HOSPITAL INFORMATION SYSTEM

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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.

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ABSTRACT

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This thesis investigates hospital information system. The traditional systems were found to be completely manual and subject to numerous problems like duplication, loss of records, huge storage space and time consuming. A through study on the modern computerized hospital information systems is made and their main features discussed. A sample system is developed using design tools like ERDs, Microsoft access2007, and Microsoft visual basic 6.0. This system is convenient, makes it easy to share information and it is user friendly. The benefits of the computerization of health records management system is therefore emphasized in all hospitals.

Keywords: Electronic Health Records, Computerized Health Records, Hospital Information System

ÖZET

HASTANE BİLGİ SİSTEMİ

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M.Sc., Matematik ve Bilgisayar Ana Bilim Dalı, (Bilgi Teknoloji Bölümü)

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Bu tez hastane bilgi sistemlerinin araştırılması amacıyla hazırlanmıştır. Geleneksel sistemlerin tamamen Manuel olduğu ve tekrarlama, kayıt kaybı, dev depolama alanı ve zaman kaybettiricilik gibi birçok problemle maruz kaldığı tespit edilmiştir. Çağdaş bilgisayarlı hastane bilgi sistemleri ve bunların başlıca özellikleri üzerinde detaylı bir çalışma üzerinde görüşülmüştür. ERD, Microsoft access2007 ve Microsoft visual basic 6.0A gibi tasarım araçları kullanılarak bir model sistem geliştirilmiştir. Bu sistem elverişli olup, bilgi paylaşımını kolaylaştırmakta ve kullanıcı dostudur. Dolayısıyla, sağlık kayıtları işletim sisteminin bilgisayar kontrollü getirileri tüm hastanelerde vurgulanmıştır.

Anahtar kelimeler: Elektronik Sağlık Kayıtları, Bilgisayarlı Sağlık Kayıtları, Hastane Bilgi Sistemi

DEDICATION

To my Family:

My dear husband kursel, daughter: Tuna, who have greatly missed my company during this whole period while pursuing this study.

Good things in life are not easily accomplished,

But when accomplished, they will always be reckoned for many generations to come."

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Success in life is never attained single handedly. It is on this note that I express my heartfelt gratitude to God for the strength and wisdom.

My sincere appreciation goes to my co_ supervisor, Assist. Prof. Dr. Reza HASSANPOUR, without whose help this work would not e as it appears.

Last but not least to my family, my dear Dad and Mum your ceaseless support me, my dear husband who helped me and still help me.

MAY GOD BLESS YOU ABUNDANT

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ACRONYMS

EHR: Electronic Health Records

ERD: Entity Relationship Diagram

ICA: International Committee on Archives

ISO: International Standard Organization

IT: Information Technology

MOH: Ministry of Health

NFRs: Non Functional Requirements

WHO: World Health Organization

ICU: Intensive Care Unit

IRM: Information Resource Management

HIS: Hospital Information System

FTP: file transfer protocol

WWW: World Wide Web

PDMS: Patient Data Management System

CPOE: Computerized Physician Order Entry

MAR: Medication Administration Records

EKGs, ECG: Electro cardiogram

PACS: A picture archiving and communication system

CT: Computed Tomography

MRI: Magnetic Resonance Imaging

RIS: Radiology Information System

ARC-NEMA: American College of Radiology, National Electrical Manufacturer Association

DICOM: Digital Imaging and Communications in Medicine

HL7: Health Level Seven

SSL: Secure Sockets Layer

PCT: Private Communications Technology

CHAPTER 1

INTRODUCTION

Electronic Health Record system is such an important area in healthcare delivery because without proper records, planning is rendered difficult. The aim of this study was build a computerized records management system that would be more effective and efficient than the existing manual system. This was done by looking at the existing health records management system, analyzing its strong and weak points design and implementation of a new system .Microsoft Access Database were used for design. Relationship diagram and the data dictionary were results of the design and implementation saw different interfaces.

1.1 Statement of the Problem

The current manual system generates huge amount of paper work that is difficult to deal with, in terms of storage, retrieval, maintenance and sharing among the medical personnel. Duplication of records resulting from multiple registrations. This does not favor the generation of reports in terms of timeliness and accuracy. This project therefore develops a system for computerizing health records management.

1.2 Objectives

Objectives of the current system are to computerizing health records, Including general objective and specific objective.

1.2.1 General Objective

To build a system for computerizing health records, that will replace the current manual records management.

1.2.2 Specific Objectives

The specific objectives of the research program are to:

i. To investigate issues related to patient's demographic data, diagnosis, and treatment.

ii. To design a computerized health records management system.

iii. To implement and test the system.

1.3 Scope

The health record component is dedicated to the acquisition, storage, retrieval; processing and communication (interchange) of patient-related health data. It is directly related to the management of the electronic health record (EHR). Medical records will be considered and these include:

1. Patient personal information

2. Laboratory examinations

3. Diagnosis

4. Prescriptions and Treatment

5. Follow up of the patient

In summary, health records are instantiations of an almost infinite number of health concepts composed of rich multimedia data types and their relations encompassed in a wide lattice of terms. It can be used in any Hospital, Clinic, Dispensary or Pathology labs for maintaining patient details and their test results.

1.3 Significance of the Study

1. There has been automation and streamlining of clinicians work flow. This has reduced medical errors, as there is readily available of necessary information on which to base their decisions.

2. Patients records can now be accessed anywhere in the departments of the hospital on a computer screen. The problem of moving from department to department to get some records is no more which has increased time to attend to the patient.

3. Paper work has been considerably reduced with the introduction of computer-assisted method of storing the records.

4. Paper-based record-keeping system was adding to the expense of health care. Doctors and nurses used to spend time away from patients attending to a great deal of paperwork. The reliance on paper-based medical records used to add enormous

financial burden, with substantial costs for records storage and administrative support staff.

5. Delayed or missing paperwork used to add time to patient hospital stays and could lead to unnecessary or duplicate clinical tests.

6. Periodic reports are now easier to make and on time. Since the necessary data is available in one place and the computer is able to manipulate it like sorting, stratifying, carry out computations, then the reports are easy to make unlike using the manual system where functions like computations were difficult to handle.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Hospitals and other health units base their decisions on records to know which drugs to stock and which services to prioritize. It is important therefore to give due attention to health records management to ensure that right information is available at the right time in the right place. There is an important trend today to shift from a "healthcare provider–centered record to a computer-based, virtual, longitudinal patient-centered record.

2.1.1 Records Management

Records Management is practice of identifying, classifying, archiving, preserving, and sometimes destroying records according [1].[1] defines records as "information created, received, and maintained as evidence and information by an organization or person, in pursuance of legal obligations or in the transaction of business". In the electronic era, the words "record" and "archive" have acquired new and very different meanings. In an Information Resource Management (IRM) environment, a record is simply any discrete piece of information. As the electronic and paper recordkeeping environments have drawn closer together, archivists and records managers have been compelled to refine and expand their definition of a record in order to differentiate it from the IRM definition, and also in order to recognize and accommodate the alterations that the electronic environment has imposed.

The current US government definition of a record includes all books, papers, maps, photographs, machine readable materials, or other documentary materials, regardless of physical form or characteristics, made or received by an agency of the United States Government under Federal law or in connection with the transaction of public business and preserved or appropriate for preservation by that agency or its legitimate successor as evidence of the organization, functions, policies, decisions, procedures, operations, or other activities of the Government or because of the informational value of data in them…(44USC Sec. 3301) While this is a great deal more specific that Schellenberg's1965 definition, it does not go as far as the International Council on Archives' 1997 definition, which precisely addresses the way the electronic environment changes records, stating that a record is

…a specific piece of recorded information generated, collected or received in the initiation, conduct or completion of an activity, and that comprises sufficient content, context and structure to provide proof or evidence of that activity (CIA/ICA) [2]. While the definition of a record is often identified strongly with a document, a record can be either a tangible object or digital information which has value to an organization. For example, birth certificates, medical x-rays, office documents, databases and application data, and e-mail are all examples of records [1].

