STREAMLINING A HOSPITAL INFORMATION SYSTEM

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

BY

DUYGU DAĞLI

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION
IN
THE DEPARTMENT OF BUSINESS ADMINISTRATION

JUNE 2011

Approval of the Graduate School of Social Sciences

_____

Prof. Dr. Meliha ALTUNIŞIK
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Business Administration

_____

Assist. Prof. Dr. Engin KÜÇÜKKAYA
Head of Department

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 Business Administration.

_____

Assoc. Prof. Dr. Zeynep ONAY
Supervisor

Examining Committee Members

Prof. Dr. Semih BİLGEN	(METU, EE)	_____
Assoc. Prof. Dr. Zeynep ONAY	(METU, BA)	_____
Assoc. Prof. Dr. Uğur ÇAĞLI	(METU, BA)	_____

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name : Duygu DAĞLI

Signature :

ABSTRACT

STREAMLINING A HOSPITAL INFORMATION SYSTEM

Dağlı, Duygu

MBA, Department of Business Administration

Supervisor: Assoc. Prof. Dr. Zeynep Onay

June 2011, 125 pages

The success of a Hospital Information System (HIS) is related to the software, its users, and the fit between the system and the hospital's operations. The objective of this thesis is to analyze the Hospital Information System used by a private hospital, and streamline the system to better fit the requirements of the hospital. The modules of the HIS, the processes, the requirements of external parties, the attitudes of users as well as the control mechanisms and the forms are analyzed through observations, interviews and document inspections. The results of the study indicate that only a small proportion of problems are noticed by managers, and inaccuracies occur when users provide inputs to the system. Moreover, the HIS yields additional clerical work. Lack of standardization and partial automation are among the main reasons for inefficiencies. Improvements in the software design are proposed as a means for streamlining the existing system.

Keywords: Hospital Information Systems, analysis, streamlining

ÖZ

BİR HASTANE BİLGİ SİSTEMİNİN ANALİZİ VE İYİLEŞTİRİLMESİ

Dağlı, Duygu
Yüksek Lisans, İşletme Bölümü
Danışman: Doç. Dr. Zeynep Onay

Haziran 2011, 125 sayfa

Hastane Bilgi Sistemlerinin (HBS) başarısı kullanılan yazılıma, kullanıcılara, ve kullanılan bilgi sisteminin hastanedeki iş akışı ile uyumuna bağlıdır. Çalışmanın hedefi, özel bir hastanede kullanılan Hastane Bilgi Sistemini analiz etmek, hastanenin bilgi gereksinimlerini tespit etmek ve bilgi sistemini hastanenin ihtiyaçlarını karşılayacak şekilde geliştirmektir. Bu amaçla kullanılmakta olan HBS'nin modülleri, iş akışı ve operasyonlar, Sağlık Bakanlığı'nın HBS'ler ile ilgili yönetmelikleri, kullanıcıların yaklaşımları, sistemdeki kontrol mekanizmaları ve kullanılan formlar görüşmeler, gözlemler ve doküman incelemeleri yoluyla analiz edilmiştir. Çalışmanın sonuçları, HBS'lerde karşılaşılan problemlerin büyük oranda yöneticiler tarafından fark edilmediğini, bilgi hatalarının kullanıcıların sisteme veri girişi yaptığı noktalarda oluştuğunu göstermektedir. Ayrıca, HBS'lerinin mevcut iş yükünü arttırdığı gözlenmiştir. Standardizasyonun olmaması ve kısmi otomasyon verimlilik kaybının temel sebepleridir. Mevcut sistemin iyileştirilmesinin bir yolu olarak yazılım tasarımında düzenlemeler önerilmiştir.

Anahtar Kelimeler: Hastane Bilgi Sistemleri, analiz, iyileştirme

ACKNOWLEDGMENTS

It is a pleasure to thank those who made this thesis possible, to only some of whom it is possible to give particular mention here.

First of all, I would like to thank Assoc. Prof. Dr. Zeynep Onay for her guidance, support and patience throughout the study. The feedback and opinions of Assoc. Prof. Dr. Uğur Çağlı and Prof. Dr. Semih Bilgen are also acknowledged.

Moreover, I would like to thank the Hospital's managers, physicians, nurses, technicians, and administrative staff for their help, for informing me with every detail and supporting this project. It would not have been easy without their contribution.

I would also thank my family for their support and giving me the inspiration.

Finally, I would like to thank Görkem Turgut Özer for the motivation and emotional support.

TABLE OF CONTENTS

PLAGIARISM iii
ABSTRACT iv
ÖZ v
ACKNOWLEDGMENTS vi
TABLE OF CONTENTS vii
LIST OF FIGURES xi
LIST OF ABBREVIATIONS xii

CHAPTER
1. INTRODUCTION 1

1.1 Factors That Enforce the Use of Hospital Information Systems 3
1.2 Types of Data and Information Collected or Generated 5
1.3 Aim and Scope 8

2. LITERATURE REVIEW 9

2.1 Historical Development of Hospital Information Systems 9
2.2 Hospital Information Systems in Turkey 11
2.2.1 Requirements of the Ministry of Health 15

2.3 Hospital Information Systems Software Vendors 17
2.3.1 Hospital Information Systems Software Vendors in Turkey 17
2.3.2 Hospital Information Systems Software Vendors Abroad 19

2.4 Problems in Hospital Information Systems 21
2.4.1 Data Related Issues 22
2.4.2 Communication Problems with Software Developers 23
2.4.3 User Involvement 23
2.4.4 Over Trust to Hospital Information System's Alerts and Notifications 25
2.4.5 Operational Complexities 25
2.4.6 Organizational Fit 28
2.4.7 Persistence of Paper Based Records 28
2.4.8 Security Concerns 30

2.5 Solutions to the Problems 31
2.5.1 Training 31
2.5.2 Systems Design 32
2.5.3 Organizational Consciousness 33
2.5.4 Patients' Involvement 34
2.5.5 Evaluation 35

2.6 Other Studies in Turkey 35

3. THE HOSPITAL AND ITS INFORMATION SYSTEM 37

3.1 Asclepios Hospital 37
3.2 HasBilSoft 38
3.2.1 Management Module 39
3.2.2 Registration Module for Outpatients 39
3.2.3 Polyclinic Module 41
3.2.4 Laboratory Module 43
3.2.5 Archive Module 43
3.2.6 Radiology Module 44
3.2.7 Compendium Module 46
3.2.8 Registration/Discharge of Inpatients Module 46
3.2.9 Ward Module 46
3.2.10 Infants' Room Module 47
3.2.11 Accounting Module 47
3.2.12 Pharmacy and Inventory Module 48
3.2.13 Surgery Module 50
3.2.14 Queuematic Module 50

4. ANALYSIS OF THE HOSPITAL'S INFORMATION SYSTEM 51

4.1 Methodology 51
4.2 Analysis 53
4.2.1 Outpatients Registration 54
4.2.2 Inpatients Registration 55
4.2.3 Appointment 57
4.2.4 Outpatient Appointment Approval and Payment 61
4.2.5 Medical Examination and Preparation of Epicrisis Reports 64
4.2.6 Laboratory Test Request 66
4.2.7 Laboratory Test Approval 67
4.2.8 Laboratory Test 68
4.2.9 Laboratory Results 71
4.2.10 Inpatient Hospitalization 71
4.2.11 Inpatient Treatment 72
4.2.12 Drug and Consumable Request 74
4.2.13 Supplying of Drugs 75
4.2.14 Inpatients Discharge 77
4.2.15 Determining Payments 78
4.2.16 Receiving Payments from Private Health Insurance Companies and NSSI 78

5. CRITICISMS AND PROBLEMS 80

5.1 Tracking Inpatient's Status through the System 80
5.2 The Online Appointments Process 81
5.4 The Payment Process 83
5.5 The Laboratory Test Request Process 83

5.6 Key Identifiers 83
5.7 Training of System Users 84
5.8 Grouping of Processes 85
5.9 Module Design 85
5.10 Form Designs 86
5.11 Controls 87
5.12 Guiding Users 88
5.13 PACS in Wards 90
5.14 Clerical Work 90
5.15 Inventory Control 91
5.16 External Service Providers 92
5.17 Withdrawing Payments from the National Social Security Institution 93
5.18 Requirements of the Ministry of Health 95

6. RECOMMENDATIONS AND SYSTEM DESIGN 96

6.1 Patient Smart Card 96
6.2 Upgrades in the Online Appointment System 96
6.3 Improvements in Form Designs 97
6.4 Process Improvements 98
6.4.1 Improvements in Polyclinics 98
6.4.2 Improvements in Wards 99
6.4.3 Improvements in Outpatient Registration Desk 100

6.5 Upgrades in Module Designs 100
6.6 Technological Improvements 101
6.7 Controls 101
6.8 Training 102
6. 9 Patients as System Users 102

7. CONCLUSIONS 104

APPENDICES 107

Appendix 1- Modules That Have To Be Included In a Hospital Information System 107
Appendix 2 – List of Clinics 108
Appendix 3- Work, Information and Material Flow among Departments 109
Appendix 4 – Information Exchange Among Departments 110
Appendix 5 – Time study of Outpatient Appointment Approval and Payment Process 112
Appendix 6- Outpatient Appointment Approval /Laboratory Test Approval and Payment Process Flow Chart 113
Appendix 7- Sample Epicrisis Report 114
Appendix 8- Periodic Observations Report 115
Appendix 9- Drug and Consumable Request Form 116

Appendix 10 - Drug Application Form 117
Appendix 11- Patient Record Book 118

REFERENCES 119

LIST OF FIGURES

Figure 1: Optimizing the Trade-off between Structured and Unstructured Data (Source: Leavitt, 273) 26
Figure 2: Registration Module for Outpatients Input Screen 40
Figure 3: Polyclinic Module 42
Figure 4: Radiology Module- Sample Report Template 45
Figure 5: Accounting Module- Ledger 47
Figure 6: Pharmacy and Inventory Module 49
Figure 7: Labels Printed at the Inpatient Registration Desk 56
Figure 8: Label Delivered at the Outpatients Registration desk 63
Figure 9: Barcodes and Label Delivered at the Outpatient Registration desk 68
Figure 10: Discharge Request Form 77
Figure 11: Online Appointment Form 81
Figure 12: New Label Design for Inpatient Registration Desk 98
Figure 13: New Label Design for Outpatient Registration Desk 98

LIST OF ABBREVIATIONS

EMR	Electronic Medical Records
HIPAA	Health Insurance Portability and Accountability Act
HIS	Hospital Information System
HL7	Health Level Seven International
ICD	International Classification of Diseases
ID	Identification
IOM	Institute of Medicine
IT	Information Technology
LAN	Local Area Network
NSSI	National Social Security Institution
PACS	Picture Archiving and Communication Software
PDA	Personal Digital Assistant
SMS	Short Message Service

CHAPTER 1

INTRODUCTION

A big challenge in the world of healthcare delivery is to provide timely, accurate, comprehensive, reliable and relevant patient information to any member of the healthcare team. Using information technology in healthcare delivery provides the opportunity for healthcare organizations to improve quality of care and patient safety through satisfying these necessities.

Using an information system may serve many functions. Data is created, collected, collated, modified, managed, transferred and reported through information systems. The data that is collected can be analyzed, and this analysis can be used for recognizing the trends, making projections, identifying problems and suggesting different solution alternatives (Reichertz, 283). As in any other organization, hospitals need information to analyze the costs and outcomes of the healthcare for improving quality and utilizing the resources fully. Information systems are used in hospitals for satisfying this necessity. As the necessity for accurate information multiplies with the increasing concerns on the quality of the healthcare service offered, information technology becomes a fundamental asset. Hospital Information Systems (HIS) represent a huge potential for quality improvement, cost savings and decreasing workplace inefficiencies (Gurley). When healthcare managers and physicians know the activities that have a positive impact on the quality of the care given and how and how much these activities have an impact, then current resources can be allocated more efficiently.

Optimization and automation are examples of workflow management that can be achieved through the use of HIS. Appointments can be arranged in a manner that the

equipments are not left underutilized. Similarly, routine work can be automated in which case physicians or technicians do not have to deal with clerical tasks (Lagor, et al.,352). Additionally, HIS ensure standardization as each patient has to pass through the same processes defined in the system to receive care (Kuperman and Gibson, 31).

The objectives of implementing a Hospital Information System may be many. Not only clinical requirements but also research necessities, administrative and economic issues encourage healthcare managers to implement a Hospital Information System. Apart from the healthcare organization's internal data and knowledge necessities, such as patient information, billing, finance and accounting, scheduling and staffing, prescription handling, pharmacy ordering, diagnostic reports and laboratory monitoring, external pressures such as government legislation on storing patient's data, supplier's clinical and financial information requirements, insurance company regulations and guidelines encourage HIS to be used. (Frost & Sullivan). Thus, the complexity of processes within a healthcare organization, the amount of data that should be collected, processed and shared, and the advances in information technology encourage the use of HIS (Blobel, 9). Additionally, with fully accessible and integrated patient data, faulty decision making that results from lack of information is reduced.

Another function of HIS is document management. Paper intensive patient information can be collected, stored and shared. These information include laboratory test results, insurance claims, and accounting data. Documents can be stored for a long period of time, can be shared with people from remote sites immediately and can be updated continuously.

HIS also provide data mining opportunity. Large amount of data collected can be used for knowledge discovery. Descriptive statistics and sophisticated pattern recognition algorithms can be applied to the data obtained (Lagor et al., 355).

1.1 Factors That Enforce the Use of Hospital Information Systems

Factors that enforce the use of HIS in hospitals are as follows;

- **Advances in Healthcare Industry:** Driven by the need to lower the costs, hospitals started to form partnerships with other hospitals –horizontal integration- and other organizations such as insurance companies or drug providers. This integration is facilitated when information flows accurately.

- **Problems in the Paper-based Records:** Prior to the implementation of electronic medical records, documentation of patient data was held through handwriting or dictation. Even though these records had a rough format to be followed, certain data elements could be omitted. Therefore, records were varying in terms of completeness and legibility. Additionally, these records were yielding additional work as physicians' reports were deciphered, corrected and completed afterwards by the medical record technicians (Leavitt, 271). Data stored in paper based forms can be inaccurate, incomplete, miss diagnoses, follow-up plans, allergies and medication details. Additionally, duplicated data entries of the same information on multiple forms are possible outcomes of the use of paper-based records (Gurley). Another limitation of using paper based records is the difficulty of transferring records both within the organization and among organizations. Paper-based records are insufficient to meet today's information necessities (Koeller, 1).

  Even though paper based records are insufficient to meet the information necessities within a hospital, implementation of a HIS does not ensure the elimination of paper based records, but reduces the dependency on paper (Campbell, Sittig et al., 547). Details on why HIS cannot completely

eliminate the dependency on paper based records are discussed in sections 2.4.3, 2.4.5, and 2.4.7 respectively.

- **Medication Errors:** According to the book "To Err is Human" published by the Institute of Medicine, health care is not as safe as it should be. A study by Healthgraders points out that in years 2000, 2001 and 2002, on the average 195.000 patients over 37 million died due to preventable medical errors (Loughran). These medical errors include adverse drug effects, allergies, transfusion errors, wrong-site surgeries, and treatment related infections; some of which can be eliminated through effective use of information systems (Institute of Medicine, 2000, 35). According to another study conducted by Lesar et al. using the wrong drug abbreviation or dosage in paper based prescriptions, incorrect dosage calculations and prescribing a drug that previously caused an allergy to a patient are the most frequent medication errors (Institute of Medicine, 2000, 37). In the "To Err is Human" report, it has also been mentioned that these medical errors were preventable through effective diagnosis, appropriate drug usage, and elimination of technical errors (36). Reducing the medical errors is a major driver for using HIS. An analysis conducted by Leape, Buttes and Cullen suggests that prevention strategies targeted at systems rather than individuals are most effective in reducing errors (38). As HIS potentially draw the attention of physician on the allergy records, adverse drug effects and drug dosages, medical errors can be reduced significantly.

- **Coordination:** The healthcare industry has a complex business model which is composed of different trading partners such as pharmacies, insurance companies and hospitals. The decentralized nature of the healthcare industry is an obstacle for information sharing even though the health care industry is information sensitive. HIS provides centralization and enables data sharing (Rada,16).

Coordination within a hospital is equally important. Even though different departments of a hospital are working independently, outputs of the independent departments are used for delivering healthcare to a single patient. In other terms, one patient may visit different laboratories and clinics; diagnosis can be made and treatment can be decided through collaboration of these individual departments. Therefore test orders should be shared with laboratories, test results should be shared with physicians, patient's medical history should be shared with wards for delivering the care effectively.

1.2 Types of Data and Information Collected or Generated

According to Health Insurance Portability and Accountability Act's definition, health information is

> "any information, whether oral or recorded in any form or medium that –(A) is created or received by a health care provider, health plan, public health authority, employer, life insurer, school or university, or healthcare clearinghouse, and (B) relates to the past, present or future physical or mental health or condition of an individual, or the past, present and future payment for the provision of healthcare to an individual. (HIPAA)"

Information can only be obtained through processing data. Therefore, healthcare information would not be complete without an examination of data obtained from internal and external sources. Internal data is generally created inside the hospital and is related to activities patients encounter. Majority of the patient specific information is created and used in clinics and usually stored in the medical records of the patient. According to Blobel's classification, information shared within a hospital falls in one of the following four categories; patient related medical communication such as information about the diagnosis, patient related non-medical communication such as bills, non patient related medical communication such as epidemiological results and non medical communication such as materials (10).

According to the American Health Information Management Association's list common patient specific medical records contain patients' identification sheets (which usually contains patient's ID and insurance information), patients' problem lists, patients' medical history and medication records, physicians' orders, consultation reports, imaging and X-ray reports, laboratory reports, pathology reports, operative reports, consent and authorization forms and discharge summaries (AHIMA). Physicians, nurses, technicians, medical record personnel, hospital admission staff and hospital's equipment are responsible for providing these information to the system. In addition to the clinical information listed, patient specific administrative data is captured in the system. Schedules, certifications, insurance eligibilities, bills and payment verifications are all examples of patient specific administrative data.

Patient specific clinical and administrative data collected from several patients are then aggregated. These aggregated data often yield meaningful information about diseases and treatments, cash flows and cost reports.

Finally there are external sources of data generated. External data can be gathered from the suppliers (such as drug prices), insurance companies, government or non-governmental organizations, or knowledge based information resources (such as healthcare literature). Physicians may directly reach and refer to the literature through the system over the Internet whenever necessary (Wager, 37).

The major constituent of HIS are electronic patient records which can be defined as;

> "electronic patient records are not merely automated forms of today's paper-based medical records, but encompass the entire scope of health information in all media forms. Thus electronic patient records include medical history, current medications, laboratory test results, x-ray images and etc." (Leavitt, 257)

Electronic patient records deliver substantial improvements over the paper based records. First of all, they facilitate access to the records. A single patient record can be reached by a team of physicians through different workstations in contrast to the paper based records that can be reached by only one physician at a time. Secondly, data can be presented in various ways; electronic medical records can quickly summarize quantitative data in tables or charts, integrates all of the activities and presents data in a chronological order. Therefore, physicians may get a snapshot of the patient's history easily. Thirdly, manual tasks such as filling laboratory results can be automated and timeliness of the record is enhanced (Leavitt, 263).

Electronic patient records can be used for improving the risk management and risk assessment practices. Through the use of electronic patient records charting times, charting errors and medical errors caused due to illegible notes can be reduced (Gurley). In a financial aspect, electronic patient records provide more accurate billing information and claims can be tracked in an easier manner. In addition to the benefits mentioned above, electronic patient records allow standardization of the information observed in terms of report formats and data display.

Use of the Internet, intranet and extranet for information sharing is common in the healthcare organizations. Internet technology generally serves research and communication purposes of medical professionals. Intranet and extranet on the other hand are used for information sharing and collaboration. With the help of Internet, intranet and extranet and HIS, information sharing can appear within a unit, among different units of a single organization, between different healthcare organizations, and between the healthcare organization and other partners such as pharmacies, insurance companies and ministries.

Considering the benefits mentioned above, hospitals, and governmental organizations give importance to the implementation of HIS. In some countries effective implementation of HIS in all hospitals takes place in strategic health plans.

In Turkey, effective information management through HIS is a step of Health Reform and every hospital has to use HIS. However, sometimes information management in hospitals does not occur as efficiently as planned.

1.3 Aim and Scope

The importance of Hospital Information Systems is understood by many hospital managers, as more hospitals are using a HIS software. Most HIS software designed have common characteristics as hospitals' major operations are nearly same. However, as each hospital may have unique requirements, the information system used should be customized to meet them. Sometimes, managers of the hospital cannot define their requirements fully which results in a mismatch between the system implemented and operations.

The aim of this study is to analyze the fit between the operations performed in a hospital and the Hospital Information System used, and identify the problems caused due to a mismatch between the organization's operations, external parties' requirements and the system; and to develop solutions for streamlining the current system from both the hospital and system perspectives.

The analysis covers the processes in 8 different units, which are the appointment desk, outpatients registration desk, inpatients registration desk, polyclinics, laboratories, ward, pharmacy, and accounting department. The work flow is observed at the cardiology and cardiovascular surgery clinic due to the clinic's variability of operations, and high volume of incoming patients.

The Hospital's name and the software's name are not disclosed due to privacy reasons and fictitious names (Asclepios Hospital and HasBilSoft Software) have been used instead.

CHAPTER 2

LITERATURE REVIEW

2.1 Historical Development of Hospital Information Systems

Hospital Information Systems were firstly developed in the 1960's. After the Medicare and Medicaid programs were implemented in U.S. for providing healthcare insurance to the elderly and poor, healthcare executives realized that organizations need information for automating patients' billing process and for obtaining accurate cost reporting. Hospitals were providing financial cost reports and receiving money for their Medicare and Medicaid patients. However, the reimbursed amount was higher than the reported costs. For obtaining accurate billing information, hospitals started using information systems (Rada, 5). Few clinical data which were mostly focused on patients' demographics were captured by individual clinics through department specific applications as demographic information are required for the bills. Only the large hospitals that had the capability, staff and resources to develop, implement and support these department specific applications were able to use such systems (Wager, 93). As in house development was costly, information technology could not be used by relatively small sized hospitals.

In the 1970's, the systems that were concentrated on financial operations started to change direction. With the increased interest on patient care, which can be improved through integrating the information coming from different clinics, "integrated files and logistics of patient care information" became a major focus while designing the software (Reichertz, 284). However, that integration could not be achieved until the 1990's. As improvements in the accuracy and handling of clinical data had a direct

impact on the quality of the care given, demand for patient specific data and information systems increased (Kennedy and Davis, 53).

In the 1980's, there still was not any integrated Hospital Information System. Hospitals had the strategy to purchase the "best application or best software available in the market" for individual clinics. Departments were not able to modify the software available in the market; therefore, vendors whose system was a close fit to the department's necessities were selected. As each of these applications had different structures, integration was extremely challenging. With improvements in technology, microcomputers started to be used more commonly in hospitals, and users became more demanding. Additionally with the progress of local area networks (LAN), communication between computers became possible (Wager, 97).

In the 1990's, personal computers became cheaper, and the initial capital investment required for implementing a HIS dropped. Healthcare providers became more familiar with the computers, HIS started to be used more commonly (Leavitt, 259). Physicians began to recognize the necessity for accurate, timely and complete clinical information, and healthcare managers were motivated to acquire departmental information systems for substantiating the profits. In 1991 the Institute of Medicine (IOM) published "The Computer Based Patient Record: An Essential Technology for Healthcare" report. This report was mainly presenting the problems that occurred as a result of using paper based records and encouraged the use of electronic patient records. IOM also drew attention to the importance of physicians' involvement, and stated that the HIS main focus should be the patient, not the financial status of the hospital. The report underlines the necessity for connectivity, confidentiality and security of the patient specific medical records (Institute Of Medicine, 1997, 37). After that report, Health Insurance Portability and Accountability Act (HIPAA) was designed to protect the confidentiality of health information.

After 2000, patient safety, reduction of medical errors, and health care quality became the top priority of HIS. Significant technological advances such as broadband Internet access, smaller and portable devices, wireless technologies and radio frequency identification devices started to be used in the healthcare industry. Even though HIS promote integration and patient safety, paper based medical records are still in use due to their ease of use and legal reasons (Haux, 271). Reasons for the persistence of paper based records are discussed in detail in section 2.4.7. The wider adoption and implementation of HIS still continues.

