The Ergonomics in the Operations among the Units of Hospitals
The Example of Sultan Hospital in Diyarbakir

F. Demet AYKAL¹, Meltem ERBAŞ² & Bişeng Jinda KARAKAŞ³

Abstract
The operation of hospital’s policlinic, clinic, taking a blood sample, getting results etc., its own mechanism, and the relationship of these units with each other must be correctly fictionalized. At the same time, the determination of layout plays an important role ergonomically as well as being very important in terms of receiving and providing quality services. One of the most important problems is the workflow of service units in the hospitals where they serve in the different density and have a complex physical structure every moment of the day. In hospitals, it is supposed to be detected suitable size of the residential areas for each unit by determining necessary human power and the needs of machine in accordance with the relationship of workflow among them. Thus, the medical negatives experienced in the hospital will be removed and all staff's productivity with the ergonomic workflows which will be arranged will increase. From this point of view, it is intended to examine ergonomics from the points of workers, patients and patient’s relatives among units in the hospitals. Considering the historical developments of it, it is focused on the important of the principle of ergonomics in this examination. Later on, it is touched upon ergonomic design and the effects on users among units in hospitals. In this context, the relationships which are required to be among them and the structure of units were evaluated by taking over function between units as a perspective of Sultan Hospital. To specify the problems and hitches in this relationship, between 8th and 22nd of May at 09.00-12.00 / 13.00-17.00, a questionnaire of 12 questions was conducted to 150 users, 59 men and 91 women, who were the staff of hospital, patients and their relatives by using the technique of random sample face to face like a quinary conversation. The data obtained in SPSS 23.0 Statistical Data Analysis Program was analyzed. The diagram of workflow was manufactured towards the usage of ergonomics during designing by offering solution recommendation in the direction of analyzes for problem areas.

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1. Introduction

Ergonomics are determined in consequence of examination of design for human-system interaction and compatibility with human’s physical, spiritual, social feature and limitations. (Kawrowski, 2005:436; Putkonen, 2010:360). Therefore, it needs to be understood the principles of ergonomics design in order to examine effects on patients and workers. In this context, “International Ergonomics Unit” defines ergonomics as three subcomponents, physical, cognitive and organizational ergonomics.

Physical Ergonomics: It is supposed to associate with workers anatomic, anthropometric, their physiological and biomechanical features. It contains subjects about working postures, carrying materiel, repetitive moments, the disturbance of the muscle and skeleton system, the layout of workplace and security.

Cognitive Ergonomics; It is about people’s mental process such as perception, memory, information, thinking and reactions and it expresses the interaction with human and other system elements. (Putkonen, 2010: 360). The goal of Cognitive Ergonomics is based on how ideas and business influence each other. This is expressed the figure of effect on products, services and output by consolidating sovereignty of workers on business system and processes and it also focuses on business quality (Hollnagel, 1997: 1170).

Organizational ergonomics or cooperate ergonomics; organizational structures include in processes and policies, and aim to optimize socio-technical systems. Topics include communication, team resource management, working time design, participant ergonomics and quality management (IEA, 2015).

In particular, participatory ergonomics is seen as an important factor in describing the associational link between organizational ergonomics and patient and employee safety in a hospital setting. International Ergonomics Unit describes the participant ergonomics as follows; the inclusion of employees into the plan has provided sufficient level of knowledge and strength. At the same time ensuring that they control a significant amount of their business activities (IEA, 2015).

Thanks to the developing technology, especially in the hospitals, with the facilities to increase the diagnostic possibilities, with the development of electronic device and as a result of these, in today’s life, with the places that will ensure the correct and quick; Le Corbusier emerges as a group of buildings that does not fall outside the definition of “a living machine”. (Harputlugil, 2005: 27).

Hospital personnel, stationary and portable equipment; Technology interacts with each other. This interaction plays an important role in human performance. Among the factors directly affecting the system performance in the hospital environment are; lighting, temperature, noise, confusion, access to the patient and inability to use appropriate tools (Johnson and Barach, 2007: 95-107).

