

## Abstract

The interior design of living and workspace are emerging with a new awareness that reconnects mind and body, fostering a sense of place and time and true well-being. Poor design in the workplace environment, which affects human behavior and contributes to psychological illnesses and physical illnesses such as musculoskeletal problems due to stress, constitute the most important cause of work-related absence due to illness and occupational disability.

The Phlebotomy area of our laboratory could use a well-needed overhaul in interior and ergonomic design. The waiting area and the blood drawing area are small and very crowded to accommodate the increasing number of patients that come to our facility. In addition, the layout and the interior design of the room could use much needed help to improve the mental attitude, the workflow efficiency, prevent work-related injuries for the laboratory staff and to promote positive health and well-being for our patients before and after their blood is drawn.

## Introduction

The Clinical Laboratory's purpose of operation is to perform analytic tests and procedures on body fluids and tissues taken from patients and to provide the results of these tests to physicians in order to confirm diagnosis, determine prognosis or ascertain or assess the patient's treatment. The Laboratory Medical Staff function in an atmosphere of continual pressure from the responsibility of providing accurate and precise information with no margin of error. Results must be carefully checked and rechecked since the responsibility for treatment of the patient depends on the reports issued from the laboratory.

Phlebotomist plays as the public relations representative of the laboratory. They are in the front-line of the laboratory operation and have the direct contact with the patients. They collect blood samples from patients to be analyzed in the laboratory. It is very critical that correct identification of patients using two identifiers are followed. If the quality of the sample is bad during collection, the rest of the process phase up until the final test analysis will have no value to the physician and the patient.

I have recently transferred to this Laboratory facility and I have been helping out in the phlebotomy area due to short staffing problem. One of our phlebotomy technicians has been out on a work-related disability for a while. I also have a pre-existing carpal tunnel syndrome, coupled with shoulder tendonitis, which I have noticed to be flaring up more each day due to what I believed is the nature of the work aggravated by a bad workplace design.

Musculoskeletal Disorders (MSDs) are injuries and illnesses that affect muscles, nerves, tendons, ligaments, joints, spinal disc, skin, subcutaneous tissues, blood vessels, and bones. Work-related Musculoskeletal Disorders (WMSDs) are disorders to which the work environment and the performance of work contribute significantly, or that are aggravated or prolonged by work conditions.<sup>3</sup>

Many work and everyday situations are hazardous to our health. The reporting of cumulative trauma disorders (CTD) and other work-related disorders because of ergonomic hazards in the laboratory has increased significantly. These conditions can be partly due to poor design of equipment, technical systems and tasks. Much of the increase is due to changes in process and technology that exposes employees to increased repetitive motion and other ergonomic risk factors.

On November 14, 1996, the California Occupational Safety and Health Standards Board passed the Repetitive Motion Injuries (RMI) Standard, which applies to businesses with 10, or more employees that have a job, process or operation in which repetitive motions occur.<sup>3</sup>

In order to comply with the law and have an effective program, it is important to be objective, look beyond specific requirements, and address all hazards. Commitment by

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management is the key to motivating employees and providing the resources for a safe workplace. Worker safety and health is a fundamental concern of any organization and commitment to that end should be an organizational goal. With the help of an HFE specialist, employee involvement and feedback are essential in evaluating workstations.

The phlebotomy area of the laboratory will undergo a remodeling project in the future. It is not known when this will occur; however, the closest improvement that was done was to replace the mobile cabinet to a built-in cabinet with more storage room for our supplies.

But for now, the laboratory staff will have to do with what is available to them. Humans are remarkably adaptable. This adaptability makes it possible for people to function, and to function well, under circumstances that they would never choose if they were offered any alternatives. This universal adaptability is hardly an excuse for careless planning.

Medical Technology is expanding rapidly, requiring more and more highly specialized equipment. As specialized treatment techniques increase, so do needs for specialized personnel, resulting in a more complex building type.