2.2 Hospital Information Systems in Turkey

In Turkey, the Ministry of Health, that owns 65% of the hospitals, is the largest organization which uses HIS (Çakar). The initiatives to establish HIS started in 1990, after the Ministry of Health and the World Bank started to implement the "Healthcare Information Systems" project. The first agreement of the project was published in the Official Journal on October 7, 1990, and the second agreement was published on December 22, 1994. This project was followed by The 2nd Health Project, funded by the World Bank and Turkish Republic, between 1995 and 2001 (Özsarı, 36). The planned output of both projects was to extend management capacity, and healthcare information accuracy in addition to its reliability.

The Healthcare Information Systems project started in 1992 with the planning phase. During this phase, problems in the quality and accuracy of the information obtained from the hospitals were determined. At the end of the planning phase, it was clear that even though information was obtained from hospitals, it was unreliable due to lack of standardization, could not be analyzed and turned into useful information, and was not up to date. Based on these results, the implementation of Hospital Information Systems became a major focus of the project (Öncel,15). The major components of the Healthcare Information System planned for implementation were:

- Basic Health Statistics Module
- Core Resource Management System
- Hospital Information Systems
- Primary Healthcare Information Systems
- Executive Decision Support Module

After 1995, hospitals' interest in Hospital Information Systems increased, and hospitals started to implement HIS. Therefore when the "Healthcare Information Systems Project" was implemented, there were hospitals that had already been using Hospital Information Systems. However, the applications used were not standardized. This was preventing the Ministry of Health from tracking and auditing operations of hospitals, and disabling information flow between the hospitals and other organizations (such as the Ministry of Health or the National Social Security Institution). In order to ensure standardization the Ministry of Health prepared the "Principles of HIS Purchases" report and distributed it to all hospitals belonging to the Ministry. In that report, the responsibilities of the software vendor and basic modules that have to be included in the software are regulated (Appendix 1). Additionally, as information collected from the hospitals is used for developing healthcare strategies by the Ministry of Health, the international classification of diseases system that assigns a code for each disease, was implemented. As long as the software met the requirements, hospitals could purchase any HIS available in the market (Taşdemir, 37).

HIS developed by Turkish companies has to be approved by the Ministry of Health. The Ministry checks whether the software meets the requirements specified in the "Principles of HIS Purchases" report. Authorized software can be sold in the market.

Despite the regulations mentioned above, it has been realized that software used by hospitals were not standardized, could not meet hospitals' information necessities, and as HIS was new to the Turkish market, technical staff in hospitals were not

specialized enough to maintain systems. In 1999, the Ministry of Health decided to get more involved in HIS purchases. The Ministry suggested three different options to hospitals that already owned a HIS or planning to implement one. These options were:

- Purchasing a software developed in Turkey: Each hospital can purchase its own software but the software purchased has to fit the regulations of the Ministry.
- Using a software developed by the Ministry: A project team formed by the Ministry would develop HIS software to the hospitals requesting a system.
- Purchasing a software developed abroad: As HIS software developed abroad cannot be approved by the Ministry of Health, vendors that want to sell these HIS to hospitals are expected to purchase the license and rights of usage from the software developer. After the rights of using the software are purchased, the software is modified by the local software vendor according to the necessities of the hospital and the requirements of the Ministry, and approved by the Ministry. Then, the software can be sold in the market just as software developed in Turkey.

In order to carry out the second option, the Ministry of Health established the "SB Bilişim Elektronik Bilgi Sistemleri Turizm ve Sağlık İşletmesi Sanayi ve Ticaret Limited Şirketi" firm. The software developed by that firm has been implemented in 9 hospitals. Even though implementing software developed by the same firm nationwide would enable integration and transmission of patients' information, the software developed could not be maintained and updated, as hospitals did not have IT teams, and SB Bilişim does not have enough staff to handle these tasks (Ilgar, 46).

Currently, the Ministry of Health does no longer offer the second option to the hospitals. Hospitals purchase, modify and use commercial software. There are many HIS software producers in Turkey, including MedData, Talys Software, EES, Fonet, Veta, Kardelen, Turkuaz, Medi-Pro, Bizmed, ARESHIS, OIMED and MediTEC.

The Ministry of Health checks whether the software developed by these firms meets the regulations.

As each of the software developed by these companies gather different sets of data in different forms, integration between hospitals and with the Ministry is hard to achieve.

After the "Social Security Reform" was implemented in 2005, three different social security institutions which were SSK, Bağ-Kur and Emekli Sandığı, and their contracted hospitals were merged under one institution called the National Social Security Institution (NSSI). After that merger, NSSI controlled the payment process of patients registered with NSSI over the MEDULA system, and required each HIS to be integrated with MEDULA over the Internet.

In 2007, the "Principles of HIS Purchases" report was updated as the Ministry of Health implemented the "Primary Care" study in 2004, and the "Health-NET" project in 2007. Since both of these projects required the primary, secondary and tertiary care providers to work in synchronization, information flow is to be managed through the HIS of each hospital. Data obtained from HIS is to be shared over the Health-NET platform through the Internet. Patients' health information is to be stored through Health-NET. In order to enable the standardization of data, ICD-10 codes for coding diseases systematically has been implemented (OECD, 36-40). Additionally, in order to ensure standardization in the information flow between healthcare organizations hospitals and the Ministry of Health, the HL7 V3 messaging standard has been implemented (Sağlık-NET). In the future, patients will be provided with a Smart Card that enables them to make appointments online and track their health records over the Health-Net portal (Sağlık-NET).

In the past few years, the Ministry of Health's Healthcare Information System Project, which is called E-Health, has progressed considerably (OECD, 47).

To sum up, the use of Hospital Information Systems has a history of 20 years in Turkey. With the framework of Health Reforms in Turkey, using Hospital Information Systems became mandatory for all hospitals.

2.2.1 Requirements of the Ministry of Health

As mentioned above, in order to ensure standardization of HIS, the Ministry of Health regulates HIS purchases. The responsibilities of the software vendor and required modules are defined in "Principles of HIS Purchases" report. The Ministry of Health checks whether a HIS software fulfills these requirements before giving authorization to the software vendor.

Some requirements of Ministry of Health are mentioned below.

Updates: The software should have flexibility for vertical and horizontal expansion. These expansions may vary from basic upgrades in module designs, or report formats to system's integration with other systems of the Ministry of Health or National Social Security Institution. Software vendors have to follow the upgrades requested by the Ministry of Health or NSSI, and are required to implement the updates or upgrades requested within a month and provide these updates to each customer.

Modules: The software should be in modular format. Hospitals can purchase the modules they want. The software should be able to support barcode applications in any module. Barcode applications may be used for patient identification, employee identification, drug and consumable identification, and tests/examinations. The Ministry of Health requirements for modules used by the hospital investigated in this thesis are summarized below.

- Appointment Module: The appointment module should enable patients to make their appointments in person, via telephone or via the Internet. Patients should be guided properly if they prefer to make an appointment through

Internet. All types of appointments should not be made without taking either the cellular or fixed phone number of the patient. By using this phone number, patients can be notified about their appointment date and time. While making the appointment, the type of appointment should be entered to the system. The system should avoid overlapping appointments; a patient cannot take more than one appointment on the same day at the same hour.

- Registration Module: The registration module should eliminate record duplications.
- Policlinic Module: During the first appointment, patient's allergy records and chronic illnesses should be recorded. If a laboratory test is requested by physicians, the system should automatically generate procedures that the patient has to obey for taking that test (such as hunger) as a report. Epicrisis Reports should be completed within 24 hours after the examination.
- Ward Module: If a surgical operation is required for a patient, his or her room or bed should be reserved on the system. The number of days a patient's companion stays in the hospital should be recorded electronically.
- Pharmacy and Inventory Module: Drug interactions should be tracked through the system; if a patient is assigned two drugs that may have interaction, the system should warn the physician or the pharmacist. The system should also track the expiration dates of drugs and warn pharmacist when a drug's expiration date is near.
- Laboratory Module: The laboratory module should automatically calculate the number of laboratory samples to be taken from the patient.
- Radiology Module: Through the radiology module, the radiology departments' physicians, nurses and technicians should be able to assign their own appointments.

Controls: In order to minimize input errors, data authentication and data proposition should be implemented within the software. The software should guide users about the process and type of input to be entered. Inconsistent data should be eliminated

through range and consistency controls. When a user provides data that violate controls, the software should warn the user and make auto corrections or suggest alternatives wherever possible. As prepared lists or dropdown menus eliminate transcription or transposition errors, they can be used for error prevention.

Security: It is the software provider's responsibility to keep data secure. Antivirus software and firewalls should be implemented. If an error is detected in an Epicrisis Report, only the doctor who has prepared the report can correct it.

Training: The software vendor should organize training programs for system users. System users should be informed about how to use computers, software and how to keep the software secure.

In addition to the requirements mentioned above, information flows, types of transactions, logs to be held, how data should be stored, sorted and reported, report formats and reporting requirements, authorizations and how the system should be kept secure are described in the "Principles of HIS Purchases" report.

2.3 Hospital Information Systems Software Vendors

2.3.1 Hospital Information Systems Software Vendors in Turkey

As briefly mentioned in Section 2.2, there are many software vendors in Turkey. In terms of functionality, products offered should be similar to each other since, the Ministry of Health only certifies software that fits the requirements. However, software could differ from each other in terms of the type of database used, hardware offered, security solutions offered, maintenance and training programs, user interface of the system and additional services. Some of the HIS software and their capabilities are described below.

Medisoft: Medisoft HIS is developed by Talya Software, and is especially designed for private hospitals. The software is composed of 33 different integrated modules.

- Patients can be given bar-coded Patient ID cards. By using that card patient's records can be tracked easily.
- Tracking numbers obtained from NSSI through MEDULA can be transferred to the system automatically.
- Call center appointments are automated. Therefore, patients can make appointments by themselves with the guidance of the Interactive Voice Response System.
- Patients can make appointments and track their laboratory results online.
- Physicians can fill the Epicrisis Reports by selecting appropriate templates from the drop down menus.
- Inpatients status can be tracked through the system. Daily observations can be recorded on an hourly basis. Delayed operations are reminded to physicians or nurses automatically.
- Radiologic images can be stored in Picture Archiving and Communication Systems (PACS).

Turkuaz Software: Turkuaz Software offers an Oracle based Hospital Information System. In addition to the HIS, Turkuaz Software offers Queuematic Systems, Appointment through SMS or Internet Service, Laboratory Integration Systems, Personnel Tracking Systems and Patient Smart Card System.

Sarus: Sarus is a completely web based, modular system developed by EES for medium to large scaled hospitals. As the software is completely web based, installations, upgrades and updates in the program can be handled easily.

Fonet: Fonet HIS is developed for both public and private hospitals. It is a .Net and Oracle based software which is composed of different modules. Fonet is especially specialized in mobile communication technologies. In addition to the call center and

online appointment options, an SMS appointment system is available. Moreover by using their smart cards, patients can make their appointments from kiosks placed in hospitals. Reporting options are expanded and managers can take reports through SMS.

Medi-Pro: Medi-Pro allows hospitals to rent the software instead of purchasing it. They offer two different products which are specialized for private or public hospitals. These softwares differ in terms of payment and accounting processes.

ARESHIS: ARESHIS is a web based HIS. Instead of keeping all data in a central database, ARESHIS stores data in multiple databases. For instance while policlinic data is held in a policlinic database, accounting data is held in a completely different database. Touch-operated technological devices (such as kiosks) can be used in polyclinics and wards by physicians and nurses. Voice recording technology is also implemented which enables physicians to record their notes instead of typing them. Additionally a smart barcode system is implemented. In that technology, patients are given smart cards and any computer in the hospital has a barcode scanner. If patient's barcode is scanned at the registration desk, the patient's registration page loads automatically. If the barcode is scanned at a laboratory, the patient's laboratory tests or test results page is loaded.

2.3.2 Hospital Information Systems Software Vendors Abroad

According to Research and Market's "Hospital Information Systems – A Global Update of Market Trends and Opportunities" Report, there are 22 major players in the international Hospital Information Systems market, four of which are described below.

Akhil Systems: Akhil Systems is a software company located in India. It is specialized in developing Hospital Information Systems, Electronic Medical

Records, Laboratory Information Systems and Radiology Information Systems. The HIS is in a modular format.

- Status of the outpatients' clinical orders and inpatients' ward orders can be tracked through the system.
- Pharmacy and Inventory Module can send purchase indents to suppliers.

Siemens Medical Solutions: Siemens HIS is a SAP based software and in modular format. The modules are specialized according to departmental requirements. For instance, the cardiology and cardiovascular surgery department's module is completely from the gastroenterology department's module. As cardiology and cardiovascular surgery department's patients have long medical histories, documentation is considered more important for that module. On the other hand, gastroenterological examinations usually involve video images (such as endoscopic images). Therefore, this module is more suitable for storing and watching video images. Siemens also offers pathway module through which patients' treatment can be defined. This module provides guidelines for examinations and documentations, lists required laboratory tests or routine drug orders.

QuadraMed: QuadraMed offers not only a transaction processing system but also an Enterprise Resource Management program. Scheduling is a function of the software offered. Through that option resources are utilized better, and patients do not wait for the operations to be performed.

- Through Electronic Data Interchange drug and consumable orders are directly sent to the suppliers.
- Through Patients Web Portal, patients can take retake or cancel appointments online. They can also review forms and reports, check the requirements of tests they have to take, and edit their personal information.
- By using electronic signatures, physicians can prepare and sign reports or prescriptions electronically.

iSOFT: iSOFT HIS is developed by IBA Health Ltd in Australia.

- iSOFT provides application development tools to users. Therefore, hospitals can modify the software according to their necessities without taking support from IBA. Similarly, all interfaces are customizable.
- Patients' information are shared with General Practitioners and other external care providers through the software's collaboration suite.
- Prescriptions of both inpatients and outpatients are prepared online. The system automatically checks drug interactions and patient's allergy records and alert physician while the prescription is being prepared.
- Remote recordings are possible through portable devices. Drugs and consumables' inventory records can be held by using barcode scanners.
- Patient's waiting times can be tracked. Therefore, bottlenecks can be determined and system performance can be increased.

2.4 Problems in Hospital Information Systems

Even though information technology has progressed considerably over the last 50 years, healthcare information technology has not developed that fast (Beaver, 3). There is a general perception that the use of information technology in the healthcare industry is ten to fifteen years behind that of other sectors in the industry (Raghupathi, 9). In 2009, 90% of the hospitals in U.S. did not have HIS (Jha, DesRoches et al., 1630). According to a study conducted by Anderson, 70% of the HIS either fail or do not provide end-user satisfaction.

Successful implementation and utilization of information systems depends on several factors including technological, organizational and individual variables, and the interaction between them (Nowinski et al., S175). However, examples of successful implementations are few. While HIS may be essential for improving efficiency and quality of health care, the implementation of an HIS requires substantial capital investments and organizational change. Development of information systems

requires a focus on organizational strategies, design and dynamics, besides the procurement of appropriate software and hardware.

Reasons for the delay in the development of Hospital Information Systems and the failure of the Hospital Information System implemented are many, and most of the reasons are interrelated. These reasons and problems are explained below.

2.4.1 Data Related Issues

There are many software developers just as there are many different types of software applications available. Among these different alternatives, hospitals implement a HIS which is most suitable to their data standards and operations. As the way hospitals capture data may be different for each hospital, a standardized terminology, system architecture and indexing cannot be developed. Additionally, there are not unique patient identifiers in use. A unique patient identifier may allow health care providers to reach patient's previous health records regardless of where the patient appears in the continuum of care. Using a unique patient identifier would help healthcare providers to eliminate duplication of tests, and review previous activities (Leonard, 47).

Data related issues may even arise in one hospital. Departments individually may be successfully collecting data to perform their internal tasks, but they may not be able to share the information due to lack of integration.

Due to the reasons mentioned, a network among hospitals cannot be set. Data cannot be shared with other hospitals, as each hospital has its own data standards and there are no unique patient identifiers.

2.4.2 Communication Problems with Software Developers

The first step in developing an information system should be the determination of user requirements completely and accurately (Leonard, 48). However, managers, who are mostly involved in system design, usually are not aware of the information requirements of physicians, nurses or technicians, since managers do not use the Polyclinic Module or the Laboratory Module. These users' true information needs and the user interface they look for are not communicated to the developers as only managers are involved in the system design process.

In addition, some problems arise due to communication problems between the developers or technology consultants and management. Even though technology consultants are aware of recent technology trends that can help healthcare managers, they may not be able to offer the best alternative as they may not fully understand the manager's requirements. On the other hand, healthcare managers do not demand technological improvements, as they cannot follow the developments in technology, or understand how new technology could help them. Due to a communication gap between the two parties, neither side is aware of the constraints or opportunities, which results in delays or inefficiencies in the implementation of HIS.

2.4.3 User Involvement

IT assimilation typically takes place at two different levels within an organization. Top management decides to implement a management information system and employees decide to integrate their daily tasks with the information system (Fichman, 105). The main users that have a significant contribution to the HIS are the physicians who had been performing their tasks successfully prior to the implementation of the HIS. With the use of HIS, patients get better care. However, the cost of this improvement is the physician's changing work routine. In contrast to other information systems, users of the HIS are generally physicians who are

characterized by a high level of job autonomy (Sharma, 763). Therefore, they are not willing to change their working habits for adapting to the use of HIS. A survey conducted by Ash and Bates in 2005 indicates that only 5-10% of the physicians use electronic medical records in their office practices (9).

Users of the system are expected to learn different user interfaces, order vocabularies and workflows. Moreover, these systems yield additional clerical work to the physicians who are already heavily burdened. Problems in the user interfaces such as forms that are not user friendly makes data entry tasks harder for the physicians. Another study that shows the impact of the usability on the physicians HIS usage patterns was conducted by Lee et al. Results of this study indicates that for the physicians, the most difficult task to learn in a HIS is to "move around the system." Since physicians were finding it difficult to learn the relationship between screens, menus, submenus and how to get from one screen to another, they are more willing to assign their tasks to nurses. This fact can be anticipated from a general response that nurses give which is "The most difficult thing to perform in HIS is entering medication orders for physicians." (Lee et al., 49)

Users of the system should easily understand how to complete the tasks that are assigned to them. Young recognizes that usability can be an obstacle that affects the implementation and efficient use of HIS (106). The design of user interfaces becomes more crucial when use of the HIS starts to cause errors. Physicians may mistakenly order wrong tests when tests listed on the menu are hard to select. Systems implemented must be user friendly for enabling the physicians to retrieve and understand data that are relevant to their decision making tasks. Otherwise, these systems are likely to be rejected by users, or will not be used to its fullest capacity.

2.4.4 Over Trust to Hospital Information System's Alerts and Notifications

According to Wellen, Bouchard and Houston, a well designed HIS should support medical professional decision making through supporting autonomy, and collecting and disseminating information. Most of the decision support systems currently used in HIS are reminders, alerts or warnings that may be triggered when there is a problem with drug interactions, when the patient has an allergy or when the medication ordered is overdose.

However, after the implementation of such systems, new concerns about their consequences arose. Physicians may trust the decision support suggested by the system more than it is actually called for.

Another problem may be "the decision support overload" (Ash et. al, 109). The system may send too many alerts and reminders to the user, so that the user may start to ignore the alerts or close the notification system completely.

2.4.5 Operational Complexities

Computer applications are useful when they automate routine work, but the complexities of the operations performed in the health care delivery usually make the process anything but routine.

Information technology provides better opportunities and higher functionality in using patient data; more information can be stored and analyzed with the help of HIS. However, in order to feed the information system for analysis purposes, more data is asked from the physicians. Therefore, physicians of today have to deal with higher amounts of data (Haux, 271). In order to obtain the required data fully, HIS records are designed in a fragmented and structured manner. Physicians many times

lose their cognitive focus while fragmenting the information they have to enter and going through different fields or pages to fill the information required (Ash et. al, 107). Moreover, in order to receive the information, laboratory results, and images, they again have to pass through various pages. HIS records may hamper the thinking structure of the physicians significantly. Leavitt illustrates the tradeoff between the value of Electronic Medical Records (EMR) which is also known as Electronic Patients Records and data structure in Figure 1. The author mentions that as the design of the data structure moves from paper (which provides complete flexibility) to completely structured, physicians who are the primary users receive a great penalty. On the other hand, structured data enables secondary users, who are managers, insurance companies and researchers, to capture a lot of information. When values received by the primary users and secondary users are combined, an optimization peak occurs when the data is partially structured and physicians have some autonomy (273).

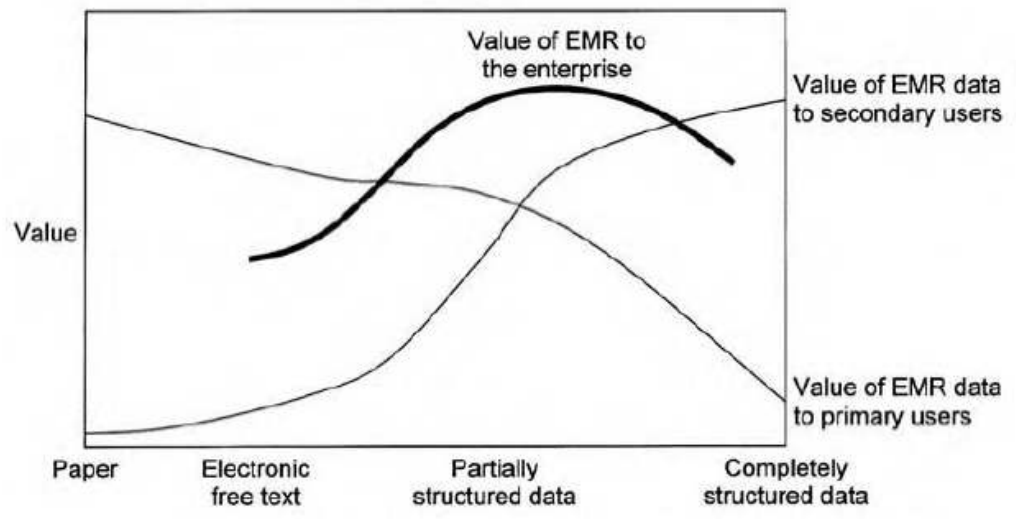


Figure 1: Optimizing the Trade-off between Structured and Unstructured Data (Source: Leavitt, 273)

Another problem that is caused due the increased amount of data to be entered is called “over completeness”. As systems collect too many data and present all of them

in one report, physicians have difficulty in finding the necessary part. Sometimes, even if the reports do not contain all data available, the system automatically puts the necessary information in prepared templates. These templates includes standardized phrases which actually decreases the transparency and readability of the reports (Ash et at., 107)

Moreover, there are not any standard operating procedures for treatments or diagnosis. Blood and urinary tests are not asked from every patient. Physicians usually determine the operations to be performed. Due to that fact, automation is not easy to be performed in HIS.

In addition to the complexities mentioned above, the healthcare environment itself is not suitable for computing in contrast to other industries. As healthcare services are mostly delivered at bedside not at the department, access devices cannot be used frequently throughout the service. The overhead of reaching an available workstation, logging into a computer application, finding the right patient through that application and entering orders or new information is still so high that physicians consider it as a deterrent to electronic record keeping (Giuse and Kuhn, 109). Even though there are wireless portable devices such as PDAs, they are too costly to be implemented.

In the healthcare environment, care service delivered mostly depends on face to face communication. The communication between the physician and patient is essential for the patient to express himself or herself. When physicians start typing during an examination, patients perceive that the physician is not listening. Therefore, physicians prefer to take notes while listening to the patient and fill the electronic patient records after the patient leaves the room (Saleem et al., 623). Details of the examination may be forgotten and notes may lack some important details.

Even though the primary aim of HIS is to increase integration, it also isolates its users from each other. However, medical work is usually a collaborative activity. The traditional single physician and patient relationship is being replaced by a team of healthcare professionals. Therefore, information sharing among these professionals should be seamless in order to prevent any inconsistencies (Bose, 61). Flow of information can only be ensured if physicians are able to access and contribute to accurate data. However, the complexity of electronic communication sometimes causes errors by themselves (Chiasson et al., S93).

