EVALUATION OF AN ELECTRONIC MEDICAL RECORD SYSTEM: ZONGULDAK KARAELMAS UNIVERSITY HOSPITAL SURVEY

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DECEMBER 2006

EVALUATION OF AN ELECTRONIC MEDICAL RECORD SYSTEM: ZONGULDAK KARAELMAS UNIVERSITY HOSPITAL SURVEY

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL STUDIES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

SUAT HAYRİ UĞURBAŞ

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
SCIENCE AND TECHNOLOGY POLICIES

DECEMBER, 2006

Approval of the Graduate School of Social Science

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I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

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This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science

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ABSTRACT

EVALUATION OF AN ELECTRONIC MEDICAL RECORD SYSTEM: ZONGULDAK KARAELMAS UNIVERSITY HOSPITAL SURVEY

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M.S., Science and Technology Policy Studies
Supervisor: Assoc. Prof. Dr. Erkan Erdil
December, 2006, 95 pages

The present study investigated the electronic medical record system (EMR) of Zonguldak Karaelmas University Hospital which is used for six years now. The advantages and disadvantages of an EMR system in comparison with paper medical records were evaluated based on the user's opinion. The recommendations for the development of EMR and more efficient use of the system are principle goals of this study. The purposes of this thesis include promoting the implantation of EMR by introducing the advantages and disadvantages from the user's point of view. The main source of information used in this analysis is gathered from a questionnaire. Hundred and twenty six users of EMR selected voluntarily and randomly from the hospital staffs are included in this survey. The hospital staffs including physicians, nurses, clinicians, administrative clerks and technicians were included in this survey. Implementation for certain medical tasks and efficiency of using these tasks in EMR are evaluated. The advantages and disadvantages of the system were surveyed from the user's point of view.

In spite of the fact that health care professionals understand the benefits of electronic medical records, barriers to the use of EMR are also important for the current impediments in EMR introduction.

While the successful applications of EMR systems are evident in western word, the implementation of EMR to a hospital information system is a new topic in Turkey. There are mainly attempts to convert the paper-based medical record systems to the fully automated electronic record systems. Our study is a pioneering attempt to analyze the users' opinion for a fully integrated EMR system in a Turkish academic hospital. The suggestions such as restricting the

access, improving the hardware, integrating to the internet are made for the improvement of the system in future.

Keywords: Electronic Medical Record, Hospital Information System, Survey, Questionnaire

ÖZ
BİR ELEKTRONİK TIBBİ KAYIT SİSTEMİ DEĞERLENDİRMESİ: ZONGULDAK KARAELMAS ÜNİVERSİTESİ HASTANESİ ANKETİ

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Aralık, 2006, 95 sayfa

Bu çalışma Zonguldak Karaelmas Üniversitesi Hastanesinde altı yıldır kullanılmakta olan elektronik tıbbi kayıt sistemini araştırmaktadır. Kullanıcıların görüşlerine başvurularak elektronik tıbbi kayıt sisteminin kâğıt kayıt sistemi ile karşılaştırmalı olarak avantaj ve dezavantajları değerlendirilmektedir. Bu çalışmanın temel amacı elektronik tıbbi kayıt sisteminin geliştirilmesi ve daha verimli kullanımı için öneriler getirilmesidir.

Kullanıcı görüşüne göre avantaj ve dezavantajlarını ortaya koyarak elektronik tıbbi kayıt sisteminin yaygınlaştırılmasını desteklemek bu tezin amaçları arasında yer almaktadır. Bu analizdeki ana bilgi kaynağı bir anketten elde edilmiştir. Hastane çalışanlarından rasgele ve gönüllü olarak seçilen yüz yirmialtı kullanıcıya anket uygulanmıştır. Öğretim üyesi doktorlar, araştırma görevlisi doktorlar, hemşireler, kayıt memurları ve teknisyenlerden oluşan hastane personeli ankette yer almıştır. Çeşitli tıbbi işlemlerin elektronik kayıt sistemine uyarlanması ve verimliliği değerlendirilmiştir. Ankette sistemin avantaj ve dezavantajları sorgulanmıştır.

Elektronik tıbbi kayıt sisteminin faydaları sağlık personelince de iyi bilinmesine rağmen, sistemin kullanımında çekilen güçlükler günümüzde elektronik kayıt sistemine geçişin önünde önemli bir engel oluşturmaktadır.

Batı dünyasında başarılı elektronik tıbbi kayıt sistemi uygulamaları yerleşmekteyken elektronik tıbbi kayıtların bir hastane enformasyon sistemine uyarlanması Türkiye için yeni bir konudur.

Uygulamalar genel olarak kâğıt kayıt sistemlerinin tam elektronik tıbbi kayıt sistemlerine dönüştürülmesi olmaktadır. Bizim uygulamamız, akademik bir hastanede tam otomatik bir elektronik kayıt sistemi için kullanıcıların görüşlerini

inceleyen öncü bir çalışmadır. Sistemin gelecekte daha da iyileştirilmesi için girişin kısıtlanması, donanımın güçlendirilmesi, internete açılım sağlanması gibi öneriler ortaya konulmaktadır.

Anahtar Kelimeler: Elektronik Tıbbi Kayıt, Hastane Bilgi Sistemi, Etüt, Anket,

ACKNOWLEGMENTS

I would like to thank everybody, who spent effort with me to accomplish this thesis. In the first place, I express sincere appreciation to Assoc. Prof. Dr. Erkan Erdil for his valuable guidance and tolerance throughout the study period. This study could not have been completed without his understanding and encouragement.

I would like to express special thanks to Assist. Prof. Dr. Sait Albayrak for his valuable efforts in statistical analysis of the survey.

I wish to express thanks to the Rectorate of Zonguldak Karaelmas University and the Management of Zonguldak Karaelmas University Hospital. Without their approval and assistance it could not be possible to complete field study of this thesis. I would like to thank all participants of survey for volunteering and sparing their time.

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LIST OF ABBREVIATIONS

ANOVA	: One-Way Analysis of Variance
CPR	: Computer-Based Patient Record
CPU	: Central Processing Unit
CT	: Computed Tomography
EMR	: Electronic Medical Records
GP	: General Practitioner
HIPPA	: Health Insurance Portability and Accountability Act
HIS	: Hospital Information Systems
HMO	: Health Maintenance Organization
ICD	: International Code for Disease
IOM	: Institute of Medicine
OMR	: Optical Mark Recognition
PIN	: Personal Identification Number
POMR	: Problem Oriented Medical Record
SCSI	: Small Computer System Interface
SPSS	: Statistics Program for Social Science
US	: Ultrasound
ZKU	: Zonguldak Karaelmas University

CHAPTER 1

INTRODUCTION

Our society is increasingly influenced by modern information and communication technology (ICT). Health care is also influenced from this technology. Hospital information systems (HIS) are in use for the last 25 years now. Hospital information systems process data, information and knowledge in health care environments.

The introduction of information technology to the health care began with administrative process. Medical applications were involved in the system by means of electronic medical records. Without having appropriate access to relevant data, it is impossible to make reliable decisions including diagnosis and treatment of patients. Approximately, 10 % of the gross domestic products of nations are devoted to health care and approximately 5 % to information and communication technology (Haux, 2006). There is a tendency to increase investments in health and in ICT, particularly in developed countries. Progress in the field of health information systems is directly correlated with increased quality and efficiency of care. HIS contributes to a high quality and efficient patient care. This aim is primarily centered towards the patient.

There has been a tremendous shift from paper-based processing and storage to computer based processing and storage through the last decades (Haux et al, 2002). This shift had advantages such as higher functionality and better opportunities in using patient data and medical knowledge. It had also disadvantages such as technological complexity.

It is clear that, electronic medical record (EMR) systems have already become the preferred choice of new hospitals. Three major goals requiring this achievement have been identified by Haux et al (2002): patient-centered recording and use of medical data for cooperative care, process-integrated decision support

through current medical knowledge, and comprehensive use of patient data for research and health care reporting.

However, we are still in a phase of transition from paper to electronic records. The broad attention to electronic medical records has resulted in the analysis of successful systems and the factors contributing their effectiveness (McDonald et al. 1999). The HIS were intended to support health care professionals, mainly physicians, nurses and administrative staff. Some studies have assessed physician and nurse satisfaction with an EMR (Likourezos et al, 2004).

1.1. Objectives and Method

The present study is designed to evaluate the use of Electronic medical record (EMR) system in Zonguldak Karaelmas University Hospital and to investigate the advantages and disadvantages of an EMR system in comparison with paper medical records based on the user's opinion. The recommendations for the development of EMR and more efficient use of the system are principle goals of this study.

The purposes of this thesis include promoting the implantation of EMRs by introducing the advantages and disadvantages from the user's point of view. The main source of information used in this analysis is gathered from a questionnaire. Not only the physicians who are the main users of the system, but also the other hospital staff including nurses, clinicians, administrative clerks and technicians were included in this survey.

Zonguldak Karaelmas University Hospital is an academic hospital. The medical staff includes resident doctors who are trained on various areas of medicine to become specialist in those fields. The hospital is equipped with a fully electronic medical record system since it is opened in 2000. There are no paper forms in use during the patient treatment process. The printouts from the system can be obtained as discharge summaries, disease reports and receipts.

The basic instrument used in evaluation of EMR in Zonguldak Karaelmas University Hospital is a user survey. Hundred and twenty five users of EMR selected voluntarily and randomly from the hospital staffs are included in this

survey. The information obtained from the survey is utilized for the analysis of identified EMR system.

1.2. Structure of the Thesis

The subject of the thesis is the electronic medical record system. Its implementation for certain medical tasks and efficiency of using these tasks in EMR are evaluated. The advantages and disadvantages of the system were surveyed from the user's point of view. A comparison of electronic medical record system with the paper-based system was questioned. The users' overall satisfaction from the system was determined.

The thesis is made up of three main parts. First part (Chapter 2) is a literature review which provides the theoretical framework for the field study. Second part (Chapters 3) consists of the presentation of ZKU hospital and the EMR system used in the hospital. The third part (Chapters 4 to 6) is the field study which is a survey applied to a group of users in ZKU hospital.

Chapter 2, the literature review, starts with a discussion on the effect of information communication systems on health care. It includes a brief description of hospital information systems (HIS), historical development and common features of HIS, medical records as a part of HIS, structure of medical records, paper based and electronic medical records, their advantages and disadvantages, transition from the paper to electronic records.

Chapter 3 starts with the presentation of Zonguldak Karaelmas University Hospital which is followed by an outline of the components of ZKU hospital information system. Application of the system is also explained.

In Chapter 4, method of the field study is described and the results of survey were given in detail. In the conclusion chapter, Chapter 5, findings of the study are discussed in accordance with the objectives of the study. The overall organization of the thesis is provided in Figure 1.

1.3. Importance of the study

In spite of the fact that health care professionals understand the benefits of electronic medical records and even the Institute of Medicine presented it as an

essential technology for health care in 1991, introduction was slow (Van Ginneken, 2002). The financial burden is partly responsible for the delay. Obstacles related to use of EMR are also important for the current impediments in EMR introduction.

While the successful applications of EMR systems are evident in western word, the implementation of EMR to a hospital information system is a new topic in Turkey. There are mainly attempts to convert the paper-based medical record systems to the fully automated electronic record systems. Implementation of an EMR in the presence of an established paper based record system has additional problems. The transfer of former records to the new EMR is very problematic. The users' adoption for a new system is another obstacle. Zonguldak Karaelmas University Hospital has a fully automated EMR system since its opening (Şahin, 2006). This feature of the hospital avoids the bias of users' from these obstacles.

There are few studies evaluating the record systems in Turkish hospitals (Hayran 1997, Yılmaz 2002). But the record systems in these hospitals did not include EMRs. Our study is a pioneering attempt to analyze the users' opinion for a fully integrated EMR system in a Turkish academic hospital. User satisfaction with a six years old EMR system is assessed in this study. We discussed the EMR as a part of fully automated HIS. The participation of different employees was ensured in the survey. The applications of certain clinical tasks are evaluated. The users' perception of weak and strong points of EMR are presented. The suggestions are made for the improvement of the system in future.

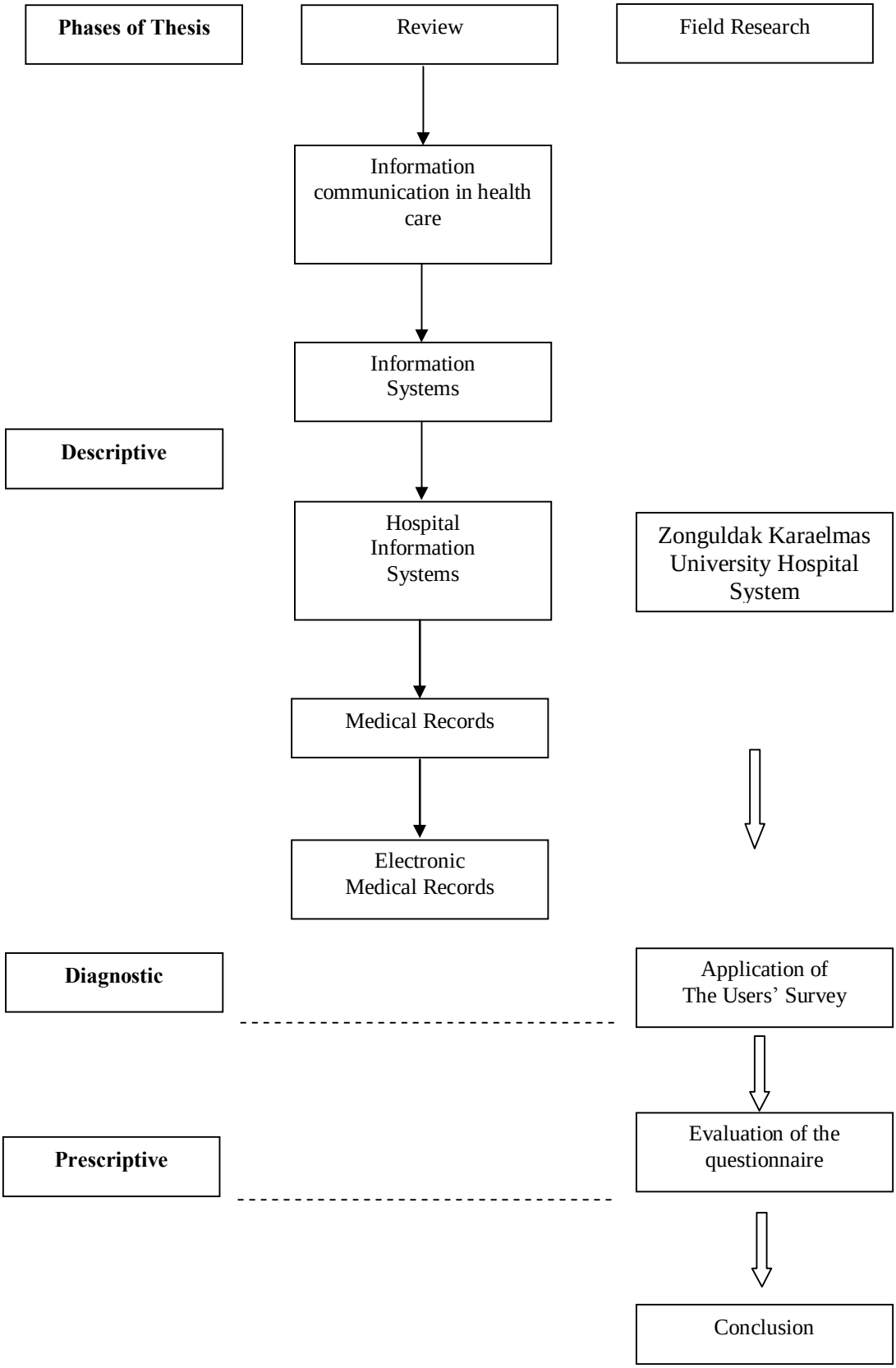

Figure 1: Overall organization and framework of the thesis

CHAPTER 2

HOSPITAL INFORMATION SYSTEM (HIS), MEDICAL RECORD, ELECTRONIC MEDICAL RECORD (EMR)

An overview of computer use in medicine and health care is given at the beginning of this chapter. Then the structure of information systems, applications of hospital information systems are described. The medical records and electronic medical records are explained in detail.

2.1. Information Communication Technology and Health Care

The computers help in decision making and patient care in many aspects of clinical practice. Any health care system must depend on a well formed information system in order to achieve a successful management. Data are at the center of all decision making in health care. The data should be reliable, complete and well structured. The computers assist in fulfilling these requirements.

Information plays a key role in interpreting data and making decisions. Examination of the patient by a physician generates data. The process of interpretation and reasoning produces information. By carefully studying and collecting many such interpretation processes in medicine lead to new knowledge (Van Bemmel and Musen, 1997). Both data and knowledge can be stored in computers.

In scientific research, the investigator collects the observations (measurements or data), arrives at a conclusion in view of hypotheses and, on the basis of his theoretical knowledge and reasoning, comes to an interpretation and rejects or revises the theory and finally plans new investigations or experiments to widen his or her knowledge. In health care, problems of individual patients are solved contrary to the abstract problem solution in scientific research. A patient tells his or her history, the clinician collects the data (e.g. during a physical examination, by laboratory tests or radiology), comes to a conclusion and possibly even a diagnosis, and prescribes a therapy or carries out some other treatment. Problems

of patients are partly generalized. The physician should address the specific problem of patient while using scientific treatment strategies.

The patient data is collected from the patient history called as anamnesis, from physical examination of the patient, and from the laboratory (such as biochemical tests, ECG) and radiological examinations. By using data in different ways and using different methods, a complete view of the patient's condition is obtained. A clinical information system is not only required to capture and store the data but also to transform it to useful knowledge.

The data was centralized and static in the past. Today, data has become distributed and dynamic, requiring software that not only responds to users' requests but also anticipates on the fact that the user is confronted with information overload. While the emphasis was on data integration giving birth to data warehouses in the past, the emphasis is on application of integration and knowledge management today (Van de Velde, 2000).

2.2. Information Systems

An information system can be defined as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making and control in an organization (Laudon and Laudon, 1994)

Three activities of an information system to produce the information organization for making decisions, controlling operations, analyzing problems and creating new products are input, processing, and output.

Input is the capture or collection of the raw data. Processing is the conversion of input into a meaningful form. Output is the distribution of processed information to the people or activities where it will be used.

The purpose of data collection from patients is to provide information for physicians. With the knowledge of disease and treatments, these data form the basis for decision making and action for the physician. Data is necessary to make a diagnosis of the patient's condition.

The computer is supportive for the diagnostic stage. They are available to provide data acquisition, storage, and processing support. Computer programs are

written for the instructions on how to handle the data. The data is stored in computer memory. The equipment which is called hardware and the programs which are called software are both needed in a computer system.

Computer systems assist in the diagnostic and therapeutic stages of patient care. The system is used to provide data needed to make decisions and take actions. This is an example of an information processing system.

2.2.1. General Structure of Information Processing System

There are several components of an information processing system: user, data entry, user interface, data- processing software and data presentation.

2.2.2. Users

Users are essential components of the system. They are responsible for entering data into the system and controlling the processing. The users can be grouped as occasional, routine and expert users.

Occasional users are familiar with the system, but they do not have all the privileges or all information to use the system. They are in need of help keys in case of an unexpected action. A navigation system in the program helps them to protect the data. The allied health personal such as porters and some technicians are occasional users.

Routine users have detailed knowledge of all functions of the applications that they use in the system. They know how the system behaves in their own applications. They may need some features which makes easy use of system such as ‘typing ahead’. This feature allows users to type before their typing appears on the computer’s screen. Doctors and nurses are the examples of routine users.

Experts are the ones who are operating the program and making new upgrades to keep up with the recent requirements. They are usually the members of the administration and computer processing department.

2.2.3. Data Entry

Low quality data result in unreliable information. Computers can process data and can help to extract the information from the data, but they can never generate information that was not contained in the data.

Data can be entered manually as in case of physical examination of the patient or by automatic measuring devices such as auto analyzers in clinical laboratories. Barcode reading is possible by means of a bar code reading devices or voice input is possible in systems that allow voice recognition.

When patient data are entered while the patient is still in the office, any missing, ambiguous, or erroneous data can be corrected by asking patient directly. However, when data are first written on paper and later entered into the computer by another person, errors detected in the data can not always be corrected without referring to the information source.

The computer can assist in helping to correct errors. The computer can detect syntactic errors. The semantic aspect of data is its meaning. For example when a blood pressure value is entered, it should be in a certain range of possible value set.

2.2.4. User Interface

The user faces with the interface of computer system. It is used for controlling the execution and the flow of the program and interactive data entry. The system acts in the same way to communicate with the user. There are standards and guidelines for building user interfaces.

In character-based interfaces only keyboard symbols are used to communicate with the user. Character-based interfaces require a low transmission rate from computer to terminal device and vice versa. They are low priced and efficient but they are not user friendly.

Graphical user interfaces are often called windows-based interfaces. Instead of the terminal devices for input entry, personal computers are used. Today, most users are familiar with windows and personal computers.

A window is an area on the computer screen with a border and a title bar on top containing text fields, pictures, buttons, selection boxes etc. A user can press a button by positioning the mouse pointer and clicking on the button of the mouse. Windows systems introduce a very important aspect of information systems look alike. All keystrokes and mouse clicks act only in an open window. A limited set

of controls is sufficient to build a complex windows interface. This gives windows applications a standard behavior for the user interface, which makes it easier for users to learn a new system once they know the behavior of a windows-based system.

Information systems are used by doctors, nurses and allied health personal. It is very efficient if all parts of a system use the same type of interface in order to provide a familiar media for all groups of users (Van Bemmel and Musen, 1997).

2.2.5. Data Processing

The required information can be presented to the user during data processing. Data sorting is the ordering of a data according to criteria such as numeric, alphabetic characters. Using several criteria, computers can group patient data according to disease, gender, age etc.

2.2.6. Data storage and retrieval

Data are stored as groups. All these groups may be related to each other. In a database system the data are stored in a structured way. The structure of the database and the relation between the different data are defined by the user using the database system. The structured databases allow us to define instructions for the computer. For example a list of patients who were admitted to the hospital in year 2006 for more than 10 days may be retrieved.

Two critical dimensions of databases are comprehensiveness and inclusiveness in health care (Donaldson and Lohr, 1994). Comprehensiveness describes the completeness of records of patient care events and information relevant to an individual patient. A comprehensive record contains demographic data, administrative data, health risks and health status, patient medical history, current management of health conditions, and outcomes data.

Inclusiveness refers to which populations in a geographic area included in a data base. The more inclusive a database, the more it approaches coverage of 100 percent of the population that its developers intend to include (Donaldson and Lohr, 1994).

2.2.7. Data Presentation

Correct presentation of information to the user is essential for proper understanding. Information processing should enable the user to extract relevant information in the most convenient way.

It is important that users be able to specify how they want the information to be presented so that the computer can be used as a data presentation tool. The user then specifies which data he or she wants to see and how the data should be presented (for example as a list or in graphical form). The computer can then reorder the data in the most convenient way for the user.

2.2.8. The hardware

The hardware of a computer system consists of a number of main components: the central processing unit, computer memory and peripherals.

The heart of computer consists of the central processing unit (CPU) and the internal or central memory. The computer memory contains the instructions and the data relevant to the execution of the active program. The CPU consists of an arithmetic unit and a set of registers. The CPU registers are used to store instructions or data once they have been retrieved or to store intermediate results of operations.

Other components of a personal computer system are the display screen, the keyboard, the central memory, and the background memory. Peripheral devices may be added such as a printer or a modem.

2.2.9. The software

The computers can operate by means of the programs. The program is permanently stored in a memory. The operating system and the user programs are important aspects of software.

The operating system is the basic software of the computer and is essential for all operations. It is always present in the internal memory once the computer has been started by the program. The operating system is responsible for the interaction with the peripherals, for loading and unloading user programs and

data, and for all internal communication for the computer. It is a bridge between the computer hardware and the user programs.

The operating system is also responsible for protecting the security of the system. In a multi user environment, users must identify themselves with a user name or identity card and type the user password or personal identification number (PIN) code to gain access to the computer system.

2.2.10. Coding

According to Zanstra et al (1998) the first phase of the introduction of information technology to the health care delivery system was mainly concerned with automating the administrative process. The second phase involved delivering medical applications. Currently, the third phase integrates a diversity of medical and administrative systems into one coherent inter-operable environment.