2.1.2 Information System

[3] Defines Information System as any organized combination of people, hardware, software, communication networks and data resources, which control, transform and disseminate information in an organization .There are various types of information systems, for example: transaction processing systems, office systems, decision support systems, knowledge management systems, database management systems, and office information systems. Critical to most information systems are information technologies, which are typically designed to enable humans to perform tasks for which the human brain is not well suited, such as: handling large amounts of information, performing complex calculations, and controlling many simultaneous processes. Information systems are implemented within an organization for the purpose of improving the effectiveness and efficiency of that organization. Capabilities of the information system and characteristics of the organization, its work systems, its people, and its development and implementation methodologies

together determine the extent to which that purpose is achieved [4]. According to World Health Organization, [5] the following terms are defined as:

1. Health information System: A system that integrates data collection, processing, reporting and use of information necessary for improving health service effectiveness and efficiency through better management at all levels of health service.

2. Health management information system: This is an Information system specially designed to assist in the management and planning of the health programs as opposed to delivery of care.

2.2 Definition of Hospital Information System

A hospital information system is defined as a subsystem of a hospital which comprises all information processing as well as the associated human or technical actors in their respective information processing roles [6].Hospitals are extremely complex institutions with large departments and units coordinate care for patients [7]. As a result, there has been widespread agreement and comprehension that IT has the potential to improve the quality and reduce the cost such as scenarios which is vividly seen in the U.S [8] [9]. Electronic Health Record (EHR) is a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. Included in this information are patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports. It is important to note that an EHR is generated and maintained within an institution, such as a hospital, integrated delivery network, clinic, or physician office.

A Hospital Information System (HIS) is a comprehensive, integrated information system designed to manage the administrative, financial and clinical aspects of a hospital. As an area of medical informatics, the aim of hospital information system is to achieve the best possible support of patient care and administration by electronic data processing. Information technology has made a significant positive impact on the healthcare sector. The past decade has witnessed the foray of numerous information systems and their resultant products into the hospital scenario. The capital invested in electronic management facilities and types of hospital systems has increased substantially to replace previous paper medical records which are cumbersome in nature, bulky to use and difficult to manage, with digital records that

much easier to handle and improve the workflow efficiency by integrating various tasks[10]. Hospital information system (HIS) provides the required information to each level of the management at the right time, in the right form, and in the right place, so that the decisions to be made effectively and efficiently. HIS plays a vital role in planning, initiating, organizing and controlling the operations of the subsystems of the hospital and thus provides a synergistic organization in the process. HIS improves patient care by assessing data and making recommendations for care and enables a hospital to move from retrospective to a concurrent review quality and appropriateness of care [11].

2.3 History of Hospital Information System

The first known medical record was developed by Hippocrates, in the fifth century B.C. He prescribed two goals:
A medical record should accurately reflect the course of disease.

A medical record should indicate the probable cause of disease [12].

Since their early beginning in the 1960s, hospital information systems (HISs) have been developed to cover both administrative and medical functions [13].However, it must be recognized that the first systems often focused on the billing and reimbursement aspects of hospital activities. The 1980s saw the implementation of two nearly worldwide changes with a significant impact on the way computer applications were used in hospitals. In early HISs, resource consumption and allocation were only roughly measured by length of stay. The usefulness of data originating from these systems was limited. Because of the significant variance between hospitals, it was impossible to compare one hospital's data with another's. Today, as patients and payers demand evidence of quality of care and cost reduction, it is obvious that these types of indicators are insufficient, and hospitals seek other competitive metrics such as process outcome measurements [14].

2.4 Barriers to the Development of Electronic Health Records

There is generally no one reason for difficulties and failures in implementing HIS [15], [16]. Furthermore, while certain factors appear to be major contributors to the failure of many HIS, there are no data to measure the relative importance of each potential cause of failure. In the literature however, there are two approaches taken to

explore the barriers to successful HIS implementation. The first of these approaches, the most common in the literature, is the analysis of critical factors important to the successful HIS which offer specific guidelines or formulas for implementation. The second approach, the socio technical approach, is critical of offering specific formulas for success and treats such approaches as attempting to place healthcare systems within the standardized, predictable context of information technology systems [17]. Trials on the automation of hospital information systems have demonstrated how complex and difficult it is to computerize health records. Although EHR systems have great potential to improve health care quality. So far, however, real and perceived barriers from high costs and decreased productivity to staff frustration-have prevented most providers from implementing them [18]. The reasons for the few successful implementations of EHRs have been analyzed. They include:

• The lack of understanding of the nature of clinical practice by systems developers. This is represented by the fact that although administration and organization structures change over time, the fundamental processes of clinical practice remain basically the same [19].

• Too much focus on purely technologic issues (choice of programming languages, databases, networking, etc.) instead of methodological, applicative, and organizational issues.

• Lack of agreement between health professionals on the structure under which information must be or should be kept and for how long.

• The lack of involvement of health professionals when applications are put into practice.

2.5 Push for Medical Record Computerization

[20] Reports that advocates say that electronic medical records could save 140 billion dollars a year in health care expenses on things like file clerks and space for file cabinets, while also saving tens of thousands of lives each year by reducing medical errors. EHR it is allows for customized views of information relevant to the needs of various specialties. The EHR is “far more flexible, allowing its users to design and utilize reporting formats tailored to their own special needs and to organize and

display data in various ways"[21].[20] Analysts say that the use of EHR significantly reduces redundant and improper treatments, and cuts back on potentially fatal medical errors resulting from incomplete or erroneous information in a patient's medical file .There have been numerous stories about fatal mistakes occurring because of illegible notes written by physicians [22]. [23] Reveals the following as some of the problems of manual information systems:

1. Paper based systems are generally very bulky both to handle and to store, and office space is expensive.

2. Information manual techniques of processing information are more tedious, laborious, slow and inefficient.

3. Labor productivity is low and the process is slower where large volumes of data need to be dealt with.

2.6 The Role of IT in Improving Health care Delivery

[24] states that there is an opportunity to transform health care and improve patient safety by better leveraging information technology to improve the efficiency , accuracy, and effectiveness of the health care system.[25] Using IT systems, medical personnel can get more or different information regarding patients and treatments so that they might dispense better care. A system can suggest the most appropriate antibiotic for a new illness or more accurately track certain vital signs allowing easier detection of a worsening condition. Furthermore, a system could alert doctors to drug-drug interactions or other adverse events relating to a given prescription. In any of these cases, the HIS can be seen as reducing the uncertainty regarding a given treatment or condition, better informing the medical care provider. However, adoption has been slow and the results have been mixed up. If deployed incorrectly, without well-conceived process improvements, IT systems can do just the reverse, leading to critical delays or mistakes.

2.7 Health care Challenges Solved through Networking

According to (Cisco, 2005) [26], managing a clinical environment today involves a large amount of paper. Clinical information stored in paper charts is difficult to access, takes up costly space dedicated to chart storage, and can impact on quality of care. On the other hand, networking can be beneficial as:

1. Connected electronic health records provide effective distribution of information to care givers at the point of care to support higher quality of care with increased efficiency.

2. Caregiver productivity and clinical efficiency can be improved by automating common

Activities, including prescribing, ordering labs, viewing results, and taking clinical notes over a network.

3. Clinicians can access patient charts and medical histories without having to search files or wait for chart pulls.

4. [27] Enhancement of personal private communications among health care staffs using electronic mail service (e-mail).

5. Transferring clinical information about patients among two hospitals or clinics for consultations or decision support using file transfer protocol (FTP) or e-mail.

6. Retrieval of up-to-date medical information with World Wide Web (WWW), and database retrieval services.

To use the functions of the Internet effectively from HISs, it is important that all the staffs in the hospital have to be able to access such services just on the same computer terminals of HIS that they use for daily health care jobs, because their demands for information retrieval or communications with other experts occur while entering clinical orders from the terminal, making a therapeutic plan based on the lab results on the display and so on.