2.4.6 Organizational Fit

Hospitals that do not have the technical capability to develop HIS in house usually prefer to purchase application software and customize it according to the necessities of the organization, if possible. Sometimes these commercial applications bring organizational change, or changes in the workflows or processes. Most of the operations performed once manually may be replaced with automation, in which case skills expected from the employees would change. Sometimes, HIS bring changes in the organizational strategy as well. Information systems that are developed for private sector hospitals may not satisfy the necessities of a public hospital as the focus of these two organizations are different. A HIS that is designed for maximizing profit may not be satisfactory in a public hospital as resource allocation may be more critical for that organization. To summarize, success of an HIS depends on "the size of the gap between the current realities and design conceptions of the software" (Heeks, 128).

2.4.7 Persistence of Paper Based Records

When implemented optimally, HIS have the potential to enhance how the patient data is documented and organized. However, HIS usually do not produce completely

paperless processes. Persistence of paper based records is both an indicator of problems with electronic medical records and causes problems in the HIS usage.

Saleem et al. classify sources of paper generation in three areas which are policy, system design and electronic patient records design (619). Based on that classification;

- Policy: Hospital's policies may mandate the employees to generate and fill certain forms.
- System Design: System design problems may involve inefficient workflow processes and the misfit between the workflow and the system. In those situations physicians are more likely to trust paper based records instead of the systems' outputs. A typical example is hand written reminders. Since some of the systems do not have a properly functioning reminder mechanism, physicians are likely to take handwritten notes and attach these notes into patient's file.
- Electronic Patient Records Design: Parts of the electronic medical records may be inadequately designed to support some clinical workflow or tasks. Data collected or presented may be incompatible with clinical care delivery services in which case physicians generate paper based records while using electronic records as well. For instance, the software may not be able to generate all data required within a form in which case forms are partially filled by the software and partially filled by the physicians manually.

  Efficiency is another factor which discourages the physicians to use HIS. Instead of entering the complex orders or long reports to the system, physicians may find it more efficient to take effective hand written notes, pass them to the nurses and request them to enter the orders or reports to the system (Saleem et al., 622).

2.4.8 Security Concerns

One major concern in the use of HIS is security, confidentiality and privacy. From a patient's perspective the contact made with the physician is no longer a contact made with "a physician". Since one of the outcomes of implementing an HIS is integration, data is owned by the hospital instead of the clinics. The health care organization is also involved in the patient and physician relationship, and can reach everything about patients' contracts, insurances, schedules and medical histories, which causes a shift in privacy concerns. Patients who are worried about the confidentiality of their medical histories may not be willing to provide information, which results in a decrease in the quality of care.

Patients' concern on information security is especially increased with the shift from stand alone Hospital Information Systems to networked healthcare information systems. Private information can now be shared with the government, or other healthcare organizations through wide area networks (Katsikas, 129). In a study conducted by Whiddett et al. 203 patients are asked with whom and to what extent they want their information to be shared. Results of this study indicate that 20% of the patients do not want to share their information with health administrators, researchers and insurance companies and government agencies. Patients are 30% more likely to share their information when it is non identifiable.

Even though patients' secure data is protected by law currently in the U.S., until the Health Information Portability and Accountability Act (HIPAA) of 1996, there were no federal regulations that govern the privacy and confidentiality of patients' information (Wager, 78). In Turkey, the Ministry of Health's Information Technology Department published the "Data Security" notice, including the "Policy towards Security and Privacy of Health Records" report in 2005. This notice calls attention to the privacy of patients' electronic records. According to the report, patients' Epicrisis Reports, information about treatments, diagnosis, laboratory

results, prescriptions, receipts and invoices are private, and should not be shared with anyone except authorized hospital personnel, National Social Security Institution and private health insurance companies.

2.5 Solutions to the Problems

2.5.1 Training

Healthcare managers, physicians and clerks have to be informed about the benefits of HIS in order to help them understand the importance of electronic medical records and HIS. This can be achieved through training. As far back as 1979, delegates of the International Medical Informatics Association Working Group recommended courses in applied informatics for medical students and physicians. Later, it has been recognized that training is essential for a successful IT implementation and adoption in hospitals (Ball, 87).

Another study conducted by Saleem indicates that, physicians are more likely to use HIS when their skill level with computerized tools is higher (623). Even though the physicians may be aware of the fact that the tasks that they are handling manually can be handled electronically, they may not be able to perform the tasks as efficiently as they can do manually. For instance, they may not be able to type accurately which results in errors or a loss of time. Therefore, through training programs, physicians' familiarity with the computerized systems and their skills may be increased.

Since HIS are replacing paper based records in hospitals, physicians may get used to the HIS through their medical education. These trainings should involve the consideration of both the positive and the negative aspects of using a HIS (Ash et al., 110).

2.5.2 Systems Design

Healthcare managers and software developers should work closer in the design phase for helping the managers to understand the capabilities and limitations of the HIS. On the other hand, designers should be involved in the hospital processes so that they can better understand the nature of the operations performed (Ash, et al, 110). Through that approach, designers can observe the complexities or specificities of the tasks, and develop potential strategies for handling these tasks electronically. Systems developed should have the flexibility to fit the work practices of the hospital.

Research indicates that, physicians' involvement in the system design process increases the adoption rate significantly (Chiasson et. al., S91). Physicians can tailor HIS applications according to their information necessities and more importantly realize the outcomes of their contributions to their system.

If the hospital decides to purchase commercial software instead of developing it, the software to be purchased should be evaluated and tested carefully beforehand. Prior to implementing the software, pilot runs should be conducted to see whether the software fits the organizational structure and satisfies the information necessities. Integration between different modules of the software and how well this integration is aligned with the current information flow should be considered.

In order to prevent any communication errors, effective feedback mechanisms can be attached into the systems. Through these feedback mechanisms, physicians can be informed about whether their orders have been received or carried out. Similarly effective control mechanisms can be inserted into the systems so that physicians do not order wrong tests or medications accidentally. Verification may be a simple but effective solution (Ash, et al. 110)

Systems also should have the capability to resolve conflicts. As each patient's files and data can be reached by multiple users at a time, there is a possibility that the same order can be entered by two different users. System must manage multiple users entering orders for the same patient (Overhage, 215)

As the debate on whether more information is better than less information in the medical field is going on, the volume of data to be collected should be kept limited. In the system design phase, managers or secondary users should be aware of the fact that data which does not have any value to the decision making process is more confusing (Davidson, 334).

2.5.3 Organizational Consciousness

Starting from the very beginning, there must be a strategic vision that motivates the organization to use HIS. Management should have clear objectives and strategic goals. These goals should be transferred to other levels of organizations through training or meetings. Expectations, length of the implementation phase, functions of the new system to be implemented, should be shared through the organization and feedbacks should be collected. If there are any technical problems, they should be solved prior to the implementation of the software to prevent users and patients to have an undesirable experience.

In cases where physicians do not perceive a new task to be performed through the system as important, actual studies of efficiency gains should be conducted. To give an example, if a physician does not fill a specific part of the electronic medical record because he or she perceives it as inefficient, he or she should be shown that consequences of unfilled information may be significant and correcting any possible problems that may arise due to these consequences may require a lot of effort (Saleem et al., 624).

While designing the HIS to be implemented, inputs and outputs of the current processes should be kept in mind in order to prevent any misalignments between the system implemented and hospital's operations. Through that approach, the detailed requirements for the new HIS to be implemented can be determined for supporting the new processes. When process design is performed without considering the current workflow or information flow, the implementation phase takes much time, and becomes an expensive and risky investment (Skinner, 348).

2.5.4 Patients' Involvement

Patients, whose primary aim is to improve their health status, are careful observers of their own care. They are willing to maintain the continuity of their care and therefore, carefully observe the protocols or procedures within the hospital or monitor their health status closely (Unruh and Pratt, 238).

Traditional HIS require clinicians or experienced staff to enter data. However, as hospital sizes get larger, the patient population increases, the data entry becomes a time consuming task. Patients may be involved in the data entry process if the system is designed in a simplistic (non-comprehensive) and static (questionnaire based) manner. Patients may enter their own ID information and provide their histories and complaints. In a pilot study conducted at St. Joseph's Health Care Center Emergency in London by Benaroia, Elinson and Zarnke, 97% of the patients provide their own information through an interactive computer system. The mean time of completing the required data was 5 minutes, even though 21.5% of these patients mentioned that they seldom or never use computers. Moreover 83.6% mentioned that the system was very easy to use as the instructions were guiding them accurately (285). Patients can be active participants in the information system; they may provide their information through the Internet. Through that approach, the clerical burden on the physicians or other medical employees may be reduced.

2.5.5 Evaluation

In order to prevent problems that may be caused due to the HIS, rigorous evaluation of the system and the software is recommended (Rigby, 1201). During the evaluation, all factors that have an impact on the information system, which are users, organizational structure, and the technology, must be considered one by one. Evaluation should be conducted in every step of the project life cycle; data verification and validation at the system development phase, pilot studies and cost-benefit and cost-effectiveness studies at the implementation phase, and monitoring studies throughout the routine use (Ammenwerth et al., 126). Through evaluation, continuous improvement in the system can be performed by considering how well operations are aligned with the information system in use, what the impact of the information system is on the processes, and how well the information system satisfies users' requirements.

2.6 Other Studies in Turkey

In recent years, HIS and problems that prevent HIS to be operated efficiently have been carried out in Turkey:

Baykan analyzed the HIS of Atatürk Research and Education Hospital which is a public hospital. In the study, inputs and outputs of operations performed in different departments, and the performance criteria for individual operations have been defined, flows between departments are shown, the capabilities of modules of the HIS are mentioned, and surveys are distributed to 37 upper level managers for understanding end user satisfaction. Baykan measured end user satisfaction with close ended questions.

Rodoplu investigated the reasons why users reject the use of HIS. 469 end users from two different hospitals in Kocaeli are surveyed. The reasons for rejection are grouped

under four titles which are fear from uncertainty, fear from failure, fear from the future and reluctance.

Erdem also analyzed the HIS of a hospital. Modules of the HIS are compared with the Ministry of Health's requirements, and the Polyclinic Module is studied in detail. End-user satisfaction is measured through surveys.

Kocamaz examined the HIS of the Konya Meram Medical Faculty Hospital, presenting a snapshot of the modules and their capabilities. The study is descriptive, and does not list the problems faced in the system and possible solutions.

Taşdemir analyzed whether hospitals were ready to implement a Health-NET by surveying 10 hospitals. Managers' experience with HIS, the Ministry of Health's role, managers' perceptions, modules used in hospitals, technological infrastructure of the hospitals are studied. He concluded that integration is not possible due to the fact that each hospital uses a different HIS.

Sağıroğlu listed the problems faced during the implementation of HIS in a private hospital. The results of study showed that the potential sources of HIS implementation difficulties were organizational problems, end user profiles, integration of different systems, inconsistencies among different workflows of different departments, and training.

Erdil et al. designed a study for evaluating the advantages and disadvantages of the electronic medical record system used at Zonguldak Karaelmas University Hospital through questionnaires. The study examines whether users are satisfied with the HIS in terms of the outputs obtained through the HIS, and whether using EMR is easier than using paper based records. Additionally, the users' usage patterns are examined.

CHAPTER 3

THE HOSPITAL AND ITS INFORMATION SYSTEM

This chapter introduces Asclepios Hospital, and describes the modules of the HasBilSoft HIS used in the hospital.

3.1 Asclepios Hospital

Asclepios Hospital is a small-scale private hospital in Ankara founded in 2005. Currently there are 21 clinics (Appendix 2) in the hospital, and 85 inpatients capacity in wards.

The hospital has 41 physicians. The daily workload of physicians differs significantly depending on the number of patients visiting the clinics. Seasonal illnesses such as flu also increase workload at specific times of the year. On average 400 patients visit the hospital per day. New arrivals compose approximately 1/3 of these visits, which means that on the average 100 new patients visit the hospital every day. The remaining 2/3 are returning patients. Only 4.25% of the daily arrivals are composed of the patients who come for a control.

The cardiology and cardiovascular surgery clinic is the largest department with 5 physicians. Among all the patients that arrive to the hospital in a day, 8% come for a cardiologic examination or surgery. The ophthalmology clinic has the largest amount of patients incoming with an average of 40 patients (10%) per day. This clinic has 2 physicians. As patients of the ophthalmology clinic do not have many surgical operations, 2 physicians are able to handle the workload.

The hospital has been using a Hospital Information System called HasBilSoft since they started operations for the past 6 years. There is an IT team in the hospital whose main responsibilities are maintaining computers and the HasBilSoft system, helping users to learn the functions of HasBilSoft, gathering the complaints of users transferring these complaints to the software developer, and asking for upgrades or updates.

3.2 HasBilSoft

HasBilSoft Information Systems was founded in Ankara in 1997. The company produces Hospital Information Systems for public and private hospitals and regional polyclinics. The firm is operating on a national scale and operations are not limited to software development. It also provides consultancy and training services. The HasBilSoft software is used in 13 public and 99 private hospitals and 106 regional clinics across Turkey.

Research and development activities are also conducted within the firm. In addition to upgrading HasBilSoft according to Ministry of Health and National Social Security Institution's requirements, the company also works on developing an Electronic Call Center system, Tablet PC applications, and appointment through SMS systems and their integration with the HasBilSoft HIS. These developments are not required by the Ministry of Health or National Social Security Institution or private health insurance companies but by the consumers of HasBilSoft. The online appointment system and queuematic system are recent additions to the software.

HasBilSoft is an Oracle based software that uses Oracle Workgroup Server and Oracle Real Application Cluster. HasBilSoft is a modular system. The modules and their areas of usage are described below.

3.2.1 Management Module

The Management Module is the module where the hospital's operations are defined within the information system. Each and every element of the information system is entered into the system through the Management Module. These elements include; clinics of the hospitals, names of physicians, nurses and the technicians, their responsibilities and authorizations, their shifts, types of tests conducted at the laboratories, surgeries and treatments that can be performed in the hospital, and protocols signed with the National Social Security Institution and other private health insurance companies. User passwords are also set via this module.

3.2.2 Registration Module for Outpatients

The Registration Module is the module where outpatient information is entered into the system. Through this module, patient's ID information, telephone number and home address, patient's health insurance institution, and briefly his or her background information (including basic complaints) are obtained (Figure 2). For each patient, a unique file is created. After the file is created, patients can be assigned appointments through the appointments option of the module. Patients who are not registered into the system can also make appointments since HasBilSoft does not have a restriction regarding registration status. Available appointment times can be reserved for unregistered patients.

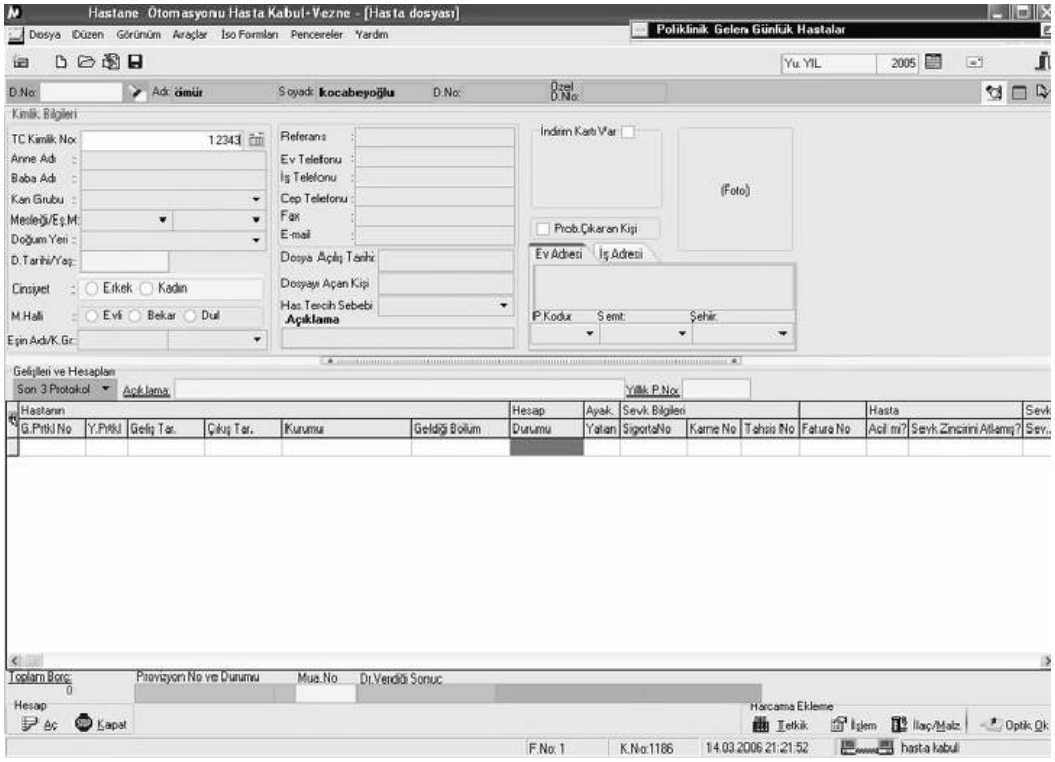


Figure 2: Registration Module for Outpatients Input Screen

The payment process is also carried out through this module. The amount of payment varies according to the social security status of the patient. The HasBilSoft system automatically calculates the total amount of payment for each patient by adding the price of the operations such as laboratory tests or examinations assigned to patient's file before the treatment. The system does not allow patient treatment unless payments are completed. Therefore each operation has to be manually approved after payment is done. Physicians, nurses or technicians who will perform the operation can only understand that the patient has made his or her payment through this approval. Following the payments, receipts are printed by using this module.

In addition to the processes mentioned above, this module can also be used for reaching daily, monthly or annual statistics such as number of patients visiting the hospital. Other more generalized statistics such as number of surgeries

performed in a month can be generated and tracked via the Archive Module which is going to be described in part 3.2.5.

3.2.3 Polyclinic Module

For each clinic within the hospital, a different Polyclinic Module is created through the Management Module. By using the Polyclinic Module, physicians can reach the appointment information of their clinics, their patients' files and accordingly patient previous illnesses, treatments and laboratory results.

For each medical examination, patient's complaints, examination results and suggested treatment – including drugs and dosages- are recorded into the system (Figure 3). Laboratory tests are ordered and results of these tests are obtained from the Polyclinic Module. Later, Epicrisis Reports which involve patient's complaints, physical examination findings, test results, diagnosis and treatment are prepared by physicians through the Epicrisis Report preparation page of the module.

Information entered to the patient's file (for that specific illness) are automatically retrieved and combined in Epicrisis Report.

Physicians can use the software's prepared report formats for entering medical examination results. These reports are classified and titled according to the type of illnesses and listed under the "Template Preparation and Loading" application of the Polyclinic Module. Physicians can search and use a template provided by the software, modify it or save his or her preferred report format as a template. Similarly, there are prepared templates for entering diagnosis. These templates automatically enter the International Classification of Diseases (ICD) code into the Epicrisis Reports.

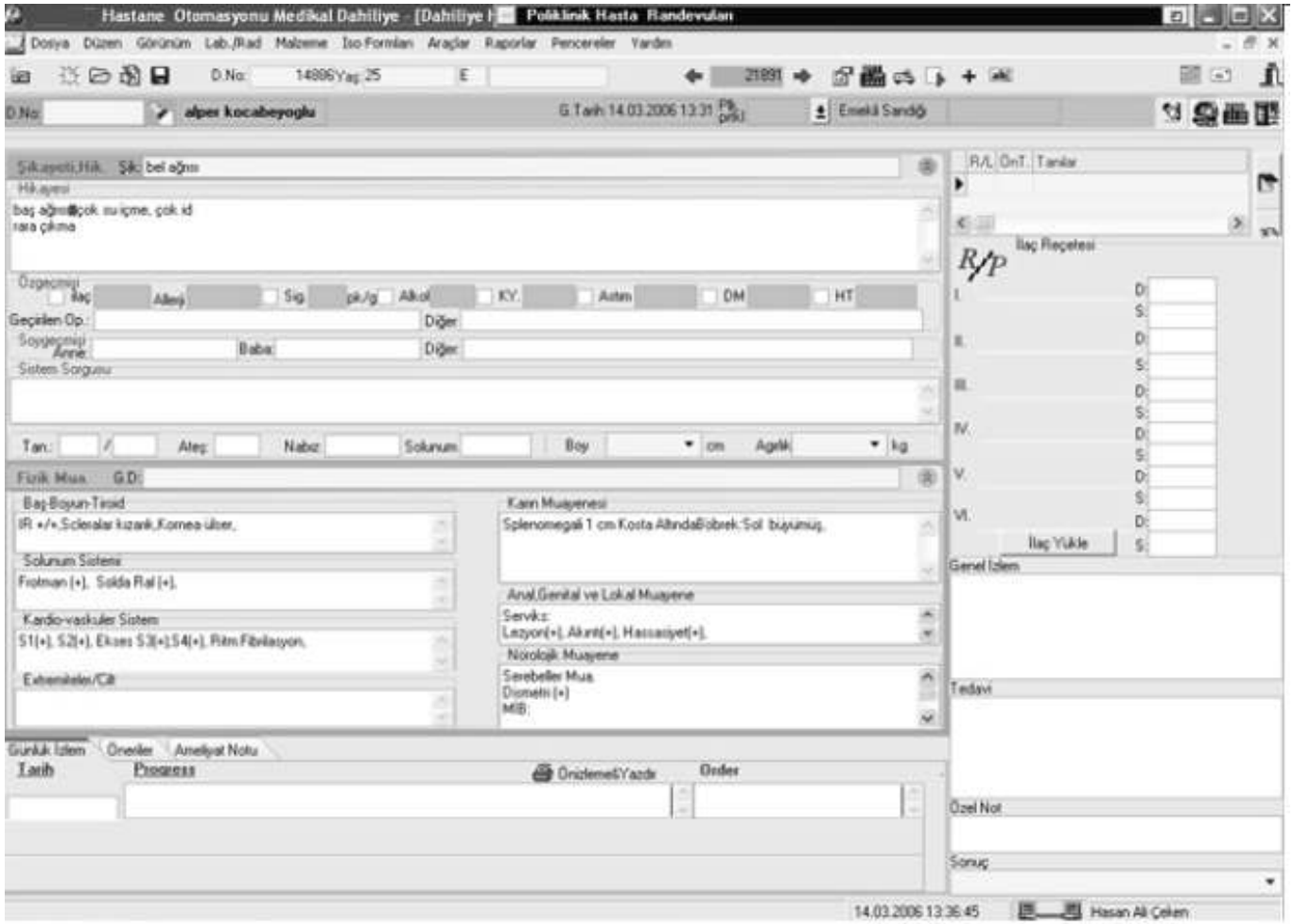


Figure 3: Polyclinic Module

3.2.4 Laboratory Module

The Laboratory Module is used by the laboratory staff for following the test requests entered from the polyclinics and wards, and entering the results into the system. Test results are uploaded to the system automatically if the test equipment is synchronized with the system. Else, technicians enter the results manually. For the equipment that is synchronized with the system, a barcode is used for identifying the owner of the sample. Barcodes are pasted on the test tubes and scanned prior to installing the samples on the equipment. The barcode identifies each sample, which means that for each test, a different barcode is pasted on the test tube. The system automatically assigns the test results to the patient's file.

The Laboratory Module automatically checks the age and gender of the patient and loads the upper and lower limits of the tests. These limits are entered by technicians only once, through the Laboratory Module of HasBilSoft.

3.2.5 Archive Module

The patients' files in the system are reached through the Archive Module. In addition to the patient's basic identification information, his or her previous illnesses, previous treatments performed within the hospital, reports and test results are held in the Archive Module. As each patient's information can be tracked from the Archive Module, general statistics can be generated through this module as well. These statistics include, fertility and mortality rates, number of surgeries, number of inpatients or outpatients classified according to clinics or physicians, and statistics on diseases.

The Archive Module is not used frequently by the physicians since they can reach patients' files through the Polyclinic Module. The Archive Module is

created for the employees who do not have access to the files through the Polyclinic Module such as employees of the archive department who need to provide information about patients' medical histories to other organizations such as insurance companies or prepare statistical reports for the Ministry of Health. Moreover, upper level managers who want to generate statistics mentioned above for evaluating the current status of the hospital use the Archive Module.