Therefore, hospitals that offer services at all hours of the day, with different concentrations at different times and with continuous human circulation, are in a complex structure, because of this, one of the biggest problems to be solved is the problem of inter-unit workflow.
In hospitals, examination, diagnosis and treatment units auxiliary medical units administrative, financial and technical units required for manpower, machinery, and equipment needs are determined and relations between them according to the workflow requires the determination of the proper size and location in residential areas. Thus, doctor will both increase productivity with nurse and other assistant and support staff, thanks to ergonomic workflows and be provided removing medical negatives happened in the hospital.

2. Importance of Ergonomics and Function between Units in Hospitals

Hospitals are the places where a process begins with patients' entry to the hospital. This process consists of a combination of the various processes and the process with tracing each other. These processes are like making an appointment - reaching policlinics - waiting in line for examination - examination - if in need; taking a blood sample, roentgen, X-ray film. They are ways to access to the other units. Therefore, a regular operation must be among them.

Besides, in the practice of health service duration, the process, without the entry and exit of the patient to be treated includes inpatient services, auxiliary medical services, hospital technical services, security services, accounting, and the units such as purchasing. (Atalay, 2015: 42).

In the section of management, services of bureau are mainly based on weighted works. Different services such as general cleaning, maintenance, repair, hygiene, Laundry, are qualified as the works of concentrated energy. The services such as X-ray. Microbiology, ultrasonography, magnetic resonance, etc. in private medical service include both energy and knowledge-intensive work in human-machine compatibility. At the same time, units of health services and clinic where the service is provided directly; they include both energy and information studies such as sensor motor. Their use and coordination are evaluated as energy-weighted works for patients and their relatives. (Çetik and Oğulata, 2002: 2).

The ergonomics in the operation among units in hospitals is very important for users in order to give and benefit these services with less energy. Besides the fact that they are not paying attention to the principles of protection and the posture, ergonomic factors also play big role in the formation of pain and the occupational pain for health workers.

Therefore, in order to increase the quality of life of patients and health care workers in the hospital environment, an ergonomic patient care system should be established in harmony with the physical, social and psychological characteristics and quality assurance related to human factors, psychology, sociology and communication science should be improved.

Ergonomics which aims to design work arrangements in accordance with human comfort are indirectly affecting people's quality of life by reducing the potential risks in business environment. Ergonomic design and organization of the working environment has a positive effect on job satisfaction and productivity (Yazıcı and Kalaycı, 2015:385).

Hospital buildings should be designed with all spatial connections in mind, since they are structures that people with disturbances refer to. Despite the fact that
there are structures in m2 that are not underestimated when considering the functions they have and the number of people they will serve with the purpose of establishment, the human scale and the ratio should not be overlooked in the whole hospital design. Hospitals should not be forgotten that whatever the functions they have, they are all designed to provide the comfort of the users in creating all the spaces (Harputlugil, 2005: 45).

In this context, in order to improve the quality of life of patients and health care workers in the hospital environment, ‘patient care ergonomic system’ which is compatible with physical, social and cognitive structures should be created; human factors associated with quality assurance, psychology, sociology and the integration of communication sciences with the health system should be improved (Babayiğit and Kurt, 2013:157).

3. Interdepartmental Workflow Issues

Ergonomic regulations to be made in the process between units in hospitals will be carried out in the most important part of the occupational health and safety practices. Even the effect on the efficiency of this arrangement, employee, patient and attendants are main issue which should provide to ensure the application of health and safety therefore, it depends on their satisfaction. The general workflow at the hospital is determined by the flows of the hospital sub-units. In this workflow;

- Internal Traffic of Patient in Hospital,
- Internal Traffic of Patient in Polyclinic,
- Internal Traffic of Patient in Clinic,
- Internal Traffic of Patient in Emergency Service,
- Internal Traffic of Patient in Operating Room,
- Internal Traffic of Patient in Intensive Care,
- Internal Medicine of Patient in Treatment Units,
- Internal Traffic of Patient Care in Alert Units (Radiology Unit, Laboratory Work Flow) problems are important.

4. Material and Method

Private Sultan Hospital in the district of Diyarbakir called Bağlar with one thousand population and the potential of intensive patient was examined in the workflow among units in the scope of work for the user satisfaction and so its proximity on ergonomic was analyzed (Figure 1).