2.8 Hospital Information System components

2.8.1 The Patient Component

The patient component is a key component in any healthcare information system that supports clinical, administrative, or epidemiologic activities [28]. The patient data management system (PDMS) is a component of HIS dedicated to the standardized interaction with critical care monitors. The PDMS cyclically collects, validates, and provides automatic charting of vital parameters [29]. The patient component is responsible for the correct and permanent identification of a patient in the healthcare organization, and the delivery of a number of services and functions to all the other components.

Patient information can be clustered into three groups:

• Basic (demographic, personal) data about a patient are necessary for the unique identification within and outside the healthcare organization.

• Patient contacts are events during which the patient has a relationship with the healthcare organization to obtain healthcare services. A contact may be sub typed into ambulatory visits, inpatient stays, day clinic, and phone consultations.

• Health-related data.

2.8.2 Computerized Physician Order Entry component

Today emphasis has shifted toward providing information systems that support providers during the process of care, resulting in the advent of CPOE systems and a much higher profile for EHRs [30].(CPOE) permits clinical providers to electronically order laboratory, pharmacy, and radiology services. CPOE systems offer a range of functionality, from pharmacy ordering capabilities alone to more sophisticated systems such as complete ancillary service ordering, alerting, customized order sets, and result reporting [31].On do, et al, report that 113,000 physicians are using CPOE regularly and 75,000 of these physicians are using CPOE in teaching hospitals [32].There have been some major CPOE successes and some notable failures. Handler, et al, in an overview article concerning CPOE and clinical decision support systems, stated “that CPOE has been well demonstrated to reduce medication-related errors. However, CPOE and dosing calculators do not entirely eliminate error and may introduce new types of error.

It has been shown that weight-based drug dosing calculators are faster for complex calculations and may be more accurate than hand calculations. Many CPOE systems have dosing calculators. However, the net effect of CPOE can be to slow clinicians."[33]

The benefits of CPOE systems can be categorized as follows:

• Improvement of the healthcare delivery process [34, 35, 36]

- Establish the basis for a patient care plan system

- Eliminate lost orders

- Eliminate ambiguities caused by illegibility of handwritten orders

- Generate related orders automatically

- Track orders and provide feedback about activities provided to the patient as part of the patient's EMR

- Integrate quality-assurance monitors into the order-capture process

- Reduce the amount of preprinted forms used in the order entry processes

• Enhanced communication within the institution

- Faster order handling reduces the time required to initiate and execute orders and phone calls (no need to carry orders around)

- Helps organize nurses' work (e.g., the nursing system interacts with the order entry system to help provide a continuum of care [37].

- Interface with billing systems and materials management

- Co-signing and verifying orders

• Tracing orders through different view mechanisms

- By status: requested, rejected, received, scheduled, in process, performed, reported, or abandoned

- By requesting or performing services (by date)

- By type or by work list

• Increased cost-consciousness: over 70% of the cost of healthcare is determined by what physicians order in the course of providing patient care; clearly, the most effective way to manage healthcare costs is to provide information and educate physicians regarding cost-effective (medication) options [38].

- By providing detailed information on order costs when physicians are making decisions through the real-time display of charge/cost data, or by proposing less expensive alternatives [39].

- By helping prescription practices remain consistent with a hospital's policy [40].

2.8.3 Clinical Documentation

Electronic clinical documentation systems enhance the value of EHRs by providing electronic capture of clinical notes; patient assessments; and clinical reports, such as medication administration records (MAR). As with CPOE components, successful implementation of a clinical documentation system must coincide with a workflow redesign and buy-in from all the stakeholders in order realize clinical benefits, which may be substantial—as much as 24 percent of a nurse's time can be saved [41]. Documentation runs the gamut from vital signs and basic nursing assessments to advanced systems that support structured data entry for clinicians. Nursing information systems have been around for quite a while but have not always been fully integrated with other systems. Clinician documentation functionality remains uncommon in most hospitals [42, 43].Medical devices can also be integrated into the flow of clinical information and used to generate real time alerts as the patient's status changes. Haugh reports that "At Cedars-Sinai Medical Center, Los Angeles, for example, intravenous medication pumps connected to the clinical information system provide automatic dosage verification and documentation for medication management. All of Cedars-Sinai's physiologic monitoring systems are networked, and data on patients is viewable on other clinical information systems in the hospital. From his office, Michael shabot, M.D., can monitor patient Electrocardiogram, EKGs using a Web-based viewing system created at Cedars-Sinai that incorporates a vendor product that provides live waveforms from ICU and monitored bedsides."[44]

2.8.4 A picture archiving and communication system

A picture archiving and communication system (PACS) is a subsystem of a hospital (or health) information system (HIS) whose purpose is to facilitate storing, archiving, and managing digital images and their transmission between the image producers (e.g., radiology, nuclear medicine, pathology) and requesters (i.e., the health professionals and the various medical departments). The potential benefits of PACS reside in the ability to retrieve images based on information maintained in the HIS rather than in the PACS , and simultaneously allowing access to other data: ECG, lab results, notes, and so on[45]. A PACS consists of different components, including technologies for:

1) Image acquisition from digital imaging de- vices including computed tomography (CT), magnetic resonance imaging (MRI), ultrasonography, computed radiography, digital fluoroscopy, angiography, and nuclear medicine

2) Archival storage and retrieval from a database management system, including short-term and tong-term electronic storage for image information and work-flow management systems

3) Display of images on diagnostic and clinical monitors

4) Communication through local and wide area networks (a network physically connects computers)

5) Interfacing between PACS and the radiology information system (RIS) to allow the ex- change of information and messages [46].The financial justification of PACS also pushes toward the integration of a PACS within existing clinical information systems to ensure the synergy of the contributions made by both systems [45]. Most literature supports the virtue of connecting a PACS to an HIS/RIS. This is important because if no RIS of HIS interface can be done, the facility must reevaluate the benefits of implementing PACS. When connectivity between PACS and HIS/RIS are created, entirely new methods of efficiency and effectiveness become possible to help to make it cost-effective. For example, selected images of studies can be made available to ah RIS/HIS workstation.[47].This gives physicians quick access to a patient's medical images without having to travel to the radiology department .PACS and HIS/RIS use different communication protocol standards. (American College of

Radiology, National Electrical Manufacturer Association) ARC-NEMA has developed the DICOM communication protocol standard for PACS. Information Systems often are configured with HL7 communication protocol. An interface must interpret and route data between these two communication protocols so that PACS and RIS/HIS can communicate and share information.

2.8.5 The Security Component

Security is a general term that covers all the precautions taken whenever health information is collected, used, disclosed, or accessed. Security is an attribute of any information system. Security includes the physical and technical tools required for assuring the availability, confidentiality, integrity, and accountability of information and critical services. Security protection can be broken down, according to the Department of Defense Trusted Computer Systems Evaluation Criteria (The Orange Book), into four broad hierarchical divisions of security protection levels

(From D minimal to A1 maximal security) [48].The confidentiality of information available to the providers and quality of care is strongly interrelated. Some security precautions mainly apply only to stored information (e.g., access rights), whereas others apply to communicated information (e.g., proof of origin) or to both categories (e.g., confidentiality). The guarantee that personal information will not be altered or tampered with is of great importance in keeping patients' confidence in the healthcare system. Patient information therefore must be handled in a secure and efficient way so that only authorized persons have access to it [49]. Organizations need fine-grained access security to an adequate level of detail to control that can do what. In general, security measures can be categorized as ***access security, communication security, content security, and security management*** [50] …***Access security*** issues include user authorization management, user identification (including smart cards, biometric devices, and password/PIN-generating "key fobs"), firewalls, and digital certification and public key infrastructure (PKI) issues. Access control is the ability to limit and control the access to host systems and applications.