3.2.6 Radiology Module

Radiological examinations requested by the physicians from the clinics through the Polyclinic Module, or wards through the Ward Module are automatically sent to the Radiology Module through the system. By using this module, physicians or radiology laboratory technicians can track the requested tests' details and the payment status of the patients (as patients have to make their payments prior to taking the test). Since patients who need a radiologic test make their appointments only after their payments are done, staff working in the radiology department have to check whether the patient made his payment or not before arranging an appointment.

The Radiology Module has a separate appointment screen that enables radiology department physicians, nurses and technicians to assign their own appointments. Through this screen, the radiology department can assign its own appointments independent from the Registration Module. Radiology department are provided these privileges due to the requirements defined on the "Principles of Hospital Information Systems Purchases" report of the Ministry of Health (Ülgü, 47).

Results of a radiological test are not necessarily images. Sometimes, physicians or technicians of the radiology laboratory have to analyze the images, report if something unexpected is observed, and provide details such as measurements. There are pre-prepared report templates in the module (Figure 4)**.** By using these

templates physicians or technicians who performed the radiologic tests can easily fill the report, without skipping critical parts. Radiologic images are stored in patient's files in JPEG or DICOM format. However, storing the images on the system is optional. As images consume storage capacity, Picture Archiving and Communication Systems software (PACS) is frequently used for this purpose.

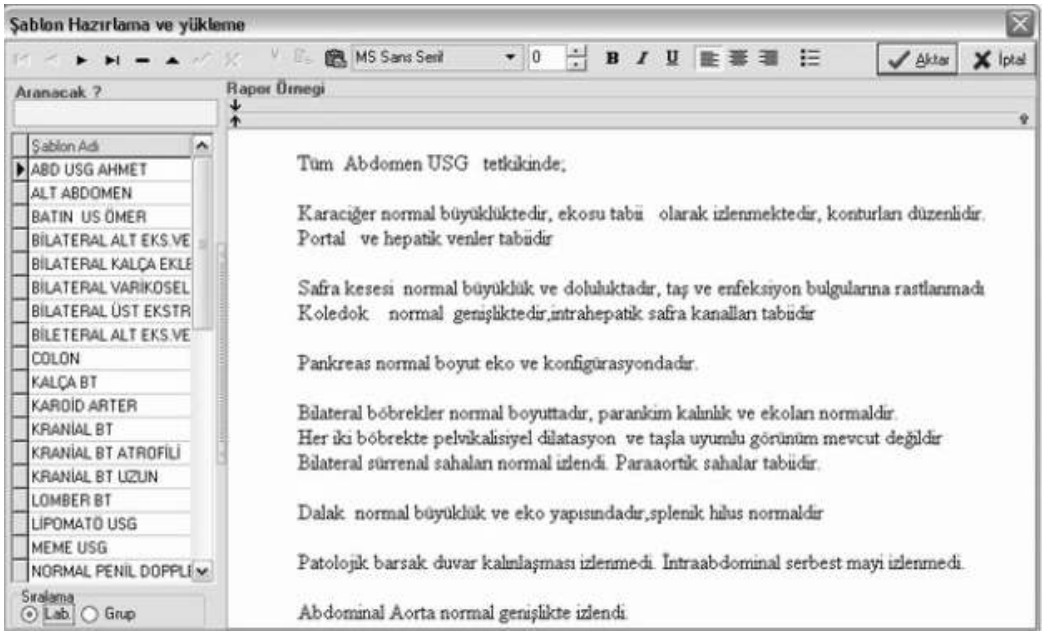


Figure 4: Radiology Module- Sample Report Template

PACS has been developed in order to provide economical storage, rapid retrieval of electronic images and reports, and simultaneous access from multiple locations (Smedema et al**.**, 373). PACS eliminates the need to file, retrieve and transport medical images or films manually. By implementing PACS, hospitals eliminate hard copy based medical images and their archives, the cost of printing the images. Additionally, as images can be reached by any hospital that has implemented the same software, images can be transferred to other hospitals.

A PACS consists of four basic components which are the archives for storage and retrieval of images and reports, workstations for reviewing images, a secured network for transmitting patient information and images, and imaging

equipments such as Magnetic Resonance (MR), or Computer Tomography (CT) (Huang et al.,17). HasBilSoft provides the network for transmitting the information and images, and workstations. Archives are owned by PACS and imaging equipments are owned by the hospitals.

3.2.7 Compendium Module

The Compendium Module enables data transfer between the National Social Security Institution and private health insurance companies, private health insurance companies and the hospital. The hospital tracks the status of payments from NSSI, payment dates, payment cuts, total amount of payment that is going to be received from the NSSI or the insurance company through the Compendium Module. Patients are classified according to their institutions and their invoices are prepared by this module.

3.2.8 Registration/Discharge of Inpatients Module

From registration to discharge, medical and administrative data for inpatients - such as the room number where the patient is staying- are stored in the Registration/Discharge of Inpatients Module. Patients are assigned to an available room in the ward. As treatments or tests performed and drugs or consumables used are assigned to the patient's file, the amount of payment the patient has to make is calculated through this module easily at discharge.

3.2.9 Ward Module

By using the Ward Module, inpatients' laboratory tests and drugs are requested. Diagnosis and treatments can be reported through this module in addition to the Polyclinic or Surgery Modules. Epicrisis Report preparation and test request

pages work in the same manner as in the Polyclinic Module. Similar to the Polyclinic Module, there are prepared report templates for Epicrisis Reports.

3.2.10 Infants' Room Module

Newborns' status is tracked through the Infants' Room Module. Tests, drugs and consumables are requested through this module. The baby's birth report including height, weight, and complications during birth are prepared using this module.

3.2.11 Accounting Module

The Accounting Module is used for preparing the receipts and invoices, tracking the cash flow, organizing the current assets and current liabilities, and keeping track of general ledger and balance sheet (Figure 5).

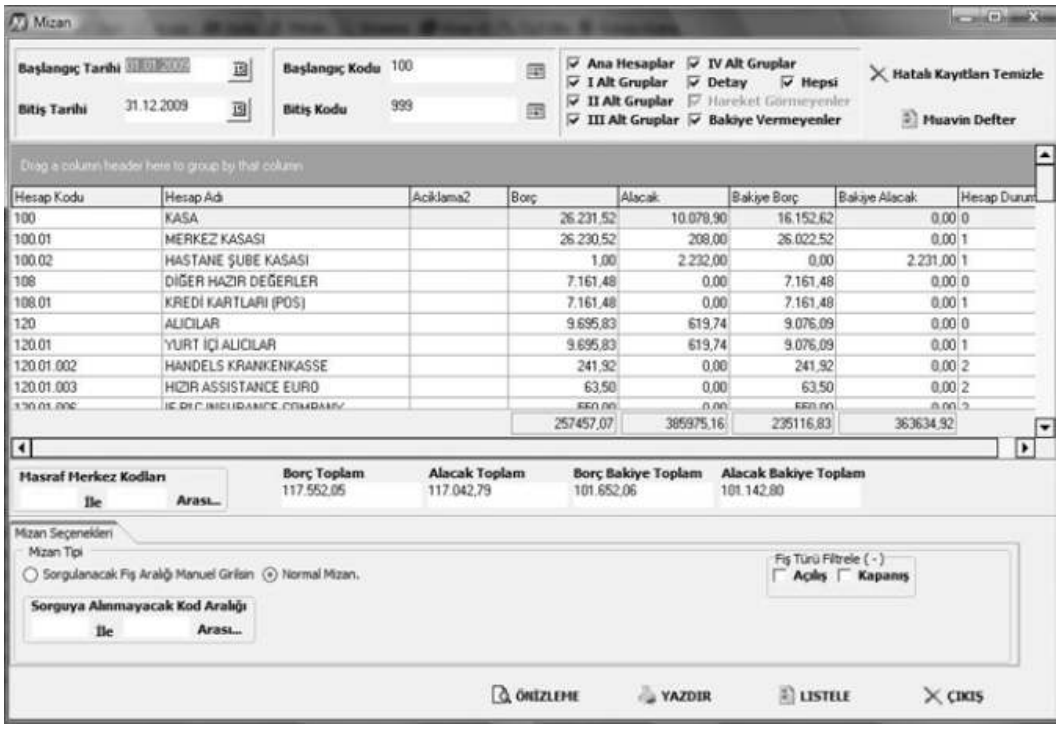


Figure 5: Accounting Module- Ledger

Receipt and invoices prepared at the pharmacy, receipts prepared at outpatients discharge or appointment approval are automatically routed to the Accounting Module. Cash inflows and outflows are directly reflected into the balance sheet, ledger or the cash flow statements of the hospital. For other infrequent purchases or activities that may result in an outflow (such as an equipment purchase which is a significant investment) amounts are entered manually.

Human resources operations are also controlled through the Accounting Module. Job applications are stored in this module and an applicant pool is created. Current employees' background information, capabilities and shifts are also reached through this module in addition to the Management Module.

3.2.12 Pharmacy and Inventory Module

The Pharmacy and Inventory Module is used for tracking the drugs' and consumables' inventory levels of the pharmacy department itself and other departments. The type of inventory held in each department and required inventory levels of each department are defined into the system through the Pharmacy and Inventory Module by pharmacists (Figure 6). The system automatically notifies pharmacy staff when a department is likely to face inventory shortage. Drugs and consumables can be transferred from the pharmacy to the departments or between the departments –if the pharmacy is out of stock- with the help of this module and with the approval of pharmacists.

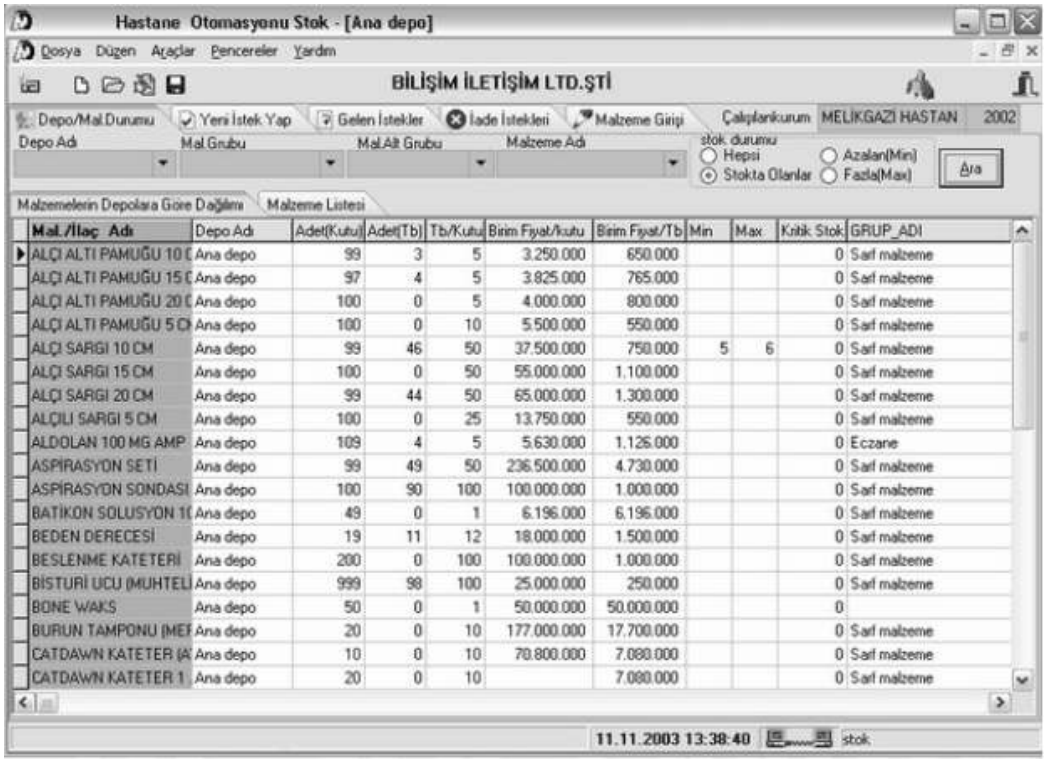


Figure 6: Pharmacy and Inventory Module

Pharmacists can define drugs' equivalents into the system if there are available substitutes in the market. When prescribed drugs are not in stock, equivalent drugs can be sent to the departments. When the pharmacy has to purchase drugs and consumables from suppliers, orders are prepared via the Pharmacy and Inventory Module by the pharmacists. Since drug vendors and prices may change frequently, the purchasing process is carried out manually; the Pharmacy and Inventory Module does not generate purchase orders automatically.

Drugs and consumables used are assigned to the inpatient's files through the Pharmacy and Inventory Module. Drug prices are entered into the system and updated by the pharmacists.

3.2.13 Surgery Module

The Surgery Module is used for retrieving and updating surgical patient's complaints, diagnosis, treatment and physical examination results that are already entered to the system at the polyclinics. Additionally, laboratory tests can be requested from this module. The Surgery Module is the same as the Polyclinic Module. The only difference is the "Surgery Notes" page into which physicians enter their notes such as complications and additional operations performed. These notes are automatically transferred into the Epicrisis Report.

3.2.14 Queuematic Module

The Queuematic Module is used in polyclinics by the physicians or nurses, and in laboratories by the technicians for calling the next patient in line. Patients who made their payments become visible at the Queuematic Module's screen. However patients are ranked according to their payment times instead of their appointment times. Payment time and appointment time are reconciled manually by the physicians, nurses or technicians in polyclinics or laboratories. When physicians, nurses or technicians call the patients by double clicking on the patient's name on the Queuematic Module screen, the patient's name appears on a screen placed in the reception area of the polyclinic.

Even though HasBilSoft has 14 modules, some of the modules are not used. Asclepios Hospital does not use the Infant's Room Module as the hospital does not have an infant's room. Similarly, Laboratory Module and Pharmacy and Inventory Control Modules were not used until 2008. As the hospital expanded over time, the number of patients and transactions increased, some of the operations that had been carried out through paper based forms started to cause delays, and as a result management decided to implement these modules.

CHAPTER 4

ANALYSIS OF THE HOSPITAL'S INFORMATION SYSTEM

This chapter presents the methodology used for analysis at Asclepios Hospital, as well as, the analysis of the workflow based on the processes performed at the hospital in relation to the HIS.

4.1 Methodology

A structured top down analysis is performed, to investigate the work and information flow at Asclepios Hospital.

System investigation is handled through;

- Interviews: In each of the departments, units and desks visited, semi-structured, face to face interviews with system users (including physicians, nurses, technicians and administrative personnel) are conducted. Throughout the interviews, users' perceptions of the system, the tasks they are responsible for, how they handle the tasks, in what aspects the system does not meet their requirements, how they handle difficulties caused due to the system's inefficiencies, and the common problems they face are asked. As the hospital has implemented the system prior to opening the hospital, comparative questions such as how the system improved their decision making, or shortened the duration of tasks could not be asked.
- Document Inspection: The instruction manuals of the software used, the hospital's procedure manuals, and information booklets about the hospital and HasBilSoft are examined to gain an understanding of the processes and the software.

- Observation: Employees performing their daily routines are observed. As observations are performed without disturbing the personnel's duties, problems that the personnel are not aware of are noticed.

Questionnaires are not used as the size of the hospital enables interviewing with the majority of the employees. The distribution of the 38 employees interviewed is as follows;

- 4 executives
- 2 IT personnel
- 2 pharmacists
- 5 physicians
- 7 nurses
- 3 technicians
- 15 administrative personnel

Aside from face to face interviews, observations of at least an hour are performed at different desks, departments and units.

The flow diagram (Appendix 3) present an overview of the work, information and material flow among departments.

Task identification is performed for each subsystem. Key tasks that are performed frequently are studied carefully. Triggers of the processes, inputs, format of these inputs, where these inputs come from, types of outputs, where the outputs are used (Appendix 4), the logical flow of the processes, indexes or keys used to track the records, and types of controls are investigated.

In order to see the time impact in work flows, time studies are conducted at the outpatients registration desk (Appendix 5).

How the system uses resources to handle processes, and how data is turned into information are studied through data transactions, and reports. For each of the processes, record examinations and document examinations are conducted. In addition to the forms used through the Hospital Information System, paper based forms are examined in order to identify the information requirements of the departments that cannot be satisfied by the system.

Additionally, the type of the data that is entered and its format, information processing capabilities of the system are observed to identify how the system can be improved.

4.2 Analysis

Asclepios Hospital purchased and implemented its information system (HasBilSoft) at the establishment phase of the hospital. The hospital's organizational chart was developed according to HasBilSoft's capabilities. Accordingly, the division of responsibilities is closely interconnected with the design of the modules, in other words each department is authorized to use a specific module. To give an example, the registration of inpatients and outpatients are managed from two different modules in HasBilSoft. As a result, there are two separate departments for the admission of inpatients and outpatients. On the other hand, two different functions of the same module are assigned to two different departments in some situations. For instance, the Registration Module's appointment function is assigned to the appointment desk, while the registration of outpatients is assigned to the registration of outpatients desk.

The hospital's workflow and information flow is triggered by the arrival of the patient. As the patient follows the procedures, visits different departments and physician's offices, and gets different tests, users enter inputs into the system. The processes performed are described below.

4.2.1 Outpatients Registration

All patients are registered into the system during their first visit to the hospital. The registration process is carried out by the registration desk over the Registration Module for outpatients of the HasBilSoft system.

When a patient arrives at the desk for registration, initially his or her registration status is checked. By asking the patient's name, surname and birth date registration desk personnel control if the patient is already registered or not.

If the patient is not registered, the patient's national ID number, mother's and father's name, place of birth, date of birth, social security status, social security institution (NSSI or private health insurance company), cellular phone number and home address are asked. Even though HasBilSoft also enables registration desk personnel to enter blood group, home and work phone numbers, and with whose recommendation the patient visited the hospital, those fields are not filled mainly because these fields are not mandatory to fill. Additionally, outpatients' registration desk personnel try to shorten the registration process as much as possible by leaving noncompulsory fields empty. After the required information are entered into the system, HasBilSoft checks whether a patient with the same information is recorded or not, then automatically assigns a unique file ID to patient. If there is another patient with the same information, HasBilSoft warns desk personnel.

There are two outpatients registration desks, which are located on different floors of the hospital. The total number of employees working at the registration desks is 7. At the steady state, registration desks do not face long queues. However during rush hours, which are 9:00 to 11:00 and 15:00 to 17:30, there may be 10 to 15 patients waiting in line.

Each patient file is kept for 5 years after the latest arrival of the patient. HasBilSoft does not notify users after 5 years. Files are scanned and erased manually by the archive personnel. Prior to removing the patient's file from the system, it is backed up. According to the Private Hospital's Regulations which was published in the Official Journal on March 27, 2002, files should be kept for at least 20 years. Therefore those back ups are held for 20 years at an external database.

4.2.2 Inpatients Registration

After the patient's initial diagnosis is performed in clinics, physicians may find it necessary to perform a surgery, or hospitalize the patient. In that case, physicians in the clinics fill a Patient Hospitalization Form manually and deliver it to the patient. On that form, patients name and surname, physician's name and surname, diagnosis, the surgery or treatment to be performed, name of the ward where the patient will be hospitalized, and time of the surgery, if necessary, are written. Patients are then directed to a separate registration desk that is assigned for inpatients. The Registration/Discharge of Inpatients Module is used at this desk.

The reason why the registration desk for inpatients is separated from the regular registration desk is related with the capabilities of HasBilSoft, and how the operations are preferred to be performed within the hospital. As those patients' condition is tracked from and recorded into a paper based file instead of the HasBilSoft system because of practical reasons, a new file is assigned to them. Additional information on why paper based files are preferred in wards is discussed in the "Inpatient Treatment" process.

At the registration for the inpatients desk, the patient's file is first found from the system and his or her status is turned to "inpatient". By this change, the patient's

payment time changes; inpatients make their payments at discharge. Later, department personnel ask for the patient's national ID card and start to prepare the patient's new paper-based file. From the system, the patient's information is obtained, and 8 labels that include patient's ID information, patient's birth date, file ID, protocol ID, name of the physician who performed the diagnosis, name of the clinic where the patient is going to be hospitalized, social security institution, and patient's arrival time are printed (Figure 7). Two of these labels are placed in the file itself and act as identifiers. The remaining six labels are placed on the informed consent forms, hospitalization form and contracts, which asks for some of the information written on the label. Even though these labels include unnecessary details, it saves the inpatients registration desk's personnel from filling these forms manually. Patients are then asked to sign the informed consent forms and contracts.

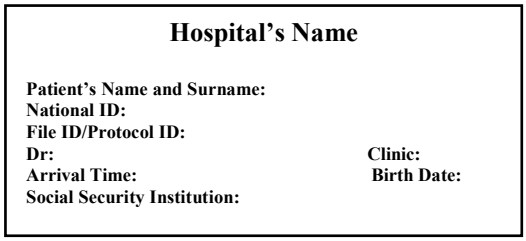


Figure 7: Labels Printed at the Inpatient Registration Desk

Protocol IDs are used for receiving payments from private health insurance companies or the National Social Security Institution, and ensuring that the patient's social security is valid, or in other words for getting provisions. A provision is a two way agreement between the hospital and the National Social Security Institution or private health insurance companies. NSSI or the private health insurance company confirms that the patient is registered into their security system, gets the protocol ID from the hospital, and ensures the hospital that drug and treatment expenditures will be covered fully or partially upon receipt of the Epicrisis Report.

Each paper-based file that is prepared at this desk includes a copy of the patient's ID card, Patient's Hospitalization Form which is manually filled by the physician, File Checklist which includes the names of the forms that should be included within the file when the patient is discharged, a contract about the payment –patients have to pay for the drugs that are not paid by the NSSI or private health insurance company-, Patient's Rights, a blank Epicrisis Report and a blank Surgery Report. When the file is complete, the patient is sent to the ward with the file.

There are two personnel working at this desk. Patients are informed about their rights and obligations at that desk as well. Since the volume of patients who have to be hospitalized is relatively low, this desk does not face queues longer than 2 people at a time.

4.2.3 Appointment

Appointments are given through the Registration Module. Asclepios Hospital has an appointment desk for arranging patient appointments. Every patient has to pass through the appointment process. The only exception is for patients requiring an appointment for a radiologic test. The radiology department (excluding the ultrasonography unit) gives its own appointments.

There are three ways of getting an appointment from the appointment desk. Patients may visit the desk, use the call center of the hospital or make an online appointment through the Internet. There are three personnel working at the appointment desk. There is not any division of responsibilities for these personnel therefore each person working at that desk has to check the Internet for appointment requests, answer phones or greet patients who prefer to visit the desk in person. The online appointment system has been recently implemented, and is not frequently used by patients. According to the hospital management, the

reason why the online appointment system is not used is due to patients' being unaware of the new system. However, patients may not have the capability to use the online appointment system since they may not have access to the Internet.

Patients who personally visit or call the appointment desk are first asked for the clinic they want to get an appointment from. If patients do not have any idea about which clinic they have to visit, a counseling service is offered by the appointment desk personnel. By listening to the basic complaints of patients, they suggest a clinic to visit. After deciding the clinic to get the appointment from and appointment time, patients are asked about their registration status. If the patient states that he or she has a registration, his or her name and surname are asked and entered into the system. Then, the patient's mother's name is asked in order to check that the result obtained from the query is true. By double clicking the result obtained from the query, registration desk personnel assign the appointment time to the patient and complete the appointment process. If the patient does not have a registration or if the query does not return a patient with the name mentioned, the patient's name, surname and cellular phone number are asked and entered into the system on the appointment screen.

The online appointment system is slightly different from making appointments through the call centre, or visiting the appointment desk. Even though patients submit their names, surnames, clinic to be visited, physician's name (Clinic to be visited and physician's name are selected from drop down menus. In some polyclinics, more than one physician works), appointment time and date, cellular phone number and e-mail address on the appointment form, there is no mechanism that checks if the appointment time requested by the patient is available or not. Therefore, the appointment desk personnel return to the patient through calling him or her via telephone, in order to re-arrange the appointment time when the original request of the patient cannot be fulfilled.

In addition to the patients who want to make an appointment at a specific clinic for the first time, the appointment desk is visited by patients who want to make an appointment for a control. During control visits, patients' laboratory test results are analyzed by their physicians; therefore the control appointments' date is determined considering the time when the test results are going to be ready. Patients usually learn the time when they could obtain their test results from the technicians or nurses who perform the test. The system does not notify the appointment desk personnel about the time when laboratory results would be ready. If the patient states an earlier date, when he or she arrives for the control appointment, laboratory results are not going to be ready. The patient has to make another control appointment in that situation. If the patient is coming for a control, the appointment desk personnel enter the type of examination as control on the appointment screen.

