15 May 2002

Naval Facilities Engineering Command
Ergonomic Risk Assessment for
Medical Center

Pharmacy – Dental Clinic - Ophthalmology

INTRODUCTION

This report summarizes the ergonomic risk assessment conducted at the al Medical Center June of 2001. The Naval Medical Center is part of a pilot project funded by the Chief of Naval Operations Hazard Abatement Program to improve occupational health and safety by implementing various ergonomic interventions. Three areas were observed: the Pharmacy, the Dental Clinic, and the Ophthalmology Clinic. This assessment is based upon interviews with workers, supervisors, industrial hygienists, and safety personnel, and on an evaluation by a Navy Ergonomist.

The risk assessment was conducted in conjunction with the Job Requirements and Physical Demands Survey (JR/PD) distributed to the Pharmacy Department, Dental Clinic, and Ophthalmology Clinic. The JR/PD is an ergonomic survey designed to assess ergonomic risk in the workplace. The JR/PD assesses risk in five body regions: Head/Eyes, Shoulder/Neck, Back/Torso, Hand/Wrist/Arm, and Leg/Foot. Appendixes A and B contain summaries of the JR/PD results for the Pharmacy Department and the Dental Clinic. Analysis in the Ophthalmology Clinic was not completed because of inadequate cooperation.

The JR/PD Overall Job Priority score is determined by selecting the human body region with the highest risk value based upon ergonomic risk factors and worker discomfort. An Overall Job Priority score of five or greater, on a scale of one to nine, establishes a task/job as an ergonomic problem area (ERPA).

The results of the JR/PD indicate the Pharmacy is an ergonomic problem area with an overall score of five. The Pharmacy operations introduce the risk of work-related musculoskeletal disorders (WMSDs) associated with the Hand/Arm/Wrist, Leg/Foot, Head/Eye, and Shoulder/Neck body regions.

Although the results of the JR/PD indicate the Dental Clinic is not an ergonomic problem area (with an overall score of three), musculoskeletal disorders among personnel in the dentistry profession are the leading cause of early retirement. Therefore, recommendations for reducing the risk of injury in the dental clinic are included.

Musculoskeletal Disorders (MSDs) are injuries and illnesses that affect muscles, nerves, tendons, ligaments, joints, spinal discs, skin, subcutaneous tissues, blood vessels, and bones. Work-related Musculoskeletal Disorders (WMSDs) are:

- Musculoskeletal disorders to which the work environment and the performance of work contribute significantly, or

- Musculoskeletal disorders that are aggravated or prolonged by work conditions.

The Pharmacy and Dental Clinic present opportunities to reduce the risk of WMSDs. Recommendations to the command to reduce the probability of injury include considering equipment purchase,[1] redesigning processes, and implementing administrative controls.[2]

Representative vendor information[3] is included in the recommendations to assist in the evaluation of products and services. Recommendations to the command include gathering input from the workers, safety specialists, occupational health professionals and other personnel to evaluate equipment before purchasing. This process will increase product acceptance, test product usability and durability, and take advantage of worker experience.

PHARMACY DEPARTMENT

Purpose of the Operation

Processing medication requests, batching medications, and performing quality control from the automated-fill system on completed medication requests.

Population

The pharmacy department employs one hundred personnel over three shifts.

Injury Data

None available.

Description of the Operation--Processing Medication Requests

The pharmacy department processes approximately 8,000 prescriptions per day through the walk-up windows or kiosk stations shown in Photo 1. The procedure and time required to process prescriptions varies with the type and quantity of medication. Narcotic medications have an extended process time due to strict control procedures. Workers process one client in approximately 10 minutes. The client flow is constant.

After the workers process the paperwork, they retrieve the various medications, count out medication quantities (if applicable), and label bottles. As seen in Photo 2, to retrieve medications workers must sometimes reach heights up to 74 inches or bend down to 10 inches above the floor. In addition to the long vertical reaches, workers must reach past the workstation top.

Workers at the kiosk stations stand all day. Current policy allows workers to wear soft-soled shoes for comfort.

