USING HFE TO IMPROVE SPECIMEN PROCESSING IN CLINICAL LABORATORY

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Title: **Using HFE to Improve Specimen Processing in Clinical Laboratory**

INTRODUCTION:

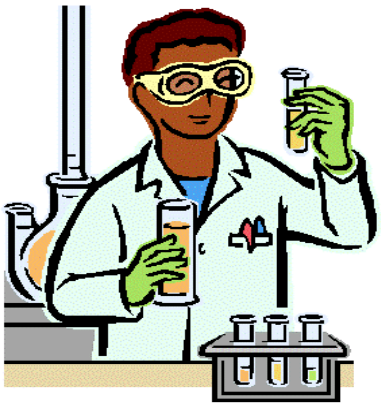
Illustration (Abstract)

Depending upon the tests that have been ordered, your blood sample may be processed before it is analyzed. Most routine laboratory tests are performed on either plasma or serum. Plasma is the liquid portion of blood. It is separated from the cellular portion of blood by rapidly spinning the specimen in a centrifuge for several minutes. The plasma, which has a light yellow color, appears at the top of the tube, while the blood cells are at the bottom. Serum is plasma that has been allowed to clot. It is prepared in the same way as plasma - however, the blood is collected into a tube with no anticoagulant. While spinning in the centrifuge, the clot moves with the cells to the bottom of the blood collection tube, leaving the serum on top. Other specimen includes body fluids, microbiology specimen, urine, and histo/ Pathology.

It is important to track injury rates and also to understand the low injury rates do not necessarily mean that there is no discomfort. Workers in Specimen Processing could be suffering from fairly frequent and severe discomfort but not reported in a workplace. During the early stage of Musculoskeletal Disorder, discomfort comes and goes, disappearing with rest. Laboratorian may or may not report the problem to the workplace or be absent from specimen processing section.

Common Laboratory Equipment

- Centrifuge
- Balance
- Pipetman



Goals and Objective:

The main purpose of this term paper is to Improve Specimen Processing in Clinical Laboratory and to protect employees from exposure to unacceptable levels of ergonomic risk. To identify and prevent workplace conditions that contribute to work related musculoskeletal disorders (WMSDs).

Problem identification:
To be able to identify common problems of specimen processing and identify work related musculoskeletal disorders that will lead me to the most common answer to improve the situation in the laboratory. I made a questionnaire to all the employees who work in specimen processing.

A. Identify Risk factors:
Risk factors are the elements of a job that increase the chance of work-related musculoskeletal disorders. The potential of a risk factor to cause injury is affected by the duration of the worker's exposure to it. There are several risk factors in the office environment that cause ergonomic stressors to employees that should be evaluated. The key ergonomic risk factors for employees in the office work environment include:

How to identify risk factors?

When identifying musculoskeletal injury risk factors, it is important to consider all components of the work. Although having a correctly designed workstation and appropriate tools is very important, so is the work organization and work environment. Even when the work station is well designed, if a person is working at a rapid pace, injuries may occur. Environmental factors, like lighting or vibrating surfaces, can also contribute to the development of musculoskeletal injuries.

In order for me to identify risk factors at my work place, I have prepared 2 sets of questionnaire.

Sample Questionnaires:

I would like to give you a brief definition of ergonomics. Ergonomics is the application of the scientific principles, methods, and data from a variety of disciplines to the development of engineering systems in which people play a significant role. Ergonomics also called human factors or human engineering (HFE). It is the discipline that examines human characteristics for appropriate design living and work environment.
In order to get the feedback from employees working in the clinical laboratory pertaining to HFE (Human factor Ergonomic), I distributed a questionnaire to get the information. Please answer the questions to the best of your ability.