The appointment desk is also visited by patients who need to have a laboratory test. Appointment desk personnel give appointments for the ultrasonography unit and phlebotomy unit. However, the phlebotomy unit runs according to a appointment basis only during rush hours which are 9:00 to 11:00 and 15:00 to 17:30. Patients who arrive at the hospital at another time do not have to make an appointment for visiting the phlebotomy unit.

Radiology laboratories (except ultrasonography unit) in the hospital hold their own appointment information due to two reasons. First of all, the Appointment Module of HasBilSoft does not access the radiology laboratories appointment information due to requirements of the Ministry of Health as mentioned previously. Secondly, in the radiology unit appointments are arranged according to the number of personnel available. For example, even if the mammography machine is available at a specific hour, laboratory technicians may be busy performing another test, in which case the patient has to wait for a technician to complete his or her task. Due to the fact that the appointment desk personnel

cannot check if there is an available technician in the laboratory at the mentioned hour and cannot check the shifts of the technicians from the system, the radiology department arranges its own appointments.

Patients who have to take a test from the laboratories are already registered to the system since they visit the laboratory after a medical examination. These patients have to make their payments prior to making an appointment as opposed to the patients who make medical examination appointments. Therefore, in the radiology laboratories, personnel who assign the appointments check the payment status of the patient from the patients' file through the system. Radiology unit personnel find the file of the patient by entering the patient's name, surname and mother's name into the system. In addition to the payment information, laboratory technicians also check the laboratory test requested by the physician from the patient's file. Considering the time required for the operation, technicians assign an appointment to the patient.

Patients who are required to visit the phlebotomy or ultrasonography unit also have to make their payments prior to visiting the laboratory. Therefore, laboratory test appointments are not finalized until the patient has made the payment.

For each appointment process, appointment desk personnel choose clinic and date from the screen, check for available hours from the table opened on the same screen, inform the patient about the available hours and enter the necessary information such as patient's name, surname and cellular phone number into the appointment table. If a patient is already registered on the system additional information -cellular phone number- is not asked from the patient, it is automatically filled by the system.

Patients who are waiting in line at the appointment desk always have priority over patients who are calling the department. Therefore, if all three personnel are busy, no one answers the telephone. Due to this fact, patients who are calling the department through the call center may not get any response.

4.2.4 Outpatient Appointment Approval and Payment

Regardless of being registered to the system or not, each patient has to visit the registration desk upon arrival at the hospital. Appointments are not finalized until the patient comes to the hospital and pays the examination fee. Appointment approvals and payments are performed at the registration desk over the Registration Module. As mentioned above, radiology laboratories have their own appointment system. Patients who need to visit the laboratories have to make their payments prior to asking for an appointment.

When a patient arrives at the registration desk for an appointment approval, appointment tables are checked through the system to see whether an appointment has been made or not. If the patient has no appointment, he/she is directed to the appointment desk. If the patient has an appointment, registration desk personnel have to check the payment to be made by the patient prior to finalizing the appointment. Prices of examinations, which are entered to the system by the accounting department once, depend on the patient's social security status and institution. Based on this, HasBilSoft calculates the payment to be made by the patient.

Each appointment can be seen from the patient's file. If the patient took the appointment before getting registered to the system, registration desk personnel find his or her appointment from the appointment screen and update the appointment by allocating a dedicated time slot to the patient once more, after creating a file for the patient. The patient may have different appointments from

different clinics. For each examination, he or she has to make a payment. Whenever the patient makes the required payment, registration desk personnel approve the appointment from the system. HasBilSoft automatically allocates a protocol ID to each approved appointment. For each different clinic to be visited, patients are assigned a unique protocol ID. In other terms, if the patient is to visit both cardiothoracic surgery and urology clinics, one protocol number is assigned for cardiothoracic surgery and one protocol number is assigned for the urology clinic.

As mentioned in "inpatients registration" process in section 4.2.2, protocol IDs are used for getting provisions from the health insurance company. The National Social Security Institution (NSSI) carries out this process through the MEDULA system. MEDULA sends a Tracking ID for each provision approved. These tracking ID's are stored in the patient's file. Epicrisis Reports that are prepared through the HasBilSoft system are sent to the NSSI and other health insurance companies with the protocol ID (and tracking ID if available) attached. Details on how the Epicrisis Report is generated are described in section 4.2.5.

There is an interface that links HasBilSoft to MEDULA. However due to problems in the MEDULA system, this interface cannot be used. Normally the interface enables users to ask for the provision over the HasBilSoft system and receive the tracking ID as a response. However, the MEDULA system does not operate smoothly and provisions are approved with a time lag of approximately 5 hours. Due to this fact, registration desk personnel ask for the provision over the web site of MEDULA, record the patient's national ID number on a separate sheet of paper and leave the tracking ID part of the patient's record empty. At the end of the day, personnel use MEDULA to search for the tracking IDs assigned, and match the tracking IDs of each patient with protocol IDs. Later, tracking ID's are entered to each patient's file manually.

The validity of protocol IDs depends on the health insurance institution of the patient. In other words, each health insurance institution determines the duration of their protocol's validity. For the National Social Security Institution or each private health insurance company, the hospital's IT department enters protocol ID's validity durations to the system through the Management Module. For the National Social Security Institution, each protocol ID can be used for 10 days. During these 10 days, patients do not have to pay for any control examinations. But if a patient comes for a control appointment after 10 days, he or she has to pay for the examination.

After a protocol ID is assigned and the appointment is approved, a pair of labels (Figure 8) are given to the patient. This label includes the patient's name, surname, birth date, file and protocol IDs, the hospital's code, national ID number, clinic to be treated, date, name of the physician and social security institution. Patients have to deliver these labels to their physicians as one of the labels is attached to the paper-based Patient Record Book in the clinics, and the other is attached to the prescription when necessary. Physicians do not write more than one prescription per visit. Therefore, one label satisfies the demand. As physicians do not have label printers in their offices, a patient who has lost his or her labels or prescription must visit the registration desk once more.

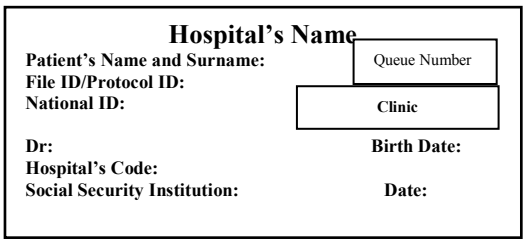


Figure 8: Label Delivered at the Outpatients Registration desk

Sometimes, employees may forget to approve the appointments. Whenever that happens, the patient is not called from the polyclinic at the appointment time, and when the patient notices that and learns that his or her appointment is not approved at the registration desk yet, he or she returns to the registration desk, shows the payment receipt and asks for an approval. The patient who faces that problem can swap his or her appointment time with the following patient in line personally; or, if the patient notices the problem early, he or she can take the approval and visit the physician in the time slot allocated for the appointment which is usually 30 minutes.

The flow chart of outpatient appointment approval and payment process is provided in Appendix 6.

4.2.5 Medical Examination and Preparation of Epicrisis Reports

Clinics are visited by patients on an appointment basis. Each clinic can reach its own appointment information entered at the appointment desk through the system using the Polyclinic Module. Clinics have to use two different screens in order to track the appointments and call patients when their appointment time comes. One is the regular appointment screen which is filled by the appointment desk personnel. However, patients who have not made their payments are also included on this screen. The other program used for tracking appointments is the clinic's own queuematic program. Whenever each patient pays for his/her examination and their appointments are approved, patients get visible on the queuematic screen. However, patients are not lined up on the queuematic screen according to their appointment time but according to their payment time at the registration desk. Therefore, physicians have to check both the queuematic screen and appointment screen in order to call patients at their appointment time. When a patient's appointment time comes, the physician double clicks the patient's

name from the queuematic program's screen through HasBilSoft, the patient's name appears on the screen that is placed at the reception area.

In emergency situations, patients directly go to the emergency department. Whenever that happens, physicians are called to the emergency room. In such situations patients who have an appointment have to wait.

During each patient examination, physicians are responsible for performing various tasks. First of all, they have to retrieve the patient's identity information (including name, surname, age, gender, cellular phone number and address) from the system and create an Epicrisis Report (Appendix 7). Then, they listen to the patient's complaints, perform the necessary examinations, order laboratory tests if required, diagnose and suggest a treatment. They also have to fill a prescription manually if the patient needs to use drugs.

Due to the requirements of the Provincial Directorate of Health, each clinic has to fill a Patient Record Book and keep track of patients' protocol IDs, examinations and diagnosis. This record book cannot be automated as Patient Record Books are delivered by the Provincial Directorate of Health. Aside from this, physicians have to fill out the Epicrisis Report. On the Epicrisis Report, the patient's complaints, former illnesses, physical examinations performed, diagnosis, type of treatment and laboratory tests performed have to be written. As some of those information are already stored in the patient's file, the Polyclinic Module automatically retrieves them and fills the report. For instance, results of laboratory tests ordered are automatically placed under the physical examination title. However, captions like patient's complaints, former illnesses, diagnosis and type of treatment are entered to the system by the physician.

As the duration between two appointments is 30 minutes, and examinations usually take less than that, physicians have enough time to fill Epicrisis Reports.

However, when examinations take longer, or physicians leave their rooms in order to have a break, they do not fill the Epicrisis Reports from the system, but fill the Patient Record Book instead. In such situations they either fill the Epicrisis Reports at a later time, or let their secretaries fill the Epicrisis Reports by using the information written on the Patient Record Book.

4.2.6 Laboratory Test Request

After the diagnosis, patients may be directed to laboratories when tests are required. Physicians choose the necessary laboratory tests from the system through the Polyclinic Module. For simplicity, tests are categorized and packed under different titles. For instance a physician may choose the microbiology pack that includes a urinary test and specific blood tests by only checking the microbiology pack title from the system. This is beneficial in two ways. First of all, physicians do not forget to choose some of the required tests as the system automatically selects all tests. Secondly, selecting a pack takes less time than finding each test from the system and selecting them one by one. As soon as these tests are assigned from the clinics by the physicians through the system, patients return to the registration desk, make their payment, make an appointment if necessary and take the test.

Laboratory tests are requested from the wards for inpatients as well. However, this process has some distinctions for inpatients. First of all, as all tests performed while the patient is staying at the hospital are included in the price of the surgery or treatment, patients do not have to pay for any of the tests performed, and do not have to make appointments. Additionally, apart from the tests that require utilization of fixed equipment such as Magnetic Resonance, test samples can be taken at the wards. As a result, the necessary equipments for printing barcodes for tests are provided to the nurses at the wards. As the module in the wards for ordering laboratory tests is the same as the one used in the clinics, the laboratory

tests that have been ordered cannot be processed until the tests' payment status is approved. As payment approvals can only be done by the outpatient registration desk, or the department itself (each department has the capability to verify its own patients' payment status), ward personnel are given the authorization to use the laboratory department's user ID. In other terms, in each of the wards, two different sessions of HasBilSoft are opened which are Laboratory's session and Ward's session. Ward personnel request the test through the Ward Module, then login to the Laboratory Module, find the test requested from the Laboratory Module's screen and approve the payment status of that test even though no actual payment is required. Only after the payment status of the test is approved, can laboratory technicians start the process.

4.2.7 Laboratory Test Approval

Even though test requirements are entered into the system by the physicians in clinics or wards, each required test has to be approved, and only the outpatients have to pay for the laboratory tests beforehand. Payments are made at the registration desk through the Registration Module. Registration desk personnel can check the tests to be performed and their costs from the patient's file. After payment, each laboratory test must be approved one by one manually by the registration desk personnel. Once the approval is completed, required tests are transferred automatically to the Laboratory Module. If blood and urinary tests are included within the tests to be performed, a set of barcodes and a label (Figure 9) are printed at the outpatients registration. These barcodes and the label include the patient's name and surname, gender and age, date and time when the barcode is printed, name of the test to be performed and a code that represents the test wanted. Apart from the set of barcodes and the label, a list of tests to be performed is printed and given to the patient. Patients have to deliver their barcodes and the list to the laboratory. For other laboratory tests such as

ultrasonography or X-ray, neither barcodes nor the list is delivered. The barcode system is not implemented for the radiology laboratories as radiology equipments are not synchronized with HasBilSoft. Additionally, the result of a radiologic test is not necessarily a set of radiologic images. For some tests such as ultrasonography or Magnetic Resonance, radiology technicians have to write reports. Due to that reason, the radiology department's tests cannot be completely automated.

Figure 9: Barcodes and Label Delivered at the Outpatient Registration desk

The flow chart of the laboratory test approval process is provided in Appendix 6.

4.2.8 Laboratory Test

The hospital has the capability to perform most of the laboratory tests required, as they have microbiology, biochemistry, neurology, radiology, cardiology and cardiovascular surgery and gastroenterology laboratories. For other tests, patients are directed to laboratories that have agreements with the hospital.

HasBilSoft's Laboratory Module is used in all laboratories except radiology department. The following paragraphs illustrate the laboratory test process for the blood test and X-ray units.

The blood test unit requires patients to take their barcodes, list of tests, and make an appointment during rush hours. Blood test unit personnel track the

appointments through both the Queuematic Module and the appointment data of the unit to call patients during the rush hours. Else, patients are tracked from the queuematic screen only; patients who make their payments earlier are called into the room earlier. When patients are called, nurses first check the list of tests, select the laboratory tubes and take blood samples. Nurses attach the barcodes delivered by the registration desk onto tubes. These barcodes not only identify the test to be applied, but also patient's information. In some situations, the number of barcodes may be less than necessary. In such cases, nurses print barcodes through the Laboratory Module, as they have barcode printers in their rooms. In other situations, more than one test can be performed by using only one sample. As nurses cannot attach more than one barcode onto the tube, they attach the label given at the registration desk which only includes the patient's name and date and time information instead (Figure 9). Laboratory technicians have to check for the tests to be given from the patient's file through the HasBilSoft system prior to starting the testing process when there is a label attached onto the tube.

The X-ray unit and other radiology laboratories use Internet based PACS software in addition to the HasBilSoft software. Radiology laboratories can create online files for patients and upload images via PACS. Physicians' computers in the clinics and wards have ExtremePACS software which is an extension of PACS. ExtremePACS enables them to connect to the server and download the necessary images. By using this system, the hospital not only keeps radiograms of patients without using internal storage space, but also transfers the responsibility to hold archives to an external service provider.

When the patient arrives to the unit on his or her appointment time, technicians recheck the tests requested by the physicians through HasBilSoft. After that, as PACS software can not pull information from HasBilSoft software, technicians create a file on PACS. They enter the patient's name and surname, age, gender

and file ID information requested by PACS. Then, depending on the test, they prepare and adjust the equipment, prepare the patient and perform the test. Images are directly sent to the computer which has PACS software. Technicians label the films, adjust contrast and upload them. 10 minutes after the upload, physicians can reach the films through Extreme PACS by entering the patient's name and surname. If the search returns more than one result, the patient's file ID is entered as a search term as well. As the name of the images in the patient's file includes a time stamp, physicians understand which record is most recent. Radiogram images are stored on the laboratory computer for a month. By keeping images on the computer for a month, the hospital prevents possible problems caused due to Internet connection problems. Images are kept for 20 years on PACS software.

The radiology laboratories have to keep a paper-based Patient Record Book that is similar to the ones in clinics. However information registered in the book is slightly different. In addition to the patient's name and surname, name of the clinic that has directed the patient to the unit, and the tests performed are written. Diagnosis is not written in the radiology laboratory's Patient Record Book.

There are two technicians working in the X-ray unit. These two technicians may work in synchronization if two different operations are to be performed for two different patients. The time slot between two appointments is 20 minutes. Some of the tests may take longer than 20 minutes, in which case the time slot after the long operation is not used for appointments. As appointments are made by the radiology laboratory technicians, they check the previous test, estimate the duration of the test, and give the appointment accordingly.

4.2.9 Laboratory Results

Test results are automatically entered on the HasBilSoft system. Therefore patients do not have to revisit laboratories to gather their test results. Upon their next visit to the clinics (control appointments), physicians can reach the laboratory results through the patients' files and interpret the results.

When patients want to take their laboratory results, in order to keep their own archive, or consult another physician, they have to visit the registration desk. The results of blood and urinary tests can be obtained and printed from the patient's file, by entering the patient's name, surname and mother's name.

Test results can also be obtained through the Internet. Patients can enter their national ID and protocol ID into the query page over the hospital's web site and obtain their laboratory results. For the test results that cannot be printed onto paper such as X-ray or ultrasonography, patients have to visit the laboratory where the test is performed. Personnel working in those laboratories can deliver the results written on a CD. Rarely, the MR unit can print the results and deliver them to the patient. Printing the images is not usually preferred as it is costly.

4.2.10 Inpatient Hospitalization

Patients who need a surgery, or who need a treatment that requires hospitalization are directed to the ward or surgery department. As mentioned in the "Inpatient Registration" process in section 4.2.2, these patients have to visit the inpatient registration desk initially to get a physical file.

Each patient arrives to the ward with his/ her file. Nurses retrieve the patient's valid protocol ID from HasBilSoft by using the file ID. Then, by using the Ward Module, they match an available room number with the patient's protocol ID.

After the patient's transfer is completed, the patient is sent to his/her room, and the physical file is kept by the nurses.

4.2.11 Inpatient Treatment

At the wards physicians and nurses keep track of the patient's status on the patient's physical file. The reasons why they use a paper based file instead of HasBilSoft are as follows. First of all placing a terminal in each of the rooms is costly. Apart from the hardware and software costs, maintenance would also consume hospital resources. Secondly, patients who had a surgery should be monitored closely. Carrying their information in a software environment would increase the risk of security attacks, or carry the risk of being unable to reach critical information in an emergency case. Thirdly, HasBilSoft does not contain some of the forms used in the wards for tracking patients' status. Therefore, HasBilSoft's usefulness is somewhat limited in the Ward Module.

Apart from allocating patients to available rooms, HasBilSoft is used for ordering and obtaining results of laboratory tests. However, as inpatients have physical files, nurses print the results and place them in the file. As X-ray images cannot be printed, physicians who need to check the patient's radiological test results, log in to ExtremePACS through the terminal of the ward and find the patient's file.

In addition to the areas of usage mentioned above, reporting the amount of consumable used per patient to the pharmacy is another process performed through HasBilSoft. As physicians who perform a surgical operation or treatment cannot log in to the HasBilSoft during the operation, they record the consumables used on paper-based Consumable Consumption Forms. After each surgery or medical intervention, ward personnel enter the consumables and the amount used to the system through the Ward Module. As the pharmacy uses a continuous

inventory control system for the consumables, not reporting the consumable used may result in inventory shortages.

All other information pertaining to inpatient treatment are recorded on paper in wards. The Surgery Report, the Periodic Observations Report (Appendix 8) and the Epicrisis Report, the Patient's Suitability to Anesthesia List, the Preoperation Control List, the Patient's Risk Factors' Evaluation Form, the Cardiopulmonary Resuscitation Form, the Patient's Diet List, the Medical Consultation Report, the Blood Transfusion Report, the Blood Request Form, the Patient's Room Transfer Form, the Patient's Discharge Form, the Consumable Consumption Form, the Drug or Consumable Request Form (Appendix 9) and the Drug Application Form (Appendix 10) have to be filled manually whenever necessary. There are 24 forms in total. Among these 24 forms, only Epicrisis Reports and consumable consumption forms are entered to the system by the secretaries or nurses working in the wards. Epicrisis Reports in the wards are different from the Epicrisis Reports in the clinic and include notes on surgical operation.

For the consumables, an inventory control system has recently been implemented by HasBilSoft. Paper-based forms (the Consumable Consumption Form) and HasBilSoft are used together. The Consumable Consumption Form is filled in the patients' room manually, entered to the patient's file through the Ward Module at a later time for the pharmacy to review the consumable inventory. Manually filled forms are sent to the pharmacy for control. In the pharmacy, the amount of consumable used entered through HasBilSoft is compared with the amount written on the form. Sometimes nurses working in the ward forget to enter the used consumables into the system. In those situations, inventory on hand does not match the inventory on the system. As a result, wards may face consumable shortages.

Drug requests are reported to the pharmacy through paper based forms. The pharmacy assigns drugs to the patients through the system later.

In each ward there are three terminals that are used for allocating patients to rooms, reporting the amount of consumables used per patient, and ordering or obtaining results of laboratory tests.

Nurses and physicians working in wards are authorized to use the system. The input of this department to the system or the system's contribution to this department is limited even though operations carried out in wards are many.

4.2.12 Drug and Consumable Request

Asclepios Hospital has a pharmacy for supplying drugs and consumables to clinics, operating theatres and wards. The Pharmacy and Inventory Module of the HasBilSoft software is used in this department.

For patients who visit clinics, consumables may be required for either treatments or examinations. Those consumables may be used for performing initial treatment such as medical dressing. Even though physicians write prescriptions for patients in order to complete the treatment, the pharmacy of the hospital is not responsible for supplying these drugs. What are required to be supplied by the pharmacy are the consumables. Patients purchase drugs from other pharmacies. Clinics and the pharmacy are connected via HasBilSoft. Nurses working in the clinics enter the amount of consumable used per patient into the system. Whenever they need a consumable that is not assigned to the clinic, they fill the Consumable Request Form manually. To give an example, oxygen tubes are not commonly used in polyclinics. Therefore, clinics are not assigned oxygen tube inventories in the system. However when a clinic requires an oxygen tube, a

Consumable Request Form has to be filled manually. The delivery process takes 5 to 15 minutes depending on the urgency of the order.

In the wards and surgery departments, consumables are ordered in a similar manner to clinics. However for ordering drugs from the pharmacy a different procedure is used.

Only physicians are authorized to write out prescriptions, and they fill Drug Application and Drug Request forms manually and send them to the pharmacy. The pharmacy checks the availability of drugs requested, allocates the drugs to the patient's file using the protocol ID through the system, and sends the drugs to the ward. A drug requested usually arrives to the ward within 10 minutes. In an emergency situation, the pharmacist sends the drug first, allocates the drug sent to patient's file later.

4.2.13 Supplying of Drugs

In the pharmacy, for the consumables, continuous review inventory management is used. The system is working in a lot size reorder (R, Q) basis. Each ward or department can store up to a certain amount of each consumable. As they use and enter the amount consumed into the system, their stock levels decrease in the system. Whenever the stock level of a certain consumable in a certain department reaches its reorder point, the software warns the pharmacy that the stocks have to be replenished by a fixed quantity. The pharmacy sends the consumables to the department, and updates the clinic's on hand inventory level.

Sometimes, stock levels in the system may differ from actual physical stock levels. These differences are usually user related. Clinic or ward employees may forget to enter the amount of consumable they use into the system, or they may mistakenly enter consumables that are not used. Whenever they run out of stock

due to these errors, they fill a consumable order form manually and send it to the pharmacy. Pharmacists send the required material and correct the stock level on the system.

As a result of using a continuous review inventory system, the pharmacy replenishes consumable inventories of departments whenever necessary. The frequency of replenishments differs from department to department. For the emergency room, replenishments occur every other day, for the surgery theater and neurology department replenishments occur once a day, for other clinics replenishments occur once a week. For the drugs required by the wards, whenever an order comes through manual drug request forms, drugs are sent to the wards. If the drug is not available in the pharmacy, a substitute is sent.

The pharmacy department employees manage the coordination between the pharmacy and drug suppliers. Whenever the pharmacy's stock levels reach the reorder level, HasBilSoft's Pharmacy and Inventory Module alerts the user by putting an exclamation mark sign next to the drug's or consumable's name. Pharmacists scan through the drugs and consumable list to find an alert, and order that drug or consumable.

Suppliers are selected by the pharmacy employees, on a bidding basis. The supplier who offers the lowest price is selected each time a purchase order is issued. Long term relationships are not preferred due to the competitive nature of the drug industry. Availability of substitutes is high and suppliers are many. Therefore, the hospital seeks to minimize its drug costs. Payments are done by the accounting department; the pharmacy is only responsible for tracking inventory levels, sending necessary consumables and drugs to clinics, wards and operating theatres, selecting suppliers and ordering the required drugs from the suppliers.