Photo 1:
Kiosk prescription / client workstation

Photo 2: Workers reaching for medication

Ergonomic Issue Description

The major ergonomic risk factors for the processing of medication requests are awkward postures (with excessive reaching) and prolonged standing. Stress associated with constant client flow and the language barrier between some clients and workers compounds ergonomic risk. Stress is a contributing factor for WMSDs.

Awkward Postures. Extended reaches are examples of awkward postures that require the body to deviate from the neutral in the arms, shoulders, and back. Repeatedly performing tasks in such positions imposes increased stress on the joints and/or spinal discs. Injuries result when stressed muscles do not have adequate time to rest and recover. The Back/Torso discomfort found in the JR/PD may be a product of the continual reaching and bending.

Prolonged Standing. Workers stand for the entire day. Standing for long periods can be a strenuous activity that promotes blood pooling in the legs and feet and has been known to produce discomfort and fatigue. Leg/Foot discomfort indicated in the JR/PD may be a result of prolonged standing.

Recommendations

- Encourage workers to take stretching breaks during the day to relieve discomfort and encourage muscle movement[2]. The following web sites include exercises that can be printed and posted. Sources should be cited when reproducing information. Web site links updated Jan 2002.

  http://www.steelcase.com/servlet/ToolsInsightsServlet?ACTION=5&CONTENT_ID=202

  www.shelterpub.com/_fitness/_office_fitness_clinic/OFC_online_stretches.html

  http://www.ucsc.edu/opers/wellness/pages/officestretches.html

  www.safety.duke.edu/Ergonomics/90_seconds.htm

- Encourage workers to wear soft-soled shoes to reduce fatigue and discomfort.

- Provide workers with sit/stand chairs. A sit/stand chair provides the support of a chair while giving the user the mobility and reach associated with standing. Workers could reduce fatigue and improve blood flow by using sit/stand chairs. Workers should alternate between sitting and standing. Footrests or foot bars should be provided to facilitate changing of the supporting leg when standing.

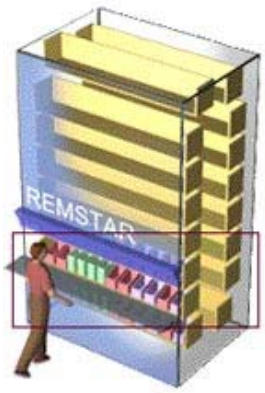
- Provide an automated retrieval system to eliminate bending and reaching and the associated risk of errors by delivering the specific medication to the worker at a natural standing height. Automated retrieval systems save space and time for medication retrieval and also eliminate the bending and reaching associated with restocking medications. This is the preferred intervention.

- If feasible, process common medication through the existing automated-fill system.

- Stock medication no higher than shoulder height and no lower then knee height (approximately 48” to 20”). If medication must be stored outside this range, provide step stools that move easily.

Table 1: Representative Products for Processing Medication Requests

Description	Vendor	Product	Est Cost	Figure

Description	Vendor	Product	Est Cost	Figure
Automated retrieval System	Remstar (800) 639-5805	Vertical Carousel Retrieval System	Varies with number of modules, software and customi-zation	
Sit/Stand Chairs				
	Alimed 1-800-225-2610	Portable Sit/Stand	$300	
	Alimed 1-800-225-2610	Stand Stool RA75195	$300	
	Global Industrial 1-800-645-1233	Lyon Sit-Stand Stool XF244849	$223	
	C&H 1-800-336-1331	Lyon Sit-Stand Stool 41-186D	$219	
	C&H 1-800-336-1331	Workspace Sit/Stand Stool 41-340A	$190	
	Lab Safety and Supply 1-800-356-0783	Lyon Sit-Stand Stool OM-27282	$221	

Description of the Operation--Compounding Station (Batching Medication

Workers in the compounding station generate lotion compounds. The resultant mixture weighs 25 pounds. After combining the ingredients, the worker lifts the 25-pound mixture above shoulder height to fill the dispensing hopper, as shown in Photo 3. While supporting the bowl weight, the worker stands on a step stool to scrape the compound into the hopper. The step stool is shown in Photo 4.