In the design of healthcare facilities it is understandable that the principal focus of concern has been on the needs of the medical and support staff. They are the ones who are responsible for providing health care and are involved in it full time.

The speed, accuracy, and convenience with which they work will affect not only the patient's well-being but also the economics of health care. Therefore, the most constructive course would be to involve the staff directly in developing the design program.<sup>1</sup>

Present study showed that the worse the working conditions, the more lost working days and musculoskeletal complaints. Since these are among factors, which directly affect productivity of an organization, one may infer that neglecting ergonomic intervention program in the workplace imposes pronounced direct and indirect costs both for employees and employers, and decreases productivity.

## **EMPLOYEE ERGONOMIC RELATED ILLNESSES**

Posture and movement play a key role in ergonomics. Poor posture or movement causes a variety of musculoskeletal disorders and illnesses. These injuries include disorders of the back, neck, upper or lower extremities, or shoulders and involved strains, sprains, or tissue inflammation and dislocation. Environmental factors include demands on the body that exceed working strength and endurance such as heavy lifting, constant twisting and repeated motions such as pipetting or data entry. Biological factors are the physical characteristics of the worker including size, endurance, and

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range of motion and strength. When the job demands exceed the physical characteristics of the worker, an injury results.<sup>3</sup>

Cumulative trauma disorders (CTD) are musculoskeletal and nervous system disorders that may be caused or aggravated by repetitive motions, forceful exertions, vibration, mechanical compression, sustained or awkward postures, or exposure to noise over extended periods. They can affect nearly all tissues, nerves, tendons and muscles. These painful and sometimes crippling injuries develop gradually over weeks, months, or years and arise from repeated actions, such as twisting and bending of the extremities. According to the Bureau of Labor Statistics, CTD are major occupational health hazards in the workplace and account for the largest share of occupational illnesses today.

Tendonitis is a form of tendon inflammation that occurs when a muscle or tendon is repeatedly tensed from overuse of the wrist and shoulder. The tendon becomes thick, bumpy, and irregular in certain areas of the body whenever the shoulder and the injured area begin to calcify. Without rest and sufficient time for the tissues to heal, the tendon may be permanently damaged. Tendonitis can easily occur in *phlebotomists*.

Trigger finger is attributed to the creation of a groove in the flexing tendon of the finger. If the tendon becomes locked in the sheath, attempts to move that finger will cause snapping and jerking movements. This disorder is often associated with using tools that have handles with hard or sharp edges such as in the gross room of anatomic pathology.

Carpal tunnel syndrome (CTS) affects the hands and wrists and is the compression and entrapment of the median nerve where it passes through the wrist and into the hand in the carpal tunnel. When irritated, tendons housed inside the narrow carpal tunnel swell and press against the nearby median nerve. The pressure causes tingling, numbness, or severe pain in the wrist and hand. The pressure also results in a lack of strength in the hand and an inability to make a fist, hold objects, or perform other manual tasks. If the pressure continues, it can cause permanent loss of sensation and even partial paralysis. CTS occurs when repetitive manual tasks such as manual pipetting, data entry into a computer, or transcription are performed over time. Compounding the problem is that employees often do not associate their pain with their work because symptoms may only occur during off-duty hours.

Back disorders are frequently caused by faulty body mechanics such as poor posture; bending and reaching; and carrying, moving or lifting loads that are too heavy or too big. Keeping the body in a neutral position with the work close to the body is helpful in maintaining proper posture. Exhausted muscles take a long time to recover and need to rest for 30 minutes to achieve a 90% recovery. Distributing the resting time throughout the day can reduce muscle fatigue. For example, it is better to have a five-minute break every hour rather than a 15-minute break during a four-hour period.

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Temperature extremes may also increase the risk of ergonomic disorders. Cold temperatures can affect a worker's coordination and manual dexterity, thus requiring more effort and additional manual force to perform the same task or to maintain productivity levels. Likewise, hot and humid conditions can result in increased ergonomic stress by causing excessive fatigue or reducing the employee's work capacity.

