NATIONAL MEDICAL INFORMATION MANAGEMENT SYSTEM

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Declaration

I Mugume Johnson and Ongal Bernard do hereby declare that this Research Report is original and has not been published and/or submitted for any other degree award to any other University before.

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Dedication

This report is dedicated to our dear Parents and my supervisor for the support provided during our stay at the University.

Acknowledgment

We would like to express our sincere and heartfelt gratitude to our beloved parents and guardians, for the spiritual, moral and financial support accorded to us throughout the course of our education.

We acknowledge Dr Benjamin Kanagwa our Field research advisor, for his support, patience and guidance throughout the duration of the project.

We also acknowledge the various medical personnel, insurance companies and medical students that provided a wealth of reliable and relevant information to us.

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CHAPTER ONE
INTRODUCTION

1.1 Background to the study

Lehman (2003) [7] indicates that medical records are created when you receive treatment from a health professional such as a physician, nurse, dentist, chiropractor, or psychiatrist. The records include medical history, details about lifestyle such as smoking or involvement in high-risk sports, and family medical history. In addition, medical records contain laboratory test results, medications prescribed, and reports that indicate the results of operations and other medical procedures. The records also include the results of genetic testing used to predict future health.

According to Bird et al. (1983) [1], effective medical care depends on thorough knowledge of the patient obtained through the patient's medical history, taking physical examinations and laboratory evaluation. Patients are passively and impersonally manipulated to yield desired information. This often results in time and resource wastage as well as duplication of efforts since the information already exists and can be accessed instead of regenerating it.

Medical recording is of great value to the country in several aspects. Kumar (2004) [2] argues that since medical records contain various facts like-personal details of the patient, illness, diagnosis, modus operandi used to find out the disease, seriousness of diseases, medicines being used by patients in the recommendation of his/her attending doctors and even the clear names and signature of attending doctors, the nation can attain the health relating information through looking up such medical records. The government can be availed with such records in the direction of making short as well as long term health strategies. Considering the significance of medical records, in Singapore no hospitals and health centers are opened without establishing a separate and well-equipped medical records section. Apart from this, provisions for imparting the required knowledge to the persons working in the medical records section have also been made. For this purpose, some institutions that impart special training have also been set-up. Such training centers were also established in India.

Taking into account of the importance of medical records, the World Health Organization introduced the International Classifications of Diseases in 1946 with the view of integrating the proper diagnosis systems and formulating the true and factual data on the basis of medical records kept by all the health entities.

In most developing countries, no institutionalized development of medical record can be realized so far. This doesn't mean that the medical record is entirely neglected since in some hospitals, there are distinct medical records sections. But these sections have not been equipped and operated well enough to meet the required level of satisfaction. Instead, they are only working as name registration sections. Though no concrete efforts are being made by the government in this sector, some hospitals are seen to be alert in this regard. They have developed their own ways for giving due importance to medical records but the efforts made have not been abundant.

Turning to Uganda, in an article titled "what works case study" [19] published in 2003, Health Net Uganda is an NGO with a vision to transform the healthcare system in Uganda through the use of handheld computers and/or Personal Digital Assistants (PDAs). The organization hopes to provide services that will not only bridge the technology gap, but also create social value by enabling health workers access up-to-date medical information, communicate with peers throughout the country, and record and analyze sensitive patient data electronically. However apart from donations the NGO has not yet received full embracement by Government.

It is the verge of 21st century. Efforts should be dedicated to implement a proper medical recording system as adopted by the developing and developed countries in the world. It would be a timely approach to establish a sound national medical records department at government level which should be entrusted with all the powers for regulating, managing and operating all the necessary functions in as far as medical records are concerned.

1.2 Problem statement

There is poor exchange of patients' medical records between hospitals or medical practitioners. As a result medical practitioners waste a lot of time trying to dig the medical history out of patients who may sometimes provide false information or are not in good condition to provide viable information. The Government also spends a lot of money on medical research to come up with appropriate health policies because this medical data is scattered all over different medical institutions in the country. This has resulted into unnecessarily high health budgets and sometimes the development of inappropriate policies due to errors in research. Because of the importance of medical data there is need for government to intervene and ensure countrywide availability and security of this medical data.

