Studies on Design of Comfortable Work Station for Doctors

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Abstract: Ergonomics plays a vital role in solving the problem of injury caused due to uncomfortable workstation of doctor's since unlike other professionals and workman, doctors work in a different environment and atmosphere where there is no time constraint and so they are prone to fatigue and MSDs and other injuries due to their hectic schedule. In this design work, a study was conducted on the working environment of doctors in a clinic and the factors that causes stress, strain and musculoskeletal disorders in doctors due to poor ergonomic setups has been identified. Based on the studies, the working environment in a clinic is enhanced using ergonomic redesigning.
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1. Introduction

Ergonomics, also called human factor engineering, studies the interaction, both physical and behavioural between human and their environment – the workplace, tools and general working conditions.India is cruising ahead as an upcoming healthcare destination in the world. Unlike other countries, where medical practice is mainly based on corporation hospitals, in India most of the practitioners carry their own practice in their private clinics. The infrastructure within the clinic in lagging way behind the promise of good treatment. Especially if we look at the clinical setup, private clinics are far behind the world standards. There is a clear need for good design of layout and products for expanding health care scene in India. In this study the clinical setup of 100 clinics were studied. The study shows that the majority of the clinic is poorly designed with uncomfortable furniture, lack of ventilation and unergonomical lighting. Doctors practicing in such environmental standards are prone to work-related musculoskeletal disorders such as lower back pain, neck pain, shoulder pain, pain in upper limbs and arms. The factors for these discomforts are thoroughly analyzed. These factors are incorporated in and the workstation is redesigned to provide optimum comfort level to the patients.

2. Review of Ergonomics

The principles of ergonomics can be applied in the design of machine and equipment displays and controls to reduce response error that could have disastrous results. Design of any work station involves physical and functional boundaries around the elements of the system. Ergonomics is the science which enables a work system to function better by improving the interaction between the users and the machines. The International Ergonomic Association has adapted the technical definition for ergonomics. Ergonomics or human factors is the scientific discipline concerned with the understanding of interaction among humans and other elements of the system, and the profession that applies theory, principle, data and methods to design in order to optimize human well being and overall system performance. To put it in simple words, ergonomics is the science of making things comfortable and efficient by providing a better working condition.

There are two ways in which ergonomics impacts upon system design in practice. Firstly, many ergonomists working in research organization discover the characteristics of people that need to be allowed for design. This research leads, directly or indirectly, to the drafting of standards, legislation and design guidelines. Secondly, many ergonomists work in a consultancy capacity. They work as part of a design team and contribute knowledge to the design of the human machine interaction in work system. This often involves the application of standards, guidelines and knowledge to specify particular characteristic of the system. In ergonomic literature, there is a wealth of information about physical structures of system and standards for noise, lighting, seating, climate, etc. apart from this, the system can be divided into two components, viz. human components and machine components.

The human is the part of physical word and obeys the same physical laws. The goal of ergonomics is to optimize the interaction between the body and its physical surroundings. This means,

ensuring the physical space requirement are met, using data on human anthropometry, and that internal and external force acting on the body are not harmful. Joanna et al [4] indicated that doctor-shopping behavior also associated with higher rates of mental illness. Ergonomic problems arise often because, although the operator is able to carry out the task, the effort required overloads the sustaining and supportive process of the body and cause fatigue, injury or errors.

The human component can be grouped into effectors and the senses. The three primary effectors are the hand, the leg and the voice. More generally, the musculoskeletal system and body weight can be regarded as effectors. No purposeful physical activity of the limb can be carried out without maintenance of the posture of the body and stabilisation of the joints.

The senses are the means by which we are aware of our surroundings. Human being often said to have five senses- sight, hearing, touch, taste and smell. Vision and hearing are more relevant to ergonomics, although smell is important in detecting leaks, fires and so on.

In order to carryout work activities, we require energy and information. Physiological processes provide energy to the working muscles and dissipate waste products. The brain can be regarded as an information processing centre, which controls the planning, decision making and problem solving activities of work. An understanding of these basic processes is essential in work design to determine workers capacity for physical work and to investigate factors that influence work capacity.