## WORK ANALYSIS

The first step in the worksite analysis is to determine what jobs and workstations are the source of the greatest problems. A systematic analysis of injury and illness records can accomplish this step. The existing medical, safety, and insurance records must be analyzed for evidence of CTD or back disorders. The OSHA 200 log (the quarterly reporting document for illnesses/injuries that result in lost time from work) should also be reviewed. Next, identification and analysis of trends or ergonomic problems relating to particular section of the laboratory, workstations, job titles, or operations are performed. Each workstation that is considered a problem or high risk should be analyzed through direct observation with assistance from qualified personnel such as an ergonomist (a scientist who studies how workstations can be adapted to the people who use them), a healthcare provider or an affected employee familiar with the risks. Use of a symptom survey checklist, (Figure1) a complaint log or a suggestion box may also be useful.

Another useful tool is a workstation checklist. A set of questions should be surveyed to the phlebotomists as to how their workstation is at present time in order to properly assess the much needed interior design and layout of the phlebotomy blood drawing area. It includes but is not limited to the following:

1. Does the working space allow for a full range of work movements?
2. Are the mechanical aids and equipment provided where feasible?
3. Is the work surface height proper and adjustable?
4. Can the work surface be tilted or angled if necessary?
5. Is the workstation designed to minimize or eliminate:
  - Twisting at the waist?
  - Reaching above the shoulder?
  - Extension of the arms?
  - Bending or twisting of the wrist?
  - Elevation of elbows?
6. Do the employees have the option to vary their posture?
7. Are the employees' hands or arms subjected to pressure from sharp edges on work surface?
8. Is an armrest provided where needed?
9. Is a footrest provided where needed?
10. Is the floor surface irregular, slippery, or sloping?

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11. Are cushioned floor mats provided for workers who are required to stand for long periods?
12. Where chairs or stools are provided, are they easily adjustable and suited to the task?
13. Is the workplace temperature too hot or too cold?
14. Are all task requirements visible from comfortable positions?
15. Is there a preventive maintenance program for mechanical aids, tools, and other equipment?

All risk factors within an area should be identified and proper controls implemented to eliminate each of them. The idea of an ergonomic approach is to make things better than they were before, with incremental improvements in reducing or eliminating some, if not all, risk factors.

### The Fundamental Features of the Phlebotomy Workstation Design

#### Overall Concept

- Phlebotomist sits down during the draw (with the option of standing occasionally and for drawing patients in wheel chairs)
- Phlebotomist typically assumes static postures with the back and neck deviated at 30 to 45° for 4 or more hours a day.
- Patients sit during blood draw
- The patient chair is non adjustable, therefore the phlebotomist must flex at the back and neck while drawing blood samples.

*The following problems and comments were identified as part of the employee complaint survey*

- The working area has a “crowded-in” feeling.
- Supplies are below the counter, that one has to stoop making it hard on the back.’
- Chairs are not adjustable.
- The working area has a bad wheelchair access
- The middle workstation is too narrow, cramped for space and supplies.
- A lot of patients have difficulty moving chairs because it’s too close to the counter.
- There isn’t adequate legroom for patient and the phlebotomist since they both sit and face each other while drawing blood.
- There is no infant drawing station in the phlebotomy area. The parents have to hold or carry the infant while being drawn.
- The workstation are too close to each other that staff are constantly bumping into each other, difficult to pass through, turnaround etc.
- Chairs for the patients and the medical staff are not user friendly.
- The workstation does not prevent tubes from falling on the floor.

- There is no room or the chair is not designed to put patient in if they faint while being drawn.
- The angle of draw while working on the workstation is sometimes hard on the wrist, arm and the back due to twisting.
- There is not enough storage room for tubes and supplies in the middle station.
- Some older and heavier people aren't able to move all the way back in the seat making it harder to draw.
- Supplies are hard to get, have to twist and turn back for each patient drawn to make an addressograph label. Same for accessing urine containers.
- Have to twist and turn body to discard sharps from behind because of lack of room which can be dangerous.