1.3 General objective

The goal of this project is to develop an online National Medical Information Management System that will allow real time access and sharing of medical data by medical practitioners and government agencies.

1.4 Specific Objectives

- To investigate into the existing medical record systems available for medical institutions.
- To establish the requirements of a National Medical Information Management System.
- To develop a design for medical record system based on the established requirements
- To implement the design of the system (user interface, process and database design)
- To test and validate the system against the specified requirements

1.5 Scope of the Study

The data was gathered from selected hospitals, ministry of health and insurance companies around Kampala district. Conceptually the project covered capturing, storage

and retrieval of medical information within hospitals and generation of statistics from the captured medical information by government.

1.6 Significance of the Study

- The system will boost efficiency and accurate diagnosis of patients country wide basing on their previous medical history.
- The system will improve record storage and reduce storage costs as well as enabling real time access to medical data.
- System will aid in the development of accurate national health policies and plans.
- The system will also reduce the cost of gathering information required in making national health policies and plans.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

There seems to be a hot debate over the issue of having a national medical database and diagnosis support system. Governments and policy makers look to be in favor of a national medical database and diagnosis system because of the advantages it promises, but medical practitioners and patients appear to be in sharp contrast, basing on the issue of privacy. According to Medical privacy [8], it is argued that an electronic national medical database will expose private information. However, the opposition is willing to adopt the idea on grounds that security measures are put in place. Various schools of thought have also subjected the different ways of maintaining information privacy.

2.2 Privacy issues of medical records

The medical privacy web site [6] presented the fact that, with the rapid advances in the computerization of medical data, the question of the protection of medical records privacy has began to arise. Storing a large amount of sensitive information in a central location (databases) could open the door to *invasion* of privacy issues that were not as common as with the keeping of paper files. Without the patient's knowledge, health records are sometimes perused by employers and insurance companies. Because medical records contain some sensitive information, such as past drug use or genetic predisposition to various diseases, it is important to keep this information truly *private*. In a typical teaching hospital, many people can have access to medical reports. For example, anyone from the nursing staff to the x-ray technician can have a look at the records and as hospitals begin to computerize their medical records, there is a legitimate fear that more people will have even more access to medical records. Hospitals are not the only ones archiving medical records on patients, data banks of such organizations as Health Maintenance Organizations (HMO's) and drug companies are also gathering information and storing them in a computer based format. By linking these computers together, some companies are beginning to sell and trade this valuable information across this vast network of computers. Medical records may also be used in a medical court case for

example if you are involved in a case in which your medical condition is an issue. The relevant parts of your record may be copied and introduced into a court case.

Vernon (2001) [3] presented a friction case between Washington's Secretary Tommy Thompson and the Department of Health and Human Services (HHS) on one hand and a group of physicians charging that proposed medical regulations promulgated by Bill Clinton to create a national database of patient records and assign all Americans a unique health identification number, would invade patients' privacy, "depend upon an unconstitutional provision that is obnoxious to most Americans" and "need to be withdrawn." They continued to argue that, the Clinton administration rules the secretary is considering are "masquerading as 'medical privacy protection' and were written to fulfill the 'Administrative Simplification' section of the Health Insurance Portability and Accountability Act (HIPAA) of 1996." However, the federal government decided to find a way to create a national database of patient medical records and identify all their medical records, even though the public is against it and the funds for Patient Identifiers were cut off by Congress.

The Gallup survey commissioned as presented by Kumar Karki (2004) [2], revealed that an overwhelming majority of Americans were against the idea of government or other third parties having access to their medical records, including genetic information, without their permission. Key findings of this survey include; 78 percent said it is very important that their medical records are kept confidential, 93 percent say that medical and government researchers shouldn't be allowed to study an individual's genetic information without first obtaining consent. This clearly reveals the sensitivity of medical records which must be handled very carefully.

