

I.D.E.A.



Improving Design through Ergonomic Analysis

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Agenda

■ Laboratory

- Seating
- Computers
- Pipettes
- Phlebotomy trays
- Microscopy
- Histology

■ Radiology

- Overhead X-Rays
- Filing Cabinets
- Filing Cart
- Slide Boards

Safe Positions At Computers

- Chair support is crucial for safest working positions
- To avoid injury it is best to have supported arms and both feet on the ground
- The wide variety of chairs in the lab did not always make this possible

Current Problems

- The most common chair was the red chair shown at the right
- The range from the top of the seat to the floor was from 16.5" to 22.5"
- This range is important, because it could impair people's abilities to find the appropriate posture



Appropriate Chair Heights

- The appropriate height for the chair seat is based on the popliteal range (bottom of foot to top of knee) of potential users
- To account for most users, this can be measured for the 1st percentile woman to the 99th percentile man
- This range is 15" to 19.5", however when 1" is added to account for clothes and shoes, the final range of the chair needs to be from 16" to 20.5"
- If users are allowed to extend beyond this range, accidental injury may occur.

Clearance Under The Lab Desks

- The appropriate chair range also allows us to determine that the range from the floor to the top of the thigh (giving us the clearance for under the desk) is 19.6" to 27.3"
- However, due to clothing, shoes, and space to move 2.5" should be added to these values
- This makes the potential range of the height of the desk 22.1" to 29.8"
- Since the desk is only 25.8" from the ground, this leaves 52% of the users unaccounted for

Example Of Poor Chair Fit



- No arm rests
- Legs don't easily fit under desk, due to low height of the desk
- Feet aren't flat on the ground or supported
- Lower back is not supported

Solutions

- New lab desks that had a vertical clearance of 30" from the ground
- Chairs that do not exceed the range of 20.5" (reduce temptation to adjust chairs inappropriately)
- Foot rests would allow people with longer or shorter legs to extend them with support
- It is important that no clutter is under the desk to make this possible



Chair Width

- Should be between 14.6" to 18.3" across the seat cushion to fit 50-99% of potential users
- Current width of 39" under the desk would accommodate new, wider seating

Leg Room Depth

- Current 21" under the desk, allows 99% of potential users to comfortably extend their feet
- However, nothing should be stored under the desk that could limit people's potential use of the space and cause them to alter their sitting position into a potentially harmful one
- Therefore a new storage room is greatly needed at the hospital

Important New Chair Qualities

- Castors that provide more traction to reduce sliding on the floor
- Increase longevity and durability to ensure support for many years
- Provide adjustable lumbar (lower back) support

Ergonomic Chairs

- Chrome-plated metal parts
 - Easy to detect and clean dirt
- Back rest with lumbar support
- Conductive glides and casters



LOC Scientific, Inc. Ergonomic High-Tech Series – Without arm rests

Problems: Glare



- Important to put computers in an area with as little glare as possible to avoid eye strain
- Anti-glare devices are available to go over monitors

Problems: Phone Usage



- Phone usage can also potentially lead to neck strain
- Headsets
 - Wireless
 - Individual units from central phone system

Basic Computer Set-Up Is Important As Well



- Monitor 2-3" above eye level
- Wrists should be flat in relation to elbows and forearms
- Center of monitor should be in front of user
- Negative slope keyboard trays are preferred
- This advice should help prevent incidences of carpal tunnel and tendonitis found in employees

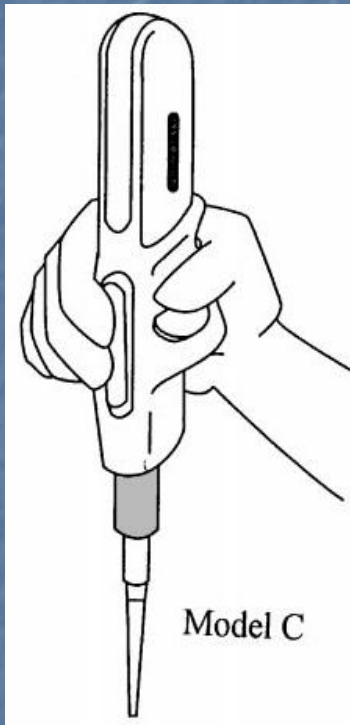
Lab Pipette Usage

- Three kinds used in the lab area:
MLA, Eppendorf, and Finn tip.