Photo 3: Worker lifts 25 pounds above shoulder height to fill hopper

Photo 4: Step stool on which worker stands while lifting 25 pounds

Ergonomic Issue Description

Lifting the batching compound places the workers at risk of injury from forceful exertions. Forceful exertions can place high loads on the muscles, tendons, ligaments, and joints being used. Prolonged or frequent exertions of this type can lead to WMSDs when there is not adequate time for rest and recovery. Additionally, a worker can easily slip and fall from the step stool while supporting the bowl during scraping.

Recommendations

- Provide a lift table for the dispensing hopper. The table will lower the hopper to table height for the workers to transfer the compound from the bowl into the hopper by resting the bowl on the adjoining table. The lift table can then be elevated for the dispensing process.

Table 2: Representative Products for Compounding Station

Description	Vendor	Product	Est Cost	Figure
Scissors Lift Table				
Scissors Lift Table	Vestil Manufacturing 219 665 7586	Portable Scissors lift Table	$2851-3098	

Description	Vendor	Product	Est Cost	Figure
Scissors Lift Table	Lab Safety 1-800-356-0783	Scissors Lift Table Presto Mobile Scissors Lift Bishamon Mobile Scissor Lift Table	$2800-$4000	

Description of the Operation--Quality Control

Workers in the quality control area check medications dispensed by the automated-fill system. The medication, in a tray on a conveyor, stops in front of the worker. The worker scans the label, and the medication name and photo displays on the computer screen. The worker then opens the medication bottle and visually compares the name and photo to the medication in the bottle. The worker then closes the medication bottle. Photo 5 shows a quality control workstation. This cycle repeats approximately 4 times per minute, 240 times per hour, or 1920 times a day. A worker can typically perform close to 4000 twisting motions to open and close medication bottles during an average day.

Ergonomic Issue Description

The major ergonomic risk factor for the quality control area is repetitive hand and arm motions and awkward postures. Additionally, stools in the quality control area provide insufficient back support for the workers.

Photo 5:
Quality Control Station

Repetitive Motions and Awkward Postures. The quality control task is highly repetitive due to the sheer volume of medications. Workers perform thousands of repetitive motions each day. In addition, the workers perform this task in awkward or unsupported postures.

Motions repeated with little variation may cause fatigue and overuse of the muscles, tendons, and joints that are involved. Overuse leads to muscle strain, inflammation of joints and tendons, and increased pressure on nerves, which eventually leads to pain and discomfort.

A worker performing this task over an 8-hour day exceeds the recommended Hand Activity Level--Threshold Limit Value from the

American Conference of Governmental Industrial Hygienists 2000 TLV and BEI guidelines. The guideline recommends controls for exposure above the TLV to reduce the risk of WMSDs.

Performing repetitive motions in awkward postures (e.g., arms unsupported, back not resting against a back support, feet dangling) adds significantly to the muscular effort required to perform each motion. The added force hastens the onset of fatigue and increases the likelihood of injury from overuse. The joints are most susceptible to repetitive motion injuries, especially the wrists, fingers, shoulders, and elbows. The combination of these risk factors and little variation in the task may contribute to the hand/wrist/arm discomfort reported in the JR/PD results.

Recommendations

- Implement worker rotation for the quality control task to reduce exposure. For example, rotate workers every two hours to a task that uses different muscle groups.

- Provide a new seat for the quality control station. Due to the height of the quality control station, a lab stool is preferred. The stool must have an adjustable backrest with lumbar support, height adjustability, and a height-adjustable foot ring.

- The prescription bottle screw top exposes the worker to a repetitive twisting and wringing motion. Provide each worker with an assistive device to open the bottles.

- If feasible, program the auto-fill system to attach the non-child resistant side of the top. Quality control can then change the top orientation after inspection.

- Engineer a custom-designed bottle opener. The device would open the bottle, separating the cap from the bottom with enough clearance for the worker to view the medication. The device would then close the bottle. The automated system would eliminate awkward postures and repetitive twisting motions. NAVFACENGCOM is available to consult on a custom designed bottle opener.