1. What is the common HFE problem you encounter in the clinical laboratory in Specimen processing?
   a. Repetitive motion
   b. Light
   c. Equipment or materials use
   d. Postures (body mechanics)

2. If you answered (a), in the first question, what part of the body is mostly affected?
   a. thumb
   b. wrist
   c. neck
   d. shoulder
   e. feet and legs
   f. back

3. If you chose light in the first question (b), what particular light settings or problem would you want to improve?
   a. adjustment of light
   b. using fluorescent light
   c. dim light
   d. back light (Glare)
   e. brand of light

4. If you chose (c), which piece of equipment or instrument gives you the most trouble?

   a. pipettes (pipettor)
   b. tubes
   c. tally counter
   e. telephone
   f. chairs (adjustable)
   g. centrifuge

5. For posture (body mechanics)
   a. bending
   b. reaching
   c. lifting
   d. twisting

6. Awkward postures are most common when performing what task?
   a. spinning whole blood by using centrifuge
   b. Plating cultures
   c. staining gram stains
   d. filtering

Please check other issues in the list that is related to specimen processing, that you have experienced or having problems with:

___ Contact Stress or Pressure Points
___ Musculoskeletal Disorder (Carpal tunnel syndrome)
___ Fatigue
___ Force
___ Sustained Postures or Exertions

Thank you for your time in answering these questions. These questions will help us in solving our problem in specimen processing and also to improve HFE in our work place. Another set of questions for laboratory safety.

1. Lab employees should wear gloves while using computer because:
    a. gloves are expensive
    b. gloves can contaminate computer keys
    c. gloves don't look professional
    d. gloves can cause irritation

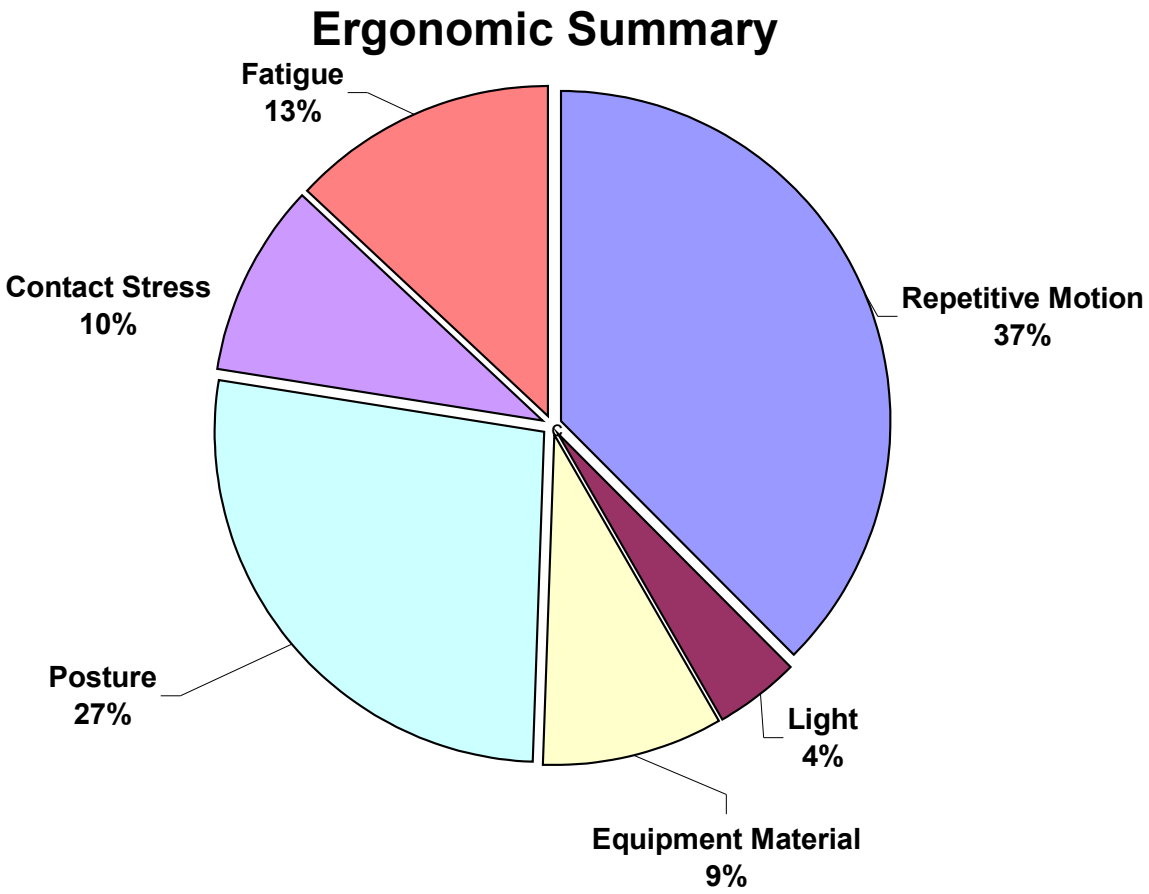
2. The principle of wearing a lab coat is to :
    a. has plenty of pockets to carry
    b. looks professional in appearance
    c. provide safeguard barrier in case of accidental splashes or spill
    d. to keep warm so that you can perform better.