Communication security issues include security communications protocols that secure messages (encryption). Security protocols generally also provide authentication. The security protocols that have emerged on the Web are Netscape's SSL (Secure Sockets Layer), NCSA's SHTTP (Secure HTTP), PCT (Private

Communications Technology) a protocol from Microsoft that provides secure transactions, and the IETF's IPSec (IP Security). Web browsers and servers generally support all the popular security protocols. ***Content security issues*** include content filtering to eliminate undesirable content (from Web sites, files, databases, and communications), encrypted file storage and databases, and virus detection. Depending on the chosen data classification scheme the following protection goals are also included: data confidentiality, data integrity, and data availability. ***Security management*** issues include security assessment, intrusion detection, vulnerabilities assessment, and support for the development and implementation of security policies and guidelines [51].

2.9 Conclusion

Although many scholars have written about computerization of health records as an urgent requirement and a lot of research has been carried out, implementation is still insufficient. However, according to the literature available, there are numerous benefits that accrue from EHR when compared with manual systems. For example there will be no duplication of records, sharing of information is made possible, the problem of missing and /or misplaced records is reduced and the information is available at the point of care. Despite the efforts by the ministry of health, hospitals remain completely manual with traditional pen and paper records management. Healthcare IT is a sleeping giant. Although healthcare budgets contribute to the bulk of government spending, healthcare information technology lags far behind other IT businesses including banking, telecommunications and the media. Local and countrywide efforts to implement electronic health record (EHR) systems have been intermittently reported. The common threads, however, that link these efforts and how they contribute to the success, barriers or failure of implementation have not been identified. The HIMSS Global Task Force investigated a battery of EHR components within each country, including security, quality, financing sources and barriers. Four common threads that hinder EHR implementation and produce a kinship between every effort around the globe were identified. These are: Communication, Standardization, Funding, and Interoperability. The need to harness and deploy this information is readily apparent. It can be used to predict the future success of efforts to imbed IT into the world of healthcare whether those efforts are parochial, countrywide or global.

CHAPTER 3

METHODOLOGY

This section describes the steps and procedures that were followed in order to accomplish the project. The study was conducted as follows:

3.1 System Analysis

System analysis describes the existing system, problems of existing system.

3.1.1 Existing System

The existing system was found to be completely manual, i.e. personal (patient) information is captured in a register at the reception. A medical form is issued to the patient who he/she take to the Clinician for prescription and treatment. The Clinician takes the medical history, writes diagnosis and treatment on the form. The Clinician sometimes can refer the patient to the laboratory for investigation before diagnosis depending on the situation of the patient. All the patient charts are collected and kept with the Records department. Filing and organization of the charts are done in the records department. Summaries and reports are also generated here.

3.1.2 Problems of Existing System

Considering the previous section, there are many problems associated with the existing manual system, they include the following:

1. There is a problem of storage of these registers and forms/charts which are produced at different levels.

2. Information retrieval from these sources is not easy

3. Some charts get lost or misplaced. This is a problem in decision making as there is inadequate information.

4. Patients have to wait for a long time as health workers are looking for their charts.

3.2 Requirements Analysis

To verify the existing system there are many requirements such as:

3.2.1 User Requirements

It is very important to get users of the system fully involved such that the problem of change management does not arise. The stake holders, who will use the system they expected of the proposed system and the following is the proposed:

1. A system that is easy to learn and use.

2. A system that improves on the efficiency of information storage and retrieval.

3. A system that is fast in producing results which will be ready at the point of care therefore reducing on waiting time and increasing on time to attend to the patients.

4. A system that has an element of error validation, i.e. one that prompts the user on

entering unusual command or data format inconsistent with the database.

5. A system that provides attractive interfaces with easy navigation throughout the system.

6. A system that is faster, flexible and convenient.

7. A system that stores data and produces reports timely and accurately.

8. A system that restricts access to information to only authorized personnel.

3.2.2 Functional Requirements

Functional requirements capture the intended behavior of the system. This behavior may be expressed as services, tasks or functions the system is required to perform. Therefore the proposed system is able to:

1. Capture the patient information, store it and make it available at the time of need.

2. Present the users with a real-time display of the number of records in a database.

3. Generate reports accurately and timely.

4. Search and display patient information details.

3.2.3 Non-functional Requirements (NFR)

Non-functional requirements are requirements which specify criteria that can be used to judge the operation of a system, rather than specific behaviors. This is contrasted with functional requirements that specify specific behavior or functions. Systems must exhibit software quality attributes, such as accuracy, performance, cost and security plus usability, i.e. easy to use for the intended users. NFRs help to achieve the functional requirement of a system. Thus the proposed system does the following:

1. The system has high performance and reliability level. The mean time between failures, mean time to repair, and accuracy are very high.

2. The system has user-friendly interfaces. This ensures the ease with which the system can be learned or used.

3.2.4 System Requirements

1. **Software Requirements**

Software Component	System Requirement
Operating System for the server	Windows NT, 2000 or above
Database Management System	Microsoft access version 2007

Table 3:1 Software Requirements

2. **Hardware Requirements**

Hardware Component	System Requirement
Processor Processor Speed Bandwidth	Intel Pentium III or above 800M HZ or above 100MBps

Table 3:2 Hardware Requirements

3.3 System Design

3.3.1 Entity Relationship Diagrams

ERD is a graphical description of the data for a particular database = a graphical data model. It represents the data at a high level of abstraction. The term "database" above usually implies a computer-based database; however, given the complexity of the ERD it might well be realized ("implemented") in the form of some type of paper based clerical system. "High level of abstraction" means that it is not necessary to show details of the various fields or indexes, just the bare bones. in these thesis we used ERD to identify the data to be captured, stored and retrieved in order to support The activities performed .The diagrams were used to show the relationships between the Entities involved in the system together with their attributes and indicate the number of occurrences an entity can exist for a Single occurrence of the related entity. Entity Relationship Diagrams (ERDs) illustrate the logical structure of databases. Entity relationship diagrams were used because they are relatively simple, user friendly and can provide a unified view of data, which is independent of any data model. The diagram below shows the ERD for the new system.

