Ergonomics in the electronic library

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New technologies are changing the face of information services and how those services are delivered. Libraries spend a great deal of time planning the hardware and software implementations of electronic information services, but the human factors are often overlooked. Computers and electronic tools have changed the nature of many librarians' daily work, creating new problems, including stress, fatigue, and cumulative trauma disorders. Ergonomic issues need to be considered when designing or redesigning facilities for electronic resources and services. Libraries can prevent some of the common problems that appear in the digital workplace by paying attention to basic ergonomic issues when designing workstations and work areas. Proper monitor placement, lighting, workstation setup, and seating prevent many of the common occupational problems associated with computers. Staff training will further reduce the likelihood of ergonomic problems in the electronic workplace.

INTRODUCTION

The term ergonomics was introduced into the literature in the eighteenth century and has been applied to bricklayer's shoulder, telegraphist's cramp, and stitcher's wrist. The current use of ergonomics dates from 1970 when the Occupational Health and Safety Agency (OSHA) created regulations that require an employer to provide a hazard-free work environment and a healthful and safe workplace. Judith Bube covered many of the common ergonomic concerns for libraries in her article in 1985 [1].

Ergonomics is a scientific, interdisciplinary study of individuals and their physical relationship to the work environment [2]. The intent of ergonomics is to design and modify the workplace to maximize production while still acting in the best interest of the health and well-being of the employee. The approach of ergonomics must be holistic. Ergonomics requires looking at the job, the job environment, and the employee. When building or renovating today's electronic library, special attention must be given to the design of computer-related work space and workstations.

COMMON ERGONOMIC PROBLEMS

Cumulative trauma disorders (CTDs) are a class of musculoskeletal disorders of tendons, tendon sheaths, muscles, and related nerves and bones of hands, wrists, elbows, shoulders, neck, and back that are caused or aggravated by repeated exertions and movements of the body [3]. CTDs are also known as "cumulative trauma injuries." The factors that contribute to CTDs in a library or office are

- repetition—repetitive work without adequate recovery time;
- sustained static exertions—prolonged holding of a single posture;
- forceful exertions—use of excessive strength during any activity;
- localized contact stresses—pressures on the soft tissues caused by external surfaces (e.g., constant rubbing against a desk edge);
- posture—certain prolonged, non-neutral positions of the joints that might stretch, compress, or otherwise stress tendons, nerves, or other tissues [4].

Repetitive strain disorders and injuries or repetitive motion disorders (RMDs) are the most commonly...
heard about injuries. The primary example is carpal tunnel syndrome, which is a specific form of repetitive strain or cumulative trauma injury. These injuries often cause a swelling and inflammation that can lead to compression of the median nerve in the wrist, which can cause numbness, tingling, loss of feeling and muscle strength, or acute piercing pain in the fingers, wrist, or shoulder [5]. According to the Federal Bureau of Labor Statistics, of the 89,875 RMDs reported in 1992, 11,111 were associated with typing or repetitive key entry [6].

Pain and injury can also result from static exertions and posture problems. Examples of sustained static exertions include holding a sheath of papers for an extended period of time while working at a visual display terminal (VDT), prolonged gripping of a computer mouse, holding the telephone to the ear for an extended period of time or holding hands above a keyboard during pauses. Devices such as headset phones or copy holders often alleviate these risks. Posture problems include those encountered while sitting at a poorly designed workstation, holding a telephone to the ear with the shoulder, or raising up shoulders and arms to get enough force on a book to hold it flat on a copy machine.

Although upper-extremity cases garner much attention, they are not the most common ergonomic problem among office workers. Back-pain cases outnumber upper-extremity cases by approximately forty to one [7]. Even among sedentary workers, 80% will have some neck or back pain requiring medical intervention. Reports indicate that 55% of workers will complain of vision problems, 45% of back pain, and 30% of headaches [8]. In particular among VDT users, eyestrain is the most frequent physical complaint reported. Other commonly seen ergonomic problems include circulatory problems, migraine headaches, sore eyes, and blurred vision.

The health care costs of ergonomic injuries are a growing concern to employers. Barbara Silverstein, special assistant for ergonomics at OSHA, has said that “poor job design results in more than $20 billion in direct worker’s compensation costs annually. Employers estimate they pay five times that amount in indirect costs” [9]. Two million U.S. workers currently suffer from cumulative trauma syndrome, and an additional 150,000 cases are reported each year. Treatment to eliminate the new cases costs industry up to four billion dollars each year, and the average cost of treating a single case of carpal tunnel syndrome is $29,000 [10].