Figure 1: The Location of Private Sultan Hospital
The hospital consists of these units: Emergency Service following the floor plan - Anesthesia, Brain - Nerve Surgery, Dermatology, Pediatrics, Physical Therapy/Physiotherapy, General Surgery, Ophthalmology, Internal Medicine, Obstetrics and Diseases, Cardiology, Neurology, Ear - Nose-Throat, Orthopedic Surgery-Traumatology, Urology, Radiology and Laboratory (Figure 2). The hospital has 350 physicians, 22 doctors, 76 nurses, 2 biologists and 250 other staff (laboratory, automation, security, nursing and cleaning).

Figure 2: Private Sultan Hospital’s Floor Plan
In the workshop, "The functioning of units in the Private Sultan Hospital was discussed through floor plans, and the structure of the units and the relations between them were evaluated. To specify the problems and hitches in this relationship, between 8th and 22nd of May at 09.00-12.00 / 13.00-17.00, a questionnaire of 12 questions was conducted to 150 users, 59 men and 91 women. Respondents were responsible for the five questions. (Absolutely No [-2], No [-1], Indecisive [0], Yes [1] and Absolutely Yes [2]). For these questions, factor analysis of the relationship between the units was performed in the SPSS 23.0 statistical analysis program. Depending on the data obtained, a solution workflow diagram for ergonomic use in the design dimension has been produced by presenting solution proposals to problem areas.

5. Findings and Evaluation

In the questionnaire applied in the scope of the study, the questions that will determine the demographic characteristics (age, sex, education status, occupation status) of the users were firstly directed and the "f" (frequency: number of persons) and "p" (percentage distributions) were determined by entering the data in the SPSS 23.0 statistical analysis program (Table 1).

<table>
<thead>
<tr>
<th>CINSIVET</th>
<th>F (frequency)</th>
<th>P(percentage) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>91</td>
<td>60,6</td>
</tr>
<tr>
<td>Men</td>
<td>59</td>
<td>39,4</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100,0</td>
</tr>
<tr>
<td>AGE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-30</td>
<td>35</td>
<td>23,1</td>
</tr>
<tr>
<td>31-40</td>
<td>25</td>
<td>16,4</td>
</tr>
<tr>
<td>41-50</td>
<td>41</td>
<td>27,3</td>
</tr>
<tr>
<td>51+</td>
<td>49</td>
<td>33,2</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100,0</td>
</tr>
<tr>
<td>EDUCATION STATUS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>8</td>
<td>5,3</td>
</tr>
<tr>
<td>Literate</td>
<td>5</td>
<td>3,6</td>
</tr>
<tr>
<td>Primary school</td>
<td>46</td>
<td>30,9</td>
</tr>
<tr>
<td>Middle School</td>
<td>26</td>
<td>17,1</td>
</tr>
<tr>
<td>High school</td>
<td>34</td>
<td>23</td>
</tr>
<tr>
<td>Associate Degree</td>
<td>15</td>
<td>9,9</td>
</tr>
<tr>
<td>Bachelor</td>
<td>14</td>
<td>9,5</td>
</tr>
<tr>
<td>Postgraduate</td>
<td>2</td>
<td>0,7</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100,0</td>
</tr>
<tr>
<td>JOB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Unemployed</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Employee</td>
<td>44</td>
<td>29,3</td>
</tr>
<tr>
<td>Civil servants</td>
<td>49</td>
<td>32,7</td>
</tr>
<tr>
<td>Self-employment</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>Retired</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>100,0</td>
</tr>
</tbody>
</table>

Table 1: Age, Gender, Educational Status and Occupational Distributions of Users
It was found that 150 respondents who participated in questionnaire were predominantly primary school graduates (30.9%) according to their age group, and (32.7%) were female respondents (60.6%), it is observed that the numbers of women are more than others. It can be said that the variable user class of the hospital is middle age, primary education level of patients and civil servants.

Then, in order to measure the satisfaction of the respondents between units in the hospital, the questions are the five; (Absolutely No [-2], No [-1], Indecisive [0], Yes [1] and Absolutely Yes [2]) in this style, answers of 12 questions which was received and data were entered in SPSS 23.0 statistical data analysis program, provided that do general statistical analysis, standard deviation and arithmetic mean are calculated (Table 2).

