

Naval Facilities Engineering Command Ergonomic Risk Assessment

Introduction

This report summarizes the ergonomic risk assessment conducted in November of 2004. The Phlebotomy, Automated, Microbiology, Cytology, Grossing, Serology, and Transfusion labs were observed. The Phlebotomy and Automated Labs contained the greatest areas for improvement, but many of the recommendations can be transferred to the other labs. This assessment is based upon interviews with supervisor, safety personnel, and employees as well as an evaluation by the Naval Facilities Engineering Command (NAVFACENGCOM) Hazard Abatement Ergonomist.

The laboratories were observed in order to determine sources of ergonomics stress and make recommendations to reduce the risk of work-related musculoskeletal disorders (WMSDs) and improve safety, health and productivity. 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.

Recommendations for the command to further reduce the probability of injury include new equipmentⁱ and administrative controlsⁱⁱ. Recommendations are included with as much vendor informationⁱⁱⁱ as possible to assist in the evaluation of products and services. Input gathered from the workers, safety specialists, and other personnel to evaluate equipment before purchasing is recommended. This process will increase product acceptance, test product usability and durability, and take advantage of employee experience.

Hazard Abatement and Mishap Prevention projects can be submitted for fiscal year 2006 funding consideration if received by February 28 2005. Naval Facilities Engineering Command (NAVFACENGCOM) manages the Hazard Abatement and Mishap Prevention Program (HAMP), which is a centrally managed fund to correct safety and health deficiencies beyond the funding capabilities of the activity. Information about the HAMP program can be found on the Naval Facilities Engineering Command web site www.navfac.navy.mil/safety and in OPNAVINST 5100.23F. Ch 12 Hazard Abatement.

Phlebotomy

Purpose of the Operation: Responsible for drawing blood for testing

Population: 12 active duty and 6 civilians

Injury Data: Workers reported back and hand pain

Description of the Operation:

Patients take a number as they arrive. As their number comes up, a technician calls them into the blood drawing area. The technician asks the patient for their identification, which is inputted into the computer to generate labels. To draw blood, the technician retrieves a needle, applies a tourniquet, cleans the arm with alcohol and draws the blood sample. Figure 1 shows employees demonstrating the blood drawing procedure. Each worker sees up to 60 patients a day. A patient can take anywhere from 2 minutes (to draw one tube of blood) to 30 minutes (to draw 18 tubes). For patients with difficult veins, two employees are required. In order to hold the patient's arm downward to allow for blood to pool, one employee kneels on the ground while another sits in a stool, figure 2. If the patient starts to faint or slide down in their chair the phlebotomist tries to catch them or stop their fall with their knee. Drawing blood requires repetitive hand movements, applying pressure, and awkward back postures.



Figure 1: Drawing blood



Figure 2: A difficult draw

The employees' primary concern is the workstation configuration. Each blood drawing area has a computer workstation with storage shelves, figure 3. Phlebotomists place tubes of blood on the keyboard tray due to a lack of space. The keyboard tray has a sharp edge which puts compressive force on the worker's forearms, figure 4. Many of the workers complained of hand and wrist problems they feel are associated with computer use. Blood drawing is a hand intensive operation with a lot of repetition which may contribute to any pain or discomfort in the upper extremities.



Figure 3: Workstation



Figure 4: Computer keyboard

Ergonomic issue description:

The blood drawing operations requires repetitive hand motions and awkward postures. The employees are also exposed to contact stress to the forearm.

Awkward Postures: Employees drawing blood are frequently bent over placing them in an awkward posture. Phlebotomists draw blood repeatedly throughout the day and occasionally for up to 30 minutes with little movement or change in posture. Risk of injury from awkward postures is increased when combined with repetition or duration. Sustained awkward postures can irritate tendons/muscles and restrict blood flow or nerve conduction leading to fatigue and possible damage to the musculoskeletal and nervous systems. Holding a posture keeps muscles in a sustained contraction which prevents blood from providing nutrients or removing waste products. A build up of waste products or lactic acid in the muscle can lead to fatigue and discomfort.

Contact Stress: The edge of the keyboard tray causes contact stress on the forearms of the workers. Contact stress can restrict blood flow and hinder nerve conduction which can contribute to or cause WMSDs.