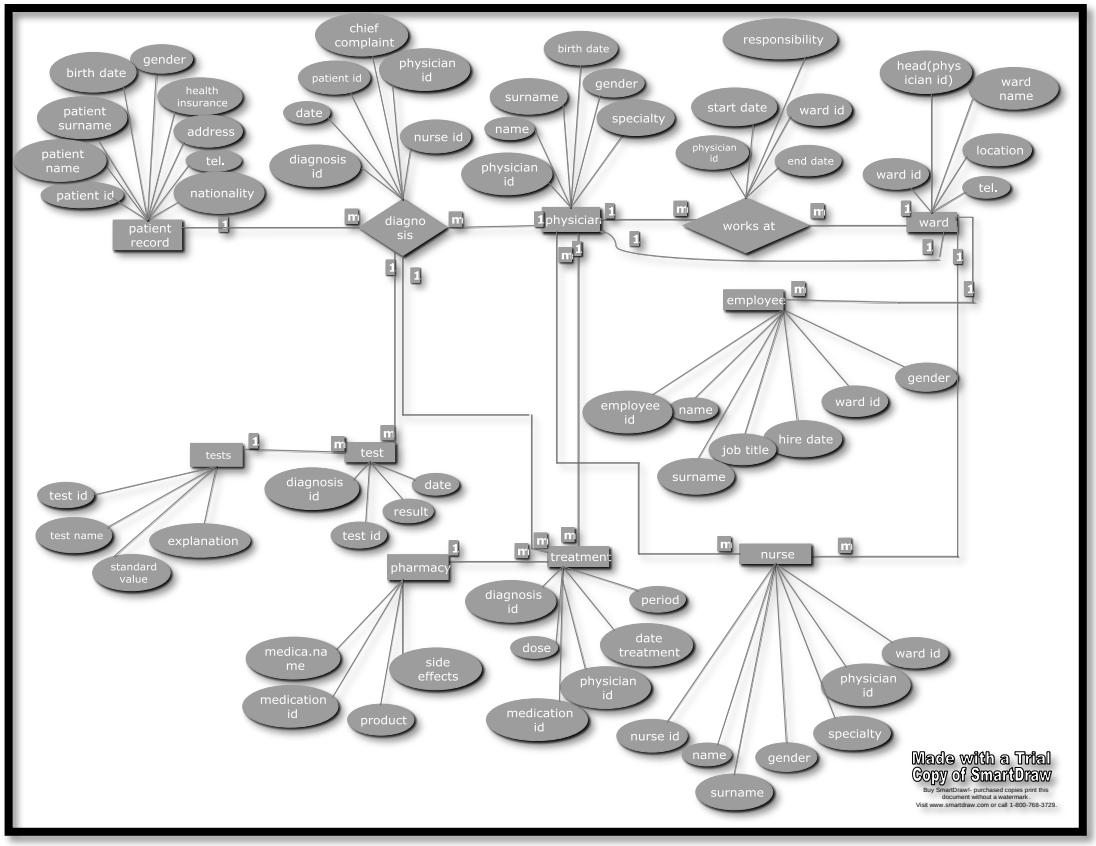

Figure 3.1: E-R diagram in the proposed system

3.3.2 Data Dictionary

This contains all data definitions for cross-referencing and for managing and controlling access to the information repository/database. Data dictionaries do not contain any actual data from the database, only book keeping information for managing it. Without a data dictionary, however, a database management system cannot access data from the database. Below are the illustrations:

Patient register: A patient is registered by capturing his /her demographic data. This includes full names, address and sex. A unique patient number is issued and all this is stored in the patient register table. The primary key here is the patient number (patient id).

Attribute	**Data Type**	**Description**
Patient id	Number	Unique serial number given to the patient
P name	Text	Patient name
P surname	Text	Patient surname
Birth date	Date/time	Patient birth date
Gender	Text	Patient's gender
Address	Text	Patient address(home address)
Telephone	Number	Patient telephone number
Nationality	Text	Patient nationality
Health Insurance	Memo	Patient health insurance

Table 3:3 Description patient registration

Physician register: The physician who treats the patient is also recorded by the system and the information kept in physician register table. The doctors ID, his name, birth date, gender, and his specialty.

Attribute	Data Type	Description
Physician id	Number	Unique identification of the physicians
Physician name	Text	Identification of the physician by name
Physician surname	Text	Identification of the physician by surname
Birth date	Date/time	Identification of the physician by birth date
Gender	Text	Identification of the physician by gender
Specialty	Text	Identification of the physician by specialty

Table 3:4 Description physician registration

Physician degree register: Also recorded by the system and kept the information about physician such as physician start date, end date, ward id and his responsibility.

Attribute	Data Type	Description
Physician id	Number	Unique identification
Start date	Date/time	Unique identification
End date	Date/time	Unique identification
Ward id	Number	Ward id
Responsibility	Text	Identification of physician by responsibility

Table 3:5 Description physician degree registration

Diagnosis register: When the patient goes to doctor, more information is captured in the system. This includes (chief complaint), ward id, and clinical notes .This is stored in the diagnosis register table as shown below.

Attribute	Data Type	Description
Diagnosis id	Number	Unique identification of the diagnosis
Date	Date/time	Identification diagnosis date
Chief complaint	Text	Identification patient chief complaint
Patient id	Number	Identification patient id number
Physician id	Number	Identification physician id number
Nurse id	Number	Identification nurse id number

Table 3:6 Description diagnosis registration

Tests register: Some basic information such as test name and standard value is stored in the tests register table as given below:

Attribute	Data Type	Description
Test id	Number	Unique identification of the tests
Test name	Text	Identification test name
Standard value	Memo	Identification standard value of the test

Table 3:7 Description tests registration

Test register: Some patients go for the laboratory. In the laboratory information like specimen, tests done, and laboratory results are captured and is stored in the test register table as given below:

Attribute	Data Type	Description
Diagnosis id	Number	Identification diagnosis id
Test id	Number	Identification test id
Result	Memo	Identification the test result
Date	Date/time	Identification date of the test

Table 3:8 Description test registration

Ward register: Other information captured by the system is the ward information. The ward id, ward name, building and telephone number are captured and stored in the ward register table.

Attribute	Data Type	Description
Ward id	Number	Unique identification of the ward
Head(physician id)	Number	Identification head physician of the ward
Building	Text	Identification the building number
Ward name	Text	Identification the ward name
Telephone	Number	Identification the ward telephone

Table 3:9 Description ward registration

Treatment register: When the patient goes to doctor, more information is captured in the system. This includes treatment, diagnosis id, medication, dose, physician id, date treatment and period. This is stored in the treatment register table as shown below.

Attribute	Data Type	Description
Diagnosis id	Number	Identification diagnosis id number
Medication id	Number	Identification medication id number
Physician id	Number	Identification physician id number
Dose	Text	Identification the dose of medication
Date treatment	Date/time	Identification the date of treatment
Period	Memo	Identification period of the dose

Table 3:10 Description treatment registration

Pharmacy register: The basic information about medication is captured in the system. This includes medication id, medication name, producer and side effect.

Attribute	Data Type	Description
Medication id	Number	Unique identification of the medication
Medication name	Text	Identification medication name
Producer	Text	Identification producer name
Side effects	Text	Identification side effects of the medication

Table 3:11 Description pharmacy registration

Employee register: The employee who works in the hospital is also recorded by the system and the information kept .The employee ID, his name and surname, gender, job title, hire date and ward id. This is stored in the employee register table as shown below.

Attribute	Data Type	Description
Employee id	Number	Unique identification of the employee id
Employee name	Text	Identification of employee name
Employee surname	Text	Identification of employee surname
Gender	Text	Identification of employee gender
Job title	Text	Identification of employee job title
Hire date	Date/time	Identification of employee hire date
Ward id	Number	Identification of ward id number

Table 3:12 Description employee registration

Nurse register: The nurse who works in the hospital is also recorded by the system and the information kept .The nurse ID, his name and surname, gender, specialty, physician id and ward id. This is stored in the nurse register table as shown below.

Attribute	Data Type	Description
Nurse id	Number	Unique identification of the nurse id
Nurse name	Text	Identification of the nurse name
Nurse surname	Text	Identification of the nurse surname
Gender	Text	Identification of the nurse gender
Specialty	Text	Identification of the nurse specialty
Physician id	Number	Identification of physician id(head of nurse)
Ward id	Number	Identification of ward id(nurse work at ward)

Table 3:13 Description nurse registration

3.4 System Implementation

System implementation was achieved using Microsoft office access 2007 and using SQL in access for database design. Microsoft visual basic 6.0 scripting language were used to develop the codes that link up the system interfaces and the database.

3.4.1 Microsoft access 2007

A reason that justifies it's choose for this project. Below is the description for the advantages of Microsoft access 2007:

1) One of the benefits is cost. Many times when you buy Microsoft Office professional Access comes right along with it. This is certainly a benefit because while the Microsoft Office software may be expensive it comes with lots of programs that save you money buying many different types of software.

2) That it is easy to use.

3) Is multi users.

4) Access databases can connect to Excel tables, ODBC connectors, SQL Servers, and SharePoint Services sites for live data. Tables created in these sources can be linked and used for generating reports.

5) Microsoft Access is the default database of Microsoft Visual Basic.

6) Microsoft Access 2007 provides many new features that make working with data and designing a database even easier.

7) Microsoft Access Database is a collection of data and objects related to particular topic or purpose. Microsoft Access Database may contain tables; queries, forms, reports, macros modules and shortcuts top data access pages.

8) Microsoft Access is a Relational Database Management System.

9) Using Access we can organize our data according to subject and can store information about how different subject are related. In general MS-Access database can have several small tables.

3.4.2 Microsoft Visual Basic 6.0

Visual Basic 6.0 is Microsoft's latest version of the Visual Basic Programming language. Visual Basic reduces the effort required on your part, and makes programming enjoyable. Visual Basic makes many aspects of programming as simple as dragging graphics objects on to screen with your mouse. Visual Basic 6.0 is more than just a programming language; the secret to Visual Basic is in its name" Visual". With to days Windows Operating System, a program must be able to interact with the screen. Keyboard, mouse and printer graphically. The environment provided by Visual Basic is suitable for any type of application. Using this environment, the user can visually design the objects that your application uses. Visual Basic is not just a languages, it's an integrated development environment in which you can develop, run, test and debug your applications.