3. Design of Work Station

Alan et al [1] discussed the time, space and opportunity in the outpatient consultation for doctors. Wang et al [7] explained the methods for establishing network platform for medical safety and security management system. Designing a workstation that will protect you from injury is not so difficult. Today, designers and engineers rely on human factors research, such as anthropometric data (body measurements) and experimental usability studies to aid the process of making products easier to understand, safer to use and better matched to human body. The following steps have to be followed:

a. Redesign workstations or work processes to eliminate contact stress
b. Avoid resting against sharp edges, or try to have them rounded.
c. If a part of the body must rest against a sharp edge, pad the edge or pad yourself to better distribute forces.
d. Spread constant forces over greater surface area to minimize tissue injury. For example, increase the size and length of tool handles.
e. Wrap handles with tape or soft, grippy materials.
f. Cover hard armrests with foam.
g. Consider using wrist and mouse rests at computer workstations.
h. Tools that have grooves for the fingers don't work well.

Whatever you design you must always keep in mind that it must fit the person it is design for. We all like and dislike a variety of colours, sounds, shapes etc., and so when we design all these factors must be borne in mind. Various factors influence the design of workstation. So these factors should be studied thoroughly and should be incorporated while designing.

3.1 Individual Contributing Factor for Ergonomic Injuries:

Multiple factors influence the body and its tolerance to activities. Those individual risk factors affect our susceptibility to injuries. Some individual contributing factors can be changed or minimized while others are outside of our control.

These factors are age, gender, previous injury, health factors, stress, physical conditioning, computer use, extracurricular activities.

3.2 Work Related Risk Factors:

Risk factors are inherent in every job or activity. Pamela [5] explained the challenges in practical capability of nurses in doctor's room and the clinic. Robet et al [6] discussed the different types of relationships between people with doctors and the difficulties in medical services. Derek et al [2] discussed the basic relationships between physician and patient with computers in the consulting room. Garry et al [3] discussed the use of computers, advantages and disadvantages of the computers in the doctor's room. Activities involving ergonomic risk factors can contribute to increased discomfort or injury. Note that combining risk factors will exponentially increase the risk of injury. Prolonged exposure to the risk factors repetitive motion, static posture, contact pressure, forceful exertion, vibration, environmental stressors, task exposure, awkward position also increases the risk of discomfort or injury.

3.3 Elements of Workstation:

a. Doctor's chair
b. Doctor's table
c. Patient's stool
d. Examination couch
e. Computer

f. Shelves and cupboards for placing instruments and drugs
g. Wash basin
h. Waste bin
i. Foot stool
j. Ventilation
k. Temperature of the room
l. Lighting
m. Aesthetics

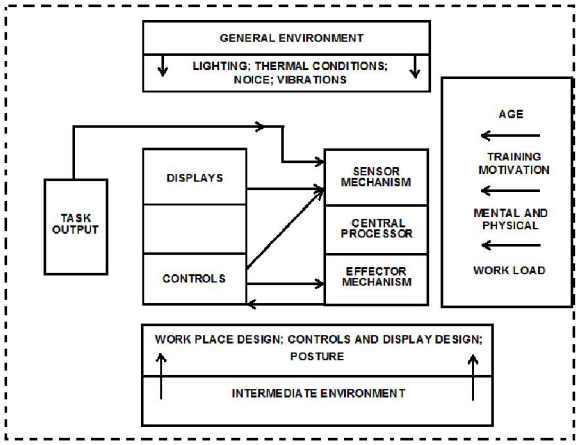

Figure 1: A Human – Machine Model

3.3.1 Chair Design Guidelines

a. The occupant should be able to sit in and get up from the chair without difficulty. The feet should rest flat on the floor without the knees projecting above the upper leg. A seat height of 16 to 18 inches fits the bill for most adults. Armrests should support the forearms without raising the shoulders (7" to 9" above seat). Half armrests enable the chair to be drawn up close to a table.