4.2.14 Inpatients Discharge

At the end of the treatment, when the patient is to be discharged, nurses in the wards fill out a patient's discharge form, deliver the form to the patient, and send the patient to the inpatients registration desk. On this form, the patients' name and surname, protocol ID, discharge date, number of days a companion stayed with the patient, and the patient's share of the payment are filled manually (Figure 10). When patients apply to the inpatients registration desk for a discharge, the department personnel checks the amount to be paid by the patient from the system. Similar to the outpatients registration desk, personnel can reach the amount of payment to be made from the system. Typically, surgeries have set prices, additional drugs used and their prices can be tracked from the patients' file on the system. Costs incurred due to staying with a companion are calculated after the stay is entered to HasBilSoft manually by the department personnel. After the payment is made, the department personnel change the status of the patient on the system to "discharged". Wards send the paper based files to the archive after the patient has left the ward.

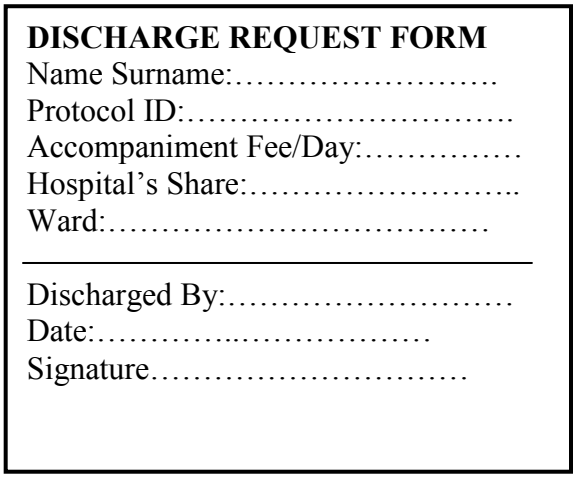


Figure 10: Discharge Request Form

4.2.15 Determining Payments

Since Asclepios Hospital is a private hospital, payments are obtained from patients, private health insurance companies and NSSI. If patients have a health insurance, part or all of the expenses are requested from private health insurance companies or NSSI. The accounting department enters contribution fees and prices of each surgery or treatment to the system through the accounting module once. The prices of surgeries or treatments are determined by the Ministry of Health. Therefore the accounting department employees update prices only if the Ministry of Health makes a change in the prices.

For each patient, the total amount of payment that includes the patient's contribution and drug prices is calculated by HasBilSoft through the Inpatients Registration or Outpatients Registration Modules. The outpatient's treatment costs do not vary since these patients cannot use drugs in the clinics, and consumable prices are already included in the treatment's price. In other terms, outpatients pay in advance. However, due to the fact that inpatients require greater flexibility in terms of operations to be performed or duration of treatment, payments are asked at discharge.

4.2.16 Receiving Payments from Private Health Insurance Companies and NSSI

The Accounting Department's major responsibility is to regulate the payments. In order to carry out this responsibility, the accounting department obtains information from clinics, wards, surgery department and pharmacy from the system and manual forms. This information is then shared with private health insurance companies or NSSI.

Patients who do not have a health insurance pay for their expenses themselves. From patients covered by NSSI or private health insurance companies, the hospital can only ask for partial payment. The remaining amount is paid by the NSSI or private health insurance companies. When the hospital requests the payment from NSSI or a private health insurance company, Epicrisis Reports must be obtained from the system. Epicrisis Reports are attached to the invoice and sent to the insurance company or NSSI. Payments are requested quarterly.

The flow of patients, materials and information explained in this chapter are visualized in Appendix 3 and summarized in Appendix 4.

CHAPTER 5

CRITICISMS AND PROBLEMS

The primary aim of using a HIS is not only limited to the ease of managing patient data, accelerating operations and reducing paperwork but also generating statistical data such as the prevalence of certain diseases, number of patients arriving in a month or physician's performances for the hospital's administrators, monitoring inventory and having better and more accurate accounting measures. However due to some inaccuracies within the software itself and users' misunderstanding of the importance of the software causes the system to operate not as efficiently as planned. The main problems faced, and causes of the problems are discussed in this chapter.

Based on the observations, examination of HasBilSoft's modules, analysis of processes, and face to face interviews conducted with physicians, nurses, technicians and administrative staffs of the hospital, several problems are identified.

5.1Tracking Inpatient's Status through the System

For inpatients, a paper based file is created. Patient's status and progress after the surgical operation or the treatment, drugs and consumables assigned, allergy records, risk assessments or complications are tracked over the paper based file. However, few of these information are later transferred to HasBilSoft. The forms that are transferred to HasBilSoft are Epicrisis Reports, laboratory results and drugs and consumables used. Other than these reports and results, none of the information can be reached through HasBilSoft at a later time. For instance, when the patient revisits the hospital these assessments have to be redone or the patient's physical files have to be retrieved from the archives. Even though personnel working in the archive

department can bring the file to the clinics if necessary, due to the fact that files cannot be multiplied, only the physician who has the file has the capability to reach the information.

Since wireless devices are not used, tracking inpatients' status through paper-based files requires physicians to move back and forth between the computer terminal and patient's room.

5.2 The Online Appointments Process

Even though the hospital has implemented an online appointment system, the system is not working efficiently. Patients pick an appointment date, clinic and physician, and enter the appointment time, their names and surnames, e-mail address, phone number and messages (Figure 11).

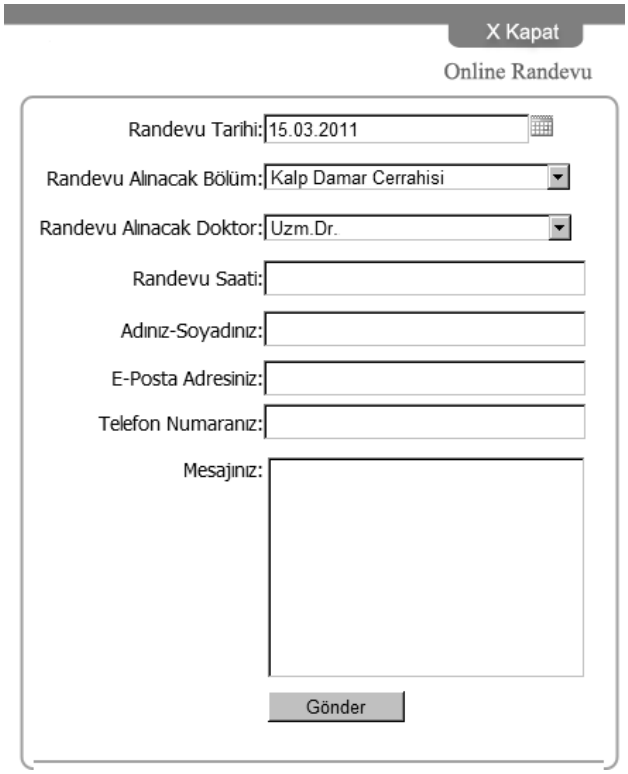


Figure 11: Online Appointment Form

While filling the form, patients are not informed about whether the time slot or date they prefer is available or not.

Submitting the online appointment form returns an email to the appointment desk personnel. If the time slot the patient asks for is available, the information provided by the patient is transferred to the appointment module manually. If the time slot is not available, appointment desk personnel call the patient and ask for another appointment date or time. Phone number is a mandatory field. Therefore, every patient has to provide a value to the phone number field. However, there is no format check, so patients can enter any value as a phone number.

The online appointment form does not contain information that differentiates registered patients from unregistered patients. Patients cannot enter their file ID's into this form. Similarly, the form does not include any key identifier such as national ID. Therefore any patient can take multiple appointments by only changing the phone number and e-mail address. Moreover, unless patients enter their appointment type (such as control appointment) to the notes, the form does not contain the appointment type.

5.3 The Appointment Process

As mentioned in section 4.2.3, patients who are not registered in the system are permitted to make appointments, even though appointments are not finalized until a payment is made. As unregistered patients do not have file ID's yet, the appointment time slot is "reserved" for the unregistered patient. The reserved time slot is allocated to the patient's file after registration and payment. Even though letting patients make appointments prior to visiting the hospital and registering on the appointment date seems reasonable, it actually opens the appointment system for abuses. One patient can make multiple appointments by providing fake information.

5.4 The Payment Process

As mentioned in sections 4.2.4 and 4.2.7, patients have to make their payments prior to taking medical examinations or laboratory tests. Registration desk personnel have to change the payment status of each laboratory test requested or medical examination appointments to “Payment Done” manually while preparing the receipts. The system can not automatically change the status of the payments. When the work load of registration desk personnel is heavy, payment approvals may be forgotten. Whenever that happens, patients cannot take the tests or visit the polyclinic.

5.5 The Laboratory Test Request Process

As mentioned earlier in section 4.2.7, outpatients have to pay for their laboratory tests before taking the test. However, inpatients laboratory tests’ costs are included in the total amount they pay for their treatment. For instance when a patient pays for the “Angiography” operation, the amount paid covers all laboratory tests, drug and consumables used while the patient is in the hospital as well as the angiography operation. Therefore, inpatients pay for their laboratory tests at the end of treatment. However, inpatients’ laboratory test requests are processed in the same way as they are for outpatients. Laboratory tests requested from the wards have to be approved, as if inpatients had made their payments. The system does not treat the laboratory tests requested for the outpatients and the inpatients differently.

5.6 Key Identifiers

Starting from the appointment process to the discharge, each and every query is performed by entering the patient’s name and surname. However, name and surname may be the same for two or more patients. When queries turn more than one result,

either the cell phone number, birth date or mother's name are asked. The additional information asked is changing from department to department or desk to desk.
Performing searches without using appropriate key identifiers results in time loss and increases the possibility of errors. Instead of patient's name and surname, unique keys such as patient's national ID number or file ID (if the patient is registered to the system) can be used in queries. Since the patient's national ID can be used for performing queries of unregistered patients during the appointment process, it would be more reasonable to use the patient's national ID as the key identifier. PACS which does not store the patient's national ID can be modified accordingly.

One possible problem that may occur when national ID becomes the key identifier can be the patient's inability to provide national ID as quickly or accurately as name, surname and mother's name. Therefore, the appointment or outpatients registration desk personnel may have to control that the patient provides the correct ID. This control mechanism is available in HasBilSoft but is not used. The outpatients' Registration Module has an interface that checks national ID number, returns ID information associated with that number, and automatically fills patients' basic ID information such as date of birth, place of birth, mother's and father's name. This function is not used by outpatients and inpatients registration desk personnel, as they do not know that the system offers such an application, and personnel enter all information manually.

5.7 Training of System Users

In Asclepios Hospital, physicians, nurses, technicians and administrative personnel use the system. During implementation, training has been given to the physicians and other personnel. Even though hospital management continues to give briefings on the importance of Hospital Information Systems and how to use the system, only administrative personnel attend the training programs. For the physicians, nurses and the technicians, training programs are not organized. These users learn how to use

the system from senior employees. Training performed by senior employees may be incomplete or inaccurate. New employees may spend a lot of time trying to discover the system's functions while they are performing their daily responsibilities. Similarly when the software is updated, no one would be aware of the upgrade as informative sessions are not available.

Refresher training about the system's functions and capabilities should be performed regularly. Through learning different functions of the software and using them, physicians, nurses and technicians may perform their routine tasks in a more effective and efficient manner.

5.8 Grouping of Processes

In HasBilSoft, certain unrelated processes are managed through a single module. For instance, Human Resources processes are managed under the Accounting Module. Through the accounting module, HR specialists of the hospital collect job applications and create an applicant pool, store current employees' background information, capabilities, responsibilities and shifts. Due to this fact, HR specialists have to learn how to use the accounting module in order to reach the specific information they need.

On the other hand, there are also some modules that are performing exactly the same processes with minor differences. For instance the Surgery Module is a slightly modified version of the Polyclinic Module.

5.9 Module Design

As the hospital grew over time, new requirements arose. HasBilSoft updates the software according to the requirements of the users. One of the recent requirements has been the queuematic system. This system is used for announcing and calling the

next patient in the appointment line at the polyclinics and laboratories. However, the Queuematic Module pulls the information from the payment screen of the Registration Module instead of the appointment screen. Therefore, patients are ranked according to their payment times instead of their appointment times. Users of the Queuematic Module have to track both the appointment screen and queuematic screen in order to call the patient on time.

5.10 Form Designs

When the paper-based and electronic input and output forms used in Asclepios Hospital are examined, problems in form designs are realized. Some of the forms such as "Labels Printed at the Inpatients Registration Desk" (Figure 7) and "Labels Delivered at the Outpatients Registration Desk" (Figure 8) present outputs in an illogical order. Outputs are not categorized based on their relevancy (like patient's ID information and appointment details) and presented in a mixed manner.

Some of the input forms capture unnecessary information. For instance, the "Discharge Request Form" (Figure 10) asks for the Hospital's Share which is a fixed amount that is already known by the accounting department.

Output forms such as laboratory reports are also problematic. As mentioned in sections 3.3.3 and 3.3.6, templates are used for preparing reports. In the template, prepared phrases about the normal findings are presented. For instance in a report for abdomen tomography, individual phrases for different parts of the abdomen (such as liver, pancreas, stomach) are presented with a note "results are normal" attached. If something unexpected is observed, the technician who is preparing the report erases the "results are normal" phrase, and enters the findings. Therefore, the final report contains unnecessary detail and useless phrases about normal results in addition to the findings. These details usually cause a loss of focus for the physician.

5.11 Controls

HasBilSoft Hospital Information System checks for systematic and random errors to some extent. For instance, it notifies the users when two appointments clash, it fills some information such as laboratory results automatically, provides report templates for the physicians and technicians, provides laboratory test packs for physicians, assigns file ID's or protocol ID's automatically, and calculates the total amount of payment to be made by the patient. However, in the fields where human input is necessary, errors may still occur.

Random errors like transpositions or transcription are frequently faced, especially in busy units such as the appointment desk or registration desk. Errors in patient's name and surname, mother's name, national ID or cellular phone number may be considered more significant when they are compared with home address. The reason why they may be more important is the fact that they are used as identifiers. Name, surname and cellular phone number are the only distinctive information obtained from the patient at the appointment desk. If they are wrong, the patient's appointment cannot be approved at the registration desk. These types of mistakes are usually corrected by the users who need that information at a succeeding step. The frequency of these errors is unknown as error records are not held.

Sometimes, some of the obligatory fields are not filled or records are not updated properly by users due to time constraints, and/or the software's failure to warn the user. A common example of this problem occurs at the registration desk. For example, even though registration desk personnel receive payment from patients for examinations or laboratory tests and print the receipts, they may forget to modify the patient's payment status. In such situations, the error is usually realized by patients who are not called at the appointment time. If the department visited is not working on an appointment basis, errors are noticed by the department personnel itself. In such situations patients are directed to the outpatients registration desk. After

approving the patient's payment status by checking the receipt, outpatients registration desk personnel correct the mistake. Another common error in this category are the unfilled Epicrisis Reports. Physicians may skip or postpone filling some of the obligatory fields such as diagnosis, as the software does not force them to do so. In those situations, Epicrisis Reports remain empty or when filled at a later time, may contain inconsistencies. The hospital suffers from these inconsistencies, especially as they cannot withdraw their payments from the National Social Security Institution. In addition, these errors are not realized until Epicrisis Reports are sent to the NSSI. Experts at the National Social Security Institution are the first people who notice inconsistencies within the reports.

HasBilSoft lacks input controls in the fields mentioned above. There are no format checks in the fields where users enter the data manually. Physicians can skip any field in the Epicrisis Report or type meaningless words to be corrected at a later time.

5.12 Guiding Users

HasBilSoft fails to notify or guide its users when some of the information is not present in the system. As mentioned in the appointment process, patients visit the clinics for controls. Control appointments have to be given after the test results are entered to the system when tests are required. However, the time required for a laboratory test result to be received is not present in the system. Therefore, at the appointment desk, for the patients who would like to make a control appointment, laboratory test requests are checked from the patient's files. Appointment desk personnel then guess the time when the results will be ready. The durations of the tests are written on a separate sheet of paper. By checking the longest test of the patient, appointment desk personnel arrange a control appointment for the patient. The system does not guide the users about the closest date available for all the tests to be completed. If the patient has to take a radiological test, this task gets even harder. Since the radiology department keeps its own appointment data, appointment

desk personnel have to trust the patient about the date of the radiological test appointment in order to arrange a control appointment. Results of radiological tests are available as soon as the test is completed. Therefore, control appointment can be on the same day with the radiologic test.

A similar problem is faced in the radiology department as well. Since each radiology test requires different durations to be performed, and equipment and staff are limited, resource allocation is performed manually by the radiology department's technicians. Prior to arranging an appointment for a patient, laboratory test technicians control the duration of the previous test for another patient from the appointment list of the unit through the Radiology Module, check if any technicians are available at the given time slot by comparing the appointment list and technicians' shift table, which is posted on the wall, and control if the equipment is available.

Additionally, the system fails to notify employees of the archive department when the retention period of patients' files has elapsed. As mentioned earlier, each patient file has to be kept for 5 years after the latest arrival of the patient. Files are scanned manually by the archive personnel; HasBilSoft does not have an application that lists the patients who have not been visiting the hospital for 5 years.

Sometimes, the system warns the users but the warning is so unnoticeable that users may skip it. For instance, in the Pharmacy and Inventory Module, inventory status is tracked through a screen which involves hundreds of SKUs. When one of the SKU's inventory level reach its reorder level, the inventory module puts a red exclamation mark near the name of the drug or consumable. Pharmacists have to track these signals carefully as they are not provided with a list or report of SKUs that needs to be ordered.

5.13 PACS in Wards

As mentioned in sections 4.2.8 and 4.2.9, results of radiologic tests are uploaded to PACS and observed through ExtremePACS software. For the physicians who have access to a computer, tracking patients' radiologic images through ExtremePACS is not a time consuming issue. However, for the physicians who are working in wards, PACS may become a problem. As these electronic images cannot be printed and placed in patients' files as other test results, physicians have to move back and forth between the computer terminal and patients' rooms throughout the examinations. For each patient, the physician has to log in to ExtremePACS, perform a search, find the most recent laboratory image, read the radiologic report (if available) and return to the patient's room. This process is time consuming and inefficient.

5.14 Clerical Work

Even though one of the major aims of implementing an information system is reducing the clerical work in processes, sometimes the system itself may cause its users to deal with additional clerical work. Or some processes that can be automated may remain manual. In Asclepios Hospital, both of these problems are faced.

In the polyclinics, physicians are responsible for filling both the Epicrisis Reports and Patient Record Book (Appendix 11) as mentioned in the "Medical Examination and Preparation of Epicrisis Reports" process. Data entered into the system and the Patient Record Book are almost the same. Epicrisis Reports involve more details such as patient's background information and complaints. In the Patient Record Book, patient's name, surname, sequence number, protocol ID, national ID, appointment date, gender, age, diagnosis and treatment are asked. Patient's name, surname, national and protocol ID, birth date, and appointment date are included in the labels (Figure 8) that patients get at the outpatients' registration desk and are attached to the Patient Record Book. However, diagnosis and treatment have to be

recorded both onto the book and in the system. This yields additional clerical work for the physicians.

As mentioned in section 4.2.4, patients who are registered to the National Social Security Institution are assigned tracking ID's through the MEDULA system. Due to the fact that MEDULA is not operating efficiently, tracking IDs cannot be received immediately. Since there is no interface that matches the tracking IDs with the protocol IDs, this task is performed manually by the outpatients' registration desk personnel at the end of the day. After sending the protocol request to the NSSI, personnel record the national ID numbers of the patients on a separate sheet of paper. In the evening, each of these national ID numbers are entered into the MEDULA system, tracking numbers are checked and recorded in the HasBilSoft system manually.

5.15 Inventory Control

Asclepios Hospital controls inventory for drugs and consumables. Clinics, surgery departments and wards need different materials. The pharmacy may supply materials directly from inventory or purchase them from a supplier.

Even though HasBilSoft has an inventory module, it has limitations on controlling the inventory levels. The system uses a continuous review inventory model. However, the success of the model depends on the users' involvement. As mentioned previously, system users may not enter the consumables used accurately. Discrepancies between the stock levels observed on the system and the actual stock levels may result in inventory shortages.

Additionally, management needs to track the amount of consumables used for each patient per treatment. Consumables are not costly when compared with the overall cost of the treatment. However, management still needs to track the amount of

consumable used per treatment per patient as they want to control whether abuses exist. Consumables may be stolen from the hospital or may be used excessively.

In HasBilSoft, it is impossible to track the amount of consumable used for each treatment type per patient. Determining the amount of consumable used per treatment per patient helps management to compare the estimated amount with the actual amount as the treatments performed are known. Therefore, hospital management is thinking of a way of the monitoring amount of consumable used for each patient and each treatment type.

5.16 External Service Providers

Asclepios Hospital asks HasBilSoft for customizations whenever necessary. Sometimes upgrades are performed automatically by HasBilSoft. For instance, when the Ministry of Health stipulates an improvement in the software, HasBilSoft works on the development and implements it before the hospital's request.

The hospital uses other external services such as for PACS used in radiology. By using this software, the hospital does not incur the cost of printing films, or the maintenance of printing machines. Additionally, the responsibility of carrying archives is transferred to an external service provider. Therefore the hospital does not carry archives of films.

However, this dependency also has its drawbacks. The hospital does not have control over their databases, and confidential patient information are delivered to a third party. It is the software vendor's responsibility to keep patient information secure. Due to the fact that archives and logs are carried by PACS, in an emergency situation the hospital may not be able to reach its images. Additionally, the use of PACS makes the hospital dependent on the Internet as well. When the hospital faces Internet access problems, radiologic images cannot be synchronized therefore, cannot

be shared with clinics or wards. This problem occurred several times in the hospital. In those situations, physicians of clinics or wards rush into radiology laboratories, asking for radiologic images of their patients. As a precaution, the radiology department backups images on its computers. However, the radiology department's computers cannot carry images older than a month due to the fact that their storage capacity is limited. As a result, images taken more than a month ago cannot be reached when the hospital has to deal with Internet access problems.

5.17 Withdrawing Payments from the National Social Security Institution

In order to prevent imbalances among private hospitals and public hospitals, and in order to create standardization, NSSI implemented a policy. According to that policy, for each type of illness, different packages are defined. Each package has a predetermined price and in each of these packages, examinations and treatments that can be performed are defined. For example, a patient who may be suffering from embolism can be asked for blood tests, electrocardiogram, and effort test and can be treated by angiography. The cost of all these operations are calculated by NSSI and announced under a package program. Therefore a hospital can ask for that predetermined price for any patient. For a private hospital, there is an exception in that procedure. Up to 30% more than the predetermined price can be asked from the patients. In any case, the fixed package price is paid by the NSSI additional 30% should be paid by the patient. Private health insurance companies may pay that package price partially or fully depending on the agreement between the hospital and the private health insurance company.

If the payment is to be done by the National Social Security Institution, the hospital has to send epicrisis or surgery reports to the NSSI. NSSI controls these reports in order to see if hospitals are asking for more tests than required, or applying unnecessary treatments which may result in higher costs than required.

NSSI issues payments on a quarterly basis. Therefore, the accounting department collects the required reports and sends them to NSSI with a report of the amount of payment asked. NSSI randomly chooses 5% of Epicrisis Reports and presents them to the institution's experts. Experts closely check these reports, read patient's complaints, examinations and treatments performed. If they come across a mismatch, they inform the institution. NSSI has the right of refusing payment or making a deduction in the amount to be paid. In such a case, NSSI returns the reports to the hospital, and asks for a correction. If a correction can be performed, reports are sent to the physician who had wprepared the report. Physicians make the necessary corrections and the reports are returned to NSSI. If corrections cannot be made, NSSI rejects the payment request. In any case, payments get delayed which is an undesirable case. All corrections are carried out manually.

Asclepios Hospital faces 2% payment loss annually. When hospital management investigated the reasons for payment cuts, they realized that Epicrisis Reports miss some essential information such as diagnosis. Lack of information on the reports lead experts in NSSI to think that physicians at Asclepios Hospital perform certain tasks without a valid reason. As performing unnecessary tasks violates NSSI's payment policy, the hospital faces undesirable payment cuts.

