Ergonomic Rx for Digital Radiology

COMPUTERS IN HEALTHCARE

It is now commonplace for patients to be admitted into a healthcare facility by someone sitting at a computer. Increasingly, computer screens are integral to every aspect of patient care, from administrative to diagnostic and clinical purposes. There is little doubt that the medical technology behind this innovation contributes to superior accuracy, efficiency and accountability. But as the overall benefits to patient care rise, so too does the risk to healthcare professionals who work for extended periods of time at a computer.

In particular, the use of computers as diagnostic tools has long-range implications for the people who use them. The radiology department is a case in point. Over the last decade, the same revolution that introduced computer screens has been occurring in radiology, namely, digital picture archiving and communication systems (PACS). Inevitably, changes to the way radiologists work have called old practices into question. As the dust settles, new approaches must be tested, verified and adopted—without skipping a beat in the campaign for treatment excellence.

An extendable keyboard tray allows the radiologist to maintain sufficient distance between his eyes and the screen. The display can be tilted to relieve glare—a common problem in reading rooms.

THE DIGITAL READING ROOM

It's no surprise that the transition from film-based (hard) to filmless (soft) images brings with it upheaval. As old-style light boxes give way to digital technology, multiple computer displays are needed to run a variety of software systems which are often incompatible. Digital imaging has created new tasks, just as it has made other tasks unnecessary. For instance, PACS workstations offer the means to manipulate images (crop, rotate, zoom, window, level and others) in ways that put new control, as well as responsibility, in the hands of the radiologist. New technology is a double-edged sword for those who are scrambling to bring film-based records into line with

the new generation of filmless imagery. Maintaining dual systems until backwards-compatibility efforts have been accomplished, along with storage issues, are part of a new classification of procedures that have fallen into the laps of already busy technicians. And ironically, the reduced image processing times can mean higher expectations among those awaiting results.

On the facilities side, soft imaging requires a complex infrastructure to support the numerous CPUs, displays and communication devices typically employed in radiology reading rooms. The logistics governing electrical, phone and network cabling (not to mention physical "real estate") can be more than some facilities are able to cope with. Thus, it would not be surprising to find cutting edge IT equipment being used in cramped, stuffy rooms where the furniture, mounting surfaces and storage are inadequate. Under these circumstances, strides made for the welfare of the patient are undermined by the compromised well-being of the caregiver. Helping radiology staff carry out their duties efficiently with minimum physical and mental strain, both short and long term, is where ergonomics comes into the picture.

BASIC ERGONOMICS

Ergonomics is defined as the application of scientific knowledge to the workplace in an effort to improve the wellbeing and efficiency of workers. An ergonomic workplace increases workers' efficiency and productivity while reducing fatigue, exertion and musculoskeletal disorders. Many studies have shown that a good ergonomics program also cuts costs by reducing injuries and absenteeism, while contributing to overall employee wellness. Efforts should include:

1. Educating employees on how their behavior and lifestyle contributes to their own wellness
2. Providing ergonomic computer support equipment and environments
3. Training employees how to safely use the computer and support equipment provided by the employer
4. Ongoing monitoring and metering of employees to account for changes that may affect their well-being.

Safe computer use depends on people understanding what their bodies require in terms of posture, motion and rest. The optimum neutral posture for computer operators is a multifaceted arrangement. Whether standing or sitting, the head should be positioned directly over the shoulders, not straining forward or backward, and about an arm's length from the screen. The neck should be extended and relaxed, the shoulders kept down and the chest held open and wide.

Elbows should be relaxed and positioned at approximately a right angle. Wrists should be in a neutral, relaxed position without flexing up or down. Fingers should be gently curved.

Rather than forcing a worker to adapt to a workstation, the workstation should be designed to adapt to each individual worker. All employees, including data entry clerks, surgeons and medical technologists, can benefit.

An ergonomic computer mounting system is a step in this direction. This type of device—or set of devices—allows a computer monitor and keyboard to be adjusted with precision, whether the employee is sitting or standing.