In order to use patient-based information effectively it is necessary to group cases in appropriate categories. Medical diseases can be classified in a variety of ways, for example based on anatomical site or on the basis of etiology.

The present International classification originates from the work of Bertillon for the International Statistical Institute based on the classification of causes of deaths in Paris (Israel, 1990). The Bertillon classification was revised in 1900 and became known as the International Classification of Causes of Death. Subsequent revisions occurred approximately every 10 years. The sixth revision introduced the term disease instead of causes of death and International Classification of Disease was prepared by The World Health Organization. The current version is known as the International Classification of Disease Tenth Revision (ICD- 10) launched on 1994.

Computer-assisted coding systems can be basically classified into two groups. Firstly, systems using statistical methods classify the diagnoses based on statistical features of learning samples (Chute and Yang, 1995). They are language- independent. Only a well-controlled training sample is required.

Secondly, systems using knowledge intensive methods represent both the coding system and the clinical text written in natural language. The creation of the

knowledge base is a resource intensive task and can support the reuse of information in various ways such as clinical decision support, exchange of information among different EMR systems (Heja et al, 2006).

2.3. Hospital Information Systems (HIS)

Hospital Information Systems are becoming one of the most important aspects of hospital operation (Rath et al, 1999). The term 'hospital information system' includes all systems of a hospital dealing with data handling and storage. This can be computer-based or manual. The combination of two is also possible.

An ideal hospital information system should include clinical, financial and administrative components. These components should be integrated to each other so that a combined database can be formed. This database provides an easy access to the clinical charts, statistical conclusions and financial picture.

At the present time, most of the information systems are financial information systems, management information systems and combination of two. Best way of making an efficient hospital management system is to combine financial and management information systems to a clinical information system. Such a clinical information system includes patient's records, nursing records, tests including blood and radiological investigations. The authorized personnel can retrieve the necessary information whenever and wherever needed as an advantage of such a system.

Before the use of computers, the information systems operated on a manual basis. Hospital information system is a paper-based recording system. The doctors are collecting and storing the medical information. The privacy and ethical issues were not the primary concern. Accessibility of the information to others was very restricted. Records are written in either of two ways (Skurka, 1998)

Source-oriented record: The health record is arranged chronologically and prepared as a patient chart. The health record is divided into sections that indicate the source of the documented data. Data from the various sources are integrated by the physician through the use of progress notes. Assessment of existing problems, reasons of therapeutic decisions, and description of the course of illness are described in these reports.

Integrated progress notes: The integrated (universal) progress notes format enables physicians and other health care professionals to enter all progress notes in chronological order on one form. The chronological recording of progress notes pools data from various disciplines, thereby stimulating improved patient care through shared knowledge. Each professional can quickly determine the patient's progress. Team concept improved here. The system encourages coincise and prompt recording of all information. The disadvantage of such a system is that only one individual can document or review progress notes in a health record at any given time. Other disadvantage is the difficulty to identify the professional discipline of recorders if they do not sign their reports in full and identify their titles or departments (Yan, 2000).

By the development of computer technology, medical records were structured as computerized data. The basic approach was to develop a fully integrated, single system implemented on a large central computer (mainframe) that would meet information requirements, both administrative and clinical.

At late 1960s, computer-based hospital information systems (HISs) began to emerge. These systems were intended primarily for communication. They collected orders from nursing stations, routed the orders to various parts of the hospital, and identified all chargeable services. They also gave clinicians electronic access to results of laboratory tests and other diagnostic procedures. Although they contained some clinical information (for example, test results, drug orders), their major purpose was to capture charges rather than to assist with clinical care. Many of the early HISs stored and presented much of their information as text, which is difficult to analyze. Moreover, these early systems rarely retained the content for more than a few days after a patient's discharge. Thus, the main use of that computerized systems was for charging purposes (Tang and McDonald, 2000).

The introduction of the problem-oriented medical record (POMR) by Weed (1969) influenced medical thinking about both manual and automated medical records. Weed was among the first people to recognize the importance of an internal structure of a medical record, whether stored on paper or in a computer.

In the problem-oriented medical record (POMR) system, Weed (1969) suggested that clinical information is organized by dividing the record into four sections-database, problem list, initial plan, and progress notes-and recording the information according to specific patient problems. Therefore, the POMR help physicians to treat patients more effectively. A major advantage of the POMR is its holistic approach to patient care. The POMR can be an important information link among all individuals directly involved with the patient's care. The record can be initiated at the ambulatory care level and carried through inpatient care without fragmentation. In addition, the POMR can facilitate self-assessments and other quality assessment activities because of its logical, organized format. A disadvantage of the POMR format is the time and commitment needed to transition to such a system. Implementation of the POMR, or any portion of it, requires the support of the medical staff, the administration, and HISs professionals. Besides, training must be provided to educate those who work with the system (Yan, 2000).

Hospital information systems are also used for preventive care. Collen (1995) used hospital-based systems to store and present laboratory-test results as part of preventive care. Use of computers to screen for early warning signs of illness was also important for health-maintenance organizations (HMOs). Other early university hospital-based systems provided feedback to physicians that affected clinical decisions and ultimately patient outcomes.

The major advance in hardware technology during the 1970s was the increasing availability of on-line computer systems, which provide direct access to computerized data files through communication terminals. For example, a central computer file of patient information might be established to provide direct access to patient information for physicians, nurses, and others involved in treatment and patient care. As services are ordered for patients, the computer system prices them automatically, and the same central data file is used to generate billing information for the business office (Yan, 2000).

The increasing availability of packaged systems, that is, generalized computer systems designed to fill the information-processing needs of any

hospital, clinic, or physician's office emerged during 1970s. Packaged systems have been developed both on an individual application basis (accounts receivable, admissions and bed availability, inventory control, medical records indexing) as well as on a total system basis. The companies began marketing fully integrated hospital communications systems. The packages which the hardware, software, installation support, and training were supplied as turnkey systems.

In addition, growing attention concentrated on the development of shared computer systems for hospitals. A central system is installed at one location, and data communications devices are placed in each participating organization to transmit data to and from the central computer.

Rapid advances in technology, particularly improvements of small and inexpensive microcomputers decreasing the cost of computer hardware increased the use of computers in many individual clinics and health service organizations. The 1990s have seen a shift of priorities in the development of information systems, with greater attention devoted to clinical applications and the use of information for strategic planning and management (Yan, 2000).

Hospitals are developing improved systems and procedures for continuous quality improvement, and information is an essential part of the quality monitoring and evaluation process. With competition increasing and vigorous controls for cost from the providers of care, health services organizations have placed increased emphasis on strategic planning, marketing, and evaluation of services and programs.

Computer hardware and telecommunications systems continue to improve, with increased emphasis on networking of computers, linking of software from multiple vendors, and development of high-capacity information storage units (digital and optical). Many hospitals have begun employing computer-based patient record to replace paper-based patient record and using relational data base systems for storage, retrieval, and special analysis of information. The Computer-Based Patient Record (CPR), a key report published by the Institute of Medicine (IOM) in 1991, stressed the need for prompt development and implementation of the CPR and stated that CPR is an important requirement for supporting the

information needs of physicians and other users of health care data. The IOM also laid out broad-based initiatives and gave strategic recommendations designed to promote and facilitate the rapid development of the CPR which was suggested by Zuckerman (1979).

Electronic medical record (EMR) system has many advantages over traditional paper-based medical record system. Computerization facilitates communication among various health care systems and the patient record system as well as among the medical facility and physician offices, third-party payers, and other provider institutions. Computerized data can provide quick and easy access to patient data and provide information in a comprehensive, integrated fashion. The EMR requires less time to maintain than the paper record; analysis of patient care outcomes is facilitated; and better reporting of data and patient care outcomes can be accomplished.

However, adoption of EMRs had some drawbacks. Legal issues include problems associated with accreditation, patient privacy and record access, record ownership, risks specific to EMR systems such as maintenance and backup of records, and computer contracting. Major vendors are marketing many components of the CPR and developing partnerships to offer comprehensive information systems. Vendors could not deliver all the components necessary to produce a complete CPR in the past. Recently, these drawbacks are overcome by the emergence of new software (Van de Velde, 2000).

Due to the emergence of EMR, a total Hospital Information System is gradually developed. A total Hospital Information System consist of a medical affairs system, an order-entry system, a retrieval system, and several subdivision systems (Institute of Medicine, 1991). The system allows doctors via a system terminal to retrieve lab exam results and drug history very quickly. In addition to filling out patients' medical records, doctors have to input order-entries for lab exams and prescriptions into the total Hospital Information System.

Thus, although the EMR can offer many benefits and a total HISs allows doctors to obtain various text-based patient data from terminal PCs, integrating textual medical information alone into an electronic medical record system is

obviously insufficient. If, in addition to text-based data, doctors were able to view medical images such as computed radiography (CR), computed tomography (CT), ultrasound (US) exams, and endoscopic (ES) images on the same terminal PCs, it is extremely useful. Therefore, the ideal electronic medical record system should also include a total HISs as well as medical images, which are vital to medical decision making. In order to find a reasonable solution to this problem, an electronic medical record system (EMRS) is becoming the subject of many intensive studies worldwide.

Since the late 1980s, because the integration of medical images comes into the total HISs, the Traditional Hospital Information Systems has been changed into Integrated Hospital Information System (IHIS). The first integrated Hospital Information System was established at Kochi Medical School in 1981, in Japan (Kurihara et al, 1999).

2.4. Medical Records

Electronic medical records are main frames of the hospital information systems. They are integrated to other facilities of the hospital system. The patient record is an account of a patient's health and disease status. Usually the notes in the record are made by the physicians.

A medical record is a confidential record that is kept for each patient by a healthcare professional or organization. It contains the patient's personal details (such as name, address, date of birth), a summary of the patient's medical history, and documentation of each event, including symptoms, diagnosis, treatment and outcome. Relevant documents and correspondence are also included. Traditionally, each healthcare provider involved in a patient's care has kept an independent record, usually paper based. The main purpose of the medical record is to provide a summary of a person's contact with a healthcare provider and treatment provided to ensure appropriate healthcare.

Information from medical records also provides the essential data for monitoring patient care, clinical audits and assessing patterns of care and service delivery. In the current environment the medical record also forms the first link in

the information chain producing the depersonalized, aggregated, and coded data for statistical purposes.

A considerable effort is invested in writing, filing, sorting, searching, retrieving, issuing and recovering the medical record, in whole or in part. There is no doubt that the ready availability of well organized, legible, accurate and comprehensive clinical notes can play a very significant role in the clinical decision making process and assisting in the provision of quality healthcare.

A medical record should enable health professionals to review previous care events, to reach timely and appropriate clinical decisions, and to develop treatment plans that minimize the risks and maximize the potential benefits to the patient.

Major advantages of medical records can be enlisted as follows:

- To provide an archival and legally acceptable record of the steps that were taken - when, why and by whom - in the care of an individual. It is also possible to audit the care provided to an individual.
- To provide material for researchers studying the etiology, natural history and cost-effective approaches to treat the specific disease conditions
- To act as a source of information which will enable various administrative functions of the healthcare service unit (such as contract management or coded statistical returns) to be carried out automatically as a by-product of the clinical data collected
- To be stored in such a way as to ensure that the data are secure from loss, alteration or damage.
- Being subject to access controls that ensure patient privacy is adequately protected, and that the risk of disclosure to unauthorized persons is minimized.

Given the changes in technology particularly the move to computerized information storage and increasing consumer or patient involvement in healthcare, one issue that must be addressed is whether the existing paper-based medical record remains the most cost-effective way of achieving these goals.

2.4.1. Disadvantages of a Paper Medical Record

First of all, the paper medical records are accused as being disorganized and confusing by many health professionals (Burnum, 1989). It has serious shortcomings such as being more difficult to follow up while content is increasing in time. The paper charts are ruined easily on the wards of hospital.

Secondly, it is difficult to find specific items of information in it (for example, an entry, and a report). Different users need different kinds and levels of information. Important information may be hidden in a thick disorganized chart. Key pointers may be missed. Information may simply not have been collected or recorded, or may have been misplaced. Similarly the process of coding for contracts and statistical returns may be seriously hampered by the difficulty of finding key items of information. From the point of view of re-use of information for research or administration, it is very difficult to abstract data from them.

Third issue is the growing need to share the care of patients between healthcare providers (for example, between general practitioner and consultant, between one clinic and another) which is also often poorly served by the paper record. It can only be in one place at a time and logistical issues make it difficult to move it around as fast as is needed. In practice every healthcare unit has a separate record for each individual, thereby creating a serious problem of record fragmentation and disintegration. This can lead to potentially serious problems of continuity of care for the patient. It also threatens the freedom of patients to choose where they go for care, as well as their right to equity in access to appropriate care.

Fourth issue is the financial. The electronic exchange of patient information is rapidly developing, because of the potential to save time and money. But in order to take full advantage of this opportunity it is highly desirable that the data are stored in electronic format - otherwise the record must be reloaded, with all the attendant issues of extra work and transcription errors. Hodgkins (1995) reported a cost reduction of 7 to 10 dollars per visit and shorter hospital stays.

2.4.2. Need for Decision Support in Medical Records

The size of the medical knowledge base is huge. New research published in more than 35,000 biomedical journals adds to this number and at the same time discrediting, altering or extending some of the other facts (Harrington, 2006). The safe and cost-effective practice of medicine is becoming increasingly complex, and relies more and more on knowledge of the results of recent research into causes, manifestations, diagnosis and effective treatment of illness.

Decision support is available through analyses related to quality of care, outcomes, claims, billing, quality assessment reporting, risk management, length of stay, variances, administrative overview etc. This can only be achieved through the support of HISs that can acquire, store, retrieve and select data. Then, the data has to be analyzed, interpreted and compared (Weingarten and Andrew, 1995).

Knowledge-based decision support tools are increasingly being used and are likely to prove invaluable as a means of ensuring and assuring best quality care and practices for all patients. There are already in excess of 1000 medical 'expert systems' in use around the world. However, the only efficient way of using them is to hold the medical records in an electronic form with which these tools can interact directly (Harrington, 2006).

2.4.3. Investment for Electronic Medical Records

An old-fashioned information system within health care work will not successfully be replaced by a new one, unless the new is better as a whole (Kyhlback and Sutter, 2006). There is no doubt that electronic medical records (EMRs) are valuable resource but they need a considerable investment of time and money. Retchin and Wenzel (1999) estimated that the introduction of EMR may require 7.5- 13.5 % of an institution’s budget.

The main problems are the planning of the investment and its financial return. There are claims that EMR may reduce healthcare cost significantly. For example Hodgkins (1995) mentions a cost reduction of 7 to 11 dollars per visit and shorter hospital stays.

An important factor for the hesitancy to invest is the fear of the invested product to become outdated. If a vendor does not keep up with new functional

requirements, the hospital has to change to a different product with all the complications of converting and transferring the existing data, or is 'stuck' with the old system (Van Ginneken, 2002).

The clinicians have a lot of potential benefits. Most of the benefits are qualitative such as task facilitation and improvement of documentation. Clinicians' main effort involves direct structured data entry which impacts their work style most. Institutions' main efforts are financial investment and reorganization. Institutions benefit mainly through reporting and data analysis for the purpose of resource management, cost control, and quality assessment (Van Ginneken, 2002).

Payers, such as insurance companies and the government, may enjoy cost reduction when EMR leads to fewer medical prescriptions, procedures, complications, and hospitalizations.

2.5. Electronic Medical Records (EMR)

Electronic medical record is the entire medical record or a part of it stored in a computer. To make such a change from the paper to electronic media involves significant investment in both equipment and staff, but the benefits can far outweigh the costs, as well as setting a course for the future. Electronic records greatly extend the concept of the medical record, and enable many functions that are otherwise quite impossible.

2.5.1. Advantages of Electronic Medical Records

- Electronic files can be readily accessed from anywhere, local or remote, across a communications link or network. Data that are stored in electronic formats can be retrieved electronically: literally billions of records can be shifted through in seconds if the database has been appropriately designed and indexed.
- More than one user at a time can have access to them, and all service providers can share the same records.
- Records made by multiple providers in different locations and units can be linked and shared to create a single record for the individual. The problem of

record fragmentation can be resolved, and patient care can be shared between providers.

- All the graphic data (for example, images), incoming letters (for example, referrals) and auditory data (for example, heart sounds, spoken notes) relating to a patient can be linked to their electronic record file using multimedia techniques.
- Electronic storage of data is cheap and very compact. A single compact disc (CD) can store in the region of 600 Mbytes, equivalent to some 100,000 pages of text or about 150 large textbooks which would need about 10 meters of shelf space. The CD is almost indestructible (Harrington, 2006).
- One of the special benefits of computerized records is their ability to readily display different views - for example, all current medications, or problems; the last ten full blood counts in graphic display; test results for a specified admission or date range. The data in the record are no longer static and accessible only in the order and format determined by the writer, but can be dynamically displayed in any way that suits the needs of different viewers.
- Once in electronic format, records can be reported upon automatically. Patients' treatments can be assigned to the social security foundations, statistical reports can be sent to the national collections, notifications (for example, of births and deaths) can be sent to the Ministry of Health and so on. Automatic audit reports can be prepared, for example of case loads, services provided, lengths of stay, costs of care and so on. Data can quickly be gathered for research studies and up to the minute reports generated. All the data required for administration and contract management can be derived automatically from the medical records.
- Data can be checked as they are entered to ensure adequacy and accuracy by querying entries that are unlikely (for example, pulse rate over 200) or rejecting those that are impossible (for example, plasma potassium outside the range 3.5- 5.5 mmol/L). Results and reports can be entered directly from other systems, eliminating the possibility of misfiling and of transcription errors.

- Direct links to knowledge-based tools can be built: the present development of the Arden syntax[1] and a medical decision Modules[2] will make it possible for any system to incorporate intelligent alerting flags to users warning them of possible errors, and advising on the best way forward.

In very practical terms there are major advantages to the health professional/clinician in being able, at the press of a button, to automatically retrieve and repeat prescriptions, fill in forms (for example, for tests and investigations) accurately and automatically, complete and send discharge summaries and so on. There are also significant advantages to having access to the medical record, whether generated locally or in some remote care centre. The advantages to administrators are clear in that quality data for reporting, workloads; costing and audit are readily accessible. The benefit to the patient is that of continuity and integrity of care wherever the patient may be. The benefit to the community is of delivery of best quality care in the most economic ways possible.

The United States Institute of Medicine published a study that concludes the needs for immediate adoption of the concept and substantial investment in EMR development for use across USA by the year 2000, for many reasons outlined above (Dick and Steen, 1991). The report is revised in 1997 by stressing on the lag of health care organizations in moving patients' medical records from paper to computers.

2.5.2. Difficulties for Switching to Electronic Medical Records

While the benefits are clear, there are some obstacles. These, however, relate mainly to practices and people and much less to technology. All the technology that is required to create electronic medical records systems already exists, and, indeed, electronic records are already in everyday use in many parts of the world.

There should be confidence to computers among their users especially in the availability, privacy and security of data stored on computer. Active clinical use

[1] A standard language for writing situation-action rules that can trigger alerts based on abnormal clinical events detected by a clinical information system.

[2] Using Arden syntax, the rules that generate decision modules are written. These rules generate alerts or remainders for a specific medical condition.

of the electronic medical records should be supported by adoption of a positive attitude towards computers in the workplace. This may require careful strategic management of change, as well as champions for the new technology recognition and acceptance by those entering data that the usefulness of records extends beyond the needs of care of the patient: that there are many legitimate re-uses of clinical information which are in the best interests of the community as well as of various other parts of the organization (for example, billing, research, statistics) adequate skills and proficiency in the use of the computer application; users should become knowledgeable consumers of this technology (like a motorist) without needing to be experienced in its maintenance (like a mechanic). A level of basic knowledge and understanding about computer systems will be invaluable, especially for those who may have to manage their own installation, but advanced keyboard skills are generally quite unnecessary.

Retchin and Wenzel (1999) advised to start in academic centers, which already have a relatively high level of computerization, technical expertise, and a medical staff who was circulating. The residents are usually young doctors who are more familiar to new technology.

2.5.3. Content of Medical Record

The record may include a written text, codes and images. Much of the material in the record has a relatively short useful life. For example - it is not important to know whether the patient was pale 3 years ago. The other material is much more durable such as details of admissions, diagnoses, and major procedures. The material in the medical record can be separated into two different components (Harrington, 2006).

First component is the material generated locally, mostly as a consequence of a care encounter. This is of two forms:

- **Free text** that is an unstructured description of findings, conclusions and plans using any words chosen by the writer.
- Material that is **structured** in one or more of the following ways: (1) organized around a data entry template (for example, check boxes); (2) - using a controlled vocabulary (for example, picked from a list of acceptable terms).

A linkage to dictionary is possible.

- Using a system of classification or coding such as ICD. Use of ICD as diagnosis criteria became obligatory for state-based health system care providers in Turkey in 2006.

Structuring the text makes the problem of searching much more effective and efficient. Data that is not required for re-use can be held as free text. Data items which are most likely to be re-used are:

- problem/complaint and/or diagnosis
- investigations
- medications
- services
- attending professionals
- Dates, times and locations.

Second component is the material which comes from elsewhere (for example, a referral letter, or a set of biochemical measurements), and which is supplied in a paper form. This may include incoming letters and reports, pictorial (ECG traces, ultrasound views etc) and image material if provided in hard copy form only. It can be incorporated into the record only as an electronic image. The letter has to be 'scanned', in a manner similar to a photocopier or fax machine, and an electronic 'bitmap' of the arrangement of marks on the page stored as a file. It can be linked to a patient record as an 'object' associated with that record, but it cannot readily be searched, for example when preparing reports or research studies. However, if the material is transferred in an electronic format, it may be possible to incorporate it into the record as free text, or even as structured material. For example a laboratory result that is transferred electronically can be incorporated into the patient record as an entry that can be searched and analyzed, and even displayed graphically as a time sequence (for example, of changes in platelet counts).

In summary, all data that will be used for analysis or as a key for searching and sorting the record should be held in a structured, and preferably in a coded form.

2.5.4. Electronic Data Exchange

It is possible to communicate information of almost any type electronically by using computers. Some communications involve very large amounts of data (for example, a picture or X-ray) whilst others are relatively small (for example, a memo). In every case the message to be sent is translated into a sequence of 'bits' or 'digits', sent across an appropriate transmission medium, such as a telephone line, optical fiber or radio link, and returned at the receiving end into its original form.

Once medical record information has been stored in an electronic format, it can readily and automatically be exchanged in this way. There are a variety of technical requirements, but these are relatively easily accommodated.

All messaging environments require the details of message structures and syntax to be spelled out in precise detail in order to ensure that there can be no misunderstandings between sender and receiver. The message for advising a purchaser of a healthcare event and billing for it, for example, will be very different to one reporting the results of a pathology test to a provider. Any given message can be generated automatically from an electronic medical record, as long as the required data elements are stored in the record. This is done by a software routine which is designed to find the required elements from the medical records and place them in the correct place in the message. In just the same way an incoming message can be analyzed and the data elements it contains automatically dropped into the correct slots in the medical records system.

2.5.5. General Practice and Hospital records

The division of medical or health records for an individual based on the identity, specialty and/or location of the provider is a serious and growing problem. The subject of the record is the individual, and that should be the focus and organizer. The integrity and continuity of patient care can be better achieved by bringing the community and hospital care records together for an individual.

While the structure of two different record systems and their layout may appear to be quite dissimilar, there may be significant parts of the content that are closely aligned. For example, both records will contain identifying and personal data (name, address, date of birth, etc), clinical problems and diagnoses, current medications, test and investigation results and so on. All these data can be successfully aligned and exchanged using electronic messages. This could replace the existing referral and report letters which are the present means of communicating these data.

It is possible to implant clinical guidelines through an EMR system (Mikulch et al, 2001). The time required to sort the available guidelines during a physician's clinical practice may be daunting. The EMR system can be used for integrating guidelines into the clinical practice (Schriger et al, 1997).

2.5.6. Data Entry

For many potential users, the issue of data entry is a difficulty because of the need to use keyboard skills. If the medical record contains large amounts of 'free text', someone has to write it, and this does indeed require typing skills. However, it may be possible to arrange for a secretary to enter the data from notes (written or audio) made by the provider.