3. Abundant light in specimen collection area is essential because:
    e. hospital are concerned with conservation of energy
    f. it gives the appearance the lab is open
    g. it enables employees to stay alert, especially at night
    h. it reduces the rate of specimen misidentification

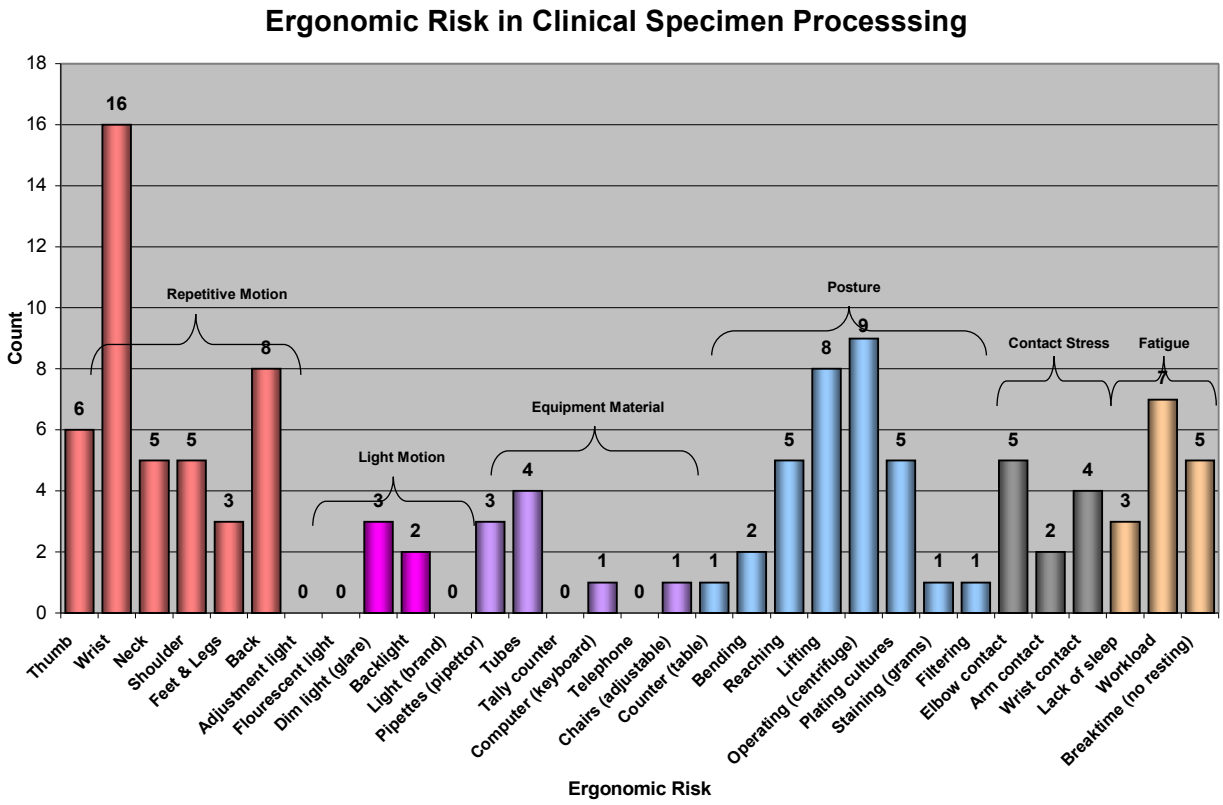
4. Cultures should be plated under a certified and well maintained hood because:
    a. it reduces the risk of airborne pathogens
    b. unpleasant odors would be eliminated
    c. it reduces the risk of specimens splashing into the eyes
    d. it allows better visibility to plate more effectively
    e. all of the above