Considering the fact that Epicrisis Reports are prepared using HasBilSoft, and the system presents the titles to be included in the report, problems with reports are associated with users and system controls.

Physicians who are working in the clinics are responsible for many tasks. They have to listen to the patients, perform necessary examinations, diagnose the illness, suggest a treatment, record patient's information, illness and examinations applied into the Patient Record Book, and fill the Epicrisis Report through the software. When clinics are busy, physicians may postpone writing the Epicrisis Report and do it later by checking what is written in the Patient Record Book, or they fill the

Epicrisis Reports improperly. Additionally, as some of the physicians lack the necessary computer skills, they ask their secretaries to fill Epicrisis Reports. A secretary cannot fill the Epicrisis Report as detailed as a physician could as the Patient Record Book does not contain all details required in the Epicrisis.

Even though HasBilSoft tries to ease physicians' responsibilities by filling some of the required fields of the Epicrisis Report automatically, their busy schedule often prevents physicians from giving the required importance to the Epicrisis Reports. Moreover, for the physicians who do not have the necessary computer skills, no training is performed.

5.18 Requirements of the Ministry of Health

Some requirements of the Ministry of Health are not fulfilled in HasBilSoft.

- The system does not provide the patient with a list of requirements for taking tests. For instance, certain blood tests require patients to stay hungry for at least 8 hours. These requirements are stated to patients by physicians or appointment desk personnel. However, patients may forget what is verbally stated and additionally, appointment desk personnel or physician may misinform patients unintentionally.
- Drugs' and consumables' expiry dates are not defined on HasBilSoft as stipulated by the Ministry of Health. Due to this fact, pharmacists have to physically check expiry dates of drugs and consumables held in inventory one by one.

CHAPTER 6

RECOMMENDATIONS AND SYSTEM DESIGN

Considering the requirements of the Ministry of Health, the problems defined in the literature and solutions proposed for these problems, other Hospital Information Systems' capabilities, and the flow of operations in the hospital the following solutions are proposed.

6.1 Patient Smart Card

When a patient gets registered to the system for the first time, he or she can be given a smart card on which the patient's name and surname, national ID, file ID, photograph and a barcode are written. Each computer in the departments which have direct contact with patients can be provided a barcode scanner. In these departments, patients' records can be reached by scanning the barcode on the patient's smart card, instead of asking patient's name and surname, mother's name or birth date and searching patient's record in the system

Implementation of a patient smart card system automatically solves the key identifier problem. Patients' records can be found easily and the time required for locating the the correct record by taking required input from patients is eliminated.

6.2 Upgrades in the Online Appointment System

Asclepios Hospital's current online appointment system does not allow patients to make their appointments online. This system only allows patients to request an

appointment. With proper upgrades, the online appointment system may become more efficient and interactive.

First of all, the current online appointment system does not display available appointment slots to patients. Polyclinic's appointment information can be pulled from the appointment module and available slots can be displayed to the patients online. Patients may select the date from a calendar, see available time slots on that day as a response, and choose the appointment time they desire by clicking on the slot they want. As a result, appointment desk personnel would no longer need to check whether the time slot requested by the patient is available or not.

Secondly, online appointments should be taken by registered patients only. These patients should reach the online appointment screen by entering their file IDs. As a result, patients do not have to enter their phone numbers or email addresses and more importantly, the online appointment system is kept free from abuses. Patients will not be allowed to make multiple appointments.

Thirdly, the online appointment system can be merged with an online payment system. Patients can make their payments online, as HasBilSoft has the capability to calculate the amount of payment. However, for patients whose health insurance company is NSSI, taking provisions may be a problem.

6.3 Improvements in Form Designs

In Asclepios Hospital, the paper based forms have design problems. While some forms include unnecessary details, some forms ask for inputs or present outputs in an illogical flow.

The report templates (Figure 4) filled by technicians in radiology laboratories include many details, reports are therefore over complete. In order to draw the attention of

the physician to significant points, changes made in the report template can be underlined or highlighted. In the polyclinics the situation is same, since similar report templates are used.

On the labels that are printed at inpatient registration desk (Figure 7) and outpatient registration desk (Figure 8), data can be categorized according to relevancy and presented in a logical form. These labels are redesigned and presented in Figure 12 and Figure 13.

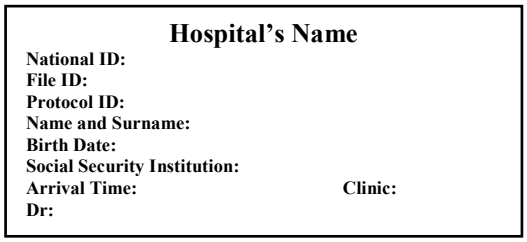


Figure 12: New Label Design for Inpatient Registration Desk

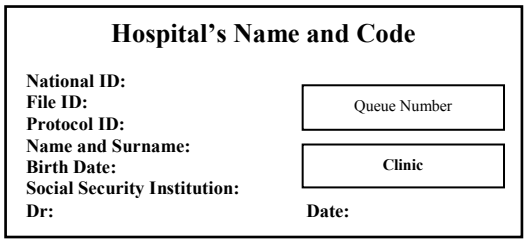


Figure 13: New Label Design for Outpatient Registration Desk

6.4 Process Improvements

6.4.1 Improvements in Polyclinics

As mentioned in section 4.11, physicians have to fill both Epicrisis Reports and the Patient Record Book. As taking hand written notes is easier for physicians, as mentioned in section 2.4.7, they prefer taking their notes on the Patient Record Book and later transfer these notes to the Epicrisis Report on the system, or ask nurses or

secretaries to fulfill this task. Recording the same information twice incurs an additional clerical task and generally, important notes taken by physicians are skipped. This problem can be solved through modifications in the Polyclinic Module.

First of all, instead of filling both the Patient Record Book and Epicrisis Reports, physicians can fill the Epicrisis Report first and print the diagnosis and treatment parts of the epicrisis, asked in the Patient Record Book on small labels. These labels can be placed on the Patient Record Book. This way, physicians are also encouraged to use HasBilSoft instead of taking hand written notes.

Secondly, if physicians prefer to fill Epicrisis Reports at a later time, they can at least voice record their notes. Therefore, important details are not lost. By listening the voice records at a later time, physicians can fill the required parts of the Epicrisis Reports.

6.4.2 Improvements in Wards

As mentioned in Section 5.5, ward personnel has to approve the payment status of the laboratory tests they have requested. This process can be completely eliminated if the laboratory tests' payment status is automatically changed by the system for inpatients. The patient's status (inpatient or outpatient) is already defined in the system. Currently, ward personnel are given the authorization to change payment status of any patient for whom a laboratory test is requested. Therefore, ward personnel may interfere in the payment status of outpatients as well. Through the development of an automated approval process for inpatients, possible abuses by ward personnel can be prevented.

6.4.3 Improvements in Outpatient Registration Desk

In the outpatient registration approval process (section 4.2.4) and laboratory test approval process (section 4.2.7), after receiving the payment and printing the receipt, outpatient registration desk personnel have to approve each appointment or laboratory test. Later, labels for the approved appointments and tests are printed. Since tests that have been paid for have already been selected while printing the receipt, the "Print the Receipt" command can automatically change the payment status, and print the labels as well. Through this development, errors will be eliminated. Outpatients registration desk personnel will not forget approving appointments and laboratory tests for which payments have already been made. In addition, the time spent for the appointment approval process can be reduced by 10 seconds on average (Appendix 5).

6.5 Upgrades in Module Designs

HasBilSoft's Pharmacy and Inventory Module has to be upgraded according to the Ministry of Health's requirements in relation to the drugs and consumables expiration dates. Currently these dates cannot be entered to the system. Therefore, pharmacists cannot track the expiration dates of the drugs online. The system should be modified to enable the manual entry of expiration dates, or as in the iSOFT system drugs' and consumables' expiration dates can be stored automatically by using barcode scanners.

The Queuematic Module also does not function properly. As this module is an add-on, patients are ranked on the queuematic system according to the time they made their payments. However, Queuematic Module should pull the appointment information from the appointment module. Patients who made their payments should be ranked according to their appointment times instead of payment times.

Finally, additional notification or reporting mechanisms have to be implemented. The Pharmacy and Inventory Module's signals for low inventories are hard to notice. Instead of putting exclamation marks next to the drugs with low inventory levels, the system can generate periodic reports for drugs or consumables that have reached the re-order level. Similarly, the Archive Module does not generate notifications when retention period of patient files are elapsed. Files are scanned manually by the archive department's employees. The system can generate reports periodically and list patients who have not been visiting the hospital for 5 years.

6.6 Technological Improvements

Due to the limited number of terminals in wards, inpatients' status cannot be tracked online. Not only does the Ward Module not cover all forms used in wards, but also there are no terminals in patients' rooms. If installing computers in each patient's room is a costly solution, the hospital can at least give a wireless device to physicians and nurses working in wards. PDAs and wireless devices as used in other hospitals can be a solution. Additionally, HasBilSoft should be expanded to cover all the forms used in wards. Inpatient's medical status can thus be completely stored and tracked online.

6.7 Controls

In the Registration Module for Outpatients, patient's ID information is entered manually and is not checked unless users perform an ID check through the Internet application. Controls should be performed automatically by the system, and should not be left to the user's initiative.

Field-filling checks are implemented in the Registration Module for Outpatients and mandatory fields are marked. However there are no field-filling checks in the Polyclinic Module; this gives rise to incomplete Epicrisis Reports. Field-filling

checks should be inserted in the Polyclinic Module. Some standardized fields such as patient's complaints can be filled through check box or radio button lists.

6.8 Training

HasBilSoft provides detailed user manuals to system users, and Asclepios Hospital holds occasional training sessions emphasizing the importance of HIS. These sessions do not cover how the system can be used. Moreover, they are not targeted to physicians. System users generally do not refer to user manuals, only learn applications which can automate their routine tasks, and do not exploit the capabilities of the software fully.

Asclepios Hospital can expand the content of their training sessions. Currently the legal aspects of using HIS are covered in training sessions. Administrative personnel are aware of the fact that HIS keeps a log of the operations they have performed which protects them against patients' complaints. However, other benefits of HIS are not fully covered.

User involvement can be encouraged through incentives. Especially for the physicians who do not use the system, medical conference incentives can be used to encourage involvement.

6. 9 Patients as System Users

In order to reduce the work load of the appointment desk personnel, outpatients registration desk personnel and the physicians, patients can be turned into system users. Registered patients can log in to the system with their smart cards and make their appointments through the kiosks that can be placed inside the hospital. They can also make their payments with their credit cards and print their labels and receipts.

Additionally, patients can also enter their complaints and chronic illnesses through the same kiosks. Patients can select their complaints from radio button drop box lists. Or close ended questions can be asked to patients. For instance patient may answer questions about their aches, fever, and other symptoms such as diarrhea. When patients provide these information to the system, physicians may read patients complaints prior to the examination and not lose time obtaining and entering such information. The examinations' effectiveness would be increased, and the physicians' clerical burden relieved.

In 2009, Akçay conducted a study on use of kiosks in hospitals. The kiosk placed in Dokuz Eylül Hospital was serving consultancy purposes. The heuristic developed was collecting patients' age, gender, and symptoms, and was recommending patients a polyclinic to visit. Patients enter their complaints by selecting the body part displayed in a figure. After the selection, symptoms that may be associated with that body part are displayed to the patients. By selecting different body parts and symptoms, patients enter their complaints into the system and get a polyclinic name as a response. 79% of the 819 patients who used the kiosk system mentioned that they were satisfied with the service, and that they would use the kiosk again. In the future, the kiosk system can be integrated with the HasBilSoft's Polyclinic Module, and complaints can be automatically directed to physicians.

CHAPTER 7

CONCLUSIONS

Hospital Information Systems are widely used for creating, collecting, sharing and modifying healthcare information, as they ensure information accuracy, reliability and relevancy. Moreover, HIS serve workflow management, document management and data mining functions.

As part of the Healthcare Reforms, the Ministry of Health stipulates the use of HIS in all public and private hospitals. While some hospitals develop their own HIS in house, others select and purchase a software. Regardless of whether the software is developed in house or purchased and modified, the HIS may not operate as required. Deficiencies could be the result of communication problems during the design process, unrecognized requirements of the hospital, inconsistencies between the hospital's processes and the capabilities of the system, lack of user involvement, and attitude of the organization towards HIS.

This study examines the capabilities of HasBilSoft, the processes of Asclepios Hospital, the requirements of external parties such as the Ministry of Health and NSSI, users' attitudes, control mechanisms and forms.

The results of the analysis show that only a small proportion of problems of the system are noticed by managers. Information inaccuracies are usually corrected by users who need the relevant information at a succeeding step. When HIS cannot satisfy particular information requirements, users create shortcuts and devise their own solutions to the problems. The problems or the requirements for solutions are not reported to managers.

When the processes of the hospital and the capabilities of HIS do not match, the efficiency of the system decreases and problems occur. The HIS may be over demanding or may lack some of the processes of the hospital. In any case, users may avoid using the HIS, create their own shortcuts, or enter inaccurate information. Besides, when some of the processes of the hospital are not included in the HIS, information generated through these processes cannot be transferred to the HIS.

Information related problems usually occur when users provide inputs to the system. The information provided could be incomplete or inaccurate. The reason for incomplete or inaccurate information is partly due to deficiencies in the control mechanisms of the system. The study also shows that the system does not ensure that all required information is entered by the user. This hampers information flow thus the hospital's process flow.

Sometimes, the system design may yield additional clerical work or burden to the users. Input that is already stored in the system cannot be used efficiently because of the problems in design. For instance, inputs provided online cannot be transferred to the HIS (as in the online appointment process), inputs obtained from two different processes cannot be merged (as in the Queuematic Module), or inputs that have already been provided have to be provided once more (as in the payment approval process).

Moreover, two common problems that reduce system efficiency are the use of wrong key identifiers when performing searches, and correcting mistakes that have been done at an earlier process. The system does not operate as efficiently as planned since the users are not aware of some system capabilities such as the ability to automatically check the user ID and automatically generate patients' personal information such as name, surname and birth date.

Wrong module designs also affect the system's usability. The large number of applications may cause some key functions to remain unnoticed by users. Modules should not contain irrelevant processes. Similarly, due to poor user interfaces, users may be presented with too much information, or information may not be presented in an appropriate manner with proper notification mechanisms. In these cases, significant information may be overlooked.

Finally, patients can play more active roles in the system. Patients can directly enter information into the system through online interfaces, kiosks and smart cards.

Solutions are offered for each system and process related problems identified in the thesis. Apart from the recommendations for case specific problems, the system is streamlined through changes in the user interfaces, control mechanisms, form designs, and processes. Further studies are required in order to assess the feasibility of the patient smart card system and wireless devices, as well as kiosks. Moreover, performance criteria need to be developed in order to evaluate the impact of the design improvements that are suggested in this thesis. Additionally, patients need to be surveyed in order to assess their willingness and ability to use kiosks and Internet based applications in order to provide direct input into the system.

To conclude, this study analyses the operations performed in a hospital and the capabilities of the HIS used. The study identifies the problems which are caused due to a mismatch between the HIS, the hospital's operations and external parties' requirements. The current system is streamlined in order it to fit the processes of the hospital and the requirements of the Ministry of Health. Since the capabilities of the HIS are mainly affected by the requirements of the Ministry of Health, these requirements are also analyzed indirectly. As problems which are identified in this thesis may also appear in other hospitals, suggested improvements might be adopted by the Ministry of Health, and the "Principles of HIS Purchases" report might be revised in the future.

APPENDICES

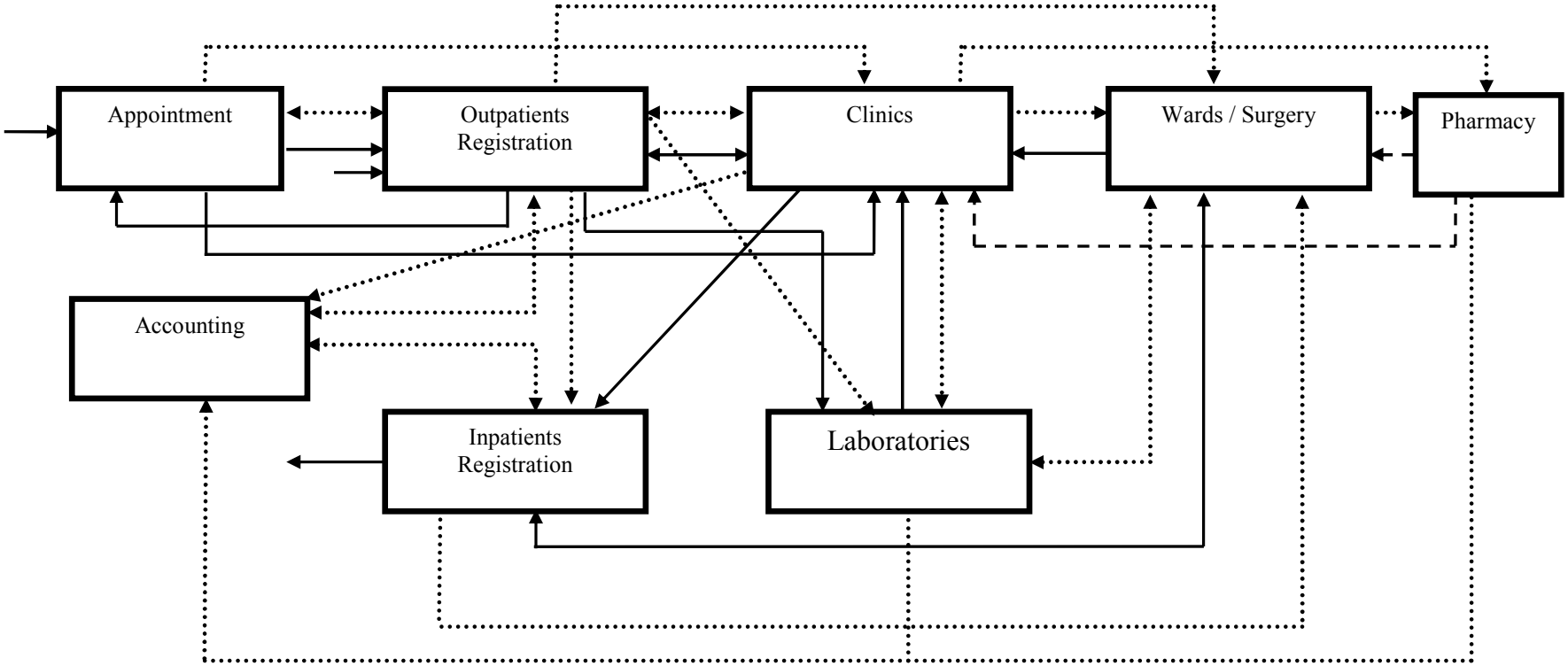
Appendix 1- Modules That Have To Be Included In a Hospital Information System

- Registration Module
- Outpatient (Polyclinic) Module
- Inpatient Module
- Accounting Module
- Pharmacy / Inventory Module
- Laboratory Module
- Radiology Module
- Surgery Room Module
- Treasury Module
- Personnel Module
- Statistics Module
- Archive Module
- Dental Health Module
- Dietary Module

Appendix 2 – List of Clinics

- Cardiology
- Internal Diseases
- Pediatric Diseases
- Dermatology
- Neurology
- Physiotherapy and Rehabilitation
- Chest Diseases
- Gastroenterology
- Radiology
- Nutrition and Dietary
- Emergency Room
- Cardiovascular Surgery
- Urology
- General Surgery
- Neurosurgery
- Orthopedics
- Otorhinolaryngology
- Ophthalmology
- Obstetrics and Gynecology
- Mouth and Dental Health
- Anesthesiology and Reanimation

Appendix 3- Work, Information and Material Flow among Departments



Appendix 4 – Information Exchange Among Departments

From/To	Appointment	Outpatients Registration	Inpatients Registration	Clinics	Laboratories	Wards / Surgery	Pharmacy	Accounting
Appointment	*Patient's Name and Surname * Patient's Phone Number *Patient's Mother's Name *Clinic to be Treated *Appointment Time *Appointment Date *Appointment Type	*Patient's Name and Surname *Clinic to be treated *Appointment Time *Appointment Date		*Patient's Name and Surname *Appointment Time *Appointment Date *Appointment Type	*Patient's Name and Surname (optional) * Appointment Time (optional) *Appointment Date (optional)			
Outpatients Registration	*Patient's Name and Surname *Patient's File ID *Patient's Protocol ID * Patient's Telephone Number *Patient's Mother's Name	*Patient's Name and Surname *Patient's ID information *Patient's address and telephone information *Patient's social security number *Patient's File ID *Patient's Protocol ID	*Patient's Name and Surname *Patient's ID information *Patient's address and telephone information *Patient's File ID *Patient's Protocol ID *Patient's social security ID	*Patient's Name and Surname *Patient's ID information *Patient's Protocol ID *Patient's File ID * Patient's Payment Status	*Patient's Name and Surname * Patient's File ID *Patient's Protocol ID *Patient's address and phone info *Patient's Payment Status	*Patient's Name and Surname *Patient's ID information * Patient's File ID *Patient's Protocol ID		*Patient's Name *Patient's Social Security Information *Patient's File ID *Patient's Protocol ID * Patient's Provision number *Patient's Payment Status
Inpatients Registration			*Patient's Physical File *Patient's Entry/ Discharge Information *Patient's Protocol Type Changed From Mobile to Discharged *Patient's Payment Status	*Patient's Protocol Type Changed From Mobile to Discharged		*Patient's Physical File *Patient's Entry Information		*Patient's Entry/Discharge Information *Patient's Payment Status
Clinics	*Available Appointment Times and Dates	*Laboratory tests required	*Patient's Report (initial diagnosis) *Patient's entry request *Surgery/treatment to be performed	*Patient's complaint *Patient's former illnesses and treatments performed *Laboratory tests required *Examinations required or performed *Epicrisis report, including diagnosis *Consumables required (may be manual or online)	*Laboratory tests required	*Patient's previous treatments, reports, diagnosis *Epicrisis report	*Consumables required (may be manual or online)	*Epicrisis report
Laboratories		*Test results		*Test results	*Test results	*Test results		*Tests performed

Appendix 4 - Information Exchange Among Departments (Ctd)

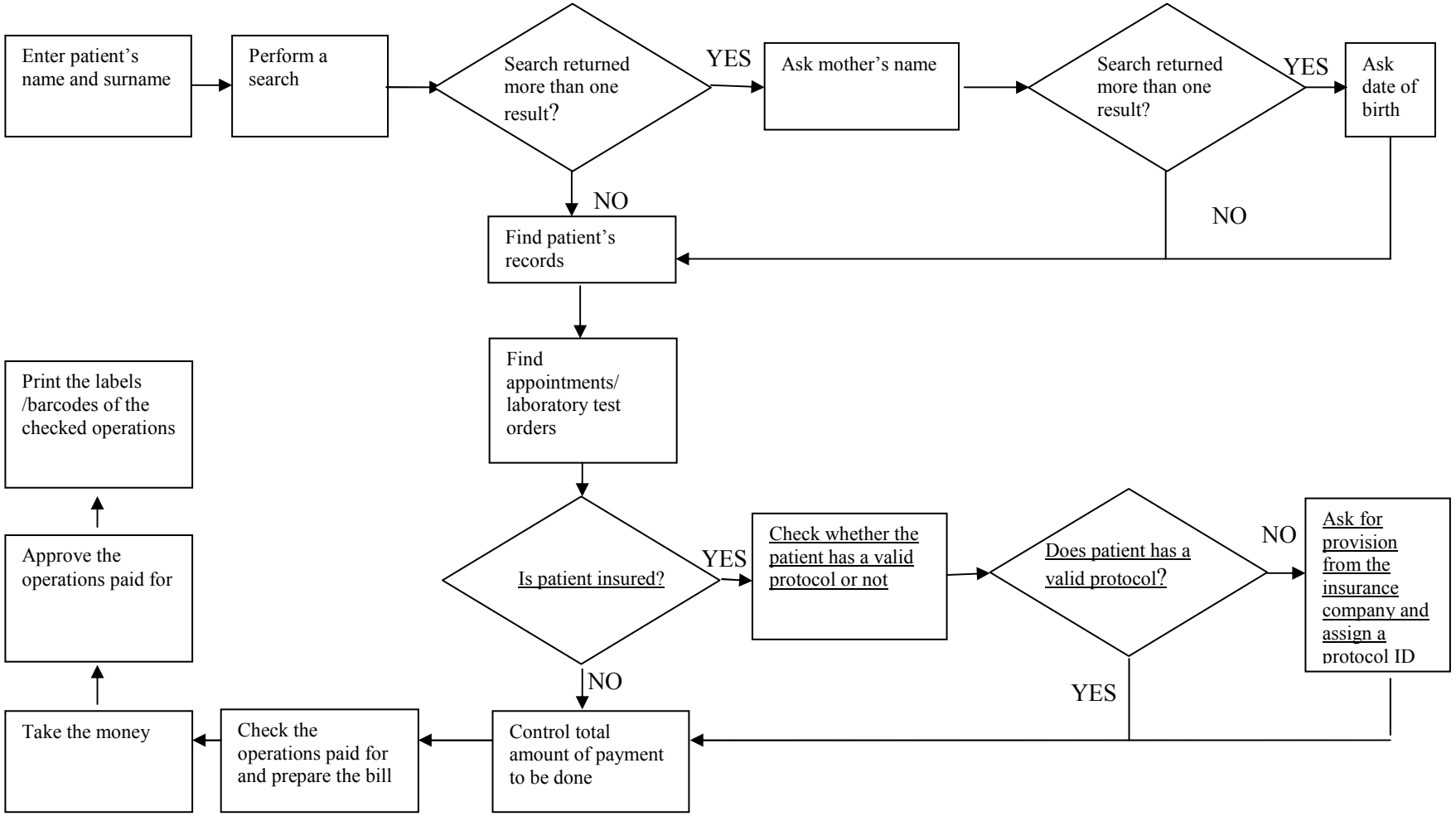
From/To	Appointment	Outpatients Registration	Inpatients Registration	Clinics	Laboratories	Wards / Surgery	Pharmacy	Accounting
Wards / Surgery			*Patient's Discharge Request *Total number of days patient spent at hospital	*Patient's hand written epicrisis	*Laboratory Tests Required	*Patient's transfer to room *Consultation reports *Surgery Reports *Dietary Reports *Risk evaluation of patients or operations *Medicine required *Consumables used *Consumables required *Patient's discharge form	*Patient Name and Surname *Medicine required *Consumables used *Consumables required	
Pharmacy				*Maximum amount of consumable that can be held		*Maximum amount of consumable that can be held	*Consumables and medicine to be purchased	*Consumables and medicine to be purchased
Accounting		*Amount of payment to be done	*Amount of payment to be done					*Payment Information

Note: Underlined information is sent manually,Hospital Information System is not used.