**PHLEBOTOMY WORKAREA**

**Objective: Reduce Musculoskeletal Risk Factors**

TASK LIST	RISK FACTORS QUANTIFIED	How does the Design address the Risk Factors
<ul style="list-style-type: none"> <li>• Patient preparation</li> </ul>	<ul style="list-style-type: none"> <li>• Risk Factors/Body Parts: Stressful wrist motions; repeated pinch grips</li> </ul>	
<ul style="list-style-type: none"> <li>• Prolonged awkward wrist posture while drawing blood (holding vacutainer adapter)</li> </ul>	<ul style="list-style-type: none"> <li>• Risk Factors/Body Parts: Awkward Posture, severe forward torso bend, twist torso, wrist, shoulder and neck</li> </ul>	<ul style="list-style-type: none"> <li>• Improve wrist position by providing angled wedges to support patient's arm at an angle.</li> <li>• Provide training that encourages phlebotomist to maintain straight wrists during the draw.</li> <li>• Reducing reach distance</li> <li>• Providing a height adjustable draw surface.</li> </ul>

TASK LIST	RISK FACTORS QUANTIFIED	How does the Design address the Risk Factors
<ul style="list-style-type: none"> <li>Awkward and repetitive wrist while picking up and placing items from the work surface</li> </ul>	<p>Risk Factors/Body Parts: Awkward Posture, severe forward torso bend, twist torso, wrist, shoulder and neck)</p>	<ul style="list-style-type: none"> <li>Reduced awkward wrist movements by providing angled wedge to support the patient's arm at an angle. This effectively lowers the work surface and improves wrist positions while picking and placing tubes.</li> </ul>
<ul style="list-style-type: none"> <li>Awkward and repetitive wrist movements while inserting and removing tubes from holder</li> </ul>	<p>Risk Factors/Body Parts: Awkward Posture, severe forward torso bend, twist torso, wrist, shoulder and neck)</p>	<ul style="list-style-type: none"> <li>Improved wrist position by providing angled wedges to support patient's arm at an angle.</li> <li>Providing training that encourages phlebotomists to maintain straight wrists during the draw.</li> <li>Reducing reach distance.</li> <li>Providing a height adjustable draw surface.</li> </ul>

**Phlebotomy Recommendations:**

- Because the phlebotomist are constantly sitting down while performing their tasks, proper seating should be made available to employees whenever possible. They should be provided with a fully adjustable task chair or laboratory stool (with built-in solid footrest) to maintain the natural curve of the spine when sitting.
- Backrest of the chair should support the lower back and tilt to allow for some movement while working.
- Chair should have a padded seat with the proper width and depth to allow the knees to bend at 90° with the feet flat on the floor or on a footrest.



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- The shoulders should be relaxed to allow a neutral position with the forearm at a 90° angle to ensure good circulation.
- Proper work height can be adjusted by either lowering the work surface or raising the employee to the work surface.
- Seat cushions can be used to compensate for height variation.
- Footrest should be provided to help reduce stress and fatigue for shorter employees.
- Providing adjustable phlebotomy chairs will greatly reduce the occurrence of awkward back and neck postures because the patient can be positioned to best meet the needs of the medical provider.
- 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.
- A phlebotomy cart that can hold a phlebotomy tray as well as point-of-care instruments and other equipment needed by the new point of care technician job is a good example of proactive ergonomic thinking. Equipment and supplies should have a definite and fixed space for storage.

**Objective: Improve Customer Service and Satisfaction**

- Workstation is effective, efficient and well-designed
- Workstation is comfortable, convenient, clutter-free and clean.
- Equipment controls and supplies should be easy to reach and equally accessible for both right and left handed employees.
- Recessed tray for preventing tubes from falling on the floor.
- Adjustable workstation for phlebotomist that sits and stands-up so less bending and reaching.
- Access to sharps with both hands within arms reach.
- Strengthening backrest and adding a headrest to the patient's chair to accommodate and protect fainting patients.