5. To reduce back strain associated with constant bending, lab employees should:
    a. takes more working breaks to reduce over use.
    b. Stand keeping your back straight while you work
    c. Call in sick to allow complete recovery
    d. Perform back stretching and strengthening exercise through out the work day.

Graph Summary:



Graph Details:



Now that we have all the data, using the graph as an aid to help us identify the risk factors related to specimen processing.

The risk factor observed in specimen processing are:

- Contact stress
- Force and light used
- Repetitiveness (repetitive motion)
- Static loading and lifting (equipment and material)
- Posture
- Fatigue

Using the most common risk factors, I developed an evaluation checklist specific to the laboratory environment. The checklist is a standardized method of evaluating an employee in a variety of work settings such as at the computer terminal, and other instruments and pieces of equipment. The risk factors for each setting were then evaluated and addressed in a consistent manner.

Repetitive Motion (Pipetting equals repetition)

Opening of the plastic bag and placing the specimen in the proper container, then aliquoting serum specimen, dividing the amount of the specimen to be process. pipetting the proper amount of solutions to be used in laboratory testing. Pupating is one of the most common tasks performed in the clinical laboratory. Many RSIs can be traced to heavy use of a pipettor. In the survey that I have made using a manual pipettor, Bjorksten et al. found that pipetting for more than 300 hours a year increases the risk of hand and shoulder ailments (*4*). However, it is possible to reduce the risk factors of force, repetitiveness, and static loading associated with the task.

Repetitive Motion

Repetitive Motion

Depress pipet
While controlling the force of the pipet, tilt the tube and start suctioning liquid from the top of the tube, lowering the pipet as the meniscus of the liquid is lowered

Posture and positioning

Whenever a lab technician process a specimen under the hood like plating specimen cultures and making gram stain. The risk factors of poor posture and awkward positioning, are the most evident and widespread problems seen. An atmost universal observation was that many tasks, such as working at the bio-safety hood or the microscope, require the head and arms to be held in a forward position with shoulders rounded forward. Such a posture can compromise the vascular supply, compress nerves to the arms, and increase muscle stress and strain. This hunched-forward posture is further exaggerated when the feet are placed on the ring-style footrest common to many lab stools.

Awkward Posture - is a deviation from the ideal working posture of arms at the side of the torso with the wrists straight and elbows, hips, and knees at 90 degrees. Activities that typically cause awkward postures in the office setting include reaching behind, twisting, working overhead, sitting with the lumbar curve flattened or exaggerated, and head in a forward leaning position.

Contact stress

Contact stress is caused by frequently putting pressure on a body part that is in contact with a hard surface (e.g., leaning forward on your elbow).

Force

Force - is the amount of physical effort required by the person to do a task and/or maintain control of a piece of equipment? The effort depends on the type of grip, object weight, object dimensions, body posture, type of activity, slipping of the object, temperature, pinching, vibration, duration of the task and number of repetitions. An example of a force risk factor may be the way an employee is gripping the mouse while sitting at a computer workstation. Another example is an office worker lifting boxes of files that are too heavy to lift.