- Continual pipette usage causes stress and strain in the thumb, as well as postural problems in the hand, wrist, arm, and shoulder.
- All require a power grip and cause:
deviated wrist
elevated upper arm
radially abducted thumb
(when used at eye level)

Ergonomic Pipettes



- Study by Lee and Jiang (1999) compared 3 pipettes; One similar to the MLA, another like the Finn tip, and a third more ergonomic design (Model C –Left).
- Measured performance time, fault rate, posture recording, as well as subject preferences.
- Ergonomic pipette: palm faces downward; Button is pressed by the index, middle finger, or both; Basic power grip but hand position results in less muscle stress.
- Ergonomic design had the lowest performance time and fault rate, and resulted in the best posture:
 - Shoulder less abducted, elbow less extended, and wrist least radially extended.
- It also had lower subjective ratings of exertion levels and better ratings for gripping, precision, and overall preference.

Additional Recommendations

- Electronic/Automated pipettes are recommended for highly repetitive tasks.
- Limit periods of continuous pipetting to 20 minutes or less.
- Vary activities, or take frequent short breaks.
- Rotate pipetting tasks among several people.
- Work with arms close to the body to reduce strain on shoulders.
- Keep head and shoulders in a neutral position
- Use adjustable chairs or ergo-task stools with built-in solid foot rest.
- Do not elevate your arm without support for lengthy periods.

Phlebotomy Trays



- Approximately 8 to 10 people per day carry phlebotomy trays.
- On average each phlebotomist carries the tray 10-15 times per day:
 - Each phlebotomist carries the tray 2-3 times per day to the living centers and 8-10 times per day to the acute hospital floors.
- Average weight of sample tray: 5 lbs, 4 ounces.
- Handle height/clearance: 2.1 inches.
Length of space: 4.75 inches.

Preventative Suggestions

- Although no health problems have been attributed to tray usage, preventative measures should be taken to use trays that fit appropriate anthropometric requirements.
- Minimum hand clearance should be 2.4 inches high and 4 inches wide in order to accommodate even the 99th percentile man.
- Instead of individual baskets explore lightweight carts or shoulder strap bags
 - Prevents dropping and spilling of equipment

Microscopy

- Operating a microscope for long hours puts much strain on:
 - the neck
 - shoulders
 - eyes
 - lower back
 - arms and wrists.

Microscopy – Preventive Measures

Preventive Measures:

- Make sure leg and knee clearance under workbench is adequate.
- Use a fully adjustable ergo-task chair or stool with built-in solid foot rest.

Current Microscope Setup



Problems associated with microscope use often stem from postural issues and poorly designed microscopes.

Microscopy – Preventive Measures

Preventive Measures:

- Make sure leg and knee clearance under workbench is adequate.
- Use a fully adjustable ergo-task chair or stool with built-in solid foot rest.
- Adjust the eyepieces and angle of observation to prevent neck strain.

Current Microscope Setup



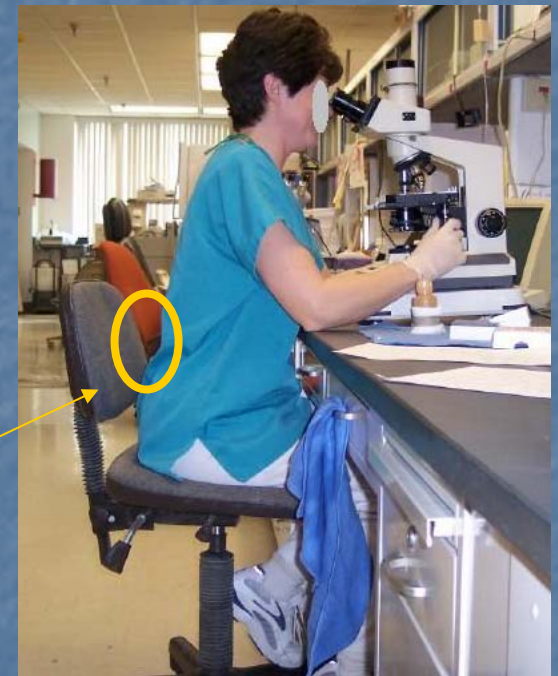
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Microscopy – Preventive Measures

Preventive Measures:

- Make sure leg and knee clearance under workbench is adequate.
- Use a fully adjustable ergo-task chair or stool with built-in solid foot rest.
- Adjust the eyepieces and angle of observation to prevent neck strain. Use adjustable microscope stands.
- Use proper sitting posture and positioning.
- Take stretch breaks and rotate tasks.