Where the data in the record are structured, data entry can be greatly facilitated by the use of checkboxes or picking lists: these require minimal keyboard skills. Placed in the context of a data collection protocol, the entire data set associated with a specific care encounter (for example, an antenatal care visit, an assessment for cardiac surgery) can be collected without any conventional typing at all.

There are various other ways of entering data, for example:

- Optical mark recognition (OMR), where a mark on a standard form is sensed by a reader and converted into a data item in the record
- Bar coding, where the data are stored as a sequence of bars of variable width and separation and can be detected with a light pen or scanner.

Both of these have important roles to play in the development of full electronic medical records systems that are easy to use.

'Voice recognition' systems are also getting great interest. While efforts for voice recognition have been made in recent years, there would seem to be little prospect in the immediate future for cost-effective systems suitable for hospitals where there may be hundreds of staff needing to write material, all using different accents and dialects, often in relatively high ambient noise environments. The advent of multimedia systems does make it possible to store spoken notes: these have all the same restrictions on them as material from elsewhere making them unsuited to searching, sorting, analysis or reporting.

With all data collection the aim should be to collect the information as soon as possible after the event and to have it recorded by the most appropriate person. The appropriate person is usually the one responsible for carrying out the particular task or making a particular decision (Burrows et al, 1994).

2.6. Implementation of EMR to health care

While the technologic progresses overcome the difficulties and barriers to the development of EMR, patient records are becoming social systems that use information technology. The implementation of such systems not only enhances our ability to deliver health care, it also affects practice patterns and professional relations among individuals and groups within the organization. The ultimate success of any system depends upon integrating it into a complex organizational environment and ensuring that it is used effectively by the individuals for whom it is designed (Anderson et al, 1995).

For the next two chapters we will present an EMR model which is used in an academic hospital and measure the impacts of this system compared to paper medical records.

CHAPTER 3

ZONGULDAK KARAELMAS UNIVERSITY EMR SYSTEM

This chapter starts with a presentation of Zonguldak Karaelmas University (ZKU) Hospital. The application of the electronic medical record (EMR) as a part of ZKU hospital integrated information system is given next.

3.1. Zonguldak Karaelmas University Hospital

Zonguldak Karaelmas University was founded in 1992 on the site of the former campus of Zonguldak Technical College which was affiliated to Hacettepe University. The faculties other than the faculty of medicine are still located on the campus. The faculty of medicine was established as result of a necessity for the 3rd stage health care in western Black sea region. The health campus of the university is built in Esentepe location of Kozlu district. The site including hospital and faculty of medicine buildings covers an area of almost 100 ha. It is surrounded by an area of woodland of over 200 ha. The closed area of hospital in use is 21.000 m^2. The hospital has been continually extended since its foundation and has achieved an enviable position compared to other university medical faculties in the field of research and treatment of patients, as confirmed by its ranking with other Turkish Universities (announcement from Higher Education Council, 2006).

The Hospital's facilities include inpatient wards which operates 24 hours a day, 365 days a year. The patient rooms are double and triple occupancy. There are 4 and 7 bed wards as well as private accommodations.

Zonguldak Karaelmas University Hospital serves to Western Black Sea area including Zonguldak and Bartın provinces. The Hospital's strengths include a cardiovascular surgery department which is capable of doing Coronary By-pass surgeries, 40-bed intensive care unit, 12-bed dialysis unit. Full clinical laboratory services are provided. A comprehensive radiology department including magnetic resonance imaging and computerized tomography is also present.

The staff is approximately 700 people. It consists of up to 35 departments and up to 13 wards with 240 beds and about 30 outpatient units. Annually, approximately 12.244 inpatients and 142.918 outpatients are treated, and 8876 operations were performed in 2005. A total of 139.204 patient records are created since the hospital's foundation.

3.2. Zonguldak Karaelmas University Hospital Information System

Zonguldak Karaelmas University Hospital Information System is a comprehensive, fully integrated electronic medical record system. It contains more than 130.000 separately coded patient charts. It can display the records for any of these patients from the computer terminals throughout the hospital by means of a security code required for each user identified to the system. There are approximately 450 entries to the system every day. 302 doctors (119 academicians and 183 resident doctors), 164 nurses, 82 technicians, 63 administrative clerks enter the system. It carries all of the medical and administrative data collected since October 2000, when the hospital started to accept patients. It meets IOM (Institute of Medicine, 1999) ideal of pure source data entry at all sites.

The records in all of these files are physically sorted by patient ID, observation ID, date and time. Recently it included ICD 10 codes for the diagnosis part as a requirement for the social security organization's payment rules in Turkey.

In the present web structure only the system administrator has access to the system. The risks of virus transmission to the system are avoided by an antivirus system. There are 2 servers with same qualifications. There are two 60 GB x 10 ultra SCSI discs raid-5 working as mirror. In case of a technical error, switching to the second server is possible in 3 minutes. Back-up procedure is done as three times a day (8.00 am, 12.00 pm and 12.00 am) to the second server.

The system operates on 30- 40 MB load daily. The configurations of main servers consist of four processors in speed of 1 GHz with 4 GB RAM and 60 GB hard disc.

The users' workstations work on a network of personal computers with a minimum speed of Pentium III Celeron 1.7 processor and hard discs with a capacity of minimum 20 GB and128 megabit RAM.

Communication from the central system is via 10 megabit Ethernet links to the user terminals. The fiber optic cables are used between the blocks of the building.

The Software for Zonguldak Karaelmas University Hospital EMR system is MS Windows 2000 and MS SQL Server 2000. The MS Windows 2000 Pro program is the software for the end-user terminals.

3.2.1. Main Components of the System

Zonguldak Karaelmas University Hospital uses a Hospital Information system developed by a common venture of Rectorate of Zonguldak Karaelmas University and a software company. All patient care facilities and related departments such as archives, statistics, stock, pharmacy, billing office are included in this system. All administrative and financial procedures are integrated in this modular software.

We will discuss the main features of the system in different application modules. These modules include patient application and patient admission procedures for the registration of patients. The cashier's window is included in the system for payment. The examination suits and clinics, the specimen collection for medical investigations, imaging appointments, entering laboratory results and physical approval and medical imaging (Radiology, ultrasonography, computerized tomography and magnetic resonance imaging) are other components of the system. The stock (main and intermediate) inventory, accounting and receipt formation, statistics are the adjunctive units of the system.

3.2.1.1. Patient application

Personal data of the patient is entered to the system for the first entries. The examination, return and consultation appointments are given. Every patient is given a protocol number for the medical and billing account. Forensic cases are identified during the registration process.

3.2.1.2. Patient admission

Admission is done to the related ward and patient bed. A deposit is determined and a billing account is opened. Forensic cases are also identified here.

3.2.1.3. The cashier's window

The examination fee and laboratory requests done by the physician are purchased in cashier's window. The transactions are done either with cash or credit card and receipts are printed.

3.2.1.4. The examination suits and clinics

Patient's main complaint, history, review of systems, past medical history, drugs, operations, habits are recorded. The findings of physical examination are noted. The physicians directly enter their notes, orders and findings into the computer. Such an approach eliminates the delays, costs and potential errors associated with the use of intermediaries to enter the physician's data. Further, it permits validation by person who knows the information best (McDonald et al, 1999).Consultation requests, investigations, procedures, treatment and suggestions are all made from the end user terminals in the hospital.

3.2.1.5. The specimen collection

The physician requests in examination suits and ward modules appear in specimen collection module and marked as the specimen is collected. A barcode is printed and sticker is affixed on the specimen tube. Following the approval of doctor, results are entered by the related laboratory staff.

3.2.1.6. Appointment for imaging

The physician requests in the examination room and ward modules are seen in the module of radiology department. The appointment is given. After the approval, date and time of appointment come to the screen.

3.2.1.7. Entering Laboratory results and physician approval

The results of laboratory or radiological investigations are entered by the technicians and if the result is automatically transferred, directly seen in the

patient's chart. If the physician approval is needed, it is seen in the chart after approval.

3.2.1.8. Medical imaging

The radiological investigations, ultrasonographic examinations, computerized tomography and magnetic resonance images are obtained. Images obtained from the patients are interpreted by the physicians and the report is entered into the system.

3.2.1.9. Main stock (Accounting Office) - intermediate stock (hospital pharmacy, clinics, laboratories and exam suits)

A main stock inventory is constituted in accounting office and connected with intermediate stocks which are created in hospital pharmacy, clinics, laboratories and examination suits. The requests for individual patient procedures are made directly from the main stock or from the main stock by the intermediate stock with a request form. Buying procedure starts. Receipts of the goods are entered to the main stock. The main stock transfers them to the intermediate stocks by stock transfer receipts. The material used for the patient is charged to the patient's account while it is declined from the intermediate stocks.

3.2.1.10. Accounting

All the procedures performed for an individual patient are entered to the patient's account which is formed in the entrance to the hospital. If all procedures are done, this account is closed by the administration. The patient's receipt is ready now. The patient who pays cash is given a receipt from the cashier's Office or the receipt is sent to the social security association (Retirement Fund, Social Security Institution, etc.) of the patient.

3.2.1.11. Statistics

General hospital statistics in weekly, monthly or annual bases or all real time movements can be observed. The profit of individual departments can be monitorized.

The investigations, medications and expenditures can be seen.

3.2.2. Applications of the system

The patient applies to the hospital by making an appointment or directly in emergency cases. A barcode number is assigned and an identity card is given to each patient who applies to the hospital first time. All hospital information data related to the patient is stored under this number. There is also a protocol number given for the each application of the patient to a department.

While the barcode number is for filing patient information on a single file, the protocol number is for filing and billing the examination, investigations and treatment of the patient in a department. The patient demographics data are entered by the patient admission department.

The name and number of the patients who has social security coverage appear in the screen of the outpatient clinic as soon as the patient admission department made the entry. If the patient is self paying for the entry, his or her name appears on the screen as soon as payment is made.

The history and physical examination findings are entered by the physician into the patient file created in the system. All the investigations and procedures requested for the patient were entered by means of the related windows in the file. There are no paper forms for requests and no form approval is needed for any request.

A patient file is recalled by using either the protocol number or the patient's name.

If the patient has social security coverage, investigation requests are entered simultaneously to the related laboratory or department's computer unit otherwise requests are entered when the payment is made to the cashier's office. The department personnel takes the specimens or does the procedure requested (such as taking X-rays) and sticks the barcode number on to the specimen. The specimen is sent to the related laboratory. The results of the investigations are entered to the patient's file after approval of the result by the authorities of the related department. By this way, no paper is used for giving the results. The results are seen on the patient's file while the patient visits his or her doctor. They

can be printed into the paper if requested. The doctor makes his treatment plan while checking the results from the screen.

3.3. Presentation of electronic medical record system in ZKU hospital

All data entries about a patient should be done in electronic automation environment by hospital personnel (faculty members, resident doctors, nurses, technicians etc). All departments communicate by means of the automation system. The patients travel between the departments without using a written paper form.

System is designed as window modules. Each window is assigned for a part of medical record such as main complaint, history, physical examination etc. The file is organized in a windows- based interface. On top of the screen, name of the patient and assigned protocol numbers appear. If the patient admitted to the hospital, the day of stay also appears.

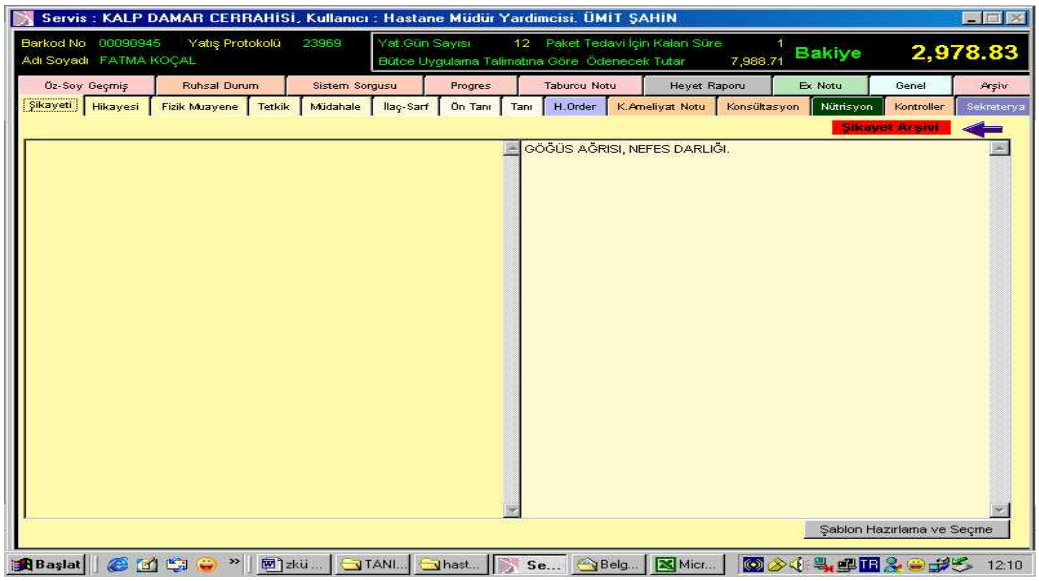

Figure 2: Main frame of a patient chart while the main complaint window is open

Starting from July 2006, The Ministry of Health declared a new payment plan for health expenditures. According to the plan, the hospitals are paid a fixed amount for case basis. The balance of patient's account also appears on the upper right corner of the screen (Figure-2). The fee for the each investigation is subtracted from the balance as soon as it is marked on the screen. This is a very

efficient way of making the physician be aware of the balance of payment by government fund on real time basis.

The basic components of the medical record are located on two row bars under the name, protocol numbers and account data. These are designed as separate selection boxes. The previous and family history of patient, psychological state, review of patients, progress notes, discharge report, disease report, exitus report, general (general summary of findings), archive are placed in the first row. The main complaint, history (of the present illness), physical examination, investigations, operations, drugs and medical material used, pre-diagnosis, diagnosis, patient order, operation notes, consultations, nutrition, controls and secretarial notes are placed in the second row.

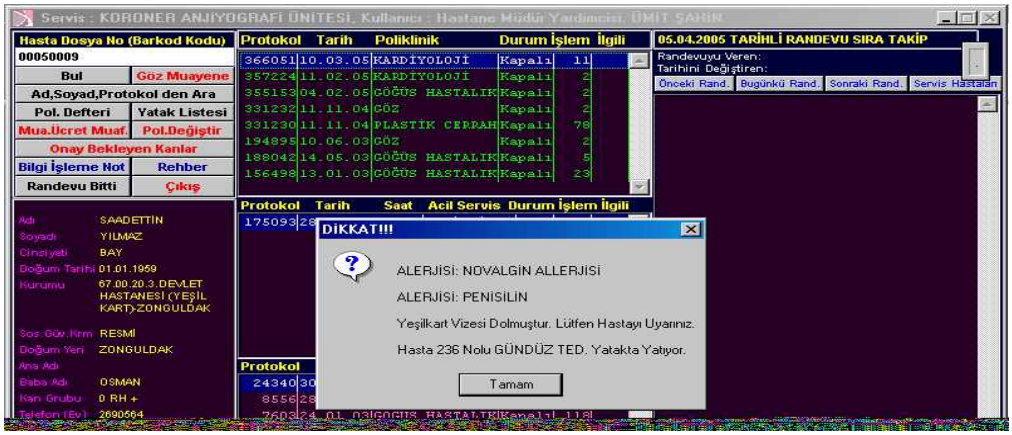

Figure 3: The critical findings are coming into the screen as a warning in every entry to the patient's chart

Figure 2 shows the main frame of a patient chart while the main complaint window of the system is open. If an important previous data is present such as drug allergies, it comes as a reminder into the screen (Figure 3).

The physician enters the data directly to the chart of the patient as shown in Figure 4. The chart is filled by physician as free text. Since this part is not structured, it is difficult to retrieve specific information if needed later.

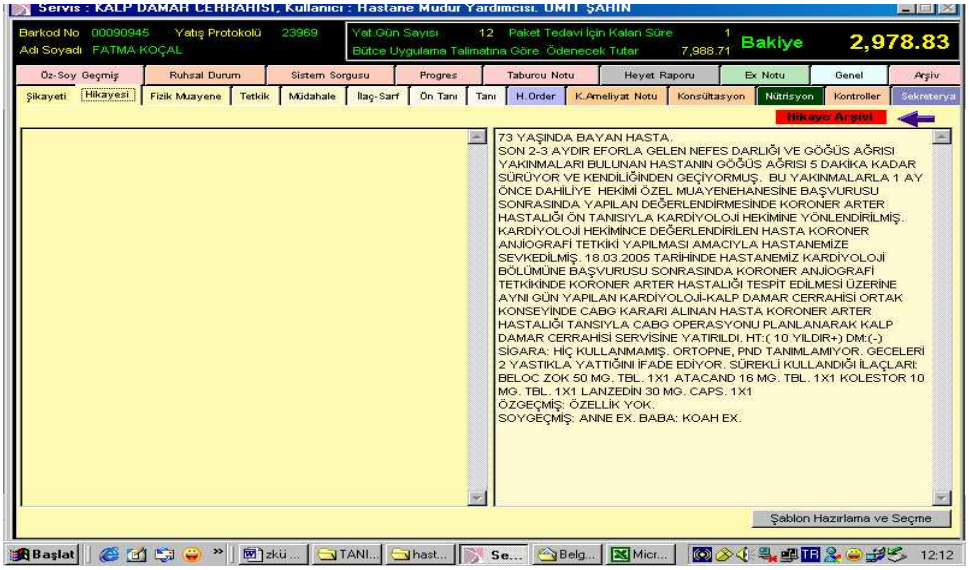

Figure 4: The history of the patient is entered to the file

The laboratory investigations can be requested from the investigation window by selecting appropriate row on the opened window (Figure 5). This part is structured; the doctor does not need to write down each investigation requested. Instead, he or she selects one of the title headings on the opened window. On the other hand, the doctor needs to know which heading the requested investigation is placed under. It takes time to memorize the location of investigations under these headings.

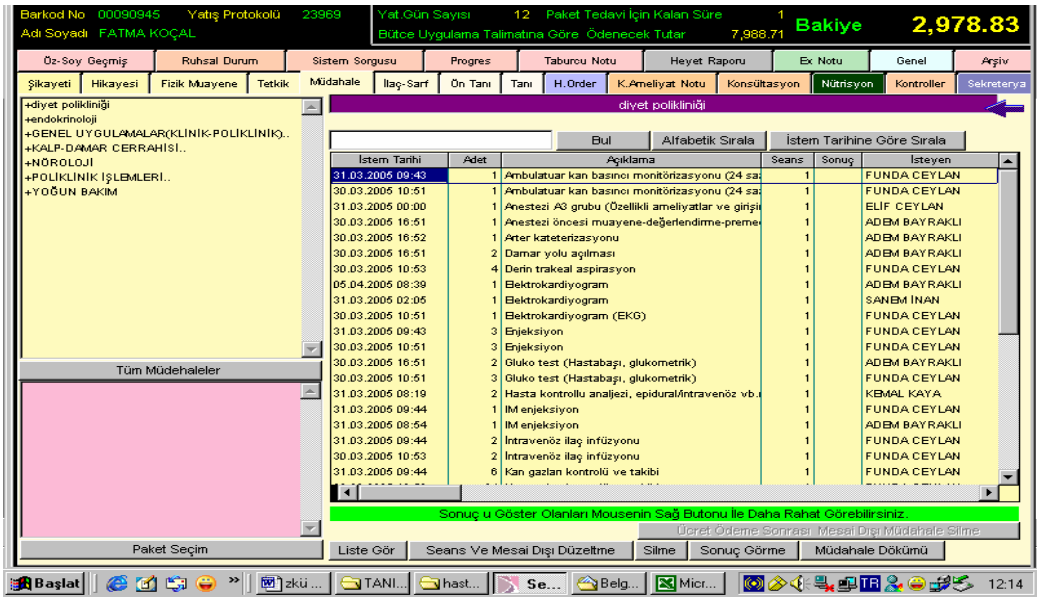

Figure 5: Laboratory investigations can be requested from the 'investigation' window

The laboratory results can be followed from the screen (Figure 6). If the result has not entered yet, it is seen as a yellow color band on the screen. If the specimen is not given by the patient after the request it appears as red band on the screen. By this way it is possible to check if the patient passed through all the requested investigations. This is important for billing purposes as well. Since the investigation which is not done can not be billed.

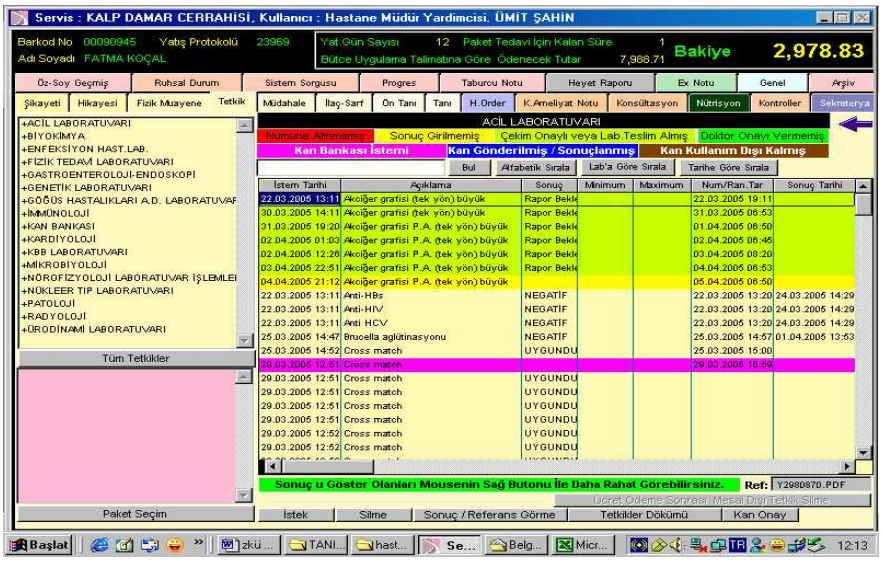

Figure 6: Laboratory results are seen on the screen

The Physician writes down the daily progresses and gives orders for the patients who are admitted to the hospital beds. There are related windows in the system for these procedures (Figure- 7 and 8). The time of the order and the name of the doctor who gave it are also seen in the screen.

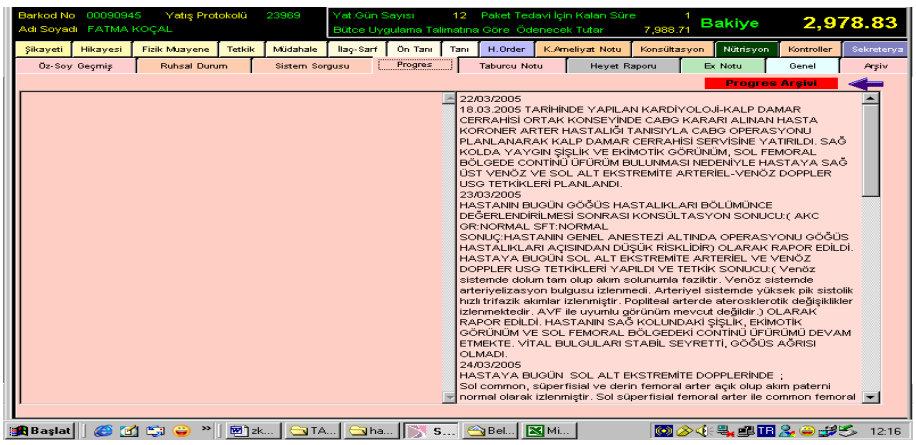

Figure 7: The progress notes window

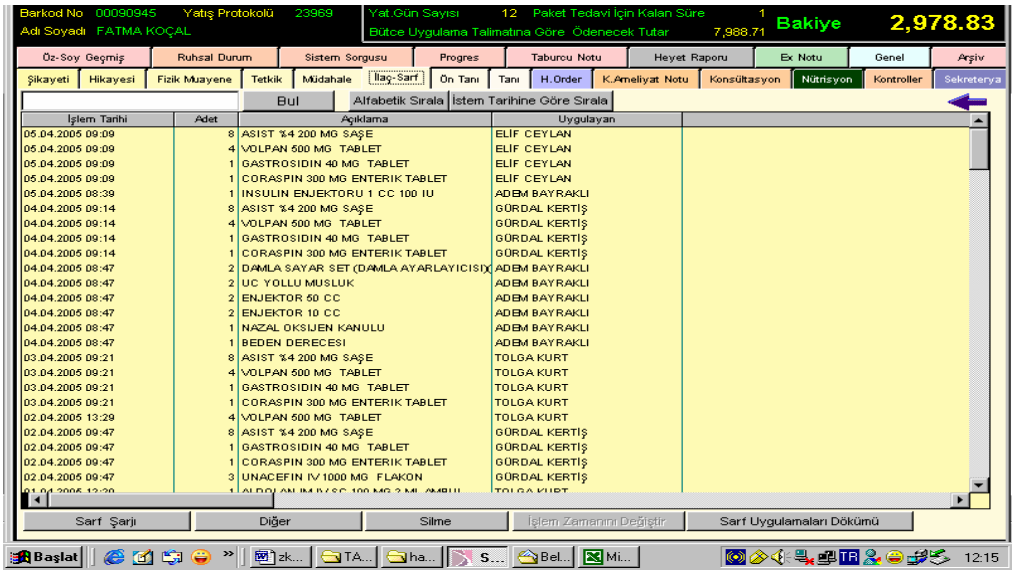

Figure 8: The physician's orders are seen on the screen

It is possible to restrict some parts of the chart for general use. This is important for preserving the confidential data. For example, only the psychiatrists have access to enter the psychiatric chart of a patient (Figure- 9).