There has been some debate on the validity of many of these so-called ergonomic injuries, and conflicting views exist about the scientific basis and validity of many of the studies [11]. Contributing factors that exist outside of the workplace further confuse the issue. However, irrespective of the debate, there is still bodily harm that can be traced at least partially to the workplace. The human body was not designed to be immobile or to perform repetitive movement for hours at a time.

Libraries, like other industries, are experiencing ergonomic problems. For example, eight cases of carpal tunnel syndrome among circulation clerks were traced to sensitizing and desensitizing library materials as part of the security system. Librarians have reported on listservs that there have been injuries from holding down volumes on scanners at Ariel stations.

Overall, a well-designed ergonomic workplace helps decrease absenteeism and dissatisfaction and increases morale and performance. It has been suggested that a good ergonomic chair can increase productivity of a VDT user by 40% to 80% [12]. It has been shown that good ergonomics can reduce error rates by VDT users [13]. An administrator must compare the $1,500 for a comprehensive ergonomic correction (operator’s chair, keyboard, table, screen and window glare correction, overhead lighting, and foot or wrist rests) to the $3,500 to $30,000 each injury could cost [14].

STANDARDS

OSHA has been working on national ergonomics regulations for several years. The proposed regulations would require an employer to identify problems using a government checklist of five “risk factors” and to fix the identified problem within sixty days [15]. Opposition is mounting against these new regulations. The new chair of the Senate Labor and Human Resources Committee, Senator Nancy Landon Kassebaum (R-Kansas), has stated her opposition to any federal workplace ergonomics regulations and insists that any regulations must be made by the states [16]. Further, some states and counties have passed or are considering their own ergonomic regulations. The American National Standards Institute (ANSI) established standards in 1988 that are currently being re-examined. Because the ANSI standards are the most commonly used standards, these will be used throughout this article, with a few noted exceptions [17].

THE WORK ENVIRONMENT

The planning process requires an examination of the entire work environment. It is not satisfactory to just examine one part of the environment in isolation from the rest. The right chair with the wrong desk and lighting will not work. There are a number of questions that need to be answered before planning a workstation.
How many people will be using the work environment, one user or multiple users?

What are the user variables involved, such as age, sex, handedness, body type and size, health factors, and physical impairments?

How much time will be spent at the workstation? Both the number of sessions and their length may be important.

Will the workstation have multiple uses, such as searching, training, and consultation?

Will clients or other employees be present during search sessions?

Will the area be used by children, the elderly, or people with mental or physical disabilities?

What type of work will be performed there?

Are there any repetitive physical motions available that must be accommodated, such as those found at copiers and book drops?

What is the weight of any materials handled?

Will there be any lifting, twisting, leaning, standing, or repeated bending required at the station?

The Americans with Disabilities Act mandates access but does not always fully explain its meaning. Facilities must be wheelchair accessible. This means at least a table of the proper height with sufficient leg room and with maneuvering room to bring a wheelchair to the table. A simple solution is to add blocks of wood or bricks to raise the work surface to the proper height.

A survey of the library staff will also be of benefit in designing patron areas. An employee study at Boston University revealed that the employee's concepts of what was needed did not always match that of the administration or designers [18]. For example, the staff preferred to be standing or on high stools with foot rests at the circulation terminals. They wanted the VDTs to be able to swivel so they could easily show the screen to the client. The staff also wanted a lower counter to encourage interaction with the client despite the decreased privacy and security.

There is no ideal workstation design. Much of the traditional public design data is based on research performed on young men in the military. It is obsolete, because it cannot be readily adjusted for female or nonmilitary bodies [19]. Ideally, a library should buy the most flexible workstations available. Although it may be tempting to buy task-specific furniture, that path has its own problems as future technology and needs change.

**SPECIFIC DESIGN ISSUES**

The total environment of the work area is extremely important. Although we will primarily focus on workstation design, the issues of heat, air flow and quality, noise, and lighting are also important. A typical computer or laser printer generates about the same heat as a human being. Excess heat and inadequate humidity can cause drowsiness, irritability, skin itchiness, rashes, and dryness or irritation of the eyes [20–21]. It is sometimes necessary to supplement the building heating and cooling with fans or heaters. Humidity control will also reduce static electricity, which can also be responsible for facial rashes and shocks. The ideal heat range is sixty-eight to seventy-four degrees, with a humidity of 30 to 50% [22].