**Table 2: Functional Satisfaction Levels Between Hospital Units**

<table>
<thead>
<tr>
<th>Questions</th>
<th>S. D.</th>
<th>A. M.</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is the hospital designed to enter the main entrance door as soon as possible?</td>
<td>.83</td>
<td>4.0</td>
<td>.82</td>
</tr>
<tr>
<td>2. Is the number of parking spaces at the hospital sufficient?</td>
<td>1.39</td>
<td>2.4</td>
<td>.49</td>
</tr>
<tr>
<td>3. Is the toilet and bath enough for the disabled at the hospital?</td>
<td>1.52</td>
<td>2.2</td>
<td>.45</td>
</tr>
<tr>
<td>4. Are walking paths sufficient for the disabled at the hospital?</td>
<td>.95</td>
<td>3.5</td>
<td>.72</td>
</tr>
<tr>
<td>5. Are visual and auditory announcements sufficient at the hospital?</td>
<td>.15</td>
<td>3.9</td>
<td>.76</td>
</tr>
<tr>
<td>6. Are the seating elements in the waiting rooms sufficient?</td>
<td>.05</td>
<td>4.1</td>
<td>.76</td>
</tr>
<tr>
<td>7. Are polyclinics easy to locate?</td>
<td>1.60</td>
<td>2.7</td>
<td>.50</td>
</tr>
<tr>
<td>8. Are referral signs and counselors sufficient?</td>
<td>1.42</td>
<td>2.1</td>
<td>.41</td>
</tr>
<tr>
<td>9. Is the appointment system in the outpatient clinics sufficient?</td>
<td>1.86</td>
<td>1.8</td>
<td>.37</td>
</tr>
<tr>
<td>10. Are there more densities at the hospital except during visitor hours?</td>
<td>1.29</td>
<td>2.6</td>
<td>.53</td>
</tr>
<tr>
<td>11. Is the operating room a common point for all clinics?</td>
<td>1.05</td>
<td>3.2</td>
<td>.65</td>
</tr>
<tr>
<td>12. Are laboratory and x-ray fields sufficient?</td>
<td>1.05</td>
<td>3.2</td>
<td>.65</td>
</tr>
<tr>
<td><strong>Standard deviation:</strong> S. D. <strong>Arithmetic Mean:</strong> A. M.</td>
<td>1.10</td>
<td>2.97</td>
<td></td>
</tr>
</tbody>
</table>

When Table 2 is examined, it is generally seen that respondents are not satisfied with the functioning of hospital units. The arithmetic mean of the 12 questions directed to the patient was 2.97. The arithmetic mean scores for scale analysis with a mean of the five, and those with 3 (indecisive) scores reveal the responses of the respondents in the direction of "No" or "Absolutely No". Percent density (%) is the percentage of the sum of the negative answers of the respondents in the direction of the answers towards the questions "No" or "Absolutely No" (2-1). Also, if the standard deviation is greater than "0.05", respondents say that they are in the negative direction of "No" or "Absolutely No".

The hospital was found to have a high level of satisfaction about being designed to enter the main entrance door as soon as possible. At the beginning of the issues that the satisfaction level of the users is low, appointment system, referral signs and counseling, not enough toilets and bathrooms for the disabled.

Private Sultan Hospital, personnel, patients and their relatives were determined according to the results obtained in the outcome of the questionnaire; physical environment, polyclinic, clinical, emergency, operating room, tactical unit services are the following:
The Problems of Physical Environmental Regulations

• The hospital’s main entrance door is designed to allow the patient to enter the hospital as soon as possible (Figure. 3).

  **Figure 3: Hospital Main Entrance Door**

- At the hospital, patients are not able to arrive comfortably. The hospital does not have an existing car park, vehicles cannot find parking near the building easily (Figure 4).

  **Figure 4: Hospital Parking**

- There are no toilets or bathrooms for the disabled at the hospital.
- There are no walking paths for the disabled in the hospital.
- There are no visual and audio announcements at the hospital.
- Waiting rooms where the patient and his / her relatives wait in the hospital are not enough.
- There are stacks in front of hospital cashier’s desk (Figure 5).
Figure 5: In front of hospital cashier's desk

Issues Regarding Policlinic Services
- In policlinics, there are not enough waiting areas,
- There is no place for wait for the elderly and elderly patients
- All patients should arrive in the early morning hours because there is no appointment system
- Congestion in the workflow in the outpatient clinic is experienced in the examination order, in the waiting and examination units (Figure 6).