**Objective: Improve Efficiency**

- Change to improve location of supplies, the amount of time required to reach for those supplies.
- Improve efficiency of workstation by organizing and standardizing the workstation, which helps phlebotomist quickly change from workstation to workstation.
- Provide a location in the design for phlebotomist to neatly hang a roll of tape for quick accessibility,
- Supply and trash storage were generally inefficiently located. Put in a location so less amount of time, twisting and turning needed to discard sharps.

## **PATIENT FACILITY PROBLEMS AND RECOMMENDATIONS**

Going to the doctor, or hospital is a trip viewed with apprehension by patients, family, and friends. Already burdened with health problems and apprehensive about their well-being, patients clearly do not need further stress or uncertainty imposed by their environment.

The Phlebotomy waiting area of the laboratory is so small that when a big rush of patients in the morning come, it becomes overcrowded that patients have to wait in the hallway. In addition to being a fire hazard concern, it is plainly not a good customer service to inconvenience the patients. Although the administration is aware of this problem, there is not much that can be done at this point in time until the remodeling project materializes.

Family often accompanies patients so there should be a big lounge seating area provided where they could muster and wait as a group.

Phlebotomy waiting area should have a pleasant, non-institutional design character. While the functional requirements of health care come first, once these requirements are satisfied, there is no reason why the lounge should not be enjoyable and attractive as possible.

Patients should be protected from stressful environmental conditions. The patients field of vision should be free of glare while they're waiting in the lounge area.

Patients should be provided with dividers or partition while having their blood drawn as part of the Health Insurance Portability and Accountability Act (HIPAA) regulation for their privacy and confidentiality.

Noises from mechanical sources, air conditioning should be eliminated. Most of important of all, the sounds made by other patients, children crying should be excluded or minimized to avoid stress to other patients.

The Phlebotomy waiting area should be odor free, organized and clean.

The temperature should not be too hot or too cold for the patient, but rather maintained at a comfortable temperature zone. The air movement should be flowing freely in the room for proper circulation and ventilation.

There should be an accessible place for the physically impaired on a wheelchair where there is still enough room provided in case of fire.

The Phlebotomy room should offer some diversions such as television and reading material.

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The color of the room is equally important during the interior design of a work space design since it helps sets and creates the proper mood in the surrounding environment. The color of the room should be painted with soft, light color such as soft powder blue to calm children, and ease many symptoms of stress. In a relaxed state, the patient may feel more in tune with their spirituality and more relaxed.

All the elements in the environment affect the visitors and patient's attitude toward the facility and create a significant, lasting impression on the patients and will always want to come back to the facility .

### **PROPOSED COUNTERMEASURES**

Where feasible, hazards are prevented by effective design of the laboratory. National California Clinical Laboratory Standards published a new standard on Laboratory Design (April 1998) which should be of help to anyone involved in remodeling or designing a new lab. Engineering controls are the preferred means of controlling or reducing ergonomic hazards in the workplace. Workstations should be designed so that it accommodates the specific worker who uses it, not just the "average" worker. A laboratory is ergonomically correct when pain is not experienced while performing tasks. The height of tables and chairs should be adjustable to provide proper back and leg support. Workstations should allow sufficient space for the knees and feet. When seated, the width clearance must be at least 27 inches and the depth clearance must be at least 18 inches at the knees and 45 inches at the feet for sufficient comfort.<sup>4</sup>

After employees are trained in a particular task, supervisors should ensure that work practice controls are maintained by monitoring employees and improper practices should be promptly corrected to prevent injury. Some facilities have initiated exercise periods for employees at the beginning of and throughout a shift to prevent injuries and to promote wellness.