Recommendations




- ∞ Provide employees with chairs that support the upper torso. Employees should be allowed to test chairs to ensure the chairs are feasible and the worker can still get up and down easily. Most vendors are willing to loan chairs for a trial period. Refer to table 1 for vendor information.
- ∞ Replace the pull-out keyboard trays with adjustable keyboard trays with a flat surface to reduce contact stress. In the mean time pad the edge of the tray with a cushioned material. The Microbiology lab would also benefit from keyboard trays to promote neutral wrist postures and reduce contact stress while entering data.





- ∞ Encourage the workers to stretch between patients to promote blood flow to the hands and reduce muscle fatigue. Physical Therapy should be able to provide exercises specific to the tasks being performed. The following web sites include exercises that can be printed and posted. Sources should be cited when reproducing information. Web site links updated December 2004.

<http://www.steelcase.com/na/knowledgedesign.aspx?f=10250&c=10213>

www.shelterpub.com/fitness/office_fitness_clinic/OFC_online_stretches.html

www.safety.duke.edu/Ergonomics/90seconds.asp

Table 1: Phlebotomy Equipment				
Description	Vendor	Product	Estimated Cost	Figure
Chairs	Alimed 1-800-225-2610	2966Advantage Surgeon's Chair JA93-1001	\$2,495 (chair) \$599 (armrests)	
	Hag www.haginc.com Ken Krauss/Bonnie Momsen Chicago, IL (312)321-0761	Hag Capisco*	\$442	
	ErgoResource Charles Hartman (919) 661-0300 (GSA Contract)	Hag Capisco*- Vinyl Cover Seat Height Adjusts from 16" to 20" Seat Height adjusts from 20" to 27" (ideal for bench work)	\$436.25 \$445.74	
	Cessi Ergonomics 410-315-9360	Neutral posture Ab-stool	\$336	

				
	KAB Dental 1-800-422-3520	Galaxy Assistant Stool	\$250	
Keyboard Trays	Alimed 1-800-225-2610	E2 Lever-free Keyboard Tray	\$144	
	Ergonomic Concepts	GSA item CI-810-REF \$111	\$111	
	Work-rite www.wrea.com	Contact GSA for pricing		



*The Capisco can be straddled and used to support the chest and upper extremities.

Automated Lab

Purpose of the Operation: Analyze patient samples

Population: 15 civilians and active-duty personnel

Injury Data: Not reported

Description of the Operation:

The Automated area includes Hematology, Urinalysis, and Chemistry where blood, urine and other bodily fluids are analyzed. Workers spend the entire day using microscopes to analyze slides for disease. Workers manually read differentials and enter the data into the numeric keypad portion of the computer, figure 5. Employees using microscopes tend to lean forward and bend their neck rather than lean against the back of the chair for support. The workers also rest their arms on the edge of the desk which can create contact stress. A number of other laboratories at the hospital have microscope workstations with similar issues that would benefit from the same recommendations.



Figure 5: Entering differentials

Employees in the Automated Laboratory as well as other laboratories such as Transfusion use saline cubes. Saline cubes contain isotonic saline that weigh up to 40 lbs. Saline cubes are stored on the floor, figure 6, as well as on shelving and filing cabinets up to 60" from the floor, figure 7. Saline cubes are changed out anywhere from weekly to twice a day depending on the lab use. Employees will even take a rolling task chair to the supply area to retrieve the saline cubes and roll the chair and cube back to the lab.



Figure 6: Cubes stored on the floor

Figure 7: Cubes stored on top of filing cabinets.

Workers also perform testing at standing workstations while monitoring equipment. Standing for long periods can cause fatigue in the lower extremities and back. Standing operations were also noted in the Microbiology area.

Ergonomic issue description:

Workers in the Automated laboratory spend long hours using microscopes in awkward postures and performing repetitive data entry. The saline cubes also require heavy lifting and some of the analysis machines require prolonged standing.

Awkward Postures: Microscopes are designed to maximize viewing capabilities rather than user comfort. Ergonomic stressors associated with microscope use include neck inclinations, bent back postures, non-neutral arm positions, wrist deviations, and contact stress to the forearms and elbows. While short-term microscope use can be tolerated, sustained awkward postures can cause fatigue and discomfort and place the employee at risk of developing a WMSD. Microscope work is also visually demanding task that requires workers to bend over the eyepiece. These postures can irritate soft tissues such as muscles, ligaments, and spinal discs.

Contact Stress: The edge of the desk may cause contact stress to the forearms of the workers. Contact stress results from compression of the soft tissue by a hard object. A concentrated force can reduce blood flow and nerve transmission.