CHAPTER 4

RESULTS / FINDINGS

This chapter explains in summary, the outputs or findings as per specific objectives of the study.

4.1 Patient's Demographic data, Diagnosis, Prescriptions, and Treatment

A patient's demographic data would be captured at the reception, in a register on a chart and. diagnosis, prescription and treatment would be taken by a clinician on the chart. The data on the chart would again be recorded in the register when the patient was receiving drugs in case of outpatient department patients. The patient would require to coming with the chart on subsequent visits. This was found with the following problems:

1. Patients would forget to bring the charts at their second visit
2. Some charts would be misplaced or got lost in the records centre
3. There was duplication in registration of patients

4.2 System Design

System was designed on Microsoft windows platform, using Microsoft access for database design and visual basic scripting language .The system is composed of two sections; the database and the graphic user interfaces (GUI) i.e. a two tier architecture.

4.3 System Implementation

4.3.1 The Database

The database was designed using Microsoft access database management system. The database was named "RECORDS" and it contains eleven tables which keep records or data as entered by the user it is this database that is consulted to answer queries

4.3.2 Graphical User Interface

The user interfaces consist of various windows that enable different categories of users to interact with the system. The forms were developed using visual basic. Different forms were developed to enable the users perform the following tasks:

1. Register the patients by capturing personal information

2. Capturing patient’s information i.e. patient name, surname, health insurance and address

3. Entering the test name and capturing all patient information who conducted these test

4. Capturing patient's information i.e. patient name, surname, telephone number, and address by entering patient id

5. Capturing patient's information i.e. patient name, surname, telephone number, and address by entering patient birth date.

6. Capturing patient's information i.e. patient name, surname, telephone number, and address by entering patient's gender.

7. Capturing patient's information i.e. patient name, surname, telephone number, and address by entering nurse id have diagnosed the patient.

8. Capturing physician information i.e. physician name, surname and gender by entering hire date (start date, end date in specific ward).

9. Capturing physician information i.e. physician name, surname and gender by entering specialty.

4.3.3 Screen Formats

The information that is managed by the system is captured on different screens at different stages. This section shows these screen shots and how they are used to capture the information managed by the system.

4.3.4 Patient Registration

The user can register the incoming patient by capturing the personal information. Here the user means the one who registers the patient at reception by capturing the demographic data only .A Details of the patient's demographic data is captured including first and last names, sex, age and address. He / she is assigned a unique patient number. The screen shot below shows demographic data being captured:

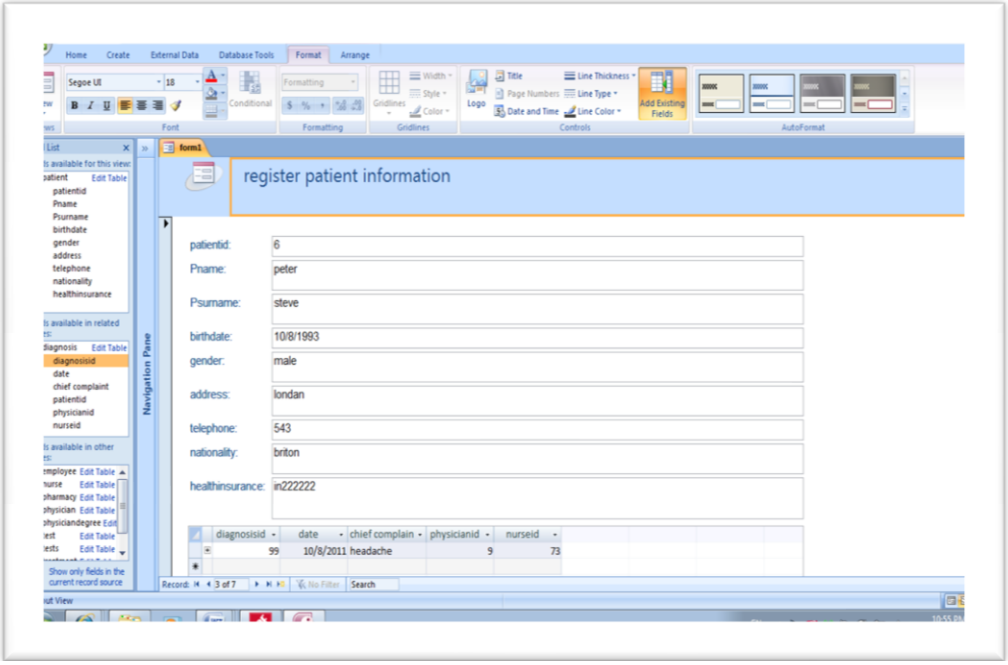

Figure 4.1: registering the incoming patient

The system allows searching for the patient who is registered. I.e. if he/she attendances case or has moved from one stage to another. For example, when a patient is registered at reception and goes to the clinician. On presenting his/her patient number or names, the Clinician will use search facility in the system to get the details of the patient as in the screen below:

4.3.5 Searching for the patient information in the system

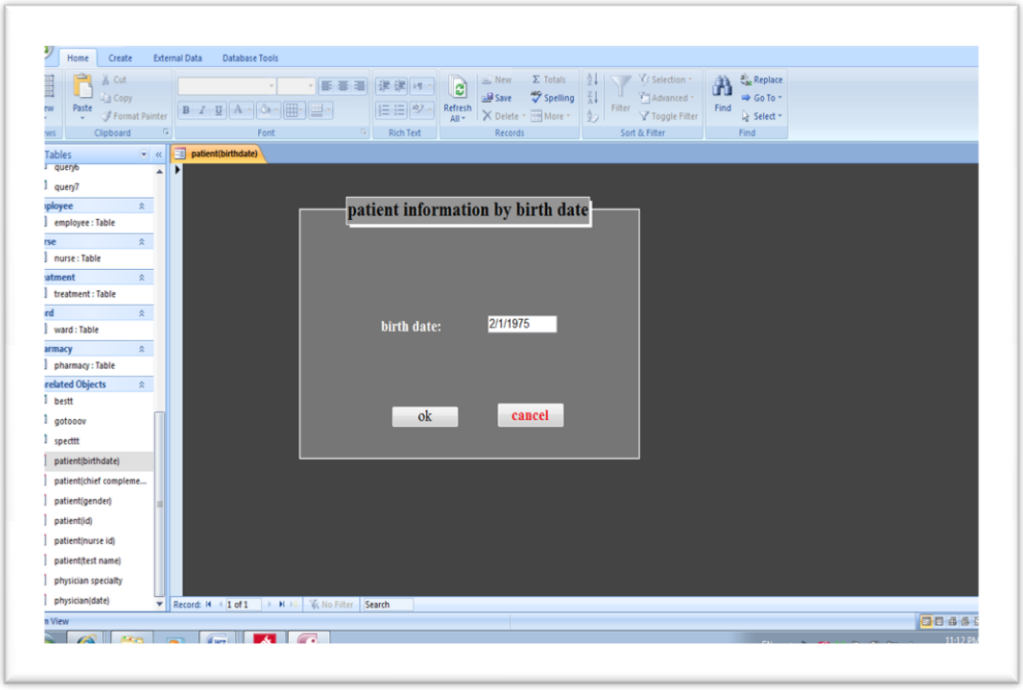

Figure 4.2: searching for the patient in the system

In the above form, the patient birth date was used to search for the patient in the system.