Table 3: Representative Products for Quality Control

Description	Vendor	Product	Estimated Cost	Figure
Bottle Opener--manual assist	Life Products	Oxo Good Grips Opener		
Electric Bottle Opener	Independent Living Products	Open-Up	42.00	
Bottle Opener--manual assist	Freedom Living Devices	Rubber Lid Gripper	3	
Bottle Opener--manual assist	Freedom Living Devices	Deluxe Jar Opener (Zim Jar Opener)	16.00	
Bottle Opener--manual assist	Freedom Living Devices	Multi Purpose Jar Wrench	9.00	

Description	Vendor	Product	Estimated Cost	Figure
Laboratory Stools				
	Global Industrial 1-800-645-1232	Effortless Stool--completely adjustable XF252374 Casters optional	$252	
	C&H 1-800-558-9966	Workspace, Bevco, and Krueger Stools	$226-$243	
	Lab Safety and Supply 1-800-356-0783	Biofit and Bevco	$206-322	

DENTAL CLINIC

Purpose of the Operation

Provide preventive and restorative care for patients' teeth. Note: A dental hygienist and a doctor were interviewed. Due to patient confidentiality, the procedures were not observed.

Population

Seventy-seven personnel work in the dental clinic.

Injury Data

None available.

Description of the Operation

In a typical cleaning procedure, the dental hygienist seats the patient and moves the chair into a working position. The hygienist sits in a work chair while performing all the teeth cleaning procedures, as shown in Photo 6. Using different tools, the hygienist first inspects the patient's mouth to assess the integrity of the teeth and gums and to

determine the amount of work necessary to scale and polish the teeth. Most dental tools have narrow handles, which require a pinch grip to use. A pinch grip, which is similar to the grip used to hold a pencil, requires the grip force to be applied over a small surface area.

Following the inspection, the hygienist scales the teeth using a thin scraping tool. This task requires from 25 to 30 minutes per patient. The hygienist removes plaque and tartar from the patient's teeth with the scaling tool. Working with the neck and back flexed forward and arms unsupported, the hygienist is in an awkward posture for up to 240 minutes (4 hours) a day while scaling teeth.

Photo 6:
Dental Hygienist Cleaning Teeth

The hygienist next uses an electric vibrating tool to polish the teeth for approximately 10-15 minutes per patient. During the polishing procedures, the hygienist maintains the same basic hand movements and body posture as associated with the scaling task. After the polishing is completed, the dental hygienist sanitizes the workstation and tools to prepare for another patient.

Ergonomic Issue Description

Repetitive Motions and Awkward Postures. The major ergonomic risk factors for the dental staff are repetitive hand and arm motions in awkward, unsupported postures and contact stress from grasping tools while applying force. The tasks also have high visual demands, which require workers to assume fixed postures for extended periods of time. In addition, non-neutral postures are often required to gain manual and visual access to the patient's mouth. Although working positions change depending on the part of the mouth and tooth surface being worked on, flexion and rotation of the neck and trunk are maintained throughout most tasks.

Contact stress. Tool design is often the cause of contact stress such as gripping small handles with edges that press into the skin. When tool handles or grips are too small or too big, workers must exert greater force to operate the tools because such handles reduce hand strength or grip capacity. The force required to hold the tool is compounded by the force required to complete the task. For example, operating certain dental tools such as scalers may require the exertion of considerable force and result in high pressure on the fingers and hand. This is because such tools have very small handles, typically narrower than a pen, and are used to scrape material from the teeth. As a result, the primary and support muscles used for grasping are constantly active or statically loaded. Studies have linked forceful grips, and grips performed in awkward postures, to musculoskeletal disorders like DeQuevain's syndrome, arthritis, tendonitis, and carpal tunnel syndrome.

Repetitive Motions in Static Postures. The chief complaint people usually make when they have worked for a long time in the same position is that they feel ‘‘stiff, sore, and tired.’’ These are some of the effects of working in static postures.

Static postures are positions that are held for extended periods. Static postures put increased loads or forces on the muscles and tendons needed to maintain those postures, which contributes to fatigue. Muscles require movement in order to allow blood flow. Blood flow brings nutrients to the muscles and carries away the waste products of muscle metabolism. Examples of static postures for the dental clinic include gripping tools tightly, grasping tools that cannot be put down, holding the neck flexed forward, and holding the hands away from the body for prolonged periods. In the dental clinic, static postures can be combined with awkward postures, such as back bent forward, torso twisted. The combination of these risk factors, frequency, and duration of the exposures places the dental clinic workers at risk of developing WMSDs.