Full Range of Motion

Computer equipment should match the user's range of motion. Standing liberates the technician, making height, depth, tilt and pan adjustments to the screen and keyboard quicker and easier.

RULES FOR READING ROOMS

The ergonomic guidelines for radiologists using computers is essentially the same as for anyone who works on a computer. But if the prescription for ergonomic computer use is the same, in a radiology reading room, the portion must be greater. Place several workstations in close proximity, and the importance of ergonomic design reaches a critical level. Given the circumstances under which radiologists commonly work, and the serious repercussions of fatigue-related errors, the level of risk for musculoskeletal disorders registers on the extreme end of the scale.

As with any occupation, the reading room workstation should be designed to support workflow, and workflow is determined to a large extent by instances of human-machine interaction. Aside from computer displays, a keyboard and mouse or joy stick, a modern radiologist workstation can be expected to include input/output devices for a speech recognition system, a hospital medical record system, hospital paging system, hospital intranet and internet, video and telephone. Each radiologist should have dedicated access to this equipment, and it should be arranged on the work surface within the work zone which corresponds to the frequency of use.

Evaluating the ergonomics of a radiology reading room should begin by describing every task and procedure, developing them into a workflow, then checking every aspect of work accomplished in that space against the following variables:

- Display resolution—accurate image interpretation hinges on correct resolution, depends on modality
- Display illumination—mitigating visual fatigue is a priority
- Ambient lighting—a combination of lighting solutions should be considered
- Ambient sound—should not breach the integrity of voice recognition/dictation activities
- Air flow—not to be compromised by room and worksurface design
- Room temperature—given the quantity of electrical equipment
- Worksurface space—input devices must be accessible as needed
- Room arrangement—accommodating several radiologists at a time
- Open architecture computer supports—to keep up with changing technologies

In its published document on computer use, the American National Standards Institute (ANSI) recommends that the width of a computer user's work surface should be at least 27.6″ wide. Since radiologists often use four or more displays at a time, that dimension should be adjusted accordingly. Support equipment must offer a wide range of motion in order for the radiologist on duty to relocate the display, keyboard and mouse into the posture-neutral position that is right for them. Apart from the mere fact that they are possible, crucial adjustments like height, depth, tilt and pan must also be easy to accomplish. Users must be trained how and why they should take advantage of them. Adjustments with forces that are too high or adjustment mechanisms which are complicated or simply inaccessible prohibit use. Truly ergonomic mounting solutions must encompass the principles of universal design and provide on-the-fly customizing based on all variables, from the weight and shape of the display, to the size of the user and the surrounding environment.

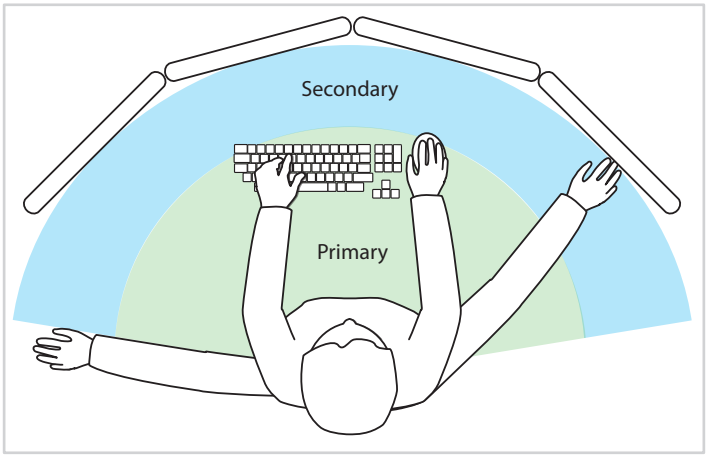
TRULY ERGONOMIC MOUNTING SOLUTIONS MUST ENCOMPASS THE PRINCIPLES OF UNIVERSAL DESIGN AND PROVIDE ON-THE-FLY CUSTOMIZING BASED ON ALL VARIABLES, FROM THE WEIGHT AND SHAPE OF THE DISPLAY, TO THE SIZE OF THE USER AND THE SURROUNDING ENVIRONMENT.