Air flow and air quality can also have an effect upon the work environment. To promote users’ comfort, do not place a workstation in the direct flow of heat or air conditioning unless it is used for periods of less than five minutes. Increased humidity can cause problems with molds and algae, which result in offensive odors and can trigger allergies. Exterior air intakes must be carefully placed so that odors are not brought into the building. Smells from a nearby cafeteria or automobile exhaust fumes will not provide a proper work environment.

Noise is a significant problem in some facilities. A small amount of noise can be very disturbing to a person’s concentration. Some libraries have even restricted the use of notebook computers because of clients’ complaints about the noise of the keyboard. Printers and copiers are probably the nosiest equipment in the library. Make plans to put copiers in their own room or enclose them with acoustic panels. Sound-absorbing pads can be placed under printers and typewriters, and acoustical hoods will muffle the sounds of a printer. Voices are frequently rated the most annoying source of noise. Judicious use of acoustic panels will provide for privacy, improved acoustics, a lack of distractions, and even an area to tack up information [23]. According to ANSI standards, ambient sound pressure levels should not be greater than fifty-five decibels, excluding noise generated by the user.

Room lighting contributes to problems with glare and should be reduced below normal in VDT areas. Recessed, indirect, baffled, or diffused lighting is preferred. While 500 to 600 lux of indirect illumination is appropriate for general room lighting [24], VDT areas should be limited to an illuminance of 200 lux to 500 lux [25]. Some studies have shown that VDT workers prefer very dim lighting of 100 lux [26]. Adjustable-intensity lighting is best, but if it is not available, reduce the wattage or remove alternate bulbs or tubes [27]. The American Optometric Association (AOA) recommends that cool white lighting tubes be replaced with cool white deluxe tubes, which emit less glare. AOA also recommends that VDT operators be provided workstation-specific lighting with flexible arm lamps of 60 to 100 watts for local document reading [28]. The amount and quality of hard copy involved in the work task will dictate the specific lighting needs.
VISUAL DISPLAY TERMINALS (MONITORS)

Computer monitors, often referred to in the literature as VDTs, are a crucial ergonomic design element. Poor design can lead to eyestrain, headaches, and neck and back problems. Choice of VDT, height and angle, and screen glare are key issues.

There are a number of important features to look for in buying a VDT that reduce visual strain and fatigue.

- The print must be of adequate size, easy to read and clearly formed.
- There should not be any flicker or drift of characters.
- The brightness, contrast, and on/off controls must be easily accessible.
- The VDT should have both horizontal swivel and vertical tilt.

These issues are particularly important to older users and people with visual impairments. The ability to control contrast, brightness, and tilt allows individuals to adjust the workstation to their needs.

The color of the screen is a matter of personal preference, as long as there is sufficient contrast. Blue/red combinations can cause visual strain and fatigue. Use of a VDT with luminous green characters on a dark background cause in some people color distortions called the McCollough effect. Ordinary white letters and lines on a contrasting background appear to be pink; this is neither long lasting nor detrimental to the health [29–30]. Choice of background color and lettering must be carefully considered, because looking back and forth between bright copy and a screen with a dark background may cause added eyestrain and discomfort. When monochrome screens are used, use an amber screen with fluorescent room lighting and a green screen with incandescent lighting.

Correct screen angle and height ensures proper posture and helps prevent common neck and back problems. VDT placement must be adjustable to accommodate individual physical and visual differences. ANSI standards state that the distance from the user to the display shall be at least twelve inches. The ideal for most people will be twelve to sixteen inches, but a distance up to forty inches can be used. The most practical approach is to use the ANSI minimum standard and design for adjustability for individual preference.

The VDT should be placed below eye level. Most sources recommend ten to twenty degrees [31–32] or fifteen to thirty degrees below eye level [33]. The ANSI standards state that the angle shall be between zero and sixty degrees below the horizontal plane passing through the eyes. This range allows for reclining posture, use of bifocals or trifocals, user preference, and seating design.

Extension platforms or articulating arms hold VDTs in adjustable positions away from the work surface. They are the most flexible and most expensive option in mounting a VDT. Tilt and swivel platforms are less expensive options, which are easily added to older-style VDTs.

Many of the problems with VDTs involve eyesight. For younger VDT users (younger than forty) there is a benefit derived from special spectacles, because accommodations involved in VDT use can lead to increased myopia [34]. In fact, some corporations have begun to pay for eye examinations and corrective lenses, because approximately 50% of all people possess uncorrected visual defects [35].