Heavy Lifting:

Lifting saline cubes is strenuous activity. Heavy lifting can place stress on the back and upper extremities. Awkward postures such as twisting of the back and lifting above shoulder height can increase stress to the spine. According to Military Standard 1472F a mixed male and female population should not lift more than 37 lbs from the floor to a height of 5 feet. Lifting saline cubes onto filing cabinets exceeds the recommended weight limit.

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 can result in discomfort and fatigue.

Recommendations

- ∞ If possible, relocate saline cubes to a height about equal to the worker's waist which creates a biomechanical advantage and reduces stress to the spine while lifting. Height adjustable carts can also be used for transporting saline cubes throughout the labs to reduce heavy lifting. High lift carts could be used for labs where saline is stored up high. Lift carts could also be used for transporting biohazard waste and delivering chests of ice. Refer to table 2 for vendor information.
- ∞ A separate numeric keypad will allow the Automated lab workers to rearrange their work to bring items closer and reduce reaching. Refer to table 2 for vendor information.
- ∞ Anti-fatigue matting will reduce discomfort associated with standing operations. Refer to table 2 for vendor information.



Microscope Recommendations:

- ∞ Following are some basic guidelines for achieving and maintaining neutral body positions while using a microscope:
 - Eyes – eyepieces should rest just below the eyes with the eyes looking downward at an angle of 30 to 45 degrees below the horizontal; interocular distance of binocular eyepieces should be adjusted to ensure that both eyes are focusing comfortably. Ensure the environment is free of glare and reflections from overhead fluorescent light and the external and internal microscope lights are adjusted to compensate for this artifact.
 - Neck – the neck and head should deviate as little as possible, preferably no more than 10 – 15 degrees below the horizontal.
 - Back – the individual should be sitting erect, leaning the entire body slightly forward with the lower back and shoulder blades supported by the chair and or lumbar support.
 - Arms/wrists – the upper arms should be perpendicular to the floor, elbows close to the body (not abducted away), the forearms parallel to the floor and the wrist straight.
 - Legs – feet should rest firmly on the floor or a foot rest. When feet are unsupported blood can pool in the feet causing circulation problems. Laboratory stools with built in footrests often cause stress on the knees if the footrest is located closer to the body than the knees. Workers appear to “tuck” their feet on the footrest if it is not far enough away. A lack of footrests was also noted in the Microbiology and Serology labs. Refer to table 3 for vendor information.
- ∞ Provide fully adjustable task chairs with sufficient lumbar support to maintain the natural curve of the spine when sitting. The Hag Capisco allows the user to straddle the chair and support the torso. The Capisco may also benefit

microscope users in the Microbiology and Cytology labs. Refer to table 1 for seating recommendations.

- ∞ Avoid contact pressure from the forearms resting on sharp bench or counter edges by placing padded edge protectors. Operating the focus or stage controls with the forearms separated from the bench (lifted) for extended periods can induce static loading which can be reduced with proper supports such as padded and tilted arm rests. Refer to table 3 for vendor information.
- ∞ If the laboratory geometry permits, utilization of cut-out work tables allow the operator to spread out and more efficiently employ auxiliary equipment necessary for microscopy observation. Adjustable workstations for technicians / technologists who exclusively perform microscopy is highly recommended. The adjustable feature enables the workers to vary their postures from seated to standing throughout the day. The ability to change postures reduces fatigue, and the risk of injury, to a single muscle group. Refer to table 3.
- ∞ Provide microscope positioning plates to raise, lower, and tilt the microscope position to meet the individual needs of the operator.
- ∞ Some older microscopes can be retrofitted with extended eye tubes. The tubes enable the operator to move away from the bench while maintaining a more supported neutral posture during extended observations.
- ∞ Ensure workers are educated in proper sitting posture and encouraged to take stretch breaks and rotate tasks frequently.
- ∞ Ensure sufficient knee and leg space is available to reduce twisted postures
- ∞ Recommended features when replacing microscopes include: swinging eyepiece tubes, extended eyepiece tubes, tilting riser. Refer to table 3.
- ∞ Further information on solutions for common laboratory equipment can be found at:
 - National Institute of Environmental Health Science Health and Safety Guide to Laboratory Ergonomics. <http://www.niehs.nih.gov/odhsb/ergoguid/home.htm>.
 - Centers for Disease Control and Prevention – Laboratory Ergonomics Guide <http://www.cdc.gov/od/ohs/Ergonomics/labergo.htm>
 - Nikon Microscopy U Basic Ergonomics <http://www.microscopyu.com/articles/ergonomics/ergointro.html>