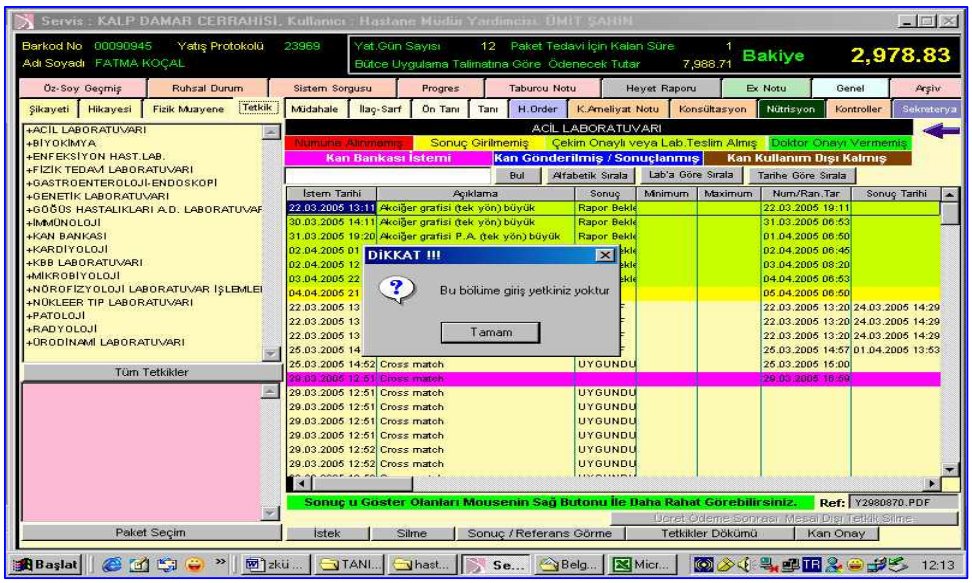

Figure 9: A window showing the restriction appears on the screen when an attempt to enter the psychiatric chart is made.

The patient orders are taken by the nurses in the system. The name of the nurse who is taking the order and when it is taken appear on the screen. At the

same time, the drugs can be ordered from the pharmacy department by the nurse who has taken the drug order (Figure 10).

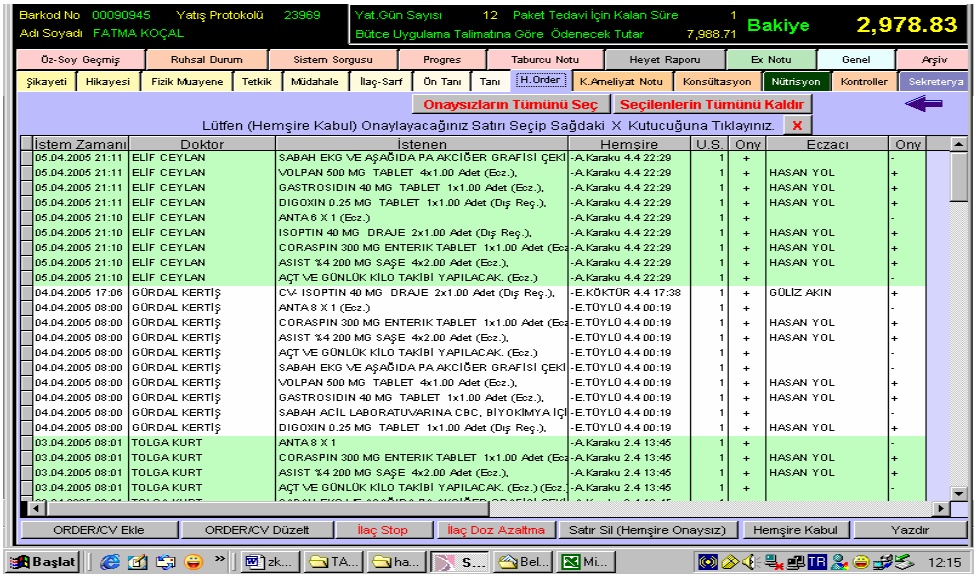

Figure 10: The doctor's order is taken by the nurse and can be asked from the pharmacy

The nurses can enter their workup data such as body temperature, blood pressure, and pulse rate to the chart in a separate window (Figure- 11).

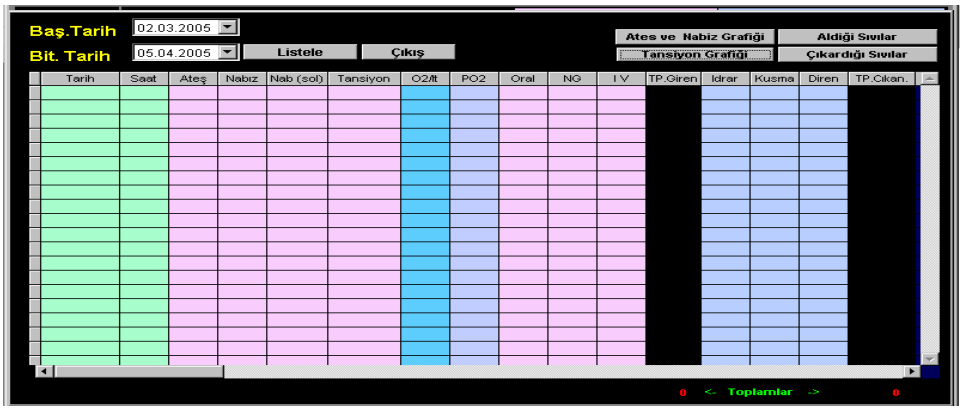

Figure 11: The nurse follow-up window

The consultations from other departments can be made in the consultation window. The results of consultation can be entered on the same window.

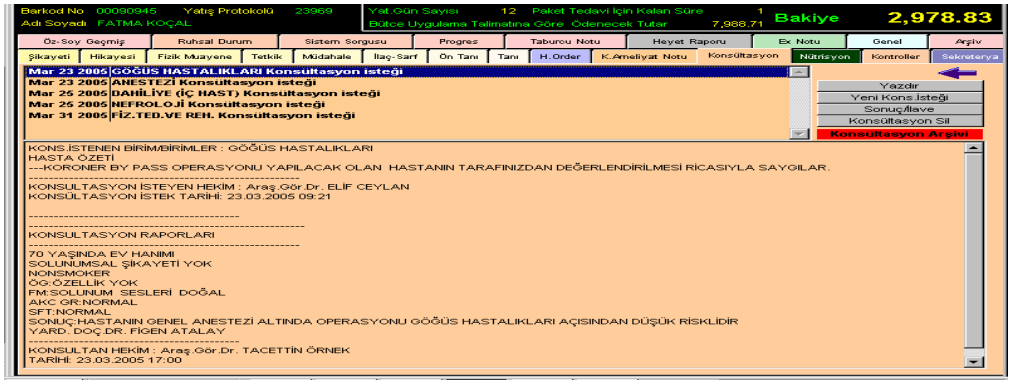

Figure 12: The consultation window

The patients who are admitted to the hospital also need a diet during their stay. A separate window for nutrition orders come to the screen (Figure- 12).

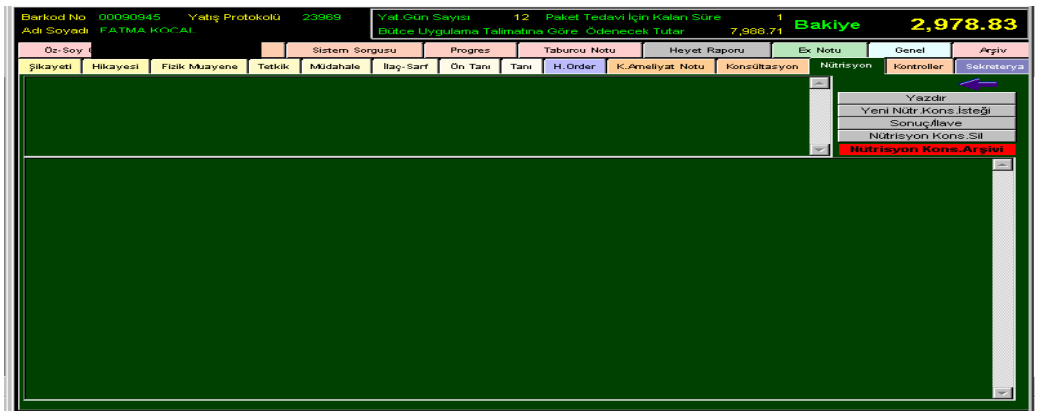

Figure 13: The nutrition order window

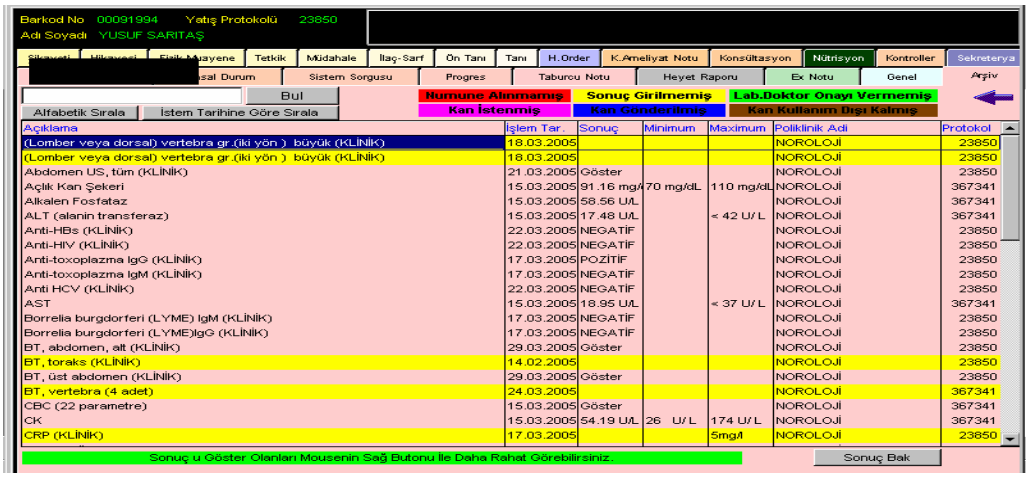

Figure 14: The laboratory results of the patient appear on the screen

The laboratory investigations of patients are seen on the screen. If the specimen is not taken, the request appears on a red color row. If the result is not entered, it appears as yellow.

The statistical module of the system is available to calculate some of the data.

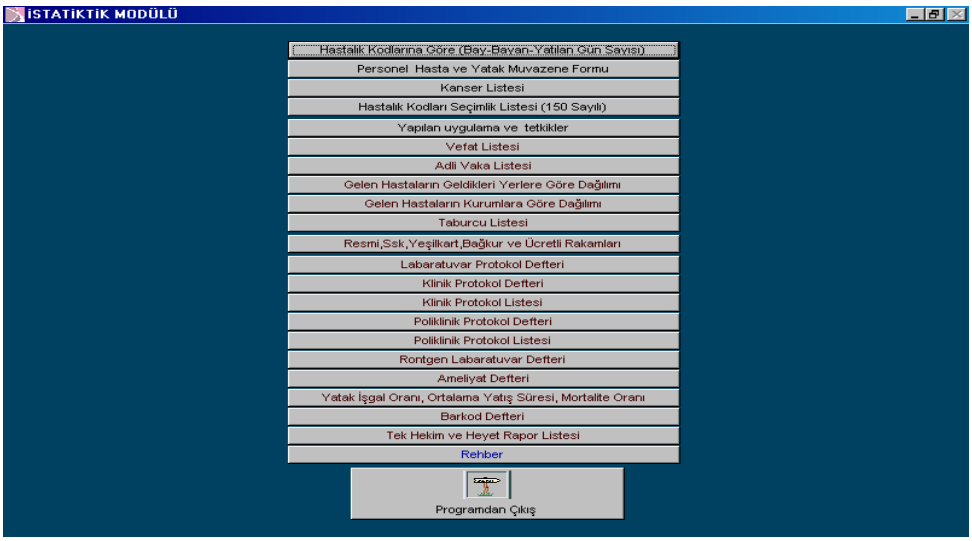

Figure 15: Statistical module window

All the procedures performed in the hospital are described in the patient charts. There is also a window for operation notes (Figure 16). The description of the operation, the time and performers' names are all included in this window.

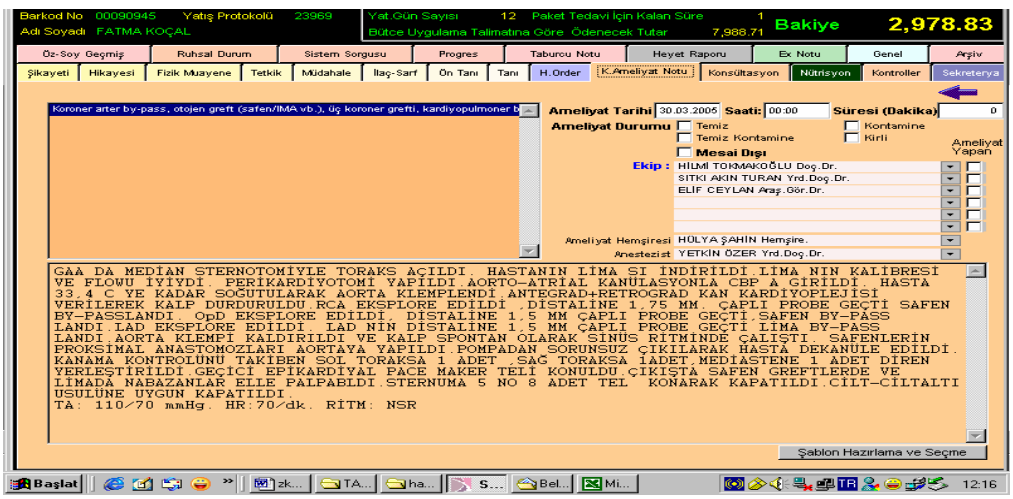

Figure 16: The window for operation notes

The diagnosis of the patient is entered from the list of ICD codes which is essential for billing purposes since 2006 (Figure 17).

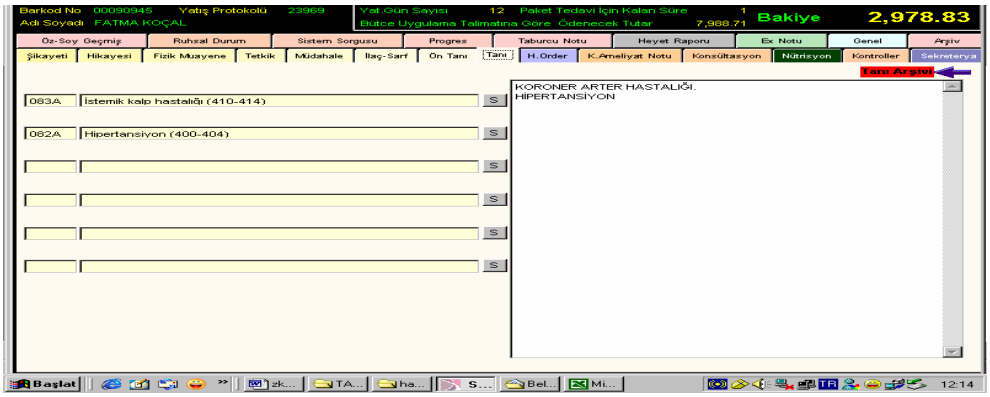

Figure 17: The diagnosis of the patient comes to the screen with related ICD code

A secretarial module is present in the program to submit several forms such as medical reports, epicrisis, receipts etc (Figure 18).

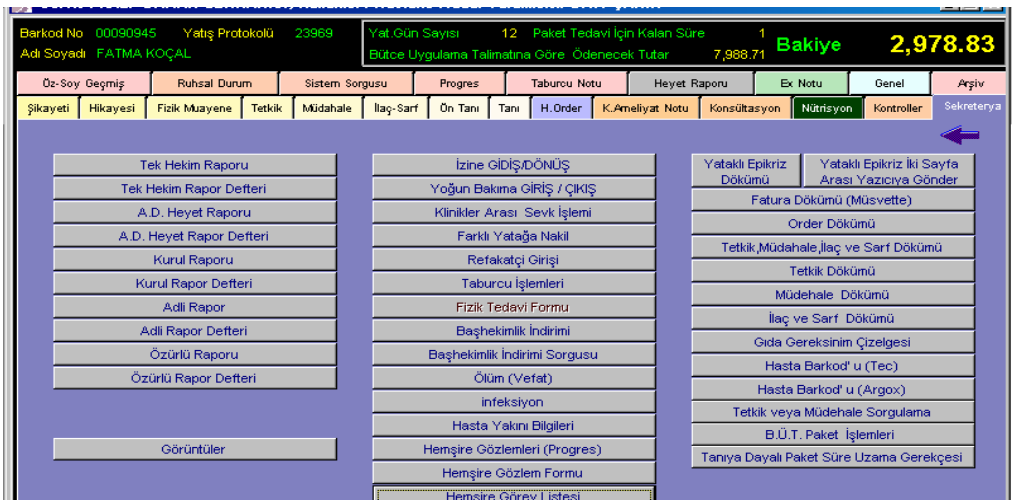

Figure 18: The secretarial module window

A detailed receipt is printed at the end of the patient's stay in the hospital (Figure- 19). A medical report describing the patient's diagnosis, progression and treatment (which is called as epicrisis in medical terms) is also given while discharging the patient from the hospital (Figure 20).

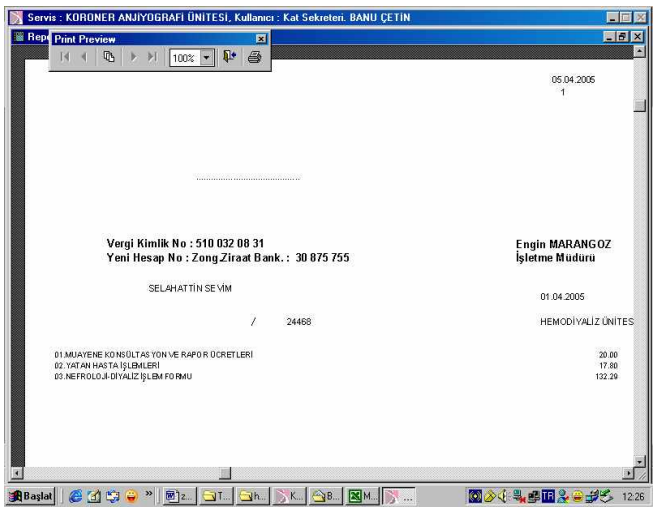

Figure 19: The preview of detailed receipt

All the files are constructed under windows system (Figure 21). This is advantageous for the users. The windows system is used in waste majority of personal computers. This makes the hospital staff familiar with the system. On the other hand, windows system uses secrete codes. There is a tendency for open codes all over the world recently.

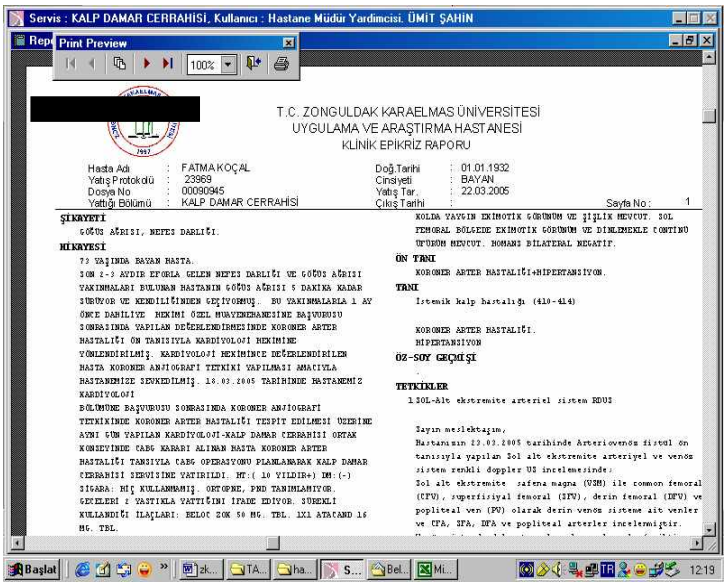

Figure 20: The preview of epicrisis form

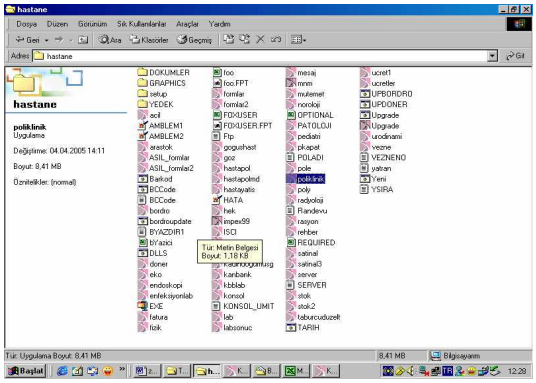

Figure 21: The windows files

3.4. Evaluation of the EMR system

In order to measure the impacts of a computer- based patient record system, relevant data must be identified, collected, analyzed and interpreted. In this section, before going into the field study, we described the EMR system that will be evaluated in the field research.

Three main approaches can be described for measuring effectiveness and impacts of an information system (Anderson et al, 1995). In the first view, the information system is seen as an external force. This approach ignores the social factor on the organization (Pfeffer, 1982). Evaluation focuses on technical performance such as cost, speed and accuracy.

The second theoretical perspective views the design of information systems as determined by the needs of managers and clinicians (Kaplan, 1991). In this view, the information system is considered to be endogenous to the organization members having control over the technical aspects of the system. According to this theory, change occurs in a rational fashion as needs are identified and problems solved.

According to the third perspective, uses and impacts of information technology result from complex social interactions within the organization. The technology is implemented and utilized in a particular organizational setting depending on conflicting objectives, preferences, and work demands.

All these three perspectives were considered for the evaluation of EMR system in our field study which is presented in the next chapter.

CHAPTER 4

FIELD STUDY

4.1. Method of the Field Study

This study is conducted in Zonguldak Karaelmas University Hospital. The hospital information system of the hospital has been launched as soon as the hospital was open on September 2000. In September 2006, we surveyed the doctors including academic staff and residents, nurses, technicians and clerk-registrars using the electronic medical record system of the hospital.

The study was approved by the Rectorate of Zonguldak Karaelmas University. Participation in this survey was voluntary and anonymous. All the data were kept confidential and used for research purposes.

The questionnaire consisted of 29 items and was developed from a task-oriented questionnaire from a previous study (Laerum and Faxvaag, 2004). The general clinical tasks in the questionnaire items had been tested by physicians and found to be relevant and comprehensible.

English and Turkish versions of the questionnaire which was applied to the participants of the survey were given in appendices A (page 84) and B (page 88) respectively. The questionnaire was divided into seven sections. The first section (A) includes check boxes for the position of responder in the hospital.

The second section (B) includes 12 questions for the clinical tasks. The responder is asked for the frequency of EMR use for them.

The third section (C) includes 12 questions for the same clinical tasks in the second section. This time, the responders were asked to reply for the ease of performing each task when using EMR.

The forth section (D) includes 4 questions about the satisfaction of users with the EMR. These questions review the content, format, ease of use and accuracy of the system.