Figure 6: Images of Private Sultan Hospital Polyclinic Services

Problems of Design of Clinical Services
- Outside of visitor hours, having visitors in clinics causes increasing the density in the hospital and the lack of the aisles, the distance between Operating rooms and Clinics,
- the distance between surgical services, with regard to the transfer of patients; losing time and getting tired of hospital employees bring about the internal hospital traffic in vain.

Problems of Design of the Emergency Services
- There is a parking problem.
- There is no lounge for patient relatives.

Problems of Design of the Operation Room
- The operation room is not planned as a common place for patients coming from other clinics.
- There is no direct clinic connection.
• For the operation room, there is no lounge for special patient relatives.

Problems of Design of the Examination Unit

• Laboratories and areas of X-rays were designed quite small. Patients wait standing.
• There happens the crowd of people, for the unit of taking blood samples is insufficient (Figure 7).
• There is no special terminus group related to the field

Figure 7: The laboratory of the Private Sultan Hospital

6. Conclusion and Recommendations

Ergonomics is a design approach centered patients and employees. Carrying out physical, cognitive and institutional principles of ergonomics in hospitals provide many benefits for increasing the performances of employees. In the workplace environment; ergonomics designs for business processes both will increase employees’ satisfaction and reinforce their commitment to their business and will gain the approach of delivering a more safe and qualified healthcare to service providers and patients (Aydemir and Yenimahalleli Yaşar, 2016:181).

For this reason, to improve the life quality of patients and health care workers in the hospital environment, ergonomics regulations should be established for interdepartmental workflow. Recommendations for these ergonomics regulations;

• The system of entrance doors should be automatically opened and closed, so patients should not deal with them.
• There should be parking areas in which cars that bring patients near the entrance door and ambulances are able to wait temporarily.
• Bars should be bars for physically disabled people while walking to hold on the walls in long corridors and large lounges,
• Some special toilets should be done for patients with disabled chairs,
• Some visual alarms should be established for people having impaired hearing to hear the announcements,
• Special walking roads should be done for people having visually impaired,
• There should be some plates for patients who come to the hospital so that they can find their destination, or understand where they are at that moment, toilets, laboratories and exit points,

• There should be nurse calling bells in toilets, all inspection units, stretcher and corridors to use for emergencies,

• Lounges where patients wait to be examined should be in sufficient sizes and special lounges should be provided especially for elderly and severely ill patients so that these patients should be given priority for examination,

• Transferring to the appointment system and providing hourly appointments, the crowd in the lounges should be reduced,

• The number of patients’ beds should be determined in accordance with room sizes in clinics,

• The visitation should be arranged in a way that not hindering the care of patients,

• A new placement plan should be made by considering the Clinic-Operation Room- Intensive Care relationship of surgical clinics,

• Emergency services should definitely be close the highway,

• One of the most important criteria for emergency departments is that the ambulance and remote patient entrance doors should be visually and functionally separate from each other,

• The connection of the emergency department with the other departments should only be from one door,

• In the emergency service design, there should be a direct proportion between the urgency of the patient and the proximity of the unit to the entrance door, that is, when the emergency service is designed, the architectural triage is applied and the rooms are ranked according to the urgency category. The resuscitation room is located right next to the ambulance entrance where the most urgent patients are brought in, while the units in which the non-urgency patients are seen should be placed in farther areas,

• The emergency service should be close to departments namely laboratories, intensive care, operating rooms, x-ray, and morgue,

• Intensive care units should have a stretcher lift with direct connection to the operating room,

• The patient carrier system between the operating rooms and the clinic should be structured,

• The planning of the distribution of operating theater rooms according to the clinics should be restructured,

• Lounges should be constructed for special patients’ relatives for the operating room,

• Laboratory and x-ray drafting areas should be designed to protect workers from physical, chemical and radiation effects,
• Laboratories and X-ray fields should be made in sufficient size,
• Lounges should be constructed for laboratory and x-ray,
• Toilets should be constructed close to the laboratory.

In line with these recommendations, the work flow diagram among the units was formed (Figure 8).

**Figure 8:** The workflow diagram among the units of the hospital

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**References**


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