4.3.6 Searching a patient information using patient id number

The patient number was used to search for the patient in the system. Since the patient number is unique, only that patient will be displayed when it is used, as in screen

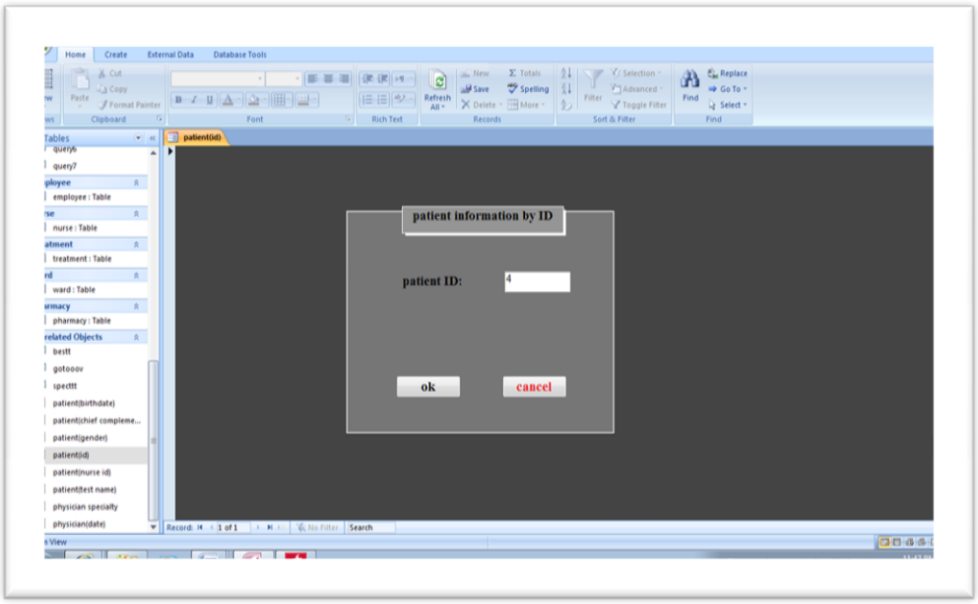

Figure 4.3: searching for the patient in the system using id number

4.3.7 Searching a patient information using patient gender

Patient gender can be used to search for the registered patient as well. In the following screen a patient whose gender is male is being searched in the system.

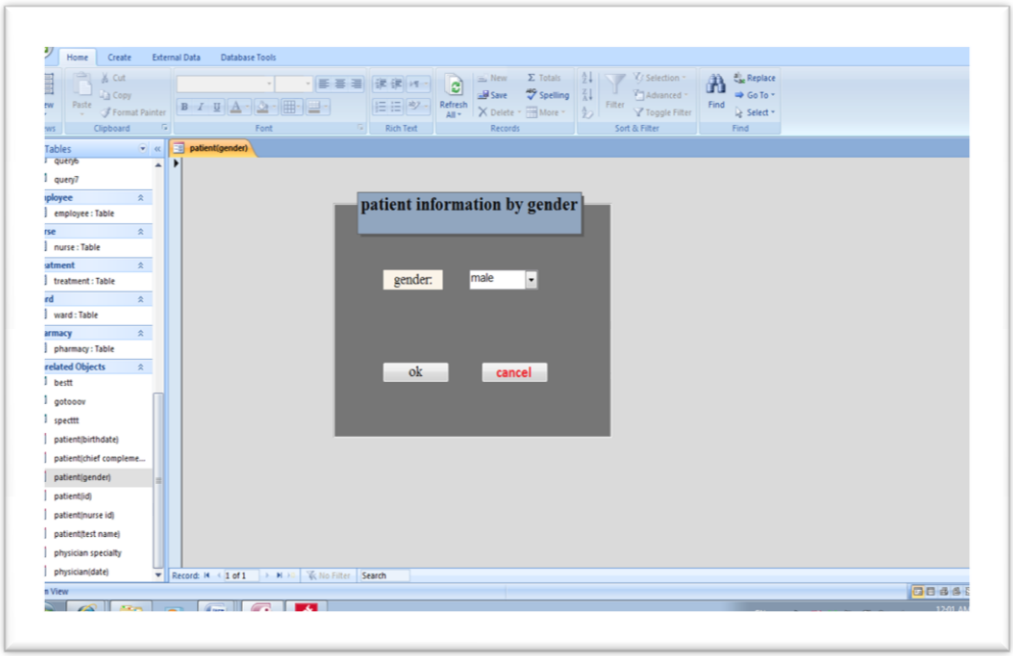

Figure 4.4: searching for the patient in the system using gender

4.3.8 Searching a patient information using patient chief complement

Patient's chief complaint can be used to search for the registered patient as in the screen below

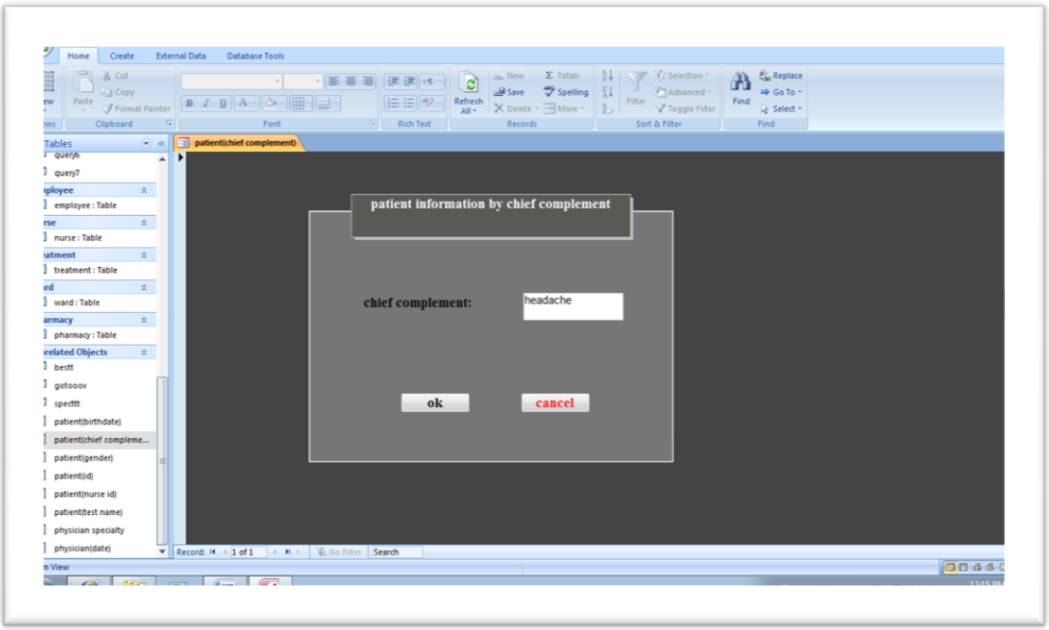

Figure 4.5: searching for the patient in the system using chief complaint

4.3.9 Searching a patient information using nurse id

Nurse id number can be used to search for the registered patient as in the screen below.

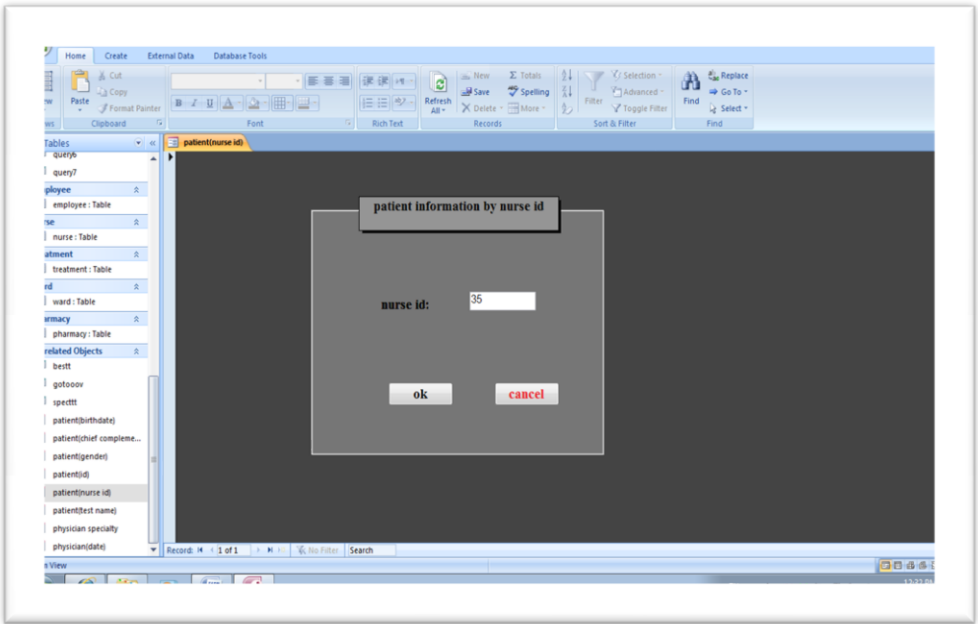

Figure 4.6: searching for the patient in the system using nurse id number

4.3.10 Searching a physician information using physician specialty

Physician specialty can be used to search for the registered physician as in the screen below.