Current Microscope Setup



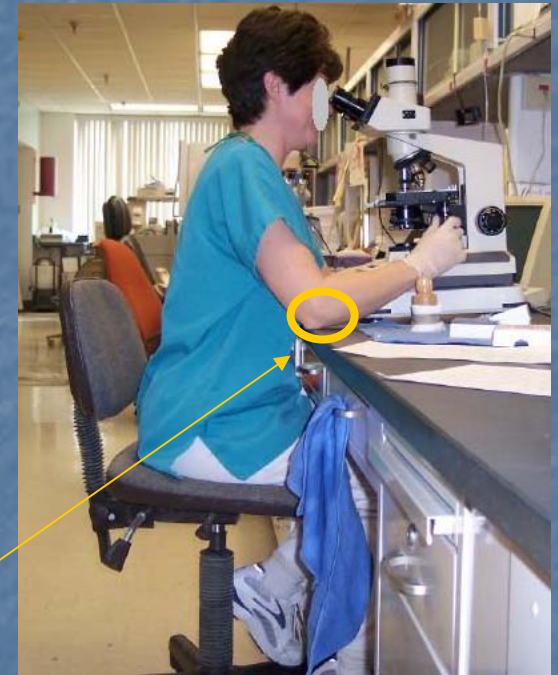
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- Take stretch breaks and rotate tasks.
- **Use lifters and angled microscope arm supports to relieve fatigue and strain.**

Current Microscope Setup



Problems associated with microscope use often stem from postural issues and poorly designed microscopes.

Suggested Equipment

- Expanded-pupil technology to enhance the ergonomic performance of the microscope.

Benefits:

- Freedom to wear glasses
 - Increased eye distance allows for safety spectacles to be worn
-
- LCD Displays or Video Microscopes
 - Reduces eyestrain by minimizing use of binocular lenses.
 - Reduces awkward neck posture



Vision BioMed DX40



SONY TechnoLOOK
Digital Video Microscope
TW-TL10S

Microscopy: Arm Support Pads

- Supports wrists and forearms in a neutral position.
 - Allowing for a more comfortable working position with less fatigue.
- Helps provide support in a more upright position
 - Relieves fatigue and discomfort to neck and back.
- Eliminates resting elbows and forearms on hard work surfaces.



Wedge-Ease™ Ergonomic Support Pads



A-Z Ergonomic sloping Arm Supports

Histology: Reported Problems

- Muscular Skeletal Disorders
 - Strain from swivel motion, turning crank, and lower back pain from leaning over machine
- Decreased range of motion
- Employees received carpal tunnel treatment, treatments of wrist and elbow tendonitis, and cervical neck pain
 - These did not have a MD's diagnosis of work-related although this is still under speculation

RULA Evaluation

- | | |
|------------------|----------|
| ■ Arm and Wrist | 2 |
| ■ Lower Arm | 2 |
| ■ Wrist Position | 4 |
| ■ Wrist Twist | 1 |
| ■ Posture | 3 |
| ■ Muscle Use | 1 |
| ■ Force | 0 |
| ■ Neck | 4 |
| ■ Trunk | 2 |
| ■ Legs | 1 |
| ■ Final | 6 |
- Score of 6 requires a change in position SOON and further investigation.



Preventive Measures

- Place microtome on appropriate workbench
 - Adjust to appropriate height.
 - Accommodate for standing or sitting positions
 - For example, use an L-shaped desk instead of a straight table. This will allow less rotation about the machine
- Allow adequate clearance for leg and thighs.
- Use only adjustable chair or stool with built-in foot and arm rest. .
- Protect wrists and forearms from contact pressure. Pad sharp edges.
- Use less force when turning hand wheel.
- Take frequent small breaks from microtome work every 20 minute.
- If economically feasible, replace manual rotary microtome with an automatic one (including foot pedal)

Suggested Equipment

- High-speed motorized unit for paraffin-embedded specimens. Motorized cutting mechanism and feed system.