Some employees may encounter particular problems while wearing bifocal eyeglasses. To focus on the VDT screen, an individual must hold his or her head back to use the bottom portion of the eyeglasses, which causes an uncomfortable posture. Possible alternatives are reverse bifocals, trifocals, progressive addition lenses, and lenses made strictly for VDT use.

Screen glare is an ergonomic concern that can be easily and inexpensively corrected. Ninety-five percent of VDT operators complain about screen glare, and 65% mention specific health problems from it [36]. Matte finishes should be used on walls, counters, floors, and furnishings to discourage glare. Blinds, shades, light-absorbing film, or curtains may be necessary to decrease window glare. VDT screens should be placed at right angles to windows.

There are several devices that can be added to the VDT to prevent glare. Glare filters are very effective and are made of several different materials. Polymer films yield high-quality image, but they are susceptible to smearing from touching and must be cleaned and maintained properly. There are also screens made of etched glass, but, although they reduce reflections, they also reduce image quality and can make the characters seem to be out of focus. Screens can cost from $30.00 to more than $250.00. Some of the glare screens are grounded and will dispose of electrostatic and low-frequency radiation. Screen hoods block outside light from reflecting upon the VDT screen in the same way a cap’s visor keeps the sun out of one’s eyes. Although they are not an ideal solution, they can help improve visibility.

Workers are frequently concerned with the hazards of VDT use. There was a scare regarding spontaneous abortion or birth defects in the 1980s; however, the Food and Drug Administration National Center for Devices and Radiological Health has reported no evidence of radiation from VDTs being responsible for adverse pregnancy outcomes. The levels necessary for such effects are at least 1,000 times higher than those to which VDT operators might be exposed [37]. No adverse effects have been shown by studies done on X-rays, very low frequency, extremely low frequency,
and other radiation emissions from VDTs [38–39]. Because there is more radiation emitted from the sides and back of VDT terminals, it is recommended that no other terminal or person be placed within three to four feet of the back or sides of nearby terminals [40].

KEYBOARDS

There are a number of considerations involved in choosing keyboards. They should be detached from the computer to ensure greatest adjustability. The keyboard should be stable and not too wide to ensure comfortable typing. Ideally, workstations should include an adjustable keyboard pan that will permit the user to keep his or her upper and lower arms at a ninety degree angle (upward arm vertical, forearm horizontal). Most users prefer a slope to the keyboard, and the ANSI standards state that keyboard slope shall be between zero and twenty-five degrees. The risk of repetitive motion injuries (RMIs) is minimized by operating the wrists at an angle of zero to fifteen degrees.

The traditional QWERTY key layout is still the ANSI standard. There are new custom keyboards that allow typists to rotate their hands as if holding a basketball, which are manufactured by a number of companies, including Microsoft and Apple, at prices from $99.00 to $600.00. The medical justification for their use is not conclusive. All keyboards should be glare free with slightly concave keys and should not require too hard a touch.

Muscles can become fatigued by prolonged use of keyboard, mouse, or trackball. A number of aids have been devised to provide support while using these input devices, such as foam wrist rests. Wrist rests can inhibit the downward motion of the wrist during high-speed typing and should be an optional feature. Chair armrests make it easier to rest at the keyboard. Alternating between a mouse and a trackball may also relieve muscle fatigue.

WORKSTATIONS

The ANSI requirements for a work surface are that it be of sufficient width and depth to accommodate VDT components and support other task-dependent items, such as hard copy. The ideal work surface would be easily and quickly adjustable from twenty-two to forty-five inches, either electrically or hydraulically, allowing both standing and sitting positions. Adjustable chairs and tables for sitting or standing allow the largest part of the population to be accommodated. Standing workstations, such as those used for online catalog terminals, should provide a bar or other type of foot rest (Figure 1).

Because adjustable workstations are more expensive, most facilities are going to have to install some static work surfaces. The workstation should reflect the work to be performed and the physical characteristics of the users. The table should not be so high that users' arms must be elevated and held away from the body, nor should it be so low that the user must bend forward at the waist or neck.

There must be adequate leg room underneath the work surface. A minimum seven-inch thigh clearance is recommended from the surface of the seat pan to the underside of the work table [41]. There must be enough clearance so that the largest person to use the station is able to sit upright with feet on the floor and knees at a ninety degree angle [42]. Shelves or drawers can be removed if necessary. Standard desks have a height of twenty-six to twenty-eight inches. Ideally, a surface height adjustable from twenty-three to twenty-eight inches would suit the majority of users. For shorter women, a twenty-three inch table might be preferable, but foot rests can be used to compensate for higher tables.