Overexertion

Overexertion - is static loading or sustained exertions which cause physical effort or body postures that are held and require muscle contraction for a long time. As muscles remain contracted, the blood flow to the muscles is reduced. Office workers can spend a large amount of their time sitting in one position with a forwardly bent or twisted trunk which can involve static forces on the back.

Ergonomic Guidelines:
Ergonomics is involved in changing the demands of the work to fit the physical activities of the worker. Ergonomic guidelines should be useful for prioritizing areas for changes. A danger with applying guidelines is the result of the assessment, maybe used to stop potential beneficial changes from occurring. General Duty Clauses exist in the Occupational Health and Safety Act. .Section 25(2) h states the following: *"An employer shall take every precaution reasonable in the circumstances for the protection of the worker".* No policy in our company sets limit for repetition. The Occupational health and Safety Act requires a minimum standard of protection for workers.

Employee Ergonomic related Illness:

Musculoskeletal Disorders:

The most common office ergonomic injuries result in disorders of the back and upper extremities.

Cumulative Trauma Disorders of the Upper Body
In general ergonomic injuries start out as a Micro-trauma. A Micro-trauma is a microscopic injury to specific parts of musculoskeletal system that are microscopic and painless. Micro-traumas occur daily and generally heal overnight. The time required for healing process can be influenced by age and current health status.

When the Micro-trauma occurs at a rate faster than the body can heal itself people can experience pain and loss of function which can result in Cumulative Trauma Disorder

(CTDs). Cumulative Trauma Disorders of the upper body include Trigger, De Quervain's Tenosynovitis, Carpal Tunnel Syndrome, and Ulnar Nerve Compression (at the wrist). CTDs take weeks, months and sometimes years to develop and recovery may take weeks, months, and years. The symptoms of CTDs are often poorly localized, non-specific and episodic. This can pose enormous frustration for the employee experiencing the pain and for supervisors and co-workers who may be relying on the employee. In many cases there may be more than one cause of the CTD which can add to the complexity of the recovery process.

The incidence of CTDs have increased during the last ten years, because of an increase in employee awareness, faster typing with computers, lack of ergonomics training, job dissatisfaction (employees feel more pain when unhappy), and more injuries/illnesses are considered work-related. It is to be expected that when an ergonomics program is introduced the report of injuries may increase dramatically. Many employees currently experiencing upper extremity pain may not attribute it to their work and are being treated outside the employee/occupational health community. Their injuries may not have been captured in the workplace injury/illness reporting systems.

Back Injuries in the Office Environment

Back disorders are multifactor in origin and may be associated with both occupational and non work-related factors and characteristics. Low back pain is common in the general population. Nearly 70% of the workforce experiences low back pain at some time during their work life. The relationship of a back disorders and work can be complex. Low back pain can be defined as chronic or acute pain of the lumbosacral

BACKGROUND:

1. Work Analysis:

Blood Specimen Collection

Labeling

1) Obtain blood specimens from patient through routine venipuncture techniques
2) Ask all patients to identify themselves by spelling their last name
3) All specimen tubes and other containers must have
   a) Patients full name (First and Last)
   b) A unique identifier (Medical Record Number, Social Security Number, or birth **date if no other identifier is available.**
   c) Date and time of collection
   d) Initials of person collecting specimen

Tube Drawing Order

1) When collecting multiple blood tubes the following is the recommended sequence:
   a) Blood Cultures
   b) Red Top
   c) Blue Top
   d) Gold SST Barrier
   e) Green Top, plain or SST
   f) Lavender Top
   g) Gray Top

Tubes are collected in a specific order based on perishibility Investigator preference for tube collection takes precedence over a preset order
Serum is collected from tubes in from tubes without anticoagulant is not added
Plasma is collected in tubes with anticoagulant. Plasma contains clotting factors