The forth section (E) includes 5 questions for evaluating the advantages of EMR and fifth section includes 5 questions for evaluating the disadvantages of EMR.

The sixth section (F) includes 2 questions about the time period spent for EMR use during daily activities. Lastly, the seventh section (G) includes 1 question for the general assessment of the EMR system.

There are blank areas for additional comments in fourth and fifth section. At the end of survey, there is another blank area for overall view of EMR and survey itself.

The responses were divided in a Likert scale: strongly agree (SA), agree (A), no idea (NA), disagree (D), and strongly disagree (SD) (Babbie, 1990).

The questionnaire items were summarized by the use of descriptive statistics, using valid percentages for all interval scale variables and using arithmetic mean, mode or median as a central tendency measure. Comparisons were made between physicians (academicians and residents), nurses, technicians and administrative staff by means of t test and ANOVA (One-Way Analysis of Variance) for interval scale variables. A probability value of less than 0.05 was considered significant. Data analysis was performed with version 13.0 of the SPSS statistical program.

4.2. Results

One hundred twenty six survey forms were evaluated. There were 27 academicians (having titles of associate professor, assistant professor), 22 resident doctors 33 nurses, 13 technicians and 27 administrative clerks (civil servants) who were participated to the survey. Four survey forms were filled by others (two medical students and two workers).

Simple random sampling method is used for the survey. The participants included 21 % (25/119) of the academicians, 12.7 % (23/183) of the resident doctors, 20.1 % (33/164) of the nurses, 15.7 % (13/82) of the technicians and 41.2 % (26/63) of the administrative clerks.

In this cross-sectional survey, we assessed the use and satisfaction of an electronic medical record system among the users of Zonguldak Karaelmas

University Hospital. Approximately twenty percent of the eligible users were included in the study.

The questionnaire used in this study was based on the previous work for the development of a task oriented questionnaire by Laerum and Faxvaag (2004). The authors suggested that the questionnaire may provide valid and reliable information about how an implanted EMR system was utilized on an overall level in clinical practice, and how well the system supports clinical tasks.

Four problems arose from the interviews with the participants of their survey. First problem was the respondent's confusion for replying the tasks in which no functionality was offered. To eliminate this problem we preferred to include the items with clear functional tasks. The second problem was distinguishing EMR from the use of other software for clinical work. The authors suggested that just considering EMR use was easier for the respondent. Our questions were organized to evaluate EMR only. As a third problem, questions about tasks which were not completely supported by the EMR system were found hard to answer. In our survey, all questions were related to the tasks that were completely supported by EMR. Lastly, distinguishing other employee's use of the system from one's own appeared as a problem in two tasks. These are entering daily notes (C02) and consultations from other departments (C07). Since the doctors enter the daily notes and request consultations themselves rather than with the help of a 'transcriptionist' (Laerum & Faxvaag, 2004) these tasks did not cause a problem in our survey.

4.2.1. Reliability and descriptive statistics of the survey

Reliability statistics of the survey showed a high rate of Cronbach's Alpha (92,2%) for all questions (Table 1-A). Cronbach's Alpha has several interpretations. It can be viewed as the correlation between this test or scale and all other possible tests or scales containing the same number of items which could be constructed from a hypothetical universe of items that measure the characteristic of interest. Cronbach's Alpha tells us how much correlation we expect between our scale and all other possible 41 item scales measuring the EMR system (Norusis, 1998).

The descriptive statistics of all survey items are shown in Table 1-B. The standard deviations of B12, B11, B09, B08 and B07 tasks were higher than the rest of items. This shows the heterogeneity of answers to these questions. On the other hand, the last item which is questioning the general satisfaction from the system has the lowest standard deviation. This shows homogeneity of answers for general assessment of the system.

The coefficient of skewness for a variable less than 2 and coefficient of kurtosis for a variable less than 7 in absolute values show that variables are distributed normally (Fabrigar et al, 1999). According to skewness coefficient, all items except E01, E02, and E03 are symmetrically distributed in our survey. Other than E01, all items were distributed normally based on kurtosis coefficients (Table 1-B).

In a frequency distribution of quantitative variables, if the frequency of a particular value has a relatively higher ratio compared to other values, mode can be used as appropriate measure of central tendency (Yamak and Köseoğlu, 2006).

4.2.2. Evaluation for 'Use of medical record system'

The questions for use of medical record system are located in part B of the questionnaire (Appendix A). The answers for the use of 12 tasks are evaluated in this section.

The answer to 'review of problems' task (B01) is given as 'in most of the occasions' and 'always' by 73 % of the users (Table 2). The cross comparison of the answers showed that this task is mainly used by doctors (residents -academic staff) and nurses (Figure C1 at appendix C).

Table 1-A: Reliability Statistics and Item-Total Statistics

	Description of Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach Alpha If Item Deleted
B01	Review the patient problems	149,02	632,121	,667	,918
B02	Enter daily notes	149,40	615,466	,705	,917
B03	To order laboratory tests	149,38	615,998	,733	,917
B04	To obtain the results of laboratory tests	149,19	620,743	,688	,917
B05	To order radiological investigations	149,60	619,661	,665	,917
B06	To obtain the results of radiological investigations	149,71	620,111	,656	,918
B07	To refer the patient to other departments	149,69	613,048	,706	,917
B08	Order treatments	150,33	609,057	,627	,918
B09	Taking the treatments orders	150,48	619,914	,525	,920
B10	Collect patient information	149,38	621,266	,721	,917
B11	Collect patient information for discharge reports	149,50	612,695	,734	,916
B12	Register codes for diagnosis	149,62	612,729	,673	,917
C01	Review the patient problems	149,24	643,844	,550	,919
C02	Enter daily notes	149,31	645,146	,506	,920
C03	To order laboratory tests	149,12	634,985	,599	,919
C04	To obtain the results of laboratory tests	149,02	635,390	,611	,919
C05	To order radiological investigations	149,10	648,918	,432	,920
C06	To obtain the results of radiological investigations	149,12	641,376	,543	,919
C07	To refer the patient to other departments	149,05	636,242	,698	,918
C08	Order treatments	149,40	620,881	,714	,917
C09	Taking the treatments orders	149,33	623,593	,724	,917
C10	Collect patient information	149,02	635,877	,683	,918
C11	Collect patient information for discharge reports	149,02	632,463	,717	,918
C12	Register codes for diagnosis	149,33	634,959	,516	,919
D01	Do you think the system provide sufficient information for you?	149,33	663,252	,250	,922
D02	Do you satisfied with the format of output from the system?	149,33	668,959	,078	,923
D03	Is the system easy to use?	149,21	656,172	,408	,921
D04	Are you satisfied with the accuracy of the system?	149,60	654,003	,342	,921
E01	Easy access to the records	148,62	671,754	,022	,923
E02	Disappearance of paper records	148,71	660,453	,211	,922
E03	Ability to see and analyze the patient data as a whole	148,69	663,634	,183	,922
E04	Ability to retrieve faster and reliable data for scientific research	148,93	659,385	,229	,922
E05	Restructuring is possible for the necessities	148,79	661,197	,243	,922
F01	To spend more time compared to the paper systems	149,76	671,991	-,015	,926
F02	Privacy of patient information is decreased	150,24	663,015	,107	,924
F03	Difficult to maintain the safety of records	150,40	666,686	,055	,925
F04	Need for frequent adjustments in parallel with technologic developments	150,31	668,560	,028	,925
F05	Possibility of breakdown or errors in computer system	151,02	652,902	,250	,922
G01	What percent of your time (during an exam, procedure or recording ect.) do you spend for entering the clinical information or results of each patient?	150,81	664,597	,143	,923
G02	What percent of your daily working time do you spent for using record system?	150,90	664,527	,138	,923
H01	How would you rate the success of the electronic medical record system installed in your department?	149,48	661,573	,378	,921

Table 1-B: Descriptive Statistics

	n										Quartile		
	Valid	No response	Mean	Median	Mode	Std. Deviation	Skewness	Kurtosis	Min.	Max.	25	50	75
B01	113	13	4,22	5,00	5,00	1,12	-1,56	1,72	1	5	4	5	5
B02	108	18	3,63	4,00	5,00	1,59	-,64	-1,27	1	5	2	4	5
B03	98	28	3,26	4,00	5,00	1,72	-,20	-1,75	1	5	1	4	5
B04	105	21	3,87	5,00	5,00	1,59	-,91	-,95	1	5	2	5	5
B05	100	26	2,92	3,00	1,00	1,76	,06	-1,80	1	5	1	3	5
B06	97	29	3,27	4,00	5,00	1,67	-,27	-1,65	1	5	2	4	5
B07	98	28	2,85	2,00	1,00	1,77	,13	-1,81	1	5	1	2	5
B08	102	24	2,58	1,00	1,00	1,88	,43	-1,78	1	5	1	1	5
B09	105	21	3,06	4,00	5,00	1,90	-,07	-1,94	1	5	1	4	5
B10	108	18	3,90	4,00	5,00	1,35	-1,03	-,28	1	5	3	4	5
B11	105	21	3,37	4,00	5,00	1,73	-,41	-1,62	1	5	1	4	5
B12	100	26	3,06	4,00	5,00	1,87	-,08	-1,92	1	5	1	4	5
C01	111	15	4,11	4,00	4,00	,90	-1,14	1,20	1	5	4	4	5
C02	98	28	3,96	4,00	4,00	,96	-1,05	1,23	1	5	4	4	5
C03	82	44	4,18	4,50	5,00	1,09	-1,49	1,51	1	5	4	5	5
C04	94	32	4,31	5,00	5,00	,93	-1,73	3,12	1	5	4	5	5
C05	77	49	4,21	4,00	5,00	,96	-1,52	2,33	1	5	4	4	5
C06	87	39	4,22	4,00	5,00	1,00	-1,58	2,37	1	5	4	4	5
C07	79	47	4,23	4,00	5,00	,92	-1,59	2,99	1	5	4	4	5
C08	71	55	3,96	4,00	5,00	1,25	-1,33	,84	1	5	4	4	5
C09	83	43	4,16	4,00	5,00	1,14	-1,62	2,06	1	5	4	4	5
C10	103	23	4,25	4,00	4,00	,92	-1,93	4,63	1	5	4	4	5
C11	87	39	4,21	4,00	5,00	,99	-1,76	3,34	1	5	4	4	5
C12	77	49	3,87	4,00	5,00	1,30	-1,15	,19	1	5	4	4	5
D01	123	3	3,80	4,00	4,00	,88	-1,05	1,47	1	5	3	4	4
D02	119	7	3,87	4,00	4,00	1,01	-,74	-,05	1	5	3	4	5
D03	119	7	3,90	4,00	4,00	,96	-,79	,31	1	5	3	4	5
D04	120	6	3,40	3,50	4,00	1,18	-,42	-,56	1	5	3	4	4
E01	117	9	4,60	5,00	5,00	,81	-2,70	7,95	1	5	4	5	5
E02	117	9	4,57	5,00	5,00	,87	-2,59	6,93	1	5	4	5	5
E03	122	4	4,63	5,00	5,00	,84	-2,59	6,22	1	5	5	5	5
E04	118	8	4,29	5,00	5,00	1,10	-1,57	1,52	1	5	4	5	5
E05	118	8	4,30	5,00	5,00	1,09	-1,51	1,25	1	5	4	5	5
F01	116	10	3,39	4,00	5,00	1,55	-,28	-1,56	1	5	2	4	5
F02	114	12	2,66	2,00	2,00	1,49	,48	-1,29	1	5	1	2	4
F03	113	13	2,67	2,00	2,00	1,48	,37	-1,37	1	5	1	2	4
F04	114	12	2,54	2,00	1,00	1,45	,48	-1,21	1	5	1	2	4
F05	121	5	1,93	1,00	1,00	1,37	1,27	,13	1	5	1	1	2
G01	108	18	2,33	2,00	2,00	,96	,26	-,83	1	4	2	2	3
G02	110	16	2,47	2,00	2,00	1,06	,10	-1,19	1	4	2	2	3
H01	118	8	3,64	4,00	4,00	,72	-,83	1,15	1	5	3	4	4

Table 2: Review the patient problems (B01)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	6	4,8	5,3	5,3
	2 Seldom	5	4,0	4,4	9,7
	3 About half of the occasions	10	7,9	8,8	18,6
	4 Most of the occasions	29	23,0	25,7	44,2
	5 Always	63	50,0	55,8	100,0
	Total	113	89,7	100,0	
No response		13	10,3		
Total		126	100,0		

The answer to enter daily notes task (B02) is given as 'in most of the occasions' and 'always' by 64.8 % of the users (Table 3). The cross comparison of the answers (Figure C2 at appendix C) showed that this task is mainly used by doctors (academic staff -residents) and nurses.

Table 3: Enter daily notes (B02)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	18	14,3	16,7	16,7
	2 Seldom	17	13,5	15,7	32,4
	3 About half of the occasions	3	2,4	2,8	35,2
	4 Most of the occasions	19	15,1	17,6	52,8
	5 Always	51	40,5	47,2	100,0
	Total	108	85,7	100,0	
No response		18	14,3		
Total		126	100,0		

The answer to order laboratory tests (B03) is given as 'always' by 42.9 % of the users (Table 4). The cross comparison of the answers (Figure C3 at appendix C) showed that this task is mainly used by doctors (academic staff -residents) and nurses. It is never or seldom used by 43.9 % of users (mainly civil servant, technician and nurses) (Figure C4 at appendix C).

Table 4: To order laboratory tests (B03)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	25	19,8	25,5	25,5
	2 Seldom	18	14,3	18,4	43,9
	3 About half of the occasions	4	3,2	4,1	48,0
	4 Most of the occasions	9	7,1	9,2	57,1
	5 Always	42	33,3	42,9	100,0
	Total	98	77,8	100,0	
No response		28	22,2		
Total		126	100,0		

The answer to obtain the results of laboratory tests (B04) is given as 'always' by 60.95 % of the users (Table 5). The cross comparison of the answers (Figure C5 at appendix C) showed that this task is mainly used by doctors (academic staff -residents) and nurses

Table 5: To obtain the results of laboratory tests (B04)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	16	12,7	15,2	15,2
	2 Seldom	14	11,1	13,3	28,6
	3 About half of the occasions	2	1,6	1,9	30,5
	4 Most of the occasions	9	7,1	8,6	39,0
	5 Always	64	50,8	61,0	100,0
	Total	105	83,3	100,0	
No response		21	16,7		
Total		126	100,0		

The answer to order radiological investigations (B05) is given as ‘always’ and ‘most of the occasions’ by 47 % of the users (Table 6). The cross comparison of the answers (Figure C6 at appendix C) showed that this task is mainly used by doctors (academic staff -residents). It is never or seldom used by 38.9 % of users.

Table 6: To order radiological investigations (B05)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	38	30,2	38,0	38,0
	2 Seldom	11	8,7	11,0	49,0
	3 About half of the occasions	4	3,2	4,0	53,0
	4 Most of the occasions	15	11,9	15,0	68,0
	5 Always	32	25,4	32,0	100,0
	Total	100	79,4	100,0	
No response		26	20,6		
Total		126	100,0		

The answer to obtain the results of radiological investigations (B06) is given as ‘always’ and ‘most of the occasions’ by 55.7 % of the users (Table 7). The cross comparison of the answers (Figure C7 at appendix C) showed that this task is mainly used by doctors (academic staff -residents) and nurses. It is never or seldom used by 41.2 % of users.

Table 7: To obtain the results of radiological investigations (B06)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	24	19,0	24,7	24,7
	2 Seldom	16	12,7	16,5	41,2
	3 About half of the occasions	3	2,4	3,1	44,3
	4 Most of the occasions	18	14,3	18,6	62,9
	5 Always	36	28,6	37,1	100,0
	Total	97	77,0	100,0	
No response		29	23,0		
Total		126	100,0		

The answer to refer the patient to other departments (B07) is given as ‘always’ and ‘most of the occasions’ by 34.9 % of the users (Table 8). The cross comparison of the answers (Figure C8 at appendix C) showed that this task is mainly used by residents.

Table 8: To refer the patient to other departments (B07)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	40	31,7	40,8	40,8
	2 Seldom	10	7,9	10,2	51,0
	3 About half of the occasions	4	3,2	4,1	55,1
	4 Most of the occasions	13	10,3	13,3	68,4
	5 Always	31	24,6	31,6	100,0
	Total	98	77,8	100,0	
No response		28	22,2		
Total		126	100,0		

The answer to order treatments (B08) is given as 'never' by 55.9 % of the users (Table 9). The cross comparison of the answers (Figure C9 at appendix C) showed that this task is mainly used by academic staff.

Table 9: Order treatments (B08)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	57	45,2	55,9	55,9
	2 Seldom	4	3,2	3,9	59,8
	3 About half of the occasions	1	,8	1,0	60,8
	4 Most of the occasions	5	4,0	4,9	65,7
	5 Always	35	27,8	34,3	100,0
	Total	102	81,0	100,0	
No response		24	19,0		
Total		126	100,0		

The answer to taking the treatment orders (B09) is given as 'always' and 'most of the occasions' by 51.4 % of the users (Table 10). The cross comparison of the answers (Figure C10 at appendix C) showed that this task is mainly used by nurses.

Table 10: Taking the treatments orders (B09)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	45	35,7	42,9	42,9
	2 Seldom	4	3,2	3,8	46,7
	3 About half of the occasions	2	1,6	1,9	48,6
	4 Most of the occasions	8	6,3	7,6	56,2
	5 Always	46	36,5	43,8	100,0
	Total	105	83,3	100,0	
No response		21	16,7		
Total		126	100,0		

The answer to collect patient information (B10) is given as 'always' and 'most of the occasions' by 78.1 % of the users (Table 11). The cross comparison of the answers (Figure C11 at appendix C) showed that this task is mainly used by doctors (academic staff- residents) and nurses.

Table 11: Collect patient information (B10)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	10	7,9	9,3	9,3
	2 Seldom	13	10,3	12,0	21,3
	3 About half of the occasions	5	4,0	4,6	25,9
	4 Most of the occasions	30	23,8	27,8	53,7
	5 Always	50	39,7	46,3	100,0
	Total	108	85,7	100,0	
No response		18	14,3		
Total		126	100,0		

The answer to collect patient information for discharge reports (B11) is given as 'always' and 'most of the occasions' by 58.1 % of the users (Table 12). The cross comparison of the answers (Figure C12 at appendix C) showed that this task is mainly used by residents.

Table 12: Collect patient information for discharge reports (B11)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	30	23,8	28,6	28,6
	2 Seldom	8	6,3	7,6	36,2
	3 About half of the occasions	6	4,8	5,7	41,9
	4 Most of the occasions	15	11,9	14,3	56,2
	5 Always	46	36,5	43,8	100,0
	Total	105	83,3	100,0	
No response		21	16,7		
Total		126	100,0		

The answer to register codes for diagnosis (B12) is given as 'always' and 'most of the occasions' by 52 % of the users (Table 13). The cross comparison of the answers (Figure C13 at appendix C) showed that this task is mainly used doctors (academic staff –residents).

Table 13: Register codes for diagnosis (B12)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	41	32,5	41,0	41,0
	2 Seldom	6	4,8	6,0	47,0
	3 About half of the occasions	1	,8	1,0	48,0
	4 Most of the occasions	10	7,9	10,0	58,0
	5 Always	42	33,3	42,0	100,0
	Total	100	79,4	100,0	
No response		26	20,6		
Total		126	100,0		

The overall review of section B which consists of the questions for use of EMR in 12 clinical tasks is shown in Figure 22. According to the figure, all tasks have a high rate of acceptance (over 3) by the users accept tasks 5, 7 and 8. 8th task (ordering treatment) is only used by doctors (academicians and residents). 7th

task (referring patients to other departments) and 5th task (ordering a radiological investigation) are also used by doctors only.

Descriptive statistics showed that the mode of answers for the 12 tasks in section B (frequency of the EMR use) of the questionnaire were mostly 4 (frequently) and 5 (always) except the tasks 5, 7 and 8. Task 5 (to order radiological investigations), task 7 (consultation from other departments) and task 8 (giving the treatment orders) had a mode of 1 (never). These tasks are less frequently used by the system users in comparison with other tasks.

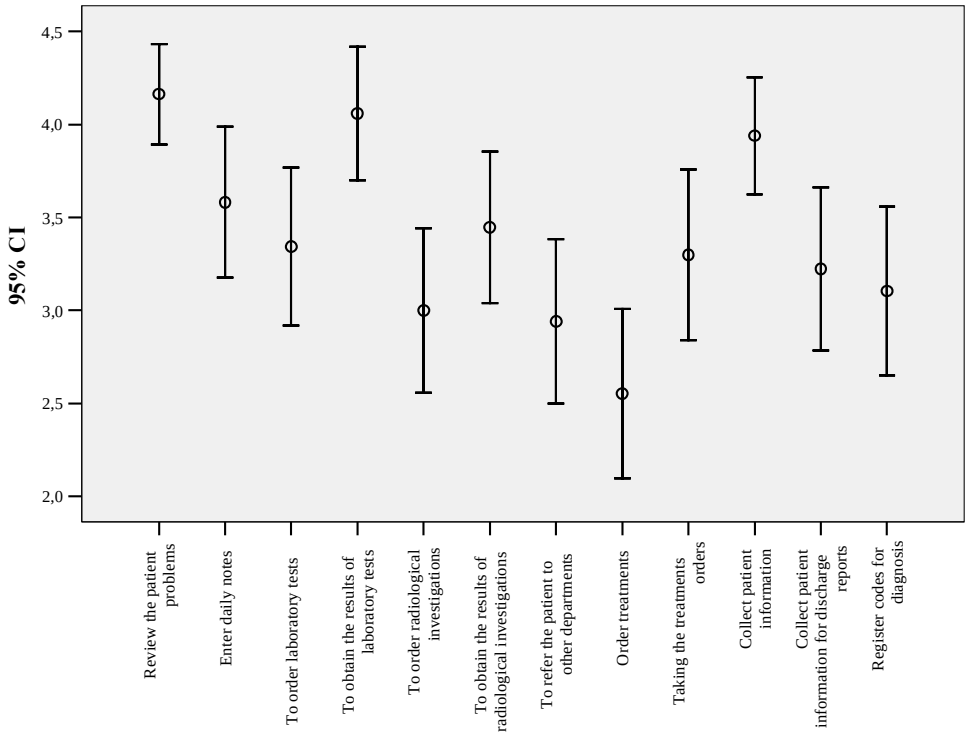

Figure 22: Use of Medical Record System

4.2.3. Evaluation for 'Ease of EMR use compared to paper record system'

The questions about the ease of EMR use compared to paper record system are located in part C of the questionnaire (appendix A, page 102). The answers for 12 tasks (same as questioned in section B) are evaluated in this section.

Since these tasks are related with patient care, only the answers of doctors (both academic staff and resident doctors) and nurses are evaluated in this section. The answers given by the other groups are not taken into account.