Hacker 300 Series Microtome

Radiology: Overhead X-ray

- The force to push the x-ray machine was approximately 3lbs at a chest level.
 - One employee of 40 years reported that she had no rotator cuff in her shoulder due to the force required to push x-ray machine
- Moving the machine in any direction required a specific button to be pushed exerting a force.
- The location of the bed adjuster was positioned too far underneath the bed making it difficult to reach.
- The grip of the x-ray machine was found to be about 1" and 4" in circumference. These dimensions are less than what is recommended for 50% of the population to have a power grip.
- The grip and the location of the button to move the machine are not close enough to have a full power grip.
- 9.5lb lead vests with shoulder straps are worn by technicians while using administering x-rays



REBA Evaluation

Trunk Score 2

Neck Score 2

Leg Score 1

Upper Arms Score 5

Lower Arms Score 2

Wrists 1

Final = 10

High Risk Level and
necessary action is needed
SOON (including further
assessment)



Radiology: Options

- Train technicians on proper use of the overhead x-ray machine and made aware that it should be positioned at chest level before pushing or pulling it.
- A machine that has only one (1) button for all movements would be better and should be located on the grip so force can be used by all fingers, not the thumb.
- Extend the pedals and have an additional button which moves the bed back and forth instead of using body force to push it.
- The grip on the overhead and chest x-ray machine can be made bigger. However, since the majority of technicians are woman with relatively small hands, this change is not critical.
- Lighter weight vests should be used and have waist bands to take the weight off the shoulders.



Rayshield QuickDrop



Rayshield Wrap Around

Radiology – Filing System

- Filing Area – used 8 hours a day.
- Constant reaching and bending.
- Frequently Reported Filing Injuries:
 - Pulling X-Ray File Folders from file racks - Right Shoulder Strain
 - Lifted 6-8 File Folders - Lower back strain (Lost Time -55 Days > \$10,872)
 - While pulling file folders X-Ray Folder fell and hit employee in face
 - Tripped on foot stool - fell on knees- contusion to knees

REBA Evaluation

- Trunk Score 4
- Neck Score 2
- Leg Score 2
- Upper Arms Score 4
- Lower Arms Score 2
- Wrist Score 1
- Final 9
- High Risk Level : Action needs to be taken SOON (including further assessment)



Filing Equipment Recommendations

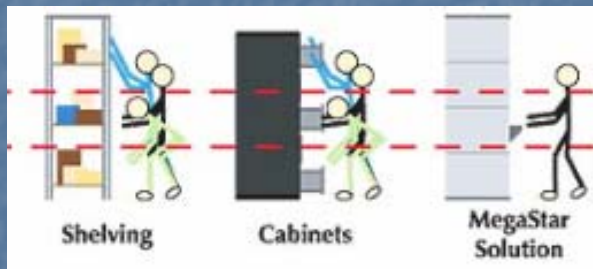
- *Increase Productivity*
- *Ergonomically Efficient*
 - Decreases injuries by minimizing physical effort such as twisting, bending and tight grasping
- *Flexible Filing*
- *Conserves Space*



MegaStar MediaStation Electric
Lateral File Vertical Carousel System

Suggested Equipment

- Series of vertically arranged rotating shelves controlled by an electronic keypad or software.
- Can store the equivalent of approximately 27 vertical file cabinets in a fraction of the space and improve records manage and productivity up to 56%.
- Minimizes physical effort such as twisting, bending and tight grasping
- Provides easy system operation regardless of the user's body size, posture or mobility.
 - Can be operated in seated position!



MegaStar MediaStation Electric
Lateral File Vertical Carousel System

Filing Cart Issues



Push Cart for Transporting X-rays

- Goes from file room to basement daily, as well as around various hospital areas.
- Metal for durability but adds excessive weight.
- Only the rear wheels can change direction, therefore making it very hard to maneuver.
- Filing cart usage has already caused 3 injuries in hospital staff.
- Average Force exerted to push cart
– 22.8lbs

Filing Cart Recommendations

- Purchase replacement cart that is made of lighter, durable material (ie plastic, wood, etc).
- Make sure the wheels are well lubricated and both rear and front wheels can change direction to aid in maneuverability.
- Divide files into 2 separate carts that attend to different areas of the hospital. This therefore reduces load and possibility of injury.
- If time and available staff permits, circulate the cart frequently to also reduce load and to prevent accumulation of files.

Slide Boards

- Current slide board made by Armstrong Medical Industries
- Dimensions: 18" wide, 72" long, .8" thick
- Dimensions for grip holes: 1" wide, 2" long, 1.5" apart, .5" from edge
- 99th percentile male is 75.6" tall, so to account for all people it would be better to have a board at least 78.6" long

Slide Boards

- The 99th percentile male is 40.1" wide at his hips (with his arms at his sides) and the 99th percentile female is 36.6"
- The slide board should therefore be at least 43.1" wide to account for the hand grips (which is over twice the size of the current slide board's width)
- Newer slide boards should also have grips that are easy to hold with a full hand and have no small edges
- Possibly having straps instead on handles
- It would also be better if the number of employees to carry the slide board could be greater than the usual two, so that those two experienced less strain