Height & Pan Adjustment
Height adjustment is essential for locating the display at eye level. Panning (left-to-right motion) accommodates the postural changes that occur naturally in the course of a user's work shift.

Multiple Displays, Multiple Movements
A configuration that allows displays to be easily re-positioned forward or back creates possibilities for customizing that contribute to worker satisfaction.

THE UPRISING

The traditional computer working posture is seated and upright, probably because typewriters were the default model for the primary input device: the computer keyboard. The current trend among some human factors professionals turns a critical eye toward sitting versus standing at a computer. As with many situations in life, the answer to this polarizing issue lies somewhere in the middle. Offering people the choice to sit or stand is the key to experience the multiple benefits of both. When not tethered in a chair, computer users have a greater range of motion, meaning that they can interact with an array of displays outside the work zones commonly associated with seated computer work. On the other hand, some types of work activities lend themselves to sitting. Interestingly, ANSI computer workstation recommendations included reclined and declined sitting to upright sitting.



Reading Room Work Zones
Primary work zone is the shape swept out on the work surface by rotating the forearm horizontally at elbow height. In the same way, the reach of an extended arm determines the secondary work zone. Note: arrangement of multiple displays at edge of secondary zone leave little space for peripheral equipment on the same vertical plane.

With the option to stand, radiology technicians automatically earn bonus workspace on the vertical plane. Wall mounted, articulating arms are particularly suited for stacked screens, keyboards, tablets, and video and audio equipment.

BEYOND THE READING ROOM

A distinct advantage of PACS in modern hospitals and clinics is that a single image can reach beyond the reading room without compromise. Busy urgent care clinics, treatment rooms, hospital corridors and operating rooms are enhanced by the presence of a digital radiology display, but are subject to stringent requirements for low profile, small footprint support equipment. Image delivery is managed in a variety of ways: both stationary and mobile, attached to walls and mounted to desks.

Whatever the form, the requirements are the same: small footprints, maximum viewing size, quick and easy access. In procedure rooms lab data can be quickly accessed with easily positioned screen mounts. Carts accommodate a changing room layout, moving information exactly where it's needed. Multi-screen solutions enhance access to PACS images; all must be easy to clean.

Operating Room
A cart supporting two, high resolution screens in an operating room facilitates patient care. Details such as integrated mouse tray, storage and cable management may seem small but have big impact on usability.

NO SUBSTITUTE FOR REST

Radiologists are under tremendous pressure to interpret images quickly and accurately; the right hardware and software can reduce image viewing times as well as the number of image manipulations. This doesn't mean, however, that the average number of images that can be processed in the course of an 8-hour shift has an unlimited ceiling. Frequent, regular breaks are an absolute trade-off to productivity. Radiology staff, and indeed, all healthcare workers, must be trained to rest.

This prescription for rest applies to anyone who works at a computer.

- Take a 2–3 minute mini-break every 20 minutes
  - To reduce visual strain, focus your eyes 20 feet ahead for 20 seconds
  - Blink your eyes
  - Breathe deeply through your nose, expelling air through your mouth
  - Drink water
  - Shake out stiff limbs
  - Check your posture and correct to neutral
- Take a 15–20 minute break every 2 hours
  - Walk around
  - Stretch muscles
  - Drink water
  - Eat raw vegetables

Corridors
Constrained or high-traffic areas require low-profile mounting solutions. The flip-up keyboard tray stows when not in use and offers back tilt to ensure wrists are flat and free from strain.

CONCLUSION

Today, healthcare organizations are being challenged to provide quality care while improving accuracy, efficiency and accountability. With the additional stress of staff shortages, space constraints, and advancements in science and medicine competing with new federal and state regulations, a situation is created where the delineation between theory and practice becomes critical. The application of ergonomic principles in extreme user settings, such as a hospital radiology department, can serve as a model for other healthcare sectors. Despite mind-bending changes occurring all around us, the most important thing to recognize may simply be that work loads will remain constant. Our ability to handle them is really the only thing that is within our control.

Stability Fosters Workflow
Using the worksurface to support the forearm while mousing is possible with small-footprint, multiple screen stands.