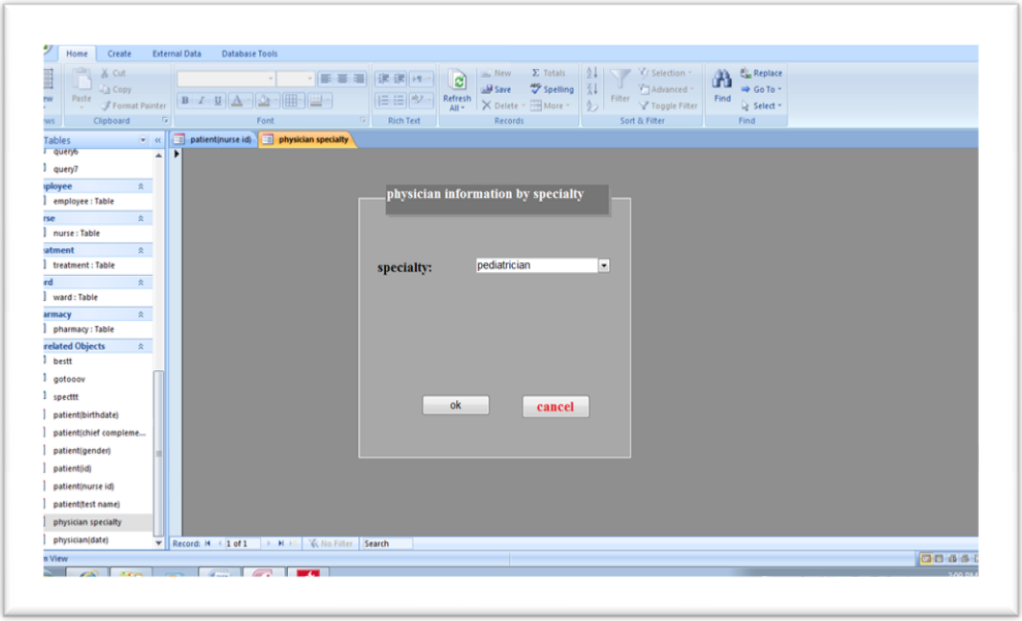

Figure 4.7: searching for the physician in the system using specialty

4.3.11 Searching a physician information using hire date

Also can find physician information by using hire date as in the screen below

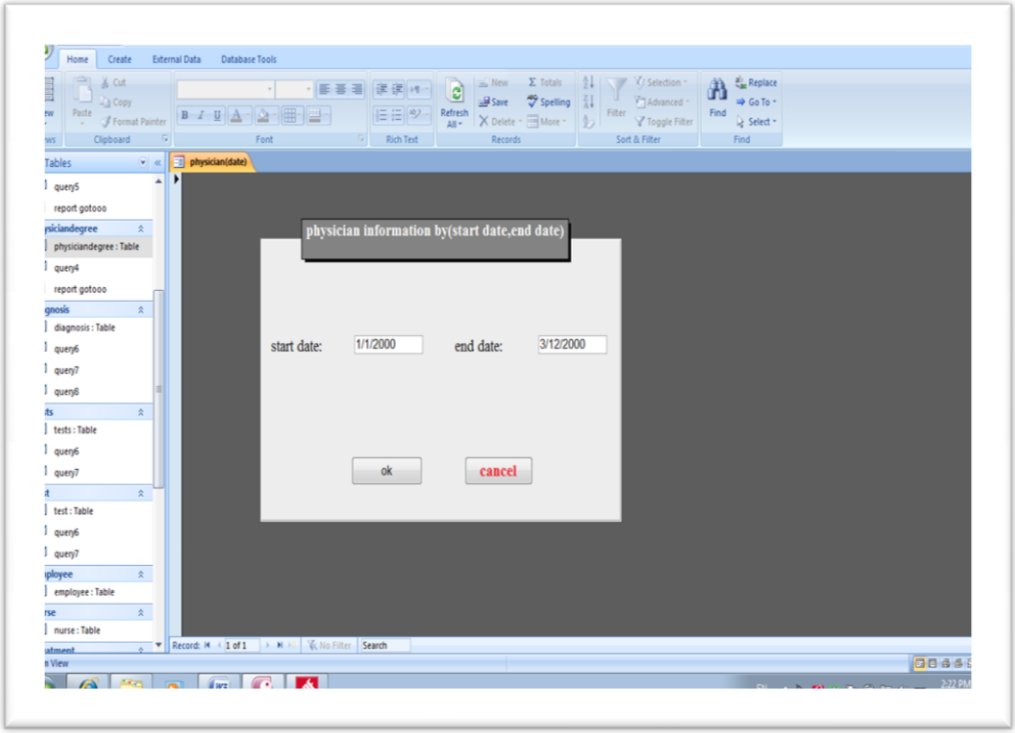

Figure 4.8: searching for the physician in the system using hire date

CHAPTER 5

PROJECT DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Discussion

The purpose of the study was to build a computerized health records management system to replace the existing manual system. To achieve the objectives of study, the existing systems was studied and analyzed, by comparing the strong and weak points of the system. Implementation was done using Microsoft access for database design and visual basic scripting language .The system is composed of two sections; the database and the graphic user interfaces (GUI). The new system is therefore able to do the following:

1. Capturing of Personal / bio data is done once; on reception as opposed to the manual system where the patient would be recorded at every level in different registers. This avoids duplication and saves time.

2. Retrieve Information from the database as quickly as one searches on the screen compared to the old system which involved paper files which were vulnerable to displacement and damage.

3. Validate the entries by prompting the user whenever a wrong command is entered to avoid unnecessary errors that can distort information.

4. Update the database whenever new information is entered

5.2 Recommendation

A more comprehensive study to exploit the full benefits of the new technology in this field of health records management is highly recommended. This may be able to unveil more gaps and therefore improve on the system more than this study has been able to do. The ministry of Health should step in to have all hospitals and health units computerize their records management systems by providing the necessary funds for

such projects. The system would be rendered useless if measures are not put in place to avert power problem. The researcher therefore recommends that a standby generator be considered such that when power goes of the system does not stop working. Training of the hospital staff in minimum computer skills is paramount. It was found out that most staff is computer illiterate. Without these skills system implementation will be difficult therefore it is recommended that a training program be made a priority.

5.3 Conclusions

Basing on the findings and analysis, computerization of health records management is venture worth to invest in. Once taken seriously and embraced, there are a lot of benefits that can be realized therein. Both the hospital and the community it is serving will benefit from it. For example patients will no longer wait for long hours to be attended to because the time that would be spent looking for information would be saved. Medical errors that were resulting from lack of information for proper decision making on the part of doctors / clinicians will be minimized. Records which were stored in the records center, in form of charts and sometimes get lost there, will now be stored electronically and will be safer. Therefore there will be the right information at the point of care. Periodic reports which are generated with the help of a computer are more accurate and quick. Therefore with the introduction of computerization, the problem of late reporting and errors in the reports will be no more.

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APPENDIX A

CURRICULUM VITAE

PERSONAL INFORMATION

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EDUCATION

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FOREIGN LANGUAGES

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