid initial medical and ergonomic evaluation, employee and management training, workstation design or redesign (with improved equipment

if needed), frequent follow-up and re-evaluation, medical intervention, management involvement and responsibility, and record-keeping. The current ergonomic and medical program model presented would be potentially applicable to any work setting in most any industry. For an ergonomic program to be effective, it should, at a minimum, contain the elements contained in the now repealed OSHA Ergonomics Program Standard (OSHA, 2000). Additionally, ergonomic programs should be flexible and evolve to manage not just occupational risk factors, but others including the personal, non-occupational, and psychosocial risk factors as well.

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