Appendix 5 – Time study of Outpatient Appointment Approval and Payment Process

Operation/ Observation Number	Enter patient's name and surname	Perform a search	Ask mother's name	Find patient's records	Find appointments	Check whether the patient has an insurance or not	Ask for protocol ID from the insurance company	Check total amount of payment to be done	Check the operations paid for and prepare the bill	Take the money	Approve the operations paid for	Print labels of the checked operations	Total Time (Seconds)
1	12,0	1,0	3,7	1,0	2,9	3,2	6,0	8,9	13,8	5,2	3,5	5,3	66,5
2	7,4	1,0	3,7	1,0	2,8	3,4	6,5	4,2	21,5	6,2	2,4	5,1	65,2
3	8,7	1,0	4,0	1,0	3,5	2,9		8,1	16,2	6,4	2,7	8,2	62,8
4	8,6	1,0	3,0	1,0	3,9	3,5		4,9	15,4	5,7	2,5	6,0	55,5
5	14,9	1,0	5,1	1,0	2,3	2,3	5,8	5,0	13,1	5,3	2,4	7,4	65,6
6	13,5	1,0	4,1	1,0	2,9	2,0	5,1	4,9	12,3	5,9	3,3	8,1	64,2
7	14,9	1,0	5,4	1,0	3,0	3,4	5,7	6,6	20,6	6,6	2,6	5,2	75,9
8	15,9	1,0	5,3	1,0	3,6	2,2	6,6	7,7	14,4	6,5	2,9	7,7	74,8
9	7,3	1,0	4,4	1,0	3,6	2,8	5,1	8,4	14,0	6,6	3,1	7,3	64,6
10	9,6	1,0	3,9	1,0	2,8	2,9	6,5	4,3	15,2	5,8	3,6	7,7	64,3
11	12,6	1,0	6,4	1,0	3,7	2,4	5,8	8,2	13,8	6,2	3,0	8,2	72,2
12	15,3	1,0	4,8	1,0	2,4	2,7	6,3	8,7	18,8	6,9	3,0	7,1	77,9
13	11,1	1,0	4,2	1,0	2,4	3,7		6,5	12,1	5,9	3,7	5,5	57,2
14	11,9	1,0	4,2	1,0	2,1	2,5	6,1	6,6	15,9	6,6	2,6	7,8	68,2
15	7,3	1,0	6,6	1,0	3,8	2,7	6,6	4,0	16,0	5,5	2,7	5,4	62,5
16	10,1	1,0	5,0	1,0	3,2	3,0	5,1	5,7	15,4	6,9	2,6	6,3	65,3
17	13,9	1,0	6,4	1,0	3,9	3,7	5,4	6,2	20,2	5,9	3,9	9,0	80,5
18	10,0	1,0	6,5	1,0	2,3	3,3		4,9	14,9	5,4	3,4	5,9	58,7
19	13,5	1,0	3,2	1,0	2,6	2,4	6,3	7,7	20,3	7,0	3,6	4,9	73,6
20	12,4	1,0	4,6	1,0	2,7	2,5	6,2	8,3	16,4	5,1	2,1	6,7	69,1
21	14,6	1,0	7,0	1,0	3,1	3,5		7,8	18,3	6,0	3,1	8,6	74,0
22	7,6	1,0	5,7	1,0	2,3	2,8	6,3	8,4	13,4	6,8	2,7	6,7	64,6
23	13,1	1,0	4,0	1,0	2,3	2,2	6,2	7,7	21,1	6,0	2,6	5,5	72,8
24	8,3	1,0	5,6	1,0	2,4	2,8	5,0	8,5	16,9	5,0	3,1	8,0	67,6
25	14,5	1,0	3,2	1,0	2,2	2,1		6,0	15,1	6,0	3,5	8,3	63,0
26	8,8	1,0	3,1	1,0	2,9	3,0		7,3	17,9	6,5	2,0	7,0	60,5
27	13,8	1,0	4,7	1,0	3,5	3,9	5,8	9,0	18,7	6,4	3,7	7,4	79,0
28	13,3	1,0	4,9	1,0	2,1	3,7	6,4	6,4	21,2	6,3	3,1	6,4	75,8
29	10,2	1,0	5,5	1,0	2,0	3,0	6,9	4,9	13,0	5,4	3,3	8,1	64,3
30	11,3	1,0	5,6	1,0	3,2	2,3	5,2	8,2	16,9	5,9	2,2	8,0	70,8
Average:	11,6	1,0	4,8	1,0	2,9	2,9	5,9	6,8	16,4	6,1	3,0	7,0	67,9
Standard Dev:	2,7	0,0	1,1	0,0	0,6	0,5	0,6	1,6	2,8	0,6	0,5	1,2	6,6

Appendix 6- Outpatient Appointment Approval /Laboratory Test Approval and Payment Process Flow Chart



Underlined operations are not performed in the laboratory test approval process

Appendix 7- Sample Epicrisis Report

HOSPITAL'S NAME

Name and Surname:	**File ID:**
Gender:	**Protocol ID:**
Place of Birth/Age:	**Arrival/Hospitalization Date:**
Phone Number:	**Discharge Date:**
Phone Number 2:	**Physician's Name:**
Address:	**MEDULA Tracking ID:**

PATIENT'S COMPLAINTS:

BACKGROUND INFORMATION:

PHYSICAL EXAMINATION:

LABORATORY TEST RESULTS:

DIAGNOSIS:

TREATMENT:

SUGGESTIONS:

RESULT:

TESTS AND OPERATIONS PERFORMED:

Appendix 8- Periodic Observations Report

PHYSİCİAN'S PERIODIC OBSERVATIONS REPORT	**Protocol ID:** **Name, Surname:** **Gender:** **Age:** **Ward:** **Room Number:** **Date:**

Physician's Name and Date	

Appendix 9- Drug and Consumable Request Form

Hospital's Name
Drug and Consumable Request Form

The following drugs and consumables listed are requested to be supplied;
Date:
Name and Surname:

	Name of the Consumable/Drug	Amount	Unit
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Appendix 10 - Drug Application Form

DRUG APPLICATION FORM

Name, Surname:		Protocol ID:	
Date of Birth:		File ID:	Female/ Male
Type of Patient:	Inpatient / Oupatient	Department:	
Hospitalization Date:		Room number:	
Allergies:		Gender:	
Height:	Weight:		

		../../....			../../....			../../....			../../....		
Order Date	Name of the Drug	Time	Dosage	By	Time	Dosage	By	Time	Dosage	By	Time	Dosage	By
	Through:												
	Through:												
	Through:												
	Through:												
	Through:												
	Through:												

Why the drug is not applied:	Name- Surname	Name- Surname	Name- Surname	Name- Surname
N: Nousea O: In operation E: In examination P: Physician Order R: Patient Refused OTHER				

Appendix 11- Patient Record Book

Sequence Number	Protocol ID	Date of Examination	Name and Surname	National ID Number	Gender	Age	Diagnosis	Result (Treatment)

REFERENCES

AHIMA, "What Is A Personal Health Record." American Health Information Management Association. Access Date: 02/04/2011. < http://www.myphr.com/StartaPHR/what_is_a_phr.aspx >

Akçay, Ozan. Hastaneler için Etkileşimli Elektronik Bilgi Ekranı (Kiosk). Diss.Dokuz Eylül University, 2009.

Akhil. "Hospital Software Solutions." Akhil Systems Pvt. Ltd Access Date: 12/04/2011 <http://www.akhilsystems.com/solution-stan.html>

Ammenwerth, Elske, Stefan Graber et al. "Evaluation of health information systems-problems and challenges." International Journal of Medial Informatics. 71(2003): 125-135

Anderson, M. « Six Levels of Healthcare IT. » Davidson, P. L. Healthcare Information Systems. Boca Raton: Auerbach Publications, 2000. 97-108

Armoni, Adi. Healthcare Information Systems: Challenges of New Millennium. Hershey: Idea Group Publishing. 2000

AresHIS. AresHİS Hastane Bilgi Yönetim Sistemleri. Access Date: 12/04/2011. <http://www.areshis.com/index.php>

Arts, D., DeKeizer, N., & Scheffer, G. "Defining and Improving Data Quality in Medical Registries: A Literature Review, Case Study, and Generic Framework". Journal of the American Medical Informatics Association, 9 .6 (2002): 600-611

Ash, S. J. and W. Bates. "Factors and Forces Impacting EHR system adoption: report of a 2004 ACMI discussion." Journal of American Medical Informatics Association. 12(2005): 8-12

Ash, S. J., M. Berg and E. Coiera. "Some unintended consequences of information technology in health care: the nature of patient care information system-related errors." Journal of American Medical Informatics Association. 11(2004): 104-112

Ball, Marion. "Hospital Information Systems: Perspectives on problems and prospects, 1979 and 2002." International Journal of Medical Informatics. 69(2003): 83-89

Baykan, Rahmi. Eğitim Ve Araştırma Hastanelerinde Bilgi Sistemi Analizi: Atatürk Eğitim Ve Araştırma Hastanesi Örneği, Diss. Dokuz Eylül University, 2006

Beaver, Kevin. Healthcare Information Systems. London: Auerbach Publications, 2003

Bernoria M., Roman Elinson and Kelly Zarnke. "Patient-directed intelligent and interactive medical history-gatheering systems: A utility and feasibility study in the emergency department." International Journal of Medical Informatics. 76(2007): 283-288

Blobel, Bernd. Analysis, Design and Implementation of Secure and Interoperable Distributed Health Information Systems. Amsterdam: IOS Press. 2002

Bose, Ranjit. "Knowledge management-enabled health care management systems: capabilities, infrastructure and decision support." Expert Systems with Applications 24(2003):59-71

Campbell, E., M., D. F. Sittig et al. "Types of unintended consequences related to computerized provider order entry." Journal of American Medical Association. 5(2006): 547-556

Chiasson, Mike, Medhu Reddy, Bonnie Kaplan and Elizabeth Davidson "Expanding Multidisciplinary Approaches to Healthcare Information Technologies: What does information systems offer medical informatics?" International Journal of Medical Informatics. 76S(2007): S89-S97

Curtis Graham, David Cobham. Business Information Systems: Analysis, Design and Practice. Harlow: Prentice Hall. 6th ed. 2008.

Çakar, Doruk. «Sağlıkta Dönüşümün Özel Hastane Rekoru.» 9 March 2011. Medimagazin. Access Date: 03/03/2011 <http://www.medimagazin.com.tr/ozel-saglik/saglik-bak/tr-salkta-dnmn-zel-hastane-rekoru-9-67-33585.html>.

Davidson, Phillip. «Healthcare versus Information Technology. » Beaver, Kevin. Healthcare Information Systems. London: Auerbach Publications, 2003. 257-287

Erdem, Ümit Rifat. Yönetim Bilgi Sistemleri Ve Bir Hastane İçin Yönetim Bilgi Sisteminin Gelistirilmesi, Diss. Gazi University, 2006

Erdil, E. S. H. Uğurbaş, A. S. Albayrak. "Evaluation Of An Electronic Medical Record System: Zonguldak Karaelmas University Hospital Survey." ZKU Journal of Social Sciences, 12(2010): 37-65

Fichman, R. «The diffusion and assimilation of information technology innovations.» Zmud, R., Framing the Domains of IT Research: Glimpsing the Future Through the Past. Cincinnati: Pinnaflex Educational Resources. 2000. 105-127

Fonet. “Fonet HBYS” Fonet Yazılım. Access Date: 12/04/2011 <http://www.fonetyazilim.com/urunler.html>

Frost & Sullivan. “U. S. Hospital Information Systems Continue to Evolve. ” Frost & Sullivan. 20.01.2007.. Access Date: 02/ 04/2011 < http://www.frost.com/prod/servlet/market-insight-top.pag?docid=93346579>

Gurley, Lori. “Advantages and Disadvantages of the Electronic Medical Record.” American Academy of Medical Administrators and Foundation. (2004), Access Date: 07/03/2011 <https://www.aameda.org/MemberServices/Exec/Articles/spg04/Gurley%20article.pdf>.

Guise, Dario and Klaus Kuhn. “Health Information Systems Challanges: the Heidelberg conference and the future.” International Journal of Medical Informatics. 69(2003): 105-114

Haux, Reinhold. “Health Information Systems: Past , Present, Future.” International Journal of Medical Informatics. 75(2006): 268-281

Heeks, Richard. “Health Information Systems: Failure, Success and Improvisation.” Journal of Medical Informatics. 75(2006): 125-137

HIMSS. “The 11th Annual HIMSS Leadership Survey Sponsored by IBM: Trends in Healthcare Information and Technology- Final Report.” Healthcare Information and Management Systems Society. Access Date: 21/03/2011 <http://www2.himss.org/survey/2000/survey2000.html>

HIPAA, “Protected Health Information Definition.” Health Insurance Portability and Accountability Act. Access Date: 1/04/2011 <http://www.hipaasurvivalguide.com/hipaa-regulations/160-103.php>

Huang, H. K. PACS and Imaging Informatics: Basic Principles and Applications. New Jersey: Wiley-Blackwell, 2010

Ilgar M., Saglık Enformasyon Sistemi, Hastane Bilgi Sistemleri Seminer Notları. Ankara: Hacettepe Üniversitesi Saglık İdaresi Yüksekokulu. 2004

Institute of Medicine, The Computer-based Patient Record: An Essential Technology for Health Care. Washington:National Academies Press, 1997

Institute of Medicine, To Err is Human: Building a Safer Health System. Washington:National Academies Press, 2000

iSOFT. “Solutions” iSOFT Access Date: 11/04/2011 <http://www.ibahealth.com/en/Solutions.aspx>

Jha, A. K., C. M. DesRoches et al. “Use of Electronic Health Records in US hospitals” The New England Journal of Medicine. 360(2009): 1628-1639

Katsikas, Sokratis. “Healthcare Management and Information Systems Security: awareness, training or education?” International Journal of Medical Informatics. 60(2000): 129-135

Kennedy O., G. Davis and S. Heda. “Clinical Information Systems: 25 year history and the future” Journal of the Society for Health Systems 3(1992):49-60

Kocamaz, Kaan. Hastane bilgi yönetim sistemlerinde veri madenciliği ve Konya Meram Tıp Fakültesi hastanesindeki hastane bilgi yönetim sistemi uygulamasının incelenmesi, Diss. Selçuk University, 2007

Koeller, Rodney L. “IT Applications in Healthcare: The electronic medical record.” University of Maryland Access Date: 12/11/2010 <http://faculty.ed.umuc.edu/~meinkej/inss690/koeller.pdf>.

Kuperman, Gilad and Richard Gibson. “Computer Physician Order Entry: Benefits, Costs and Issues.” Annals of Internal Medicine. 139(2003): 31-40

Lagor, Charles, William Lord, Nicholas Chbat et al. «Medical Information Technology: Recent advances and recent trends.» Tan, Joseph. Healthcare Information Systems and Informatics: Research and practices. New York: Medical Information Science Reference, 2008. 349-366

Leape, L., D. W. Bates and D. J. Cullen. “Systems analysis of adverse drug events.” Journal of American Medical Association. 274(1995): 35-43

Leavitt, Mark. «Electronic Medical Records. » Beaver, Kevin. Healthcare Information Systems. London: Auerbach Publications, 2003. 257-287

Lee, F., J. Teich et al. “Implementation of Physician Order Entry: User satisfaction and self reported usage patterns.” Journal of American Medical Association. 1(1996): 42-55

Leonard, K. “Information Systems for Healthcare: Why we have not had more success The Top 15 Reasons.” Healthcare Management Forum. 8(2000): 45-51

Leonard K., J.P.H. Tan and G. Pink. “Deaigning health care information systems for integrated delivery systems: where we are and where we need to be.” Topics in Health Information Management 1(1998): 19-30

Loughran, Sarah. “In Hospital Deaths from Medical Errors at 195,000 per Year USA.” (2004). Medical News Today. Acess Date: 12/05/2011. <http://www.medicalnewstoday.com/articles/11856.php>.

Medisoft. “Medisoft Hastane Otomasyonu.” Talya Bilişim, Otel ve Hastane Otomasyon Sistemleri. Access Date: 11/04/2011. < http://www.talyabilisim.net/products.asp?trwnode=9>

Medipro. “Medipro Devlet Ve Özel Hastane Bilgi Yönetim Sistemi.” Medi-Pro Yazılım-Danışmanlık. Access Date: 11/04/2011 <:www.medipro2000.com/Anasayfa.htm>

Ministry of Health, Information Technology Department. “Data Security.” Notice ID: B100BİDB – 010.06 / 1249, 2005.

Nowinski, Cindy J., Becker Susan M. et al. “The Impact of Converting to an Electronic Health Record on Organizational Culture and Quality Improvement.” International Journal of Medical Informatics. 76S (2007): S174–S183

O’Brien, James A., Management Information Systems. Boston: Irvin McGraw-Hill. 2005

OECD, OECD Sağlık Sistemi İncelemeleri: Türkiye. OECD ve IBRD/ Dünya Bankası, 2008

Overhage, Marc J. «Understanding and Implementing Computerized Physician Order Entry.» Beaver, Kevin. Healthcare Information Systems. London: Auerbach Publications, 2003. 211-221

Öncel S. “Hastane Bilgi Sistemleri.” Saglıkta Strateji Dergisi. 12(1997): 10-18.

Özsarı, H. “Sağlık Projeleri ve Sağlık Enformasyon Sistemleri Çalısmaları Hakkında Genel Bilgi Notu.” Modern Hastane Yönetimi, 8-9(1998): 25-35.

QuadraMED. QuadraMED Corp:Healthcare Information Technology Systems. Access Date: 11/04/2011. <http://www.quadramed.com/>

Rada, Roy. Information Systems and Healthcare Enterprises. New York: IGI Publishing, 2008.

Raghupathi, W. «Information Technology in Healthcare: A Review of Key Applications.» Beaver, Kevin. Healthcare Information Systems. London: Auerbach Publications, 2003. 9-29.

Reichertz, Peter. “Hospital Information Systems: Past, Present, Future. ” International Journal of Medical Informatics. (2006):282-299

Research and Markets. “Hospital Information Systems – A Global Update of Market Trends and Opportunities.” (2009). Access Date: 12/04/2011 <http://www.researchandmarkets.com/reports/1095161/hospital_information_systems_a_global_update.pdf>

Rigby, M. “Evaluation: 16 Powerful Reasons Why Not to Do It and 6 Over-riding Imperatives.” Studies in Health Technology and Informatics Amsterdam:IOS Press, 84(2001): 1198-1202

Rodoplu, Didem. Bilgi Yönetim Projeleri Uygulamalarındaki Teknolojik Değişimlere Karşı Çalışan Direncinin Ölçümü Kocaeli Üniversitesi Tıp Fakültesi Ve Anadolu Sağlık Merkezinde Bir Uygulama, Diss. Kocaeli University, 2006

Sağıroğlu, Yaşar Özge. Implementation difficulties of Hospital Information Systems: A case study in a private hospital in Turkey, Diss. Boğaziçi University, 2006

Sağlık-NET, “Sağlık-NET nedir?” Sağlık-NET Portalı. Access Date: 02/04/ 2011 <http://www.sagliknet.saglik.gov.tr/giris.htm>

Saleem, Jason, Alissa Russ et al. “Exploring the persistence of paper with the electronic health record.” International Journal of Medical Informatics. 78(2009): 618-628

Sarus. EES Sarus Hastane Bilgi Yönetim Sistemi Access Date: 12/04/2011 < http://www.ees.com.tr/sarus_hastane_bilgi_sistemi/>

Sharma, A. “Professionals as agent: Knowledge asymmetry in agency exchanges.” Academy of Management Review. 3(1997):758-798

Siemens Medical Solutions. “Clinical Information Systems-i.s.h. med” Siemens. Access Date:10/04/2011 <http://www.medical.siemens.com/>

Skinner, Rick. «Information Systems and Change: Which one is the chicken and which is the egg?. » Beaver, Kevin. Healthcare Information Systems. London: Auerbach Publications, 2003. 345-352

Smedema, Kees, Cor Loef and Bert Verdonck. «Developments in Clinical Information Technology. » Spekowius, Gerhard and Thomas Wendler. Advances in HealthcareTechnology: Shaping the Future of Medical Care. The Netherlands: Springer, 2006. 367-385

Taşdemir, Serdar. Sağlık Bakanlığının Sağlık Enformasyon Sistemi Projeleri ile Ankara’daki Sağlık Bakanlığı Hastanelerinde Mevcut Bilgisayar Sistemleri Entegrasyonunun Değerlendirmesi, Diss. Hacettepe University, 2005

Turkuaz Software, Turkuaz Software Hizmetlerimiz. Access Date: 14/04/2011 < http://www.turkuazsoftware.com/hizmetlerimiz.htm>

Unruh, Kenton and Wanda Pratt. "Patients as actors: The patient's role in detecting, preventing and recovering from medical errors." International Journal of Medical Informatics. 76s(2007): s236-s244.

Ülgü, Mahir. Hastane Bilgi Sistemleri Alımı Çerçeve İlkeleri. T.C. Sağlık Bakanlığı Bilgi İşlem Daire Başkanlığı, 2008.

Young, K. M. Informatics for Healthcare Professionals. Philadelphia: F.A. Davis, 2000.

Wager, Karen, Lee & Glaser. Health Care Information Systems: A Practical Approach for Health Care Management. San Francisco: Jossey-Bass, 2009.

Wellen, Dianna, Barbra Bouchard and Deborah Houston. "The Electronic Medical Oncology Record: Misconceptions, Barriers and Benefits" Cancer Management. 9(1998): 20-23

Whiddett, Richard, Inga Hunter et al. "Patients' Attitudes Towards Sharing Their Health Information." International Journal of Medical Informatics. 75(2006): 530-541