2) Mix **ALL** tubes with anticoagulants (especially Blue, Green, Lavender and Gray) by inverting 6-8 times after filling. Gold SST Barrier tubes and Red Top Tubes should be allowed to clot for at least 20 minutes before centrifuging.
3) Do not remove the stopper on any blood tubes. Stoppers should remain on the tube prior to and during centrifugation. Barrier tubes must be centrifuged for at least 15 minutes at a speed of 3000-3500 RPM's. Centrifugation should occur within 30 minutes of drawing.
4) When it is necessary to remove serum from a tube, use a disposable transfer pipette to place serum in a plastic screw top tube.
5) **Warning:** All blood and body fluid should be considered as potentially infections. Glovers and a lab coat must be worn when procuring or handling blood and body fluid

specimens. Blood procurement safety devices must be used when drawing blood. The safety devices and instruction on their use can be obtained from NMH laboratory.

2. Fundamental features of specimen processing:

Specimen processing and work flow

Sample processing will usually start with a set of samples and a request form.

Typically a set of vacutainer tubes containing blood, or any other specimen will arrive to the laboratory in a small plastic bag, along with the form. The form and the specimens are given a laboratory number. The specimens will usually all receive the same number, often as a sticker that can be placed on the tubes and form. This label has a barcode that can be wanded by automated analyzers and test requests uploaded from the **LIS**. Entry of requests onto a laboratory management system involves typing, or scanning (where barcodes are used) in the laboratory number, and entering the patient identification, as well as any tests requested. This allows laboratory machines; computers and staff to know what tests are pending, and also give a place (such as a hospital department, doctor or other customer) for results to go.
For biochemistry samples, blood is usually centrifuged and serum is separated. If the serum needs to go on more than one machine, it can be divided into separate tubes. Many specimens end up in one or more sophisticated **automated analyzer** that process a fraction of the sample and return one or more "results".
The work flow in a laboratory usually is heavy from midnight to 7:00 am. Nurses and doctors generally have their patients tested at least once a day with general complete blood counts and chemistry profiles. These orders are then drawn during a morning run by phlebotomists. This way the Clinical Scientist (med techs) can test the specimens and have the results in the patient's charts for the doctors to consult during their morning rounds. Another busy time for the lab is after 3:00 pm when private practice physician offices are closing. Couriers will pick up specimens that have been drawn throughout the day and deliver them to the lab. Also, couriers will stop at outpatient drawing centers and pick up specimens.

HFE COUNTER MEASURE: (Resolution and Counter Measure)

Posture

Reducing the risk factors of poor posture can be achieved by training employees in the concepts of proper posture. Proper posture is the "neutral" position, or the position that requires the least amount of muscle force and allows maximal room for blood flow. We emphasized the importance of proper posture and neutral position during each work-site evaluation. We used in-house memos, company newsletters, and informational brochures to remind employees to check the following components of proper posture:

- ears over shoulders,
- shoulders in line with hips,
- forearms 90° or more from the upper arms, and
- Wrists in a neutral position.

Other solutions to the hunched-forward position

We found that the use of an industrial-height footstool allows technicians to achieve the best possible posture and position. The footstool lets them plant their feet firmly in front of them to give a solid, three-point base of support. This position allows the employee to bend forward at the hips rather than round the neck, back, and shoulders. Most researchers noticed an immediate improvement in comfort with the addition of a footstool. Providing an adjustable lab stool with enhanced lumbar support was also an important improvement. This style of lab stool provides employees working in a forward position (such as at a biosafety cabinet) with needed support during rest periods.

Repetitive motion (pipetting equals repetition)

The choice of pipettor, which is highly individual, needs to be considered carefully. Specifically, the characteristics of the employee and the pipettor need to be analyzed, and so do the task requirements. In analyzing the employee, the most important consideration is hand size. A pipettor that is comfortably held by someone with a large hand may be hard to grasp for someone with a smaller hand. The body position needed to operate the equipment must also be considered. A technician with a long forearm may be in a better position than someone with a shorter forearm using the same pipettor.