Table 2: Automated Lab Equipment				
Description	Vendor	Product	Estimated Cost	Figure

<p>Height Adjustable Carts</p> <p>*price depends on size</p>	<p>Lab Safety 1-800-356-0783</p>	<p>Bishamon Mobile Scissor Lift Tables 330 lb. Capacity #18771</p>	<p>\$560</p>	
	<p>Global Equipment 1-800-645-1232</p>	<p>Scissor Lift Table 660 lb. Capacity #GK954850</p>	<p>\$367</p>	
	<p>C&H 1-800-558-9966</p>	<p>Mobile Scissor Lift Truck 330 lb. Capacity 71-525A</p>	<p>\$568</p>	
	<p>Grainger</p>	<p>Manual Hydraulic Elevating Scissor Cart 400 lb. Capacity #3KR46</p>	<p>\$378</p>	
	<p>Grainger</p>	<p>High Lift mobile cart Lift height 17.5"-59"</p>	<p>\$1354</p>	



Input Devices	CompUSA or your local office supply store	Numeric Keypad Contact your IT department regarding compatibility issues	\$20-\$40	
	Alimed 1-800-225-2610	USB Pocket Keypad	\$50	
Anti-fatigue matting	PeakLogix 703-819-6061	Matting prices depend on size. Most vendors will send you a sample. Matting is very subjective and it is a good idea to let your employees try it.		
	Alimed 1-800-225-2610			
	Ergomat 1-800-357-2111			

Table 3: Automated Lab Equipment


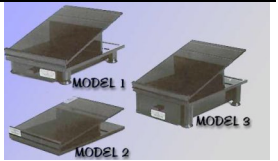
Vendor	Product		Price	Figure
Microscope Accessories	Alimed 1-800-437-2966	SoftEdge (30" in length) #JA70459	\$17.95	
		Deluxe Edge Rest (22" in length) #JA73075	\$29.95	
	Scopeease http://www.imebin.com/IMEB/pages/scopeease.html 1-800-543-8496	Scopeease Microscope tilter and arm supports	\$159-\$259	
	Alimed www.alimed.com 1-800-437-2966	Microscope Arm Support #JA73911	\$120-\$180	





Table 3: Automated Lab Equipment				
Vendor	Product		Price	Figure
	<p>Ergosource http://www.thomasregister.com/olc/ergosource/rests.htm</p> <p>A-Z Microscope www.az-microscope.on.ca</p> <p>R&D Ergonomics www.morencyrest.com</p>	<p>Labtop-Adjustable forearm support</p>	\$120-300	
	<p>Bay Optical www.bayoptical.com (415) 431-8711 Tel</p>	<p>Ergoadaptor Leika and Nikon model specific</p>	\$860	
	<p>Bi Optics Paul Means 408-736-2116</p>	<p>Bi Optics carries adjustable retrofit accessories for various microscopes.</p>	Contact the vendor for products and pricing specific to each microscope model	
	<p>Bay Optical www.bayoptical.com (415) 431-8711</p>	<p>Extended Eye Tube Leika model specific</p>	\$1300	

Table 3: Automated Lab Equipment				
Vendor	Product		Price	Figure
Furniture	Third and Fourth Microscope Service John Massey 217-425-2657	Microscope Table DV 100 Dual Viewing Microscope Table 48"x32"	\$400	
		Table with height adjustable option	\$900	
	Alimed 1-800-225-2610	Hand Crank Adjustable Height Work Tables	\$805- \$1,325	
	New Dominion 1-800-850-8559 X132	Hand Crank Adjustable Height Table	\$1,123- \$1,325	
	Lab Safety 1-800-356-0783	Adjustable Workbenches	\$1018- \$1190	
	Vestil 1-800-348-0868	Adjustable Work Benches	\$965 (30"x60")	
	Alimed 1-800-225-2610	Dyna-Lift Retrofit a table to become height adjustable	\$449	
Footrest	Alimed 1-800-225-2610	Factory Footrest- elevated height for lab stools	\$100	

Table 3: Automated Lab Equipment			
Vendor	Product	Price	Figure
	Lab Safety or your local office supply store 1-800-356-0783	\$28	

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

ⁱⁱ 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.

ⁱⁱⁱ 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.