b. The depth of the seat should allow clearance from the front edge of the seat to the back of the occupant's leg. A seat that is too deep will press against the back of the legs forcing the occupant to slouch forward. A seat that is too shallow may be unstable and feel precarious. A seat depth of 15 to 18 inches is recommended for most adult.

c. The width of the seat often tapers by 2" to 3" from the front to the rear to allow clearance for legs and clothes in front while allowing elbow room in back. Many chairs have seats that are about 15" wide in rear and 18" wide in the front. For relaxed seating, the seat should slant slightly toward the back (about 5 to 8) to keep the occupant from slipping out of the chair.

d. The seat back should support the lumbar region without being so high as to interfere with the shoulder blades. A back height of about 12" to 16" above the seat is ideal for most adults.

e. The lower portion of the seat back (first 4"-8") should curve out or be left open to allow room for the buttocks.

Table 1. Chair Dimensions for Average-Sized Adults	
Seat width	16"-20"
Seat depth	15"-18"
Seat height from floor	16"-18"
Slop of seat front to rear	5° to 8° (3/4" to 1" drop)
Armrest height above seat	7"-9"
Armrest length (full armrest)	8" minimum
Armrest width	2" average
Set back of armrest from front	2"-3"
Seat back height	12"-16" above
Seat back recline angle	0° -5° (formal); 10°-15°(casual)

3.3.2 Table Design Guidelines

a. In choosing between a round or rectangular (including square) table , keep in mind that round tables blend in easier with other furniture and also allow easy movement around them.

b. Most tables designed for writing or dining should be 28" to 30" high (29" is common) with chair seats 11" to 13" lower. The higher the tabletop, the more uncomfortable and formal the table feels. Provide about 24" of leg room below the table (height from floor to bottom of table rail) and at least 12" for knee clearance (projection of table top beyond table leg). In figuring seating capacity. Allow at least 24" of elbow room width per person and 12" to 15" depth from the edge of the table.

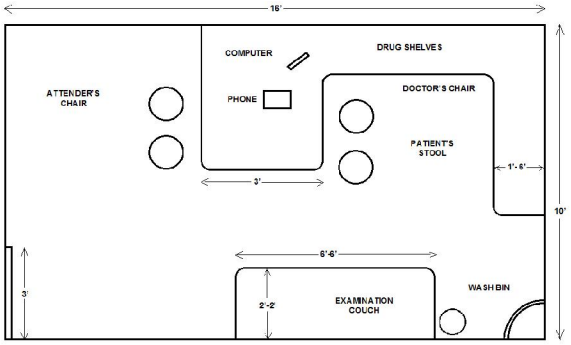

Figure 2: Layout of doctor's work station

3.3.3. Workstation Layout Design

Patient's visit to a doctor's office is essential to health care activities. Murray et al [5] describe a stochastic model by mathematical and computer modeling approach. The success of any workstation

design depends not only on the design of the element present in the workstation, but the arrangement of the elements in their proper position to give maximum comfort and efficiency in the work.

4. Conclusion

A detailed study was conducted to know about factors that cause injuries on a human body due to work related stresses. The workplace must, as far as possible, allow the users to sit or stand at will. To move from sitting position standing and vice versa must be easy. Hence the movement of body weight about the feat should be kept low. A major part of the body weight should not be on the seat surface but be distributed between the seat, back rest and feet. This reduces the subsurface pressure and allows change in weight distribution between various possible weight bearing surface. Considering these factors, the workstation is to be designed incorporating the ergonomic standards. Furniture is to be designed based on the recommendations. Adequate spaces should be provided for the free movement inside the clinic. The chair should be provided with coasters for the movement. The elements should be placed in proper place so that it can be reached easily without much stretching. Furthermore it is intended to design the chair with various density polyurethane foam and analyse the stress distribution in them. By redesigning the workstation, atmosphere of the clinic will be enhanced there by the stress of the work can be reduced.

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