Table 14: Ease of EMR use compared with paper record system (C01-C12)

Clinical Task	Values	3 Nurse			4 Doctor			5 Academic staff		
		Count	Layer	Table	Count	Layer	Table	Count	Layer	Table
Review the patient problems (C=01)	1 More difficult									
	2 Difficult	2	6,3%	1,8%	1	4,5%	,9%	4	15,4%	3,6%
	3 No change	3	9,4%	2,7%	3	13,6%	2,7%	1	3,8%	,9%
	4 Easy	18	56,3%	16,2%	9	40,9%	8,1%	11	42,3%	9,9%
	5 Very easy	9	28,1%	8,1%	9	40,9%	8,1%	10	38,5%	9,0%
Enter daily notes (C=02)	1 More difficult	2	8,0%	2,0%						
	2 Difficult	1	4,0%	1,0%				2	8,0%	2,0%
	3 No change	7	28,0%	7,1%	5	22,7%	5,1%	1	4,0%	1,0%
	4 Easy	10	40,0%	10,2%	8	36,4%	8,2%	11	44,0%	11,2%
	5 Very easy	5	20,0%	5,1%	9	40,9%	9,2%	11	44,0%	11,2%
To order laboratory tests (C=03)	1 More difficult				1	4,5%	1,2%			
	2 Difficult	1	8,3%	1,2%	1	4,5%	1,2%	2	7,7%	2,4%
	3 No change	1	8,3%	1,2%	1	4,5%	1,2%			
	4 Easy	6	50,0%	7,3%	7	31,8%	8,5%	5	19,2%	6,1%
	5 Very easy	4	33,3%	4,9%	12	54,5%	14,6%	19	73,1%	23,2%
To obtain the results of laboratory tests (C=04)	1 More difficult									
	2 Difficult				1	4,5%	1,1%			
	3 No change	1	4,5%	1,1%	2	9,1%	2,1%			
	4 Easy	9	40,9%	9,6%	9	40,9%	9,6%	6	23,1%	6,4%
	5 Very easy	12	54,5%	12,8%	10	45,5%	10,6%	20	76,9%	21,3%
To order radiological investigations (C=05)	1 More difficult	1	9,1%	1,3%						
	2 Difficult							1	4,0%	1,3%
	3 No change	1	9,1%	1,3%	3	13,6%	3,9%			
	4 Easy	3	27,3%	3,9%	8	36,4%	10,4%	9	36,0%	11,7%
	5 Very easy	6	54,5%	7,8%	11	50,0%	14,3%	15	60,0%	19,5%
To obtain the results of radiological investigations (C=06)	1 More difficult	1	5,0%	1,1%	1	4,8%	1,1%			
	2 Difficult									
	3 No change	1	5,0%	1,1%	2	9,5%	2,3%	1	4,0%	1,1%
	4 Easy	6	30,0%	6,9%	9	42,9%	10,3%	9	36,0%	10,3%
	5 Very easy	12	60,0%	13,8%	9	42,9%	10,3%	15	60,0%	17,2%
To refer the patient to other departments (C=07)	1 More difficult	1	9,1%	1,3%						
	2 Difficult									
	3 No change				3	13,6%	3,8%	1	4,0%	1,3%
	4 Easy	5	45,5%	6,3%	8	36,4%	10,1%	8	32,0%	10,1%
	5 Very easy	5	45,5%	6,3%	11	50,0%	13,9%	16	64,0%	20,3%
Order treatments (C=08)	1 More difficult	1	10,0%	1,4%				1	4,3%	1,4%
	2 Difficult	1	10,0%	1,4%				1	4,3%	1,4%
	3 No change				1	4,5%	1,4%	3	13,0%	4,2%
	4 Easy	5	50,0%	7,0%	10	45,5%	14,1%	5	21,7%	7,0%
	5 Very easy	3	30,0%	4,2%	11	50,0%	15,5%	13	56,5%	18,3%
Taking the treatments orders (C=09)	1 More difficult									
	2 Difficult	1	3,6%	1,2%						
	3 No change				2	11,8%	2,4%	4	18,2%	4,8%
	4 Easy	9	32,1%	10,8%	7	41,2%	8,4%	5	22,7%	6,0%
	5 Very easy	18	64,3%	21,7%	8	47,1%	9,6%	13	59,1%	15,7%
Collect patient information (C=10)	1 More difficult							1	3,8%	1,0%
	2 Difficult				1	4,5%	1,0%	1	3,8%	1,0%
	3 No change	1	3,7%	1,0%	1	4,5%	1,0%			
	4 Easy	10	37,0%	9,7%	12	54,5%	11,7%	13	50,0%	12,6%
	5 Very easy	16	59,3%	15,5%	8	36,4%	7,8%	11	42,3%	10,7%
Collect patient information for discharge reports (C=11)	1 More difficult									
	2 Difficult	2	12,5%	2,3%						
	3 No change	1	6,3%	1,1%	3	14,3%	3,4%			
	4 Easy	6	37,5%	6,9%	10	47,6%	11,5%	10	38,5%	11,5%
	5 Very easy	7	43,8%	8,0%	8	38,1%	9,2%	16	61,5%	18,4%
Register codes for diagnosis(C=12)	1 More difficult	1	9,1%	1,3%	2	9,1%	2,6%			
	2 Difficult				5	22,7%	6,5%	1	3,8%	1,3%
	3 No change	2	18,2%	2,6%	2	9,1%	2,6%			
	4 Easy	5	45,5%	6,5%	8	36,4%	10,4%	9	34,6%	11,7%
	5 Very easy	3	27,3%	3,9%	5	22,7%	6,5%	16	61,5%	20,8%

According to Schoeffel (2001) the paper record represents massive fragmentation of clinical information. The clinical tasks such as reviewing patient problems (C1), collecting patient information (C10) and collecting patient information for discharge reports are affected from the fragmentation of data.

The overall review of section C which consists of the questions for easy use of EMR in 12 clinical tasks compared to paper records is shown in Table 14. According to the table all tasks are found to be 'easy' and 'very easy' by the majority of users. Task 8 (ordering treatments) is only used by doctors. Since the hospital is an academic facility, treatment orders are generally given by resident doctors. 95.5 % of the resident doctors found the task as 'easy' and 'very easy'. Task 9 (taking the treatment orders) is only used by nurses. 96.4 % of the nurses found it 'easy' and 'very easy' (Table 14).

The median and mode for all questions of section C (ease of EMR use compared to paper records) were either 4 or 5. The answers for section C of the questionnaire were mostly 4 (frequently) and 5 (always). This implies that, the users found application of these tasks with EMR easier than with paper medical records (Table 1-B).

4.2.4. Evaluation for the satisfaction of users from the EMR system

The questions about the satisfaction of users from the EMR system are located in part D of the questionnaire (Appendix A). The answers to four questions are evaluated in this section.

Table 15: Do you think the system provide sufficient information for you? (D01)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	3	2,4	2,4	2,4
	2 Seldom	8	6,3	6,5	8,9
	3 Half of the time	20	15,9	16,3	25,2
	4 Most of the time	71	56,3	57,7	82,9
	5 Always	21	16,7	17,1	100,0
	Total	123	97,6	100,0	
No response		3	2,4		
Total		126	100,0		

Section D of the questionnaire is about the users' satisfaction with EMR. The system provides sufficient information (most of the time and always) according to

84.8 % of the users (Table 15). This is almost equally appreciated by all user groups (Figure C14 at appendix C).

Table 16: Do you satisfied with the format of output from the system? (D02)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	2	1,6	1,7	1,7
	2 Seldom	12	9,5	10,1	11,8
	3 Half of the time	21	16,7	17,6	29,4
	4 Most of the time	49	38,9	41,2	70,6
	5 Always	35	27,8	29,4	100,0
	Total	119	94,4	100,0	
No response		7	5,6		
Total		126	100,0		

The format of output from the system is satisfactory 'most of the time' and 'always' according to 70.6 % of the users (Table 16).

The system is 'always' and 'most of the time' easy to use according to 72.3 % of the users (Table 17). Latter two tasks were almost equally appreciated by all user groups (Figures C15, C16 at appendix C).

Table 17: Is the system easy to use? (D03)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	2	1,6	1,7	1,7
	2 Seldom	9	7,1	7,6	9,2
	3 Half of the time	22	17,5	18,5	27,7
	4 Most of the time	52	41,3	43,7	71,4
	5 Always	34	27,0	28,6	100,0
	Total	119	94,4	100,0	
No response		7	5,6		
Total		126	100,0		

Table 18: Are you satisfied with the accuracy of the system? (D04)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Never	10	7,9	8,3	8,3
	2 Seldom	15	11,9	12,5	20,8
	3 Half of the time	35	27,8	29,2	50,0
	4 Most of the time	37	29,4	30,8	80,8
	5 Always	23	18,3	19,2	100,0
	Total	120	95,2	100,0	
No response		6	4,8		
Total		126	100,0		

The system is accurate 'most of the time' and 'always' according to 50.0 % of the users (Table 18). Although 50 % of users are satisfied, this task has the lowest rate of satisfaction. The satisfaction is highest in residents group followed by academic staff and nurses (Figure C17 at appendix C). The clerk registrars have

higher heterogeneity for the accuracy of the system (Figure C18 at appendix C). This finding may imply that their knowledge about the system may not be enough.

The overall review of section D which consists of the questions for satisfaction with EMR use is shown in Figure 23. According to the figure first three questions have a high rate of acceptance (over 3.5) by the users. Fourth question (about the accuracy of the system) has a lower rate of acceptance. This may reflect dissatisfaction from the system accuracy. The computer may run slowly then expected.

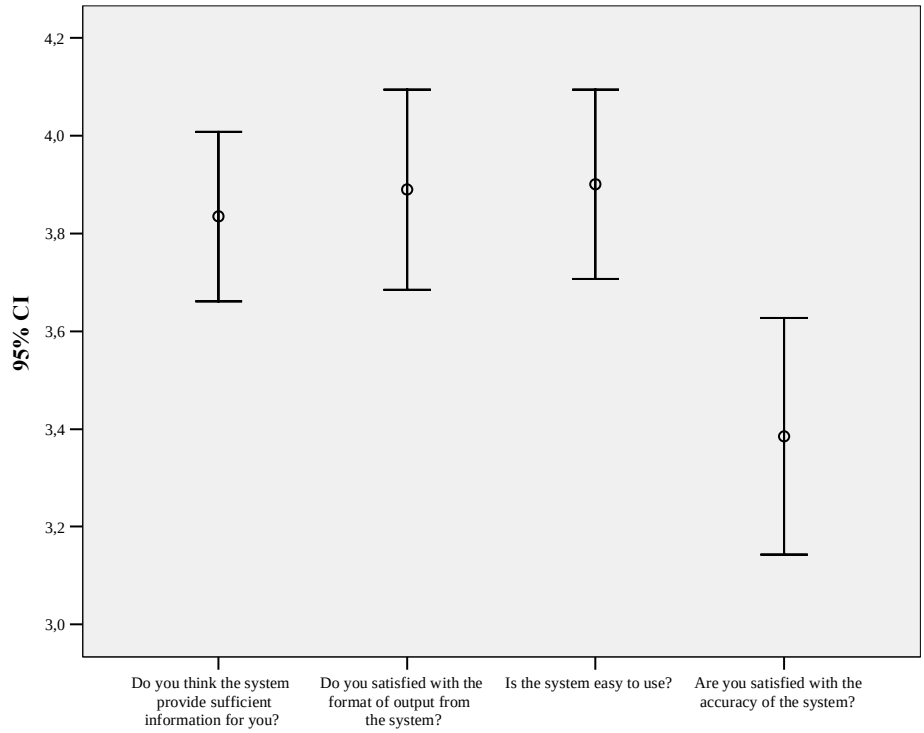

Figure 23: Satisfaction with the Electronic Medical Record System

The mode of answers to the questions of section D which is about the satisfaction of the users with EMR was 4 (frequently). This implies a general satisfaction of the users with the present EMR system.

4.2.5. Evaluation for the advantages of EMR system

Section E questions the advantages of EMR. First question is about the ease of access to the records. 94.9 % of the users are agreeing that it is easier (Table 19).

Second question of section E is about the disappearance of paper records. 92.3 % of the users are agreeing that disappearance of paper records is advantageous (Table 20).

Table 19: Easy access to the records (E01)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Strongly disagree	2	1,6	1,7	1,7
	2 Slightly disagree	4	3,2	3,4	5,1
	4 Slightly agree	27	21,4	23,1	28,2
	5 Strongly agree	84	66,7	71,8	100,0
	Total	117	92,9	100,0	
No response		9	7,1		
Total		126	100,0		

Table 20: Disappearance of paper records (E02)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Strongly disagree	3	2,4	2,6	2,6
	2 Slightly disagree	3	2,4	2,6	5,1
	3 No idea	3	2,4	2,6	7,7
	4 Slightly agree	23	18,3	19,7	27,4
	5 Strongly agree	85	67,5	72,6	100,0
	Total	117	92,9	100,0	
No response		9	7,1		
Total		126	100,0		

Third question of section E is about the ability to see and analyze the patient data as a whole. 92.7 % of the users are agreeing that ability to see and analyze the patient data as a whole is advantageous (Table 21).

Table 21: Ability to see and analyze the patient data as a whole (E03)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Strongly disagree	1	,8	,8	,8
	2 Slightly disagree	7	5,6	5,7	6,6
	3 No idea	1	,8	,8	7,4
	4 Slightly agree	18	14,3	14,8	22,1
	5 Strongly agree	95	75,4	77,9	100,0
	Total	122	96,8	100,0	
No response		4	3,2		
Total		126	100,0		

Fourth question of section E is about the ability to. 82.2 % of the users are agreeing that retrieve faster and reliable data for scientific research is advantageous (Table 22). This task is rated slightly lesser than the others. This may be due to the fact that, scientific research is not a priority for all users.

Table 22: Ability to retrieve faster and reliable data for scientific research (E04)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Strongly disagree	4	3,2	3,4	3,4
	2 Slightly disagree	9	7,1	7,6	11,0
	3 No idea	8	6,3	6,8	17,8
	4 Slightly agree	25	19,8	21,2	39,0
	5 Strongly agree	72	57,1	61,0	100,0
	Total	118	93,7	100,0	
No response		8	6,3		
Total		126	100,0		

Fifth question of section E is about restructuring of system for the necessities. 81.4 % of the users are agreeing that ability of restructuring for the necessities is advantageous (Table 23). This task is also slightly less rated than first three tasks. This may show that since the users' demands met by the current system, restructuring was not a priority.

Table 23: Restructuring is possible for the necessities (E05)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Strongly disagree	3	2,4	2,5	2,5
	2 Slightly disagree	10	7,9	8,5	11,0
	3 No idea	9	7,1	7,6	18,6
	4 Slightly agree	23	18,3	19,5	38,1
	5 Strongly agree	73	57,9	61,9	100,0
	Total	118	93,7	100,0	
No response		8	6,3		
Total		126	100,0		

The mode of answers to the questions of section E which is about the advantages of EMR was 5 (totally agree). This shows that users were agree with the advantages of EMR formulated as 'easy access to the records', 'disappearance of paper records', 'ability to see and analyze the patient data as a whole', 'ability to retrieve faster and reliable data for scientific research' and 'restructuring is possible for the necessities'.

An overview of section E is shown in Figure 24. The users were highly agreed with the advantages questioned. Slightly lower rate of last two items (ability to retrieve data for scientific research and restructuring for the necessities) may indicate that these items do not have priorities for all users of the system.

The clerk registrars group has no consensus for disappearance of paper records. Their responds show a wide range of heterogeneity (Figure 25). The clerks are computer literates, but they do not take a specific education course to

use the system. An education program may increase their efficiency of work with EMR.

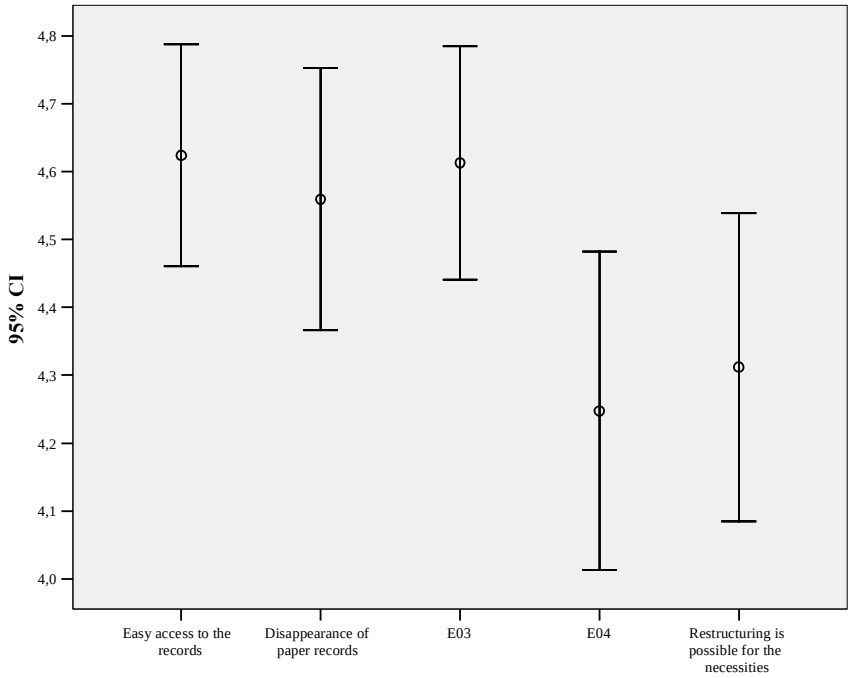

Figure 24: What is the best about electronic medical record system for you?

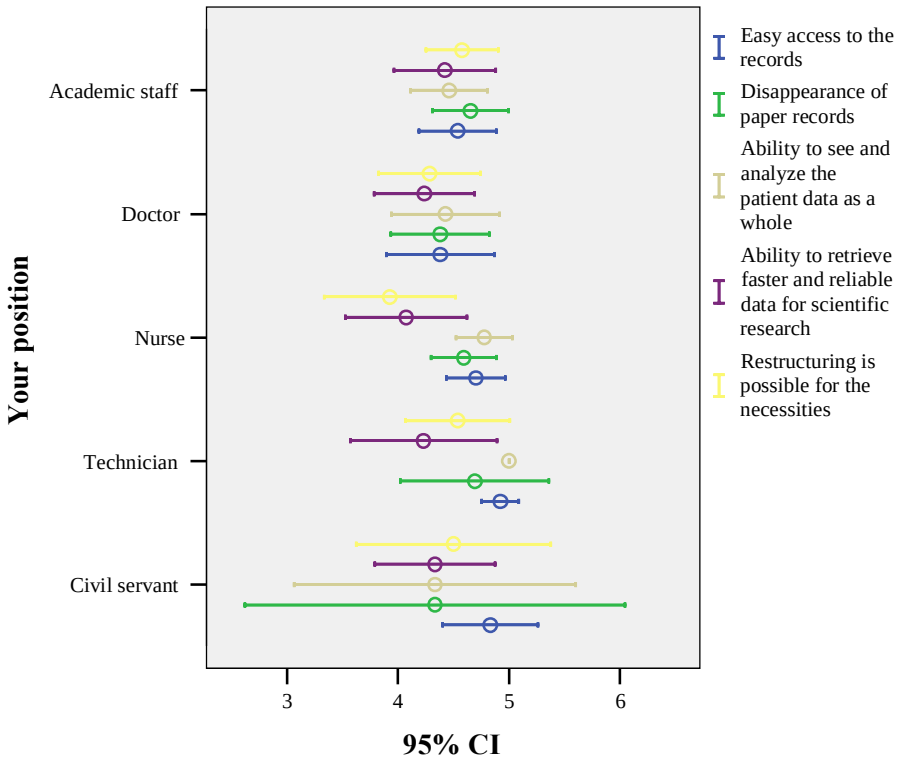

Figure 25: The advantages of EMR according to users' groups (E01-E05)

Since they use the administrative part of records, the ability to see the patient data as a whole is not appreciated by them as well (Figure 25). To maintain the privacy and security of the records users were given access only to the part of the system that they need to work on. This may explain the lower rate of response for this question in nurses' and clerks' group.

4.2.6. Evaluation for the disadvantages of EMR system

Section F questions the disadvantages of EMR. The first question is whether the users are spending more time with EMR than with paper records. Table 24 shows that 54.3 % of the users are disagree.

Table 24: To spend more time compared to the paper systems (F01)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Totally agree	17	13,5	14,7	14,7
	2 Partially agree	29	23,0	25,0	39,7
	3 No idea	7	5,6	6,0	45,7
	4 Partially disagree	18	14,3	15,5	61,2
	5 Totally disagree	45	35,7	38,8	100,0
	Total	116	92,1	100,0	
No response		10	7,9		
Total		126	100,0		

The second question of the section F is about the privacy of the patient information. 61.4 % of the users were agreed that the privacy of patient information was decreased with EMR (Table 25). This belief is more prominent in nurses' groups (Figure C19 at appendix C).

Table 25: Privacy of patient information is decreased (F02)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Totally agree	30	23,8	26,3	26,3
	2 Partially agree	40	31,7	35,1	61,4
	3 No idea	5	4,0	4,4	65,8
	4 Partially disagree	17	13,5	14,9	80,7
	5 Totally disagree	22	17,5	19,3	100,0
	Total	114	90,5	100,0	
No response		12	9,5		
Total		126	100,0		

Denley and Smith (1999) described a large scale clinical information system in the secondary care sector. Access to individual patient records has been made the key to the system with this access being granted only when the member of staff's rights match a patient's current clinical contacts. Their approach seemed to be overly restrictive in secondary areas such as clinical audit according to

O'Conor (1999). Because it may avoid sharing clinical information by reducing the amount of private information included. Sadan (2001) states that by giving individuals control over their medical data, both privacy protection and quality of information improve.

The third question of the section F is about the safety of the records. 57.5 % of the users were agreed that it was difficult to maintain safety of records in EMR (Table 26). Interestingly, administrative clerks were more optimistic than other groups for the safety of records (Figure C20 at appendix C).

Table 26: Difficult to maintain the safety of records (F03)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Totally agree	32	25,4	28,3	28,3
	2 Partially agree	33	26,2	29,2	57,5
	3 No idea	7	5,6	6,2	63,7
	4 Partially disagree	22	17,5	19,5	83,2
	5 Totally disagree	19	15,1	16,8	100,0
	Total	113	89,7	100,0	
No response		13	10,3		
Total		126	100,0		

The fourth question of the section F is about the need for frequent adjustments in parallel with technologic developments. 57.5 % of the users were agreed that frequent adjustments in parallel with technologic developments were disadvantageous for EMR (Table 27).

Table 27: Need for frequent adjustments in parallel with technologic developments (F04)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Totally agree	37	29,4	32,5	32,5
	2 Partially agree	31	24,6	27,2	59,6
	3 No idea	10	7,9	8,8	68,4
	4 Partially disagree	20	15,9	17,5	86,0
	5 Totally disagree	16	12,7	14,0	100,0
	Total	114	90,5	100,0	
No response		12	9,5		
Total		126	100,0		

The fifth question of the section F was about the possibility of breakdown or errors in computer system. 77.7 % of the users were agreed that possibility of breakdown or errors in computer system was disadvantageous for EMR (Table 28).

The mode of answer to the first question of section F which is about the disadvantages of EMR was 5 (totally disagree). This question inquires whether the

users are agreeing that they spend more time with EMR compared to the paper systems. It roots from the belief that entering the data to the computers were more difficult and time consuming than hand writing the paper records. The users were not agreeing that, using EMR took more time than using paper records. Since the younger generation of clinicians are increasingly more computer literate and more accepting of typing this response is not surprising (Rind & Safran, 1993). The structured data entry is often more time consuming than entering free text (Powsner et al, 1998). Since the free text is used in ZKU Hospital EMR system this may explain the positive view of users for EMR that is not time consuming compared to paper records in their opinion.

Table 28: Possibility of breakdown or errors in computer system (F05)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Totally agree	71	56,3	58,7	58,7
	2 Partially agree	23	18,3	19,0	77,7
	3 No idea	3	2,4	2,5	80,2
	4 Partially disagree	13	10,3	10,7	90,9
	5 Totally disagree	11	8,7	9,1	100,0
	Total	121	96,0	100,0	
No response		5	4,0		
Total		126	100,0		

The mode of answer to the second question of section F which is about the disadvantages of EMR was 2 (partially agree). The users were partially agreed that the privacy of patient information was decreased. This finding implied the concerns about the privacy of patient records. The retrieval and access is much easier from electronic records than from hard copy records stored in the archives of care providing institutions (Etzioni, 1999). The Institute of Medicine also stressed on the systemic violation of privacy via authorized abuse. The authorized abuse meant the users' abuse of their access privileges. In ZKU hospital system users have full access to the records except psychiatric chart. Various users have access to the system such as laboratory technicians, pharmacist, secretaries etc. The authorized abuse might be possible in some occasions. For example someone who has access to the system can retrieve any information from a patient's medical chart. It is very difficult to avoid authorized abuse but the users' access to the system can be limited according to their position. They can be given permission only to the parts of the chart that they are using and making entries.

The mode of answer to the third question of section F which is about the disadvantages of EMR was 2 (partially agree). The users were partially agreed that it was difficult to maintain the security of records in EMR system. In an ideal EMR system, the user authorization should be specific. The patient information can be divided into fragments. Therefore, the patient data that the physician may access can be markedly different than patient data that the receptionist should access. The system administrator assigns the access levels.

The access logs to EMR are also problematic. It should be verified. HIPAA (Health Insurance Portability and Accountability Act) legislation (1996) requires that the clinic can provide patients with a list of who has seen their chart and which parts of their chart have been viewed (Mendoza, 2003). The current system of ZKU can not verify the user who enters an individual patient's chart. Only the users who make a transaction such as ordering laboratory investigations, entering results can be identified by the system.