When planning the size of a work surface, remem-
Table 1
Ergonomic problems and possible causes

<table>
<thead>
<tr>
<th>Identified problem</th>
<th>Possible cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back not in contact with chair</td>
<td>Improper seat design or fit</td>
</tr>
<tr>
<td>Back bent forward</td>
<td>Poor work habits</td>
</tr>
<tr>
<td>Back rotated or to side</td>
<td>Seat not positioned correctly toward work space</td>
</tr>
<tr>
<td>Elbows elevated</td>
<td>Monitor height or angle</td>
</tr>
<tr>
<td>Elbow flexed at less than a 90-degree angle</td>
<td>Poor work habits</td>
</tr>
<tr>
<td>Elbow flexed at more than a 110-degree angle</td>
<td>Work surface too high</td>
</tr>
<tr>
<td>Eye strain</td>
<td>Glare</td>
</tr>
<tr>
<td>Feet have no support</td>
<td>Lack of foot rest</td>
</tr>
<tr>
<td>Hands higher than elbow</td>
<td>Seat too high</td>
</tr>
<tr>
<td>Hands lower than elbow</td>
<td>Work surface too high</td>
</tr>
<tr>
<td>Head bent down or up</td>
<td>Seat too high</td>
</tr>
<tr>
<td>Knees higher than hips</td>
<td>Poor work habits</td>
</tr>
<tr>
<td>Knees spread far apart</td>
<td>Work surface too high</td>
</tr>
<tr>
<td>Shoulders elevated or tense</td>
<td>Chair too high</td>
</tr>
<tr>
<td>Sitting on edge of seat</td>
<td>Copy placement</td>
</tr>
<tr>
<td>Thighs pressed by seat edge</td>
<td>Feet or foot rest too high</td>
</tr>
<tr>
<td>Thighs pressed together</td>
<td>Lack of knee space under work surface</td>
</tr>
<tr>
<td>Wrist bent back or forward</td>
<td>Monitor height or angle</td>
</tr>
<tr>
<td>Wrist bent back or forward</td>
<td>Armrests too high</td>
</tr>
<tr>
<td>Wrists bent back or forward</td>
<td>Poor work habits</td>
</tr>
<tr>
<td>Wrists bent back or forward</td>
<td>Cylinders added to back of chair</td>
</tr>
<tr>
<td>Wrists bent back or forward</td>
<td>Seat too far from work space</td>
</tr>
<tr>
<td>Wrists bent back or forward</td>
<td>Seat height</td>
</tr>
<tr>
<td>Wrists bent back or forward</td>
<td>Seat too narrow</td>
</tr>
<tr>
<td>Wrists bent back or forward</td>
<td>Cylinders too soft</td>
</tr>
<tr>
<td>Wrists bent back or forward</td>
<td>No wrist support</td>
</tr>
<tr>
<td>Wrists bent back or forward</td>
<td>Wrong keyboard position or slope</td>
</tr>
<tr>
<td>Wrists bent back or forward</td>
<td>Poor work habits</td>
</tr>
</tbody>
</table>

ber to provide adequate space for hardware and work materials. Approximately forty-five inches in width is needed for a VDT, central processing unit, keyboard, printer, document holder, and work space. An additional fifteen to twenty-five inches may be needed for client space, consultation, or training. Generally, a depth of thirty inches should be enough, although this can be reduced to twenty-four inches with the use of a sliding keyboard drawer.

The shape of the workstation is strictly a matter of taste. L-shaped, straight, or u-shaped workstations all have adherents. The important points are that there must be room to take notes; everything should be visible without undue movement of neck or head; surfaces must be of the correct height; and needed materials and documentation should be available without stretching, bending, leaning, or standing. The area should be well organized, with items within easy reach. Store heavy manuals at an easy lifting height or where they can be slid rather than lifted.

Document or copy holders can be an inexpensive solution to some work space and muscle fatigue problems. Adjustable holders provide the ideal location and distance for each user. The copy should be at the same height as the VDT screen to avoid the repetitive head motion from screen to desk. The more expensive hydraulic units may be more appropriate for stations where copy is frequently used.
CHAIRS

The chair is one of the most important parts of the workstation. There are no industrywide standards, and any chair can be called "ergonomic" at prices from $59.00 to $2,000.00. The key is to find a chair that is adjustable and fits the needs of the individual user. In staff areas, employee input is very important in the choice of chairs. Identify two or three styles of chairs that meet ergonomic and budget requirements, and allow the employees to choose the style that fits them best. In multi-user and public areas, choose a chair that is adjustable with easy-to-use controls.