Recommendations

- Provide a chair with a lean support, as detailed in Table 4, which would virtually eliminate awkward, unsupported postures. The chair provides support to the arms thus reducing stress on the back and shoulders. The chair allows the worker to lean forward without flexing the neck. A study by Duke University using the lean chairs in dental settings found an overall decrease in both frequency and severity of discomfort in the head, neck, low back, and shoulders.

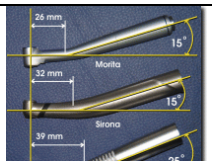
- Provide high powered magnifying glasses (loops). Magnifying the work area allows the doctor and hygienist to adequately view the work area without leaning forward. The loops help the worker maintain a neutral neck and back posture.

- Try tools with various sized grips and handle material to reduce the contact stress caused by the present small-diameter metal tools. Because workers do not all have the same size hands and grip strength, they should be allowed to select personalized tools. Having a varied tool selection during procedures is also suggested, so that workers can alternate gripping strengths. For some procedures, sonic or air driven tools can replace manual tools to reduce time in awkward postures and the force required to perform the task. In experiments with new tools, the following should be considered: overall tool and handle size and shape; weight; balance; maneuverability; ease of operation; and ease of maintenance. Hand tools with hollow or resin handles are preferred. For tools with shaped edges, round or compressible handles and carbon steel construction are preferred. For automated hand pieces, consideration should be given to lightweight, balanced models offering sufficient power; built-in light source; pliable and lightweight hoses; 360-degree swivel mechanisms; easy activation; and easy maintenance. The shape of the shank--angled or straight--should also be considered.

- Dental procedures are performed in a narrow space with reduced visibility. If the patient is anxious, the stress on the doctor and assistant may be increased. In

this interactive environment, positioning the delivery system closer to the patient and doctor would reduce the deviation in the arms and shoulders caused by reaching for equipment or fighting to bend cables that are inadequate in length. Also, positioning equipment closer to the doctor's line of sight would reduce search time when locating tools. Flexible or movable delivery systems would allow the doctor and the assistant to change position without increasing the reaching distance for tools / equipment.

Table 3: Representative Products for Dental Clinic

Description	Vendor	Product	Est Cost	Figure
Lean Chair				
	Hag (312)321-0761 (312)670-0276	Capisco	$442	
Dental Tools	Design by Feel (Morita)	Elevator #2; #5		
	Design by Feel	Hand pieces		
	W & H Dentalwerk 43/6274/6236-0	(Synea LS) Hand pieces		
	Marie Reiko 775.849.3477	Scaler or curette		

Description	Vendor	Product	Est Cost	Figure
	Burkhart Dental Supply (Dental EZ Group_ 619-565-6510	Scalers		
Delivery System	Ox Care - ODONTO-WAVE 970 490 6120	Interga Delivery System		
	Danse (705) 445-6782	Coborn Delivery Systems		

OPHTHALMOLOGY

Purpose of the Operation

Use of the refracting equipment to check vision was the only operation reviewed.

Population

No data.

Injury Data

None available.

Description of the Operation

After the initial exam, the macro refracting equipment is positioned in front of the patient. The doctor changes lenses by turning dials until the patient indicates that vision is clear or improved.

Ergonomic Issue Description

The doctor performs this task for a varied amount of time depending on the patient's response but usually for no longer than 2 minutes. The doctor can rest between settings. This task poses a minimal risk of injury.

Notes

[1] Equipment purchase without proper and repeated training will not mitigate risk and may in fact increase hazards.

[2] Administrative controls are management-controlled work practices and policies designed to reduce exposures to work-related musculoskeletal disorders (WMSDs) hazards by changing the way work is assigned or scheduled. Administrative controls reduce the exposure to ergonomic stressors and thus reduce the cumulative dose to any one worker. Examples of administrative controls that are used in the ergonomics context are employee rotation, employer-authorized changes in the pace of work, and team lifting.

[3] This report does not constitute an endorsement of any particular product. Rather, it is a recitation of how Navy personnel have addressed a particular work place safety issue. Neither the Navy nor its employees and agents warrant any product described in this report for any use, either general or particular.

Appendix A, B, C

Job Requirements and Physical Demands Survey
DELETED FOR WEB POSTING