The mode of answer to the fourth question of section F which is about the disadvantages of EMR was 2 (partially agree). The users were partially agreed that the need for frequent adjustments in parallel with technologic developments was disadvantageous.

The mode of answer to the fifth question of section F which is about the disadvantages of EMR was 1 (totally agree). The users were totally agreed that possibility of breakdown or errors in computer system was disadvantageous.

The mode of answers to the questions of section G which is about the time period spent for EMR use during daily activities were 2 (10- 25 % of the time period during the daily activities and during the examination of an patient). Poissant et al (2005) highlighted that a goal of decreased documentation time in an EHR project is not likely to be realized. But our survey showed that documentation time for clinical activities is reasonable. The overview of section F is shown in Figure 26. The first question was not appreciated by the users. 54.3 % of the users were disagreed that using EMR was time consuming compared to paper records. The other questions were agreed in lower rates than the questions

related to advantages of EMR. This may reflect the users' positive attitude towards the use of EMR instead of paper records.

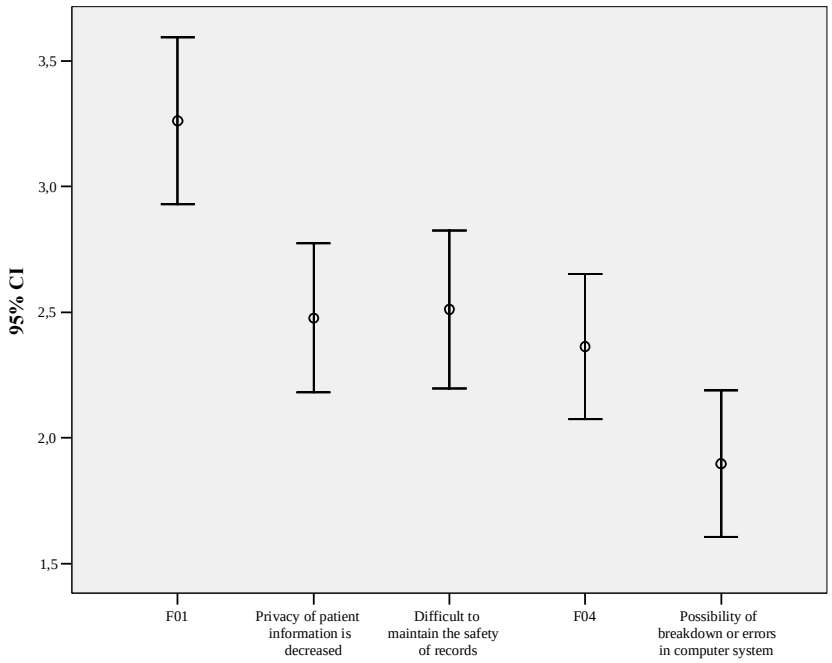

Figure 26: What Is Worst About Electronic Medical Record System For You?

The clerk registrars group showed a higher heterogeneity in answers compared to other groups (Figure C21 at appendix C). They agreed that EMR was more time consuming compared to the paper systems. They concerned more about the privacy and security of patient records in EMR compared to other groups (Figure C21 at appendix C). They are the only group who uses EMR for bureaucratic procedures only. The breakdown or error in computer system affects their job and may cause lines of impatient people who are waiting to be served.

4.2.6. Evaluation for the period of time spent for using EMR

Section G questioned the period of time that was spent for using the system. The first question of section G was determining the time period to enter data for an individual task such as an examination, procedure, etc. 60.2 % of the users spent up to 25 % of time period for entering data for an individual task (Table 29).

Table 29: What percent of your time (during an exam, procedure or recording etc) do you spend for entering the clinical information or results of each patient? (G01)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Less than 10%	22	17,5	20,4	20,4
	2 10%-25%	43	34,1	39,8	60,2
	3 25%-50%	28	22,2	25,9	86,1
	4 50%-75%	15	11,9	13,9	100,0
	Total	108	85,7	100,0	
No response		18	14,3		
Total		126	100,0		

The second question of section G was about the time period spent for using EMR in daily activities. 20.9 % of the users spent less than 10 % of daily working time. 32.7 % of the users spent 10-25 %. 24.5 % of the users spent 25- 50 % of their working time by using EMR and 21.8 of the users spent 50- 75 % of their working time by using EMR (Table 30).

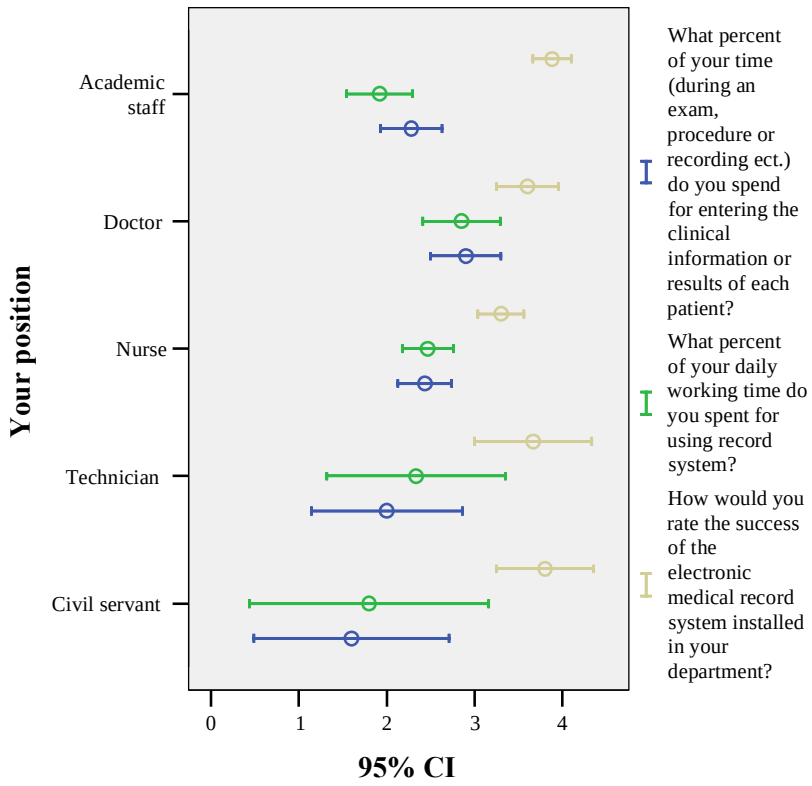

Figure 27: The period of time spent for using the system and general opinion (G01-G02 and H01)

Table 30: What percent of your daily working time do you spent for using record system? (G02)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Less than 10%	23	18,3	20,9	20,9
	2 10%-25%	36	28,6	32,7	53,6
	3 25%-50%	27	21,4	24,5	78,2
	4 50%-75%	24	19,0	21,8	100,0
	Total	110	87,3	100,0	
No response		16	12,7		
Total		126	100,0		

4.2.7. General Evaluation

Last section (H) of questionnaire was about overall rating of the EMR system in Zonguldak Karaelmas University Hospital. 65.2 % of the users rated the system as good and perfect (Table 31). All groups had similar rates (Figure 27). The mode of answers for the overall evaluation of the system in section H was 4 (good). The users are generally satisfied with the system according to this result.

Table 31: How would you rate the success of the electronic medical record system installed in your department? (H01)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Very poor	1	,8	,8	,8
	2 Poor	7	5,6	5,9	6,8
	3 Fair	33	26,2	28,0	34,7
	4 Good	70	55,6	59,3	94,1
	5 Perfect	7	5,6	5,9	100,0
	Total	118	93,7	100,0	
No response		8	6,3		
Total		126	100,0		

The EMR system of Zonguldak Karaelmas University Hospital is in use for six years. It is a fully automated hospital information system used by all health care personnel.

The twelve clinical tasks which are frequently used in EMR were asked for frequency and ease of use in different groups of hospital personnel. These twelve clinical tasks were mainly used by physicians and nurses. According to the survey, all tasks except 'taking treatment orders' (B09) were most frequently used by physicians. The 'ordering treatment' task is most frequently used by residents. This is obvious from the work model of the hospital. In every academic hospital, residents are trained to become specialists in various fields of work as main source of man power. The academic staff which consists of associate and assistant

professors also see and treat the patients. But, the main purpose of their presence is to supervise and train the residents. Their comments and suggestions were given as treatment orders by residents. This also explains the less frequent use of ordering treatments task by academic staff in the survey.

'Taking treatment orders' (B09) task was most frequently used by nurses. The treatment orders were applied by nurses. It is easily used by the hospital staff both in giving the treatment orders and taking the orders according to the survey results.

Overall, we found that hospital staffs positively perceive the EMR as helpful in their daily work. They reported that entering, accessing, and reading data is easy with the EMR. Electronic medical records also eliminated a lot of paper work and improved the ability to monitor patient progress.

There are concerns about the security, privacy and confidentiality of medical records according to the survey. The openness of the EMR system to the all users without limitations might have been brought such concerns. The limited entry to the fragments of medical record which can be identified by the user's authorized identity could be a proper solution to the authorized abuse of the reports. The limited entry to the psychiatric chart of the patients in the current system is a good example of such a regulation. Currently, only the physicians from psychiatry department can enter the psychiatric charts of patients.

The possibility of breakdown or errors of the system is also a disadvantage. This is perceived as a very important drawback of the system especially by the clerk- registrars. Since the hospital has a paperless information system including administration and billing processes, all procedures require a working electronic network.

The accuracy of the system also had a lower rating from the users that may reflect a need for upgrading the computer hardware. Since the multiple entries during the busy hours of the daily activity slows the system down, a new hardware system with cluster structure is implanted very recently. Restructuring of the system for the necessities is an advantage of EMR.

The ability to retrieve faster and reliable data for scientific research is possible with EMR. On the other hand, this needs a more structured data storage supported by statistical modules. The current EMR system has mostly a free text entry for patient charts which makes system easier to use. This is also appreciated by the users that, although proposed to be a disadvantage of EMR, EMR was not found to be time consuming according to the survey. The statistical module of the system is very limited. The statistical module and structured data entry of the current system should be developed.

The integration of the all information, ability for a safe future expansion of the system and a powerful statistical package are main requirements for effective decision support in hospital information systems (Lillehaug, 1998). The current system has a good integration of information. The analysis of health care data remains to be done.

CHAPTER 5

CONCLUSION

The principle goal of this study was the description of electronic medical records as a part of hospital information system and evaluation of an EMR system by its users.

After giving comprehensive information of hospital information systems and electronic medical records in chapter two, we have drawn a profile of our evaluated system, namely Zonguldak Karaelmas University Hospital in chapter three. The results of survey applied to the users of this system were discussed in chapter four. Now, we will emphasize the advantages and disadvantages of an EMR system by means of the users' opinion and we will make suggestions to increase the efficiency of the current system.

The EMR provides the opportunity to improve quality of care in healthcare organizations. Paper-based record systems are no longer fulfilling the needs of clinicians, and related healthcare workers according to Koeller (2002). However, just as there are advantages and disadvantages with the paper medical record, there are also advantages and disadvantages with the EMR. There are several barriers and obstacles for the application of a successful EMR system.

Choosing the right EMR system for the hospital is important. This choice should meet the requirements of individual departments and clinics. The hardware and software components of the system should be planned accordingly at the beginning. This avoids the incompetence of previously chosen hardware with newly bought software.

Implementation of an EMR system to an already functioning paper -based hospital system is more difficult than starting with a new EMR system in a new hospital. There is a problem in integrating the old archives of patient reports to new EMR system.

To avoid the common mistakes done during an implementation process, user needs and expectations should be encountered in decision making. This also helps easier acceptance of changes by the users.

There is also a substantial learning curve for EMR system. It is useful if the users have some type of computer knowledge. Physicians are the primary users of EMR performing data entry such as orders, progress notes. They are familiar with the computers during their training. On the other hand, the clerks have different backgrounds of training mainly high school grade. A training course may be useful for them before they start to use the system.

The EMR system makes the daily activity of hospital staff easier. Disappearance of paper records are highly appreciated by them. This is practical for the storage and retrieval of data. It also helps to protect forests.

The scientific research benefits from a faster and reliable data source. Restructuring of an EMR system is possible for the necessities. Recent changes in Turkish Health Care System such as 'payment based on the case' could be easily adapted to the present system.

Maintaining the privacy and security of the records are one of the obstacles in the present EMR system. Since all users have unlimited access to the charts accept psychiatric chart, the authorized abuse is possible in the present system. Entry to the patient charts can be restricted. For example, the access to the chart can only be possible during the patient's application for a medical examination.

Since the users are entering the data as free text rather than a structured text, computer literacy does not count much among the users. The users found the system less time consuming compared to paper-based reports. Switching to the use of structured text may help data storage and retrieval. The scientific research benefits more from the structured data. On the other hand, computer literacy becomes more important and the users should be educated for proper use.

The system applications are effected from the breakdown or errors of the system. The user's satisfaction is related closely to these technical obstacles. Experiencing these obstacles during the daily activities decreases the efficiency of system. The hospital system that is analyzed in our study has just upgraded the

hardware component of the system. This change will probably increase the rate of satisfaction from the system.

Integration of imaging data is another problem for the present EMR system. Since it needs a higher storage capacity and might slow down the present system. The development of faster CPU systems with high capacity storage media will solve this problem in the future.

The aim of developing electronic medical records may be defined as to contribute a high quality, efficient health care for patients and for medical research. These systems enhance opportunities for global access to health services and medical knowledge. The hospital information system architectures and contents should be appropriately designed and strategically managed. We need evaluation studies to learn what is achieved and what could be done better.

The questionnaire described in this study applied to the users of ZKU hospital EMR system is relevant for EMR evaluation. The EMR system was rated highly by the users. Such information systems will ultimately be integrated to a health care network. Internet applications of current system should be developed. The expansion of EMR use will be possible in the future by combining the advantages of EMR with the users' appreciation of successful systems.

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APPENDICES

APPENDIX A: Form of the Questionnaire (English)

Questionnaire for Evaluation of Electronic Medical Record System in Zonguldak Karaelmas University Hospital

In this questionnaire, we would like to know your use of and perception of electronic medical record system in your hospital.

(A) Your Department (Please fill the appropriate blanks)

- _____ Administrative (Patient record, reports, secretary act.)
- _____ Clinic
- _____ Laboratory
- _____ Operating room

Your position

- Civil servant [ ]
- Technician [ ]
- Nurse [ ]
- Doctor [ ]
- Academic staff [ ]
- Other _____

(B) Use of medical record system: There are questions for how frequent you use the electronic medical record system in this section. Answers are arranged as column 1 to 5 in the row next to the question. You are asked to mark proper box accordingly.

No	Description of question	(1) Never	(2) Seldom	(3) About half of the occasions	(4) Most of the occasions	(5) Always
01	Review the patient problems					
02	Enter daily notes					
03	To order laboratory tests					
04	To obtain the results of laboratory tests					
05	To order radiological investigations					
06	To obtain the results of radiological investigations					
07	To refer the patient to other departments					
08	Order treatments					
09	Taking the treatments orders					
10	Collect patient information					
11	Collect patient information for discharge reports					
12	Register codes for diagnosis					

(C) There are questions for the easy use of electronic medical record system compared to paper records in this section. Answers are arranged as column 1 to 5 in the row next to the question.

No	Description of question	(1) More difficult	(2) Difficult	(3) No change	(4) Easy	(5) Very easy
01	Review the patient problems					
02	Enter daily notes					
03	To order laboratory tests					
04	To obtain the results of laboratory tests					
05	To order radiological investigations					
06	To obtain the results of radiological investigations					
07	To refer the patient to other departments					
08	Order treatments					
09	Taking the treatments orders					
10	Collect patient information					
11	Collect patient information for discharge reports					
12	Register codes for diagnosis					

(D) In this section, your satisfaction with the electronic medical record system is asked.

No	Description of question	(1) Never	(2) Seldom	(3) Half of the time	(4) Most of the time	(5) Always
01	Do you think the system provide sufficient information for you?					
02	Do you satisfied with the format of output from the system?					
03	Is the system easy to use?					
04	Are you satisfied with the application of the system?					

(E) What is the best about electronic medical record system for you?

No	Description of question	(1) Strongly disagree	(2) Slightly disagree	(3) No idea	(4) Slightly agree	(5) Strongly agree
01	Easy access to the records					
02	Disappearance of paper records					
03	Ability to see and analyze the patient data as a whole					
04	Ability to retrieve faster and reliable data for scientific research					
05	Restructuring is possible for the necessities					

You comments:

_____
_____
_____
_____.

(F) What is worst about electronic medical record system for you?

No	Description of question	(1) Totally agree	(2) Partially agree	(3) No idea	(4) Partially disagree	(5) Totally disagree
01	To spend more time compared to the paper systems					
02	Privacy of patient information is decreased					
03	Difficult to maintain the safety of records					
04	Need for frequent adjustments in parallel with technologic developments					
05	Possibility of breakdown or errors in computer system					

You comments:

_____
_____
_____
_____.

(G) In this section, the period of time that you spend for using the system is asked.

No	Description of question	(1) Les than 10%	(2) 10%-25%	(3) 25%-50%	(4) 50%-75%	(5) >75%
01	What percent of your time (during an exam, procedure or recording ect.) do you spend for entering the clinical information or results of each patient?					
02	What percent of your daily working time do you spent for using record system?					

(H) General opinion

No	Description of question	(1) Very poor	(2) Poor	(3) Fair	(4) Good	(5) Perfect
01	How would you rate the success of the electronic medical record system installed in your department?					

Comments (You can write down f you have any comments about the system or questionnaire in this section):

_____
_____
_____
_____
_____
_____
_____
_____
_____

.

(*Thank you for your time and attendance*)

APPENDIX B: Form of the Questionnaire (Turkish)

Zonguldak Karaelmas Üniversitesi Hastanesindeki Elektronik Tıbbî Kayıt Sisteminin Değerlendirilmesi Anketi

Bu ankette hastanenizden elektronik tıbbî kayıt sistemi kullanıcısı olarak sistemin genel işleyişi hakkındaki değerlendirmeleriniz istenmektedir.

(A) Çalıştığınız Bölüm (Uygun Bölümü Belirtiniz)

- _____ İdarî (Hasta Kayıt, Rapor, Sekreterlik vs.)
- _____ Kliniği
- _____ Lâboratuarı
- _____ Ameliyathanesi

Göreviniz

- Memur [ ]
- Teknisyen [ ]
- Hemşire [ ]
- Araştırma Görevlisi [ ]
- Öğretim Üyesi [ ]
- Diğer _____

(B) Tıbbî Kayıt Sistemini Kullanım Sıklığı

No	Sorunun Tanımı	(1) Hiç Kullanmam	(2) Nadiren	(3) Yaklaşık Yarısında	(4) Çoğunlukla	(5) Her Zaman
01	Hastanın problemlerinin gözden geçirilmesi					
02	Günlük notların yazılması					
03	Lâboratuar testlerinin istenmesi					
04	Lâboratuar sonuçlarının elde edilmesi					
05	Radyolojik inceleme istenmesi					
06	Radyolojik inceleme sonuçlarının elde edilmesi					
07	Diğer bölümlerden konsültasyon istemesi					
08	Tedavi "order"larının verilmesi					
09	Tedavi "order"larının alınması					
10	Hasta bilgilerinin toplanması					
11	Epikriz için hasta bilgilerinin toplanması					
12	Teşhis kodlarının girilmesi					

(C) Elektronik Kayıt Sisteminin Kâğıt Kayıt Sistemine Göre Kullanım Kolaylığı

No	Sorunun Tanımı	(1) Çok Zor	(2) Zor	(3) Fark Yok	(4) Kolay	(5) Çok Kolay
01	Hastanın problemlerinin gözden geçirilmesi					
02	Günlük notların yazılması					
03	Lâboratuar testlerinin istenmesi					
04	Lâboratuar sonuçlarının elde edilmesi					
05	Radyolojik inceleme istenmesi					
06	Radyolojik inceleme sonuçlarının elde edilmesi					
07	Diğer bölümlerden konsültasyon istemesi					
08	Tedavi "order"larının verilmesi					
09	Tedavi "order"larının alınması					
10	Hasta bilgilerinin toplanması					
11	Epikriz için hasta bilgilerinin toplanması					
12	Teşhis kodlarının girilmesi					

(D) Elektronik Tıbbî Kayıt Sisteminin Hakkındaki Memnuniyetiniz.

No	Sorunun Tanımı	(1) Hayır	(2) Bazen	(3) %50	(4) Sıklıkla	(5) Her Zaman
01	Sistemden yeterli bilgi edindiğinizi düşünüyor musunuz?					
02	Sistemden alınan çıktıların içeriğinden memnun musunuz?					
03	Sistem kullanımı kolay mı?					
04	Sistemin işleyişinden memnun musunuz?					

(E) Elektronik Kayıt Sisteminin Sizce En İyi Özellikleri Nelerdir?

No	Sorunun Tanımı	(1) Kesinlikle Katılmıyorum	(2) Kısmen Katılmıyorum	(3) Fikrim Yok	(4) Kısmen Katılıyorum	(5) Kesinlikle Katılıyorum
01	Kayıtlara kolay ulaşılabilmesi					
02	Kâğıt evrakları ortadan kaldırması					
03	Hastaya ait bilgileri toplu olarak görebilmek ve analiz edebilmek					
04	Bilimsel araştırmalarda daha hızlı ve güvenilir bilgi edinme					
05	Gereksinimlere göre yeniden yapılandırılabilmesi					

Yorumunuz:

_____
_____
_____
_____.

(F) Elektronik Kayıt Sisteminin Sizce En Kötü Yönleri Nelerdir?

No	Sorunun Tanımı	(1) Kesinlikle Katılıyorum	(2) Kısmen Katılıyorum	(3) Fikrim Yok	(4) Kısmen Katılmıyorum	(5) Kesinlikle Katılmıyorum
01	Kâğıt sisteme göre daha fazla zaman harcamayı gerektiriyor					
02	Hastaya ait bilgilerin mahremiyeti azalıyor					
03	Kayıtların güvenliğini sağlamak daha zor					
04	Teknolojik değişime paralel olarak sık değişiklik yapılması					
05	Bilgisayar sisteminin çökmesi veya arıza olması					

Yorumunuz:

_____
_____
_____
_____.

(G) Kayıt Sistemini Kullanım Süreniz Nedir?

No	Sorunun Tanımı	(1) %10'den az	(2) %10-%25	(3) %25-%50	(4) %50-%75	(5) %75'den çok
01	Klinik bilgileri veya sonuçları girmek her bir hasta başına yaptığınız işlem (muayene, tetkik, kayıt vs.) sürenizin % kaçını almaktadır?					
02	Tıbbî kayıt sistemini kullanmak için harcadığınız zaman günlük mesainizin % kaçını almaktadır?					

(H) Elektronik Kayıt Sistemini Kullanım Memnuniyet Düzeyiniz Nedir?

No	Sorunun Tanımı	(1) Çok Zayıf	(2) Yetersiz	(3) İdare Eder	(4) İyi	(5) Mükemmel
01	Bölümünüzde kullandığınız elektronik tıbbî kayıt sistemini ne kadar başarılı buluyorsunuz?					