The important features to look for in chairs are:
- adjustable swivel and tilt,
- regulation approved gas springs,
- easy-to-use and accident-proof controls,
- seat height at least sixteen to twenty-one inches from the floor,
- seat depth at least fifteen to seventeen inches,
- curved back rest at least twelve inches wide,
- adjustable back rest height and depth,
- stable five-arm swivel base with antiskid castors, and
- fireproof, antistatic fabrics.

All of the frequently used controls should be simple to operate and easy to reach. The user should not have to kneel down by the chair to adjust the height. The seat height should be pneumatic for quick adjustment for different tasks and people. The back rest should include adjustable support to fit the lower back. The depth of the back-rest should be adjustable to permit contact in the lumbar area and to avoid pressure on the back side of the lower leg. Lumbar supports are available for chairs that lack them.

The chair seat or seat pan design impacts circulation, posture, and comfort. The front edge of the seat pan should roll forward in a "waterfall" design to prevent the seat pan from digging into the back of the thigh. ANSI standards state that the width of the chair should be a minimum of 18.2 inches or approximately 25% wider than the buttocks to allow for changes in posture. The seat pan angle should be adjustable between zero and ten degrees to encourage a seated posture that supports the weight of the thigh and buttock with the lumbar area contacting the seat back. Adequate seat depth is necessary in order to provide relief to the back of the kneecap; one should be able to place a clenched fist between the knees and the front edge of the seat. Foot rests of two inches or more should be provided for shorter users, because feet must rest on the floor for stability and to maintain blood flow. Free standing foot rests are preferred so that the user can frequently adjust their position.

Armrests reduce stress on the lower back and provide support for the arms while using the keyboard. If they are too high, they can cause shoulder elevation; however, if they are too low, they cannot be reached comfortably. Adjustable arm rests are the ideal solution.

HUMAN FACTORS

Purchasing of proper equipment and furniture will not solve all ergonomic problems. It must be accompanied by training or information about potential ergonomic problems and their cure. Employees must be taught why injuries occur in order to fully understand how they can be prevented [43]. Workshops on ergonomic issues have greater impact than written information alone. Employees need to be taught about proper work posture, exercises to relieve muscle tension and fatigue, and the proper operation of adjustable work devices. Educated employees can assist in the recognition, prevention, and control of ergonomic problems (Table 1).

One of the best ways to avoid risk is to alternate jobs or have frequent job breaks. Broadening job descriptions to include more dynamic and varied tasks may be the best and sometimes the only solution to the potential problems of cumulative trauma disorders. Research has shown that as the length of time at the VDT increases, the rate of error increases, and the individual's posture worsens. It has been suggested that employees need to take breaks of at least fifteen minutes for every two hours of moderate VDT work and as much as ten minutes every hour during demanding work [44]. Breaks can consist of relaxation exercises, a change in tasks, or an actual rest period. Some research indicates that shorter, more frequent breaks may be more beneficial.

To achieve a complete ergonomic work environment, job design must also be considered. Ideally, this is a step-by-step analysis of the job, materials, software, tools and machines, methods used, and physiological and psychological aspects of the work environment [45].

CONCLUSION

The advent of the modern electronic library has brought with it increased risk of injury to employees and clients alike. Evidence in other work environments has demonstrated the dangers of spending long hours immobilized in front of a VDT screen. There is convincing evidence that performing an innocuous task can cause injury if it is performed repeatedly. An increasing number of these ergonomic injuries are being reported in libraries. Legislation is being passed regulating a response to ergonomic hazards. Libraries will find that they will be held responsible for progressively more employee and patron injuries if the library does not address the inherent risks.
Libraries cannot escape the ergonomic problems associated with the new technologies. They must decrease the number and severity of injuries to employees and clients by a careful holistic analysis of the workplace and implementation of preventative measures. The work environment, the tools, and the persons performing the task must all be considered. The purchase of inexpensive aids such as wrist pads, lumbar supports, and foot rests can decrease the risk of injury. Significant ergonomic improvements can be made without the expenditure of large quantities of capital by including ergonomic considerations in all decisions regarding work space, furniture, employee training, and employee job descriptions.

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