Personal protective equipment should be selected with ergonomic stressors in mind so that the equipment reduces rather than contributes to the hazards. Equipment should be designed to fit the employee rather than forcing the employee to fit the equipment. Administrative controls reduce the duration, frequency, and severity of exposure to ergonomic hazards. Examples include job rotation to allow use of different muscle tendon groups, frequent breaks to reduce stress and strain, and increasing the number Of employees assigned to a task where work conditions are severe. In addition, a preventative maintenance program for equipment to verify proper working order is essential. An essential housekeeping program to minimize slippery work surfaces and related hazards such as slips and falls because of clutter is essential.<sup>7</sup>

Medical management can help to eliminate or reduce the risk of ergonomically related problems and symptoms through early identification and treatment. It is estimated that CTD victims lose an average of 30 workdays per injury. Sit down jobs restrict blood

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circulation, preventing muscles from getting the nutrients they need and eliminating waste products such as lactic acid. Ironically, lack of movement can provoke the same joint injuries that afflict athletes. For example, bending over a keyboard or a lab bench all day put pressure on the tendons of the shoulder, which can lead to a torn rotator cuff in later years. Slumping puts pressure on the lower spine, and sitting still and crossing one's legs causes edema of the lower extremities. This swelling then prompts the heart to work harder and blood pressure to rise. In one case, a facility reduced its workers compensation claims by \$90,000 in just one year by implementing workstation design.<sup>6</sup>

Training and education go a long way toward increasing safety awareness. Training allows supervisors and employees to understand ergonomic and other hazards associated with a job, their prevention and control, and their medical consequences. Suggestions and inputs from workers who are educated about ergonomic hazards can be very helpful in designing improved work practices to reduce those hazards. A good ergonomics education and training program will teach employees how to use equipment properly and the correct way to do a variety of job tasks. Helping to identify habits such as arching the neck while wearing bifocals so that one can peer at a computer screen through the lower lenses and cradling the telephone between the head and shoulder rather than using a headrest or telephone rest to alleviate ergonomic stresses is helpful.<sup>5</sup>

## **CONCLUSION**

Managers always look for factors affecting an organizations' productivity. Interior design and ergonomic considerations are among the internal factors that should be paid proper attention to. These factors positively influence organizational productivity and create a balanced, harmonious environment for the employee and the patients. Implementation of ergonomic programs in the workplace is not necessarily costly. Even if it involves expenses, the capital will be returned in the form of healthy workers, reduced lost working days, decreased medical costs, improved job satisfaction and enhanced productivity, and a profitable organization.

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FIGURE 1

**Ergonomic Symptoms Survey Checklist**

Employee Name: \_\_\_\_\_ Date: \_\_\_\_\_

Job Name or Workstation: \_\_\_\_\_

Shift: \_\_\_\_\_ Hours worked/week: \_\_\_\_\_ Time on this job \_\_\_\_\_

Have you had any pain or discomfort during the last year? \_\_\_\_\_

Check the areas:

Neck( ) Shoulder( ) Elbow/forearm( ) Hand/wrist( ) Fingers( ) Upper Back( )

Lower Back ( ) Thigh/knee ( ) Low Leg ( ) Ankle/foot ( )

Put a check by the word(s) that best describe your problem:

Aching ( ) Burning ( ) Cramping ( ) Loss of Color ( ) Numbness(asleep) ( )

Pain ( ) Swelling ( ) Stiffness ( ) Tingling ( ) Weakness ( )

Other \_\_\_\_\_

When did you first notice the problem? \_\_\_\_\_

How long does each episode last? \_\_\_\_\_

What do you think caused the problem? \_\_\_\_\_

Have you had this problem in the last 7 days? \_\_\_\_\_

Have you had medical treatment for this problem? \_\_\_\_\_

If no, why not? \_\_\_\_\_

If yes, where did you receive treatment? \_\_\_\_\_

Did the treatment help? \_\_\_\_\_

How much time have you lost in the last year because of this problem? \_\_\_\_\_ days

Please comment on what you think would improve your symptoms: \_\_\_\_\_

\_\_\_\_\_