Yorumunuz ():

_____
_____
_____
_____
_____
_____
_____.

(*Zaman ayırıp katıldığınız için teşekkürler*)

APPENDIX C: Figures

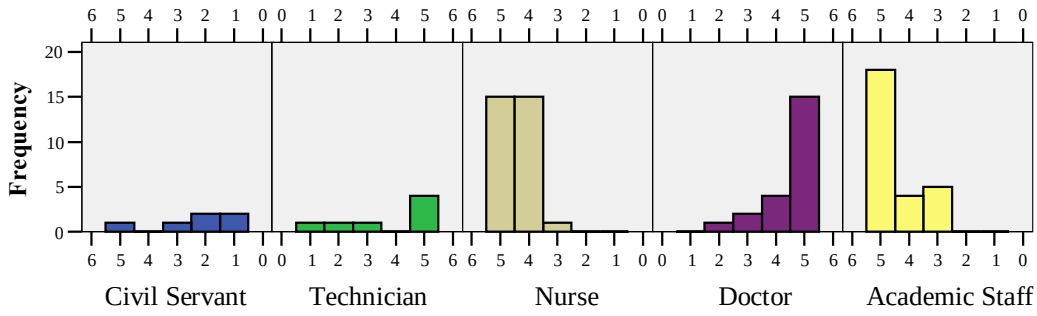

Figure C1: Review the patient problems (B01)

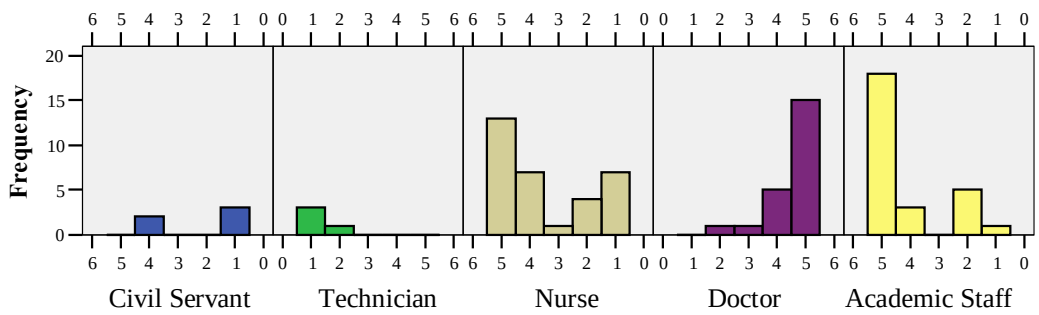

Figure C2: Enter daily notes (B02)

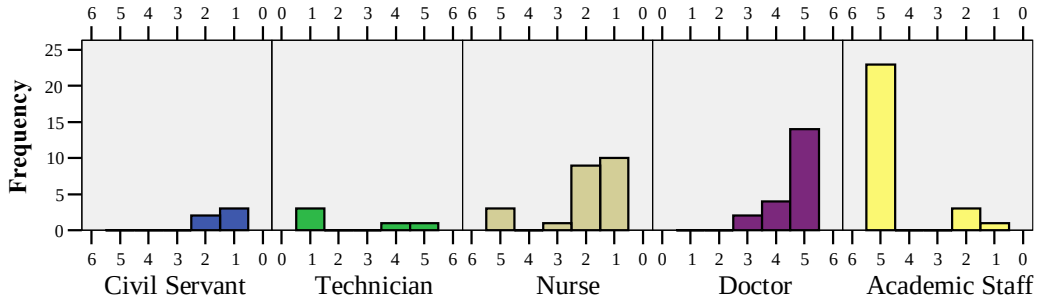

Figure C3: To order laboratory tests (B03)

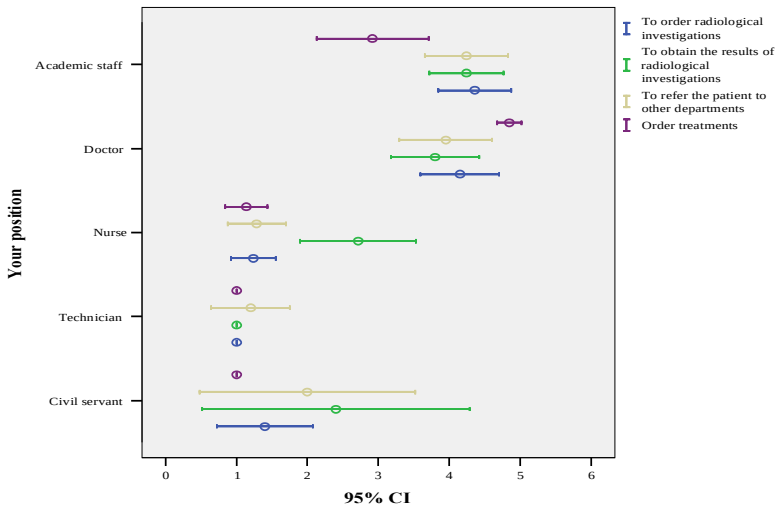

Figure C4: General evaluation of tasks B05 to B08 in groups

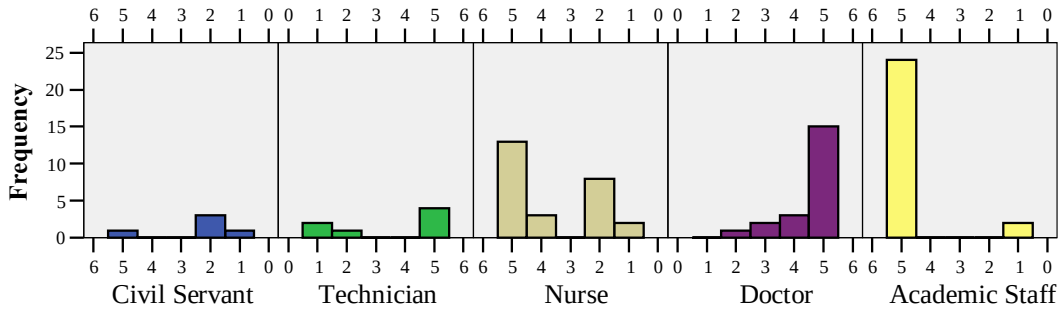

Figure C5: To obtain the results of laboratory tests (B04)

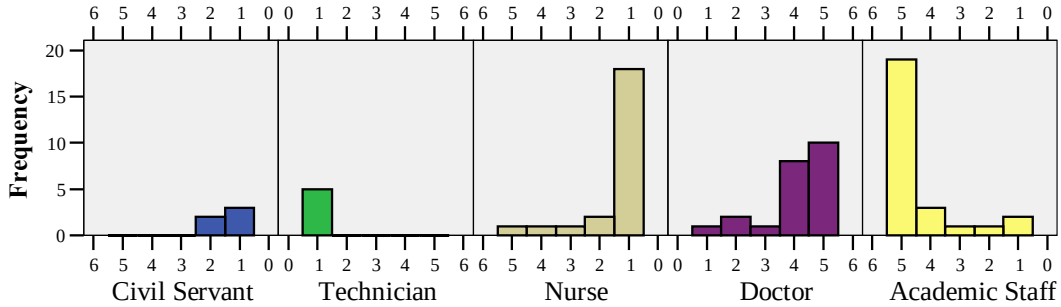

Figure C6: To order radiological investigations (B05)

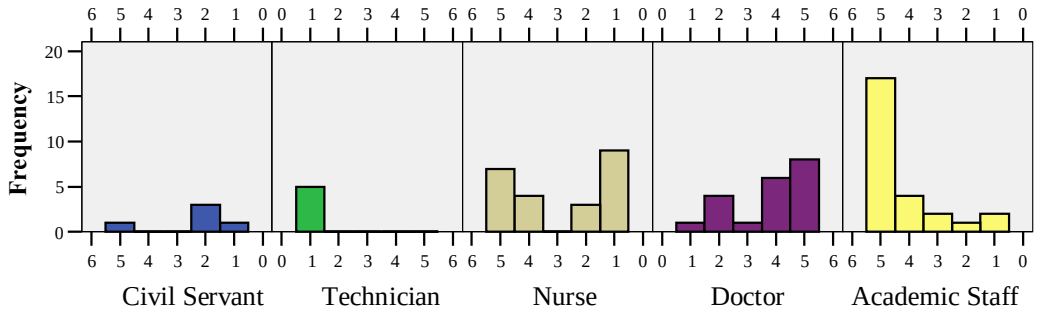

Figure C7: To obtain the results of radiological investigations (B06)

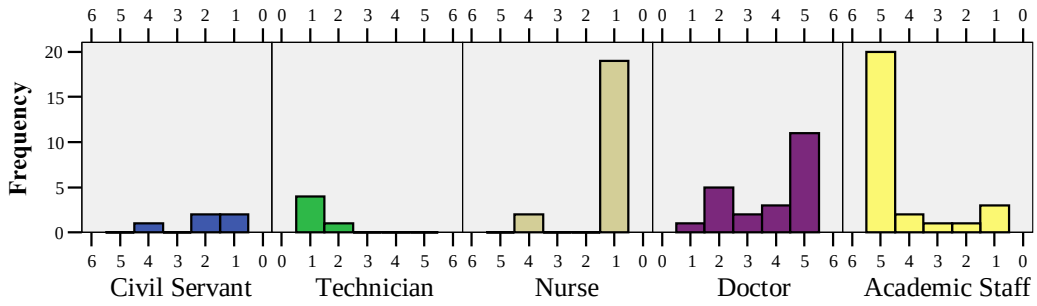

Figure C8: To refer the patient to other departments (B07)

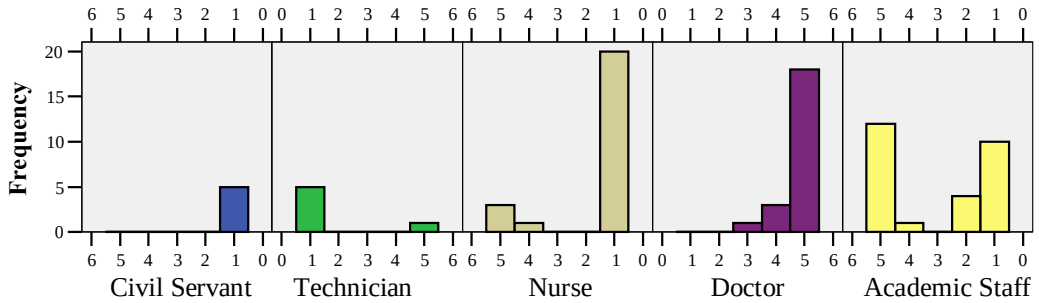

Figure C9: Order treatments (B08)

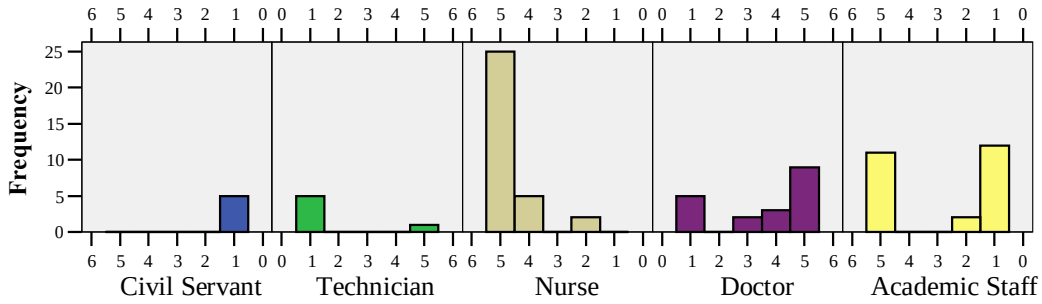

Figure C10: Taking the treatments orders (B09)

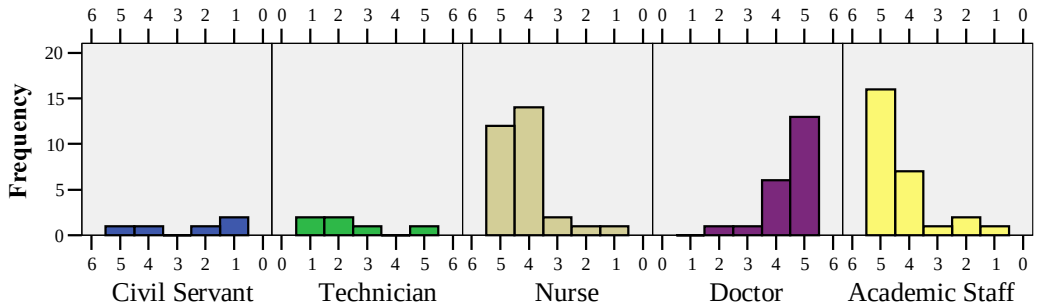

Figure C11: Collect patient information (B10)

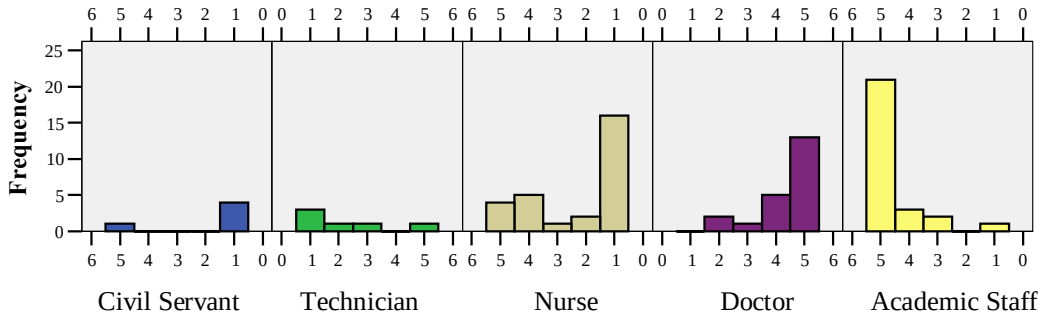

Figure C12: Collect patient information for discharge reports (B11)

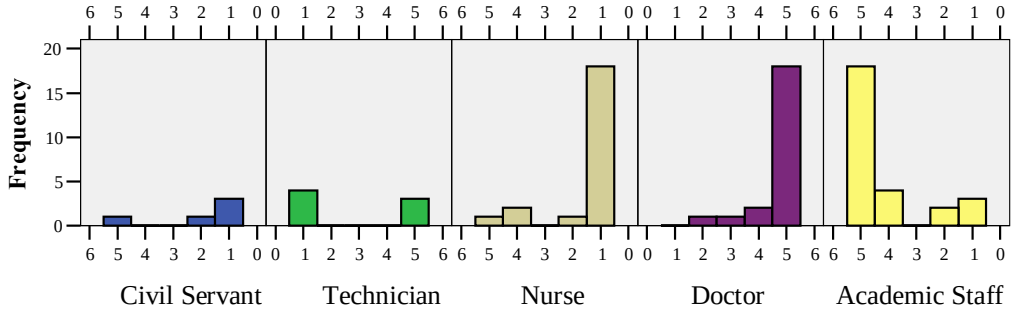

Figure C13: Register codes for diagnosis (B12)

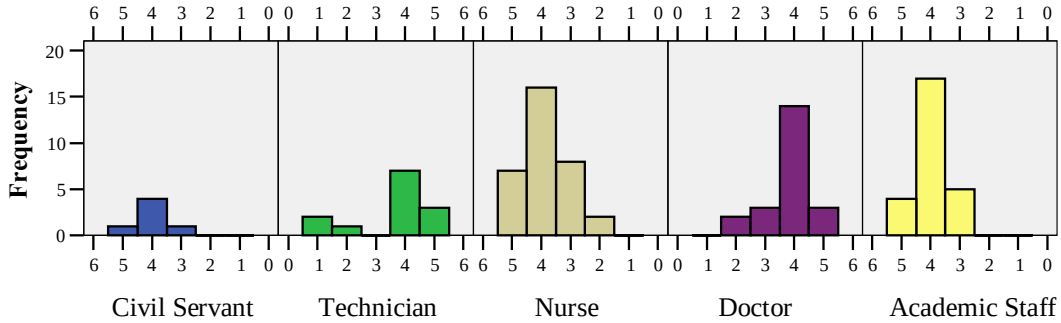

Figure C14: Do you think the system provide sufficient information for you? (D01)

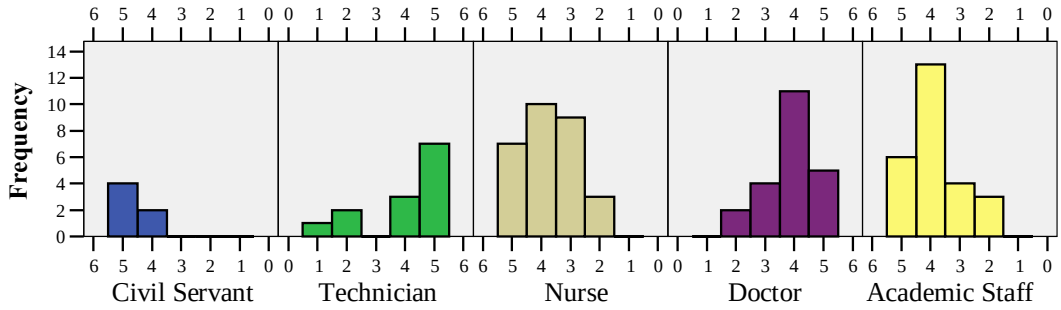

Figure C15: Do you satisfied with the format of output from the system? (D02)

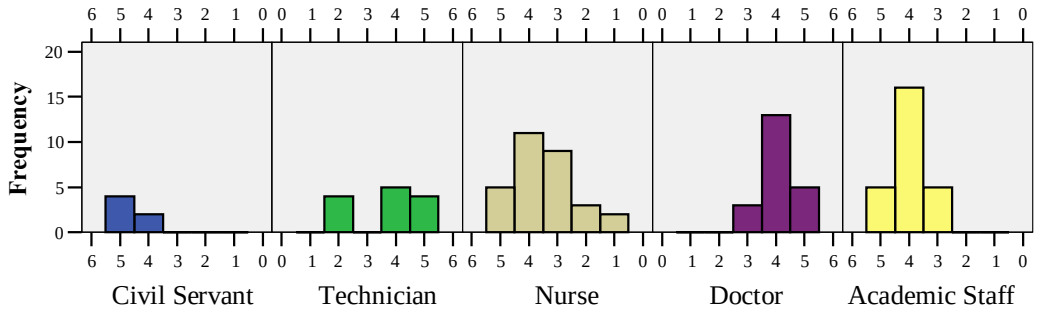

Figure C16: Is the system easy to use? (D03)

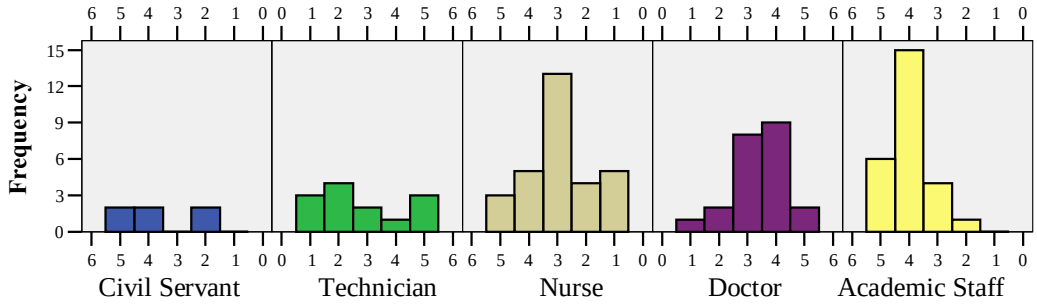

Figure C17: Are you satisfied with the accuracy of the system? (D04)

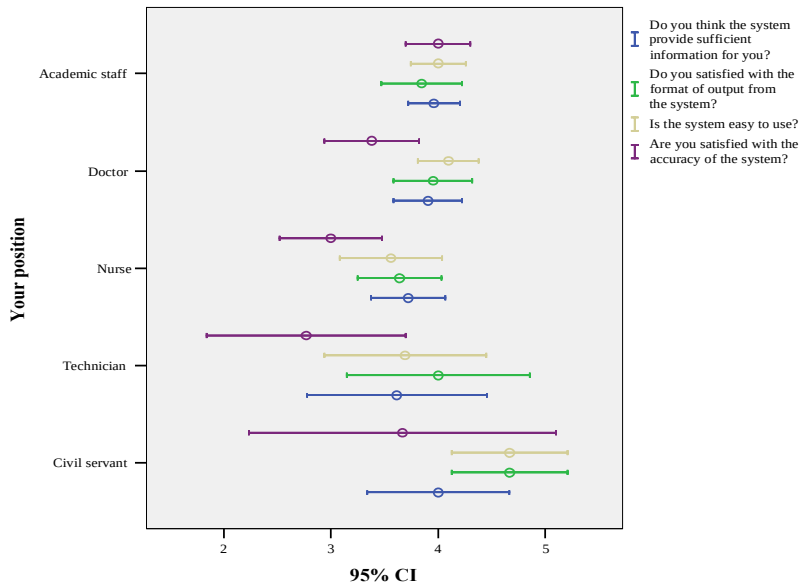

Figure C18: General evaluation of tasks D01 to D04

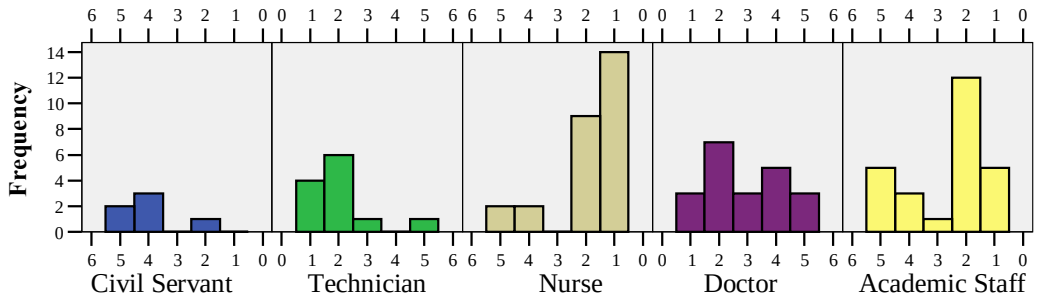

Figure C19: Privacy of patient information is decreased (F02)

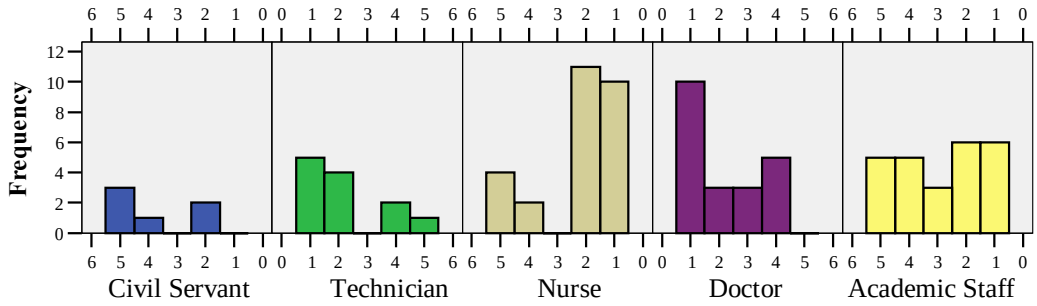

Figure C20: Difficult to maintain the safety of records (F03)

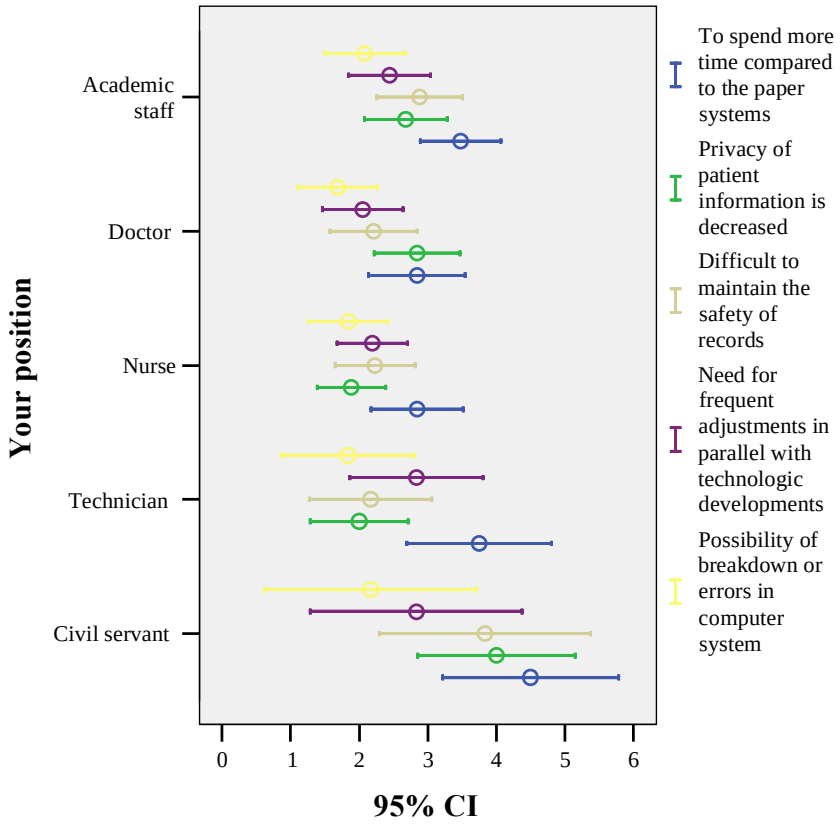

Figure C21: The advantages of EMR according to users' groups (F01-F05)