The weight of the pipettor should be evaluated. The heavier the pipettor, the more force is required to hold it in an operating position. The location of the controls is also important. In many manual pipettors and some electronic ones, the button is located on top of the pipettor, which may require the thumb to be repeatedly extended out of the neutral thumb position. The use of multi- versus one-finger controls helps to distribute the force among several fingers rather than to any one finger. The amount of force required to operate the controls is also a major consideration. Controls with a lighter touch require less muscle and tendon force and therefore reduce the tendency for injury.

The speed of a pipettor and the ease of calibration and programming, although not directly related to ergonomics, are important to the researcher. They have a direct bearing on whether a pipettor is actually used.
Tasks such as mixing or dispensing need to be carefully analyzed. Mixing requires frequent repetitions, and so the use of an electronic pipettor with mixing functions is highly recommended. The use of a pipettor for dispensing should be avoided whenever possible owing to the repetitive nature of dispensing. Furthermore, the reagent

container should be equipped with an adjustable volume dispenser to reduce the amount of hand movement required per tube.
We also recommended the use of a lightweight, finger-controlled electronic pipettor because of the frequent repetitions necessary to her work. A jar-opener tool was purchased and was given to some of the employee to remove the stress from their thumb by allowing them to keep their wrist neutral when opening chemical bottles or urine cups to aliquot urine specimen.
Through hand therapy and on-site training, laboratory technician was taught the basic principles of proper posture and positioning and the importance of taking minibreaks, rotating tasks to ease repetition, alternating hands for activities, and doing exercises specific to her injuries and work activities.

Contact stress (counter measure) - We explored aids that would relieve pressure on forearms and elbows resting on hard surfaces. We installed cleanable, removable foam rolls on some benches and biological safety cabinets, padded edge protectors on lab benches, and elbow pads for other applications. In addition, we are currently working with a manufacturer of laboratory stools to design chair armrests that can be placed in a forward position and used at a biological safety hood or laminar flow bench.
Early intervention is critical in preventing.

OSHA does not yet have an ergonomic standard. But whether ergonomics becomes subject to regulation is not the point. As with other regulations, such as chemical hygiene, radiation safety, and fire codes, ergonomics makes good sense for employee and employer alike.

Other Added HFE counter measure:

1. Revised work procedures
   Procedure can be revised to help employees practice HFE. Motivate employees and give them incentive so that good HFE practice will be their number one goal.
2. Propose new work place design
   Redesign workplace and add ergonomic furnitures.
3. Training for employees
   Provide Skills and Awareness training- ensure that all participants have the appropriate level of knowledge, tools, skills and abilities to meet their responsibilities in support of the HFE process Training is one way to achieve this. Our management and workshop or training to each employee to help them solve their problems in regards to HFE. Also management should set guidelines and rules about workplace environment.
   - Explain the appropriate steps for reporting MSD symptoms.
   - Identify ergonomic risk using ergonomic hit list.
   - Make simple changes and adjustments in the workplace to reduce exposure to HFE risk factors.
4. Automated Specimen Processing (Robotics technique)
   Automation and consolidation have allowed the hospital to eliminate one day shift FTE employees and substantial reductions on stress level. Closed- tube sampling

which allows staff members to load sample tubes without decapping them adding efficiency reducing exposure to biohazard.

Most recently, instrument have been developed to increase the efficiency of testing procedures by reducing turn around time and decreasing the volumes necessary to perform various assays. Present directions in laboratory testing focus on cost containment procedures and instrumentation. Laboratory automation is one area in which cost containment procedure are currently being explored. Robotic Engineering has evolved to such a degree that various types of robots have been applied in the clinical laboratory settings.

CONCLUSION:

I have begun and completed the survey of ergonomic risk factors. I have identified and prioritized ergonomic risks. The most significant risk identified were: posture, repetitive motion, contact stress and fatigue. Based on my findings, I have made recommendations contained in this report. Once the recommendations have been implemented, I will reassess the HFE risk factors. And if needed, I will modify or generate other recommendations in order to further reduce the risk of injuries and protect our employees.

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