According to Carvel (2007) [5], nearly two-thirds of family doctors in Britain were poised to boycott the government's scheme to put the medical records of 50 million patients on a national electronic database. A Guardian poll revealed that, with suspicion rife across the profession that sensitive personal data could be stolen by hackers and blackmailers. The poll found 59% of the health centers in England were unwilling to upload any record without the patient's specific consent. Three-quarters of family doctors said medical records would become less secure when they are put on a database that will eventually be used by National Health Service (NHS) and social services staff throughout England. Half thought the records would be vulnerable to hackers and unauthorized access by officials outside the NHS. A quarter feared bribery or blackmail of people with

access to the records and 21% suspected that social services staff would not adhere to the confidentiality rules imposed. The British Medical Association held that, "The government will not regain the confidence of the public or the profession unless it can demonstrate that its systems are safe, and doctors will wish to see for themselves how the program will work."

2.2.1 Ensuring medical record privacy

Medical Privacy web site [6], presented that experts estimate that during a typical stay in a hospital, a patient's record could be viewed by as many as 77 different people. Having a patient's record on computer would most likely increase that number dramatically. Some hospitals have developed procedures to protect the confidentiality of their electronic information. Some of these measures include: The use of passwords to limit access to the records, setting up a system that tracks who has been accessing the records and what information they examined or modified. (This is called an audit trail. Patients know who has seen their records, and medical personnel are made aware that their actions may be monitored.), Doctors can *tag* a record that they feel is particularly sensitive. If another physician would like to see the record, then they would first contact the primary doctor to view this information. Note: It does not matter what elaborate security system is implemented, human errors and unauthorized entrances are always a danger to releasing sensitive material.

2.3 Medical Languages

Lehmann (2003) [7] presented the fact that adopting a common clinical terminology and codes simplifies health care communication with the government and ultimately benefit the public. This unified system proves invaluable in facilitating the automated exchange of clinical information needed to protect patient safety, detect emerging public health threats, better patient care coordination and compiling research data for patients participating in clinical trials. The beauty of (SNOMED-CT) terminology is that it is designed to index medical record information across medical specialties and sites including signs and symptoms, diagnoses, and procedures. The clinical terms are encoded

in a computerized format, which facilitates data gathering for many purposes including public health surveillance and research."

SNOMED-CT was selected for use by both the federal and private sectors because studies have shown that it is the most comprehensive and widely used medical vocabulary in the world. At least 40 countries including the United Kingdom and small health care businesses in the United States have adopted SNOMED-CT. SNOMED evolved from a reference terminology for pathologists in the 1960s into a comprehensive clinical terminology through collaborative efforts with primary care physicians, nurses, and other allied health care professionals.

2.4 Medical Electronic Databases

The U.S. Dept. of Health & Human Services web site [10] identified a number of benefits of a national electronic medical database among which include the following:

Some health care providers and insurance companies are forming regional information networks to share electronic medical records. Their reasoning for setting up these data banks is to help with the reduction of paperwork, help with billing, identify the most cost-effective treatment, and to fight against false claims. A person's medical information would be immediately available for the attending doctor. Therefore if an individual was injured in another part of the country, the attending physicians would have the patient's entire medical history at their fingertips. Included in this information could be life saving information that would be invaluable to the attending doctor.

The creation of a large database would also allow researchers to track certain diseases as well as to patient's responses to certain drugs. The creation of these databases would allow for better organization and more legibility of medical files. Since elaborate security systems can be developed to monitor these medical databases, electronic records may actually be more secure than paper records. Anyone can steal and or fax a copy of a paper record without leaving a trace.

The Times Picayune article (2007) [16] stressed the need to move toward a system of electronic medical records: "Studies have shown that electronic records can reduce medical errors sometimes the result of chicken-scratch handwriting and eliminate waste by preventing doctors from duplicating tests that were already given in another setting". For that to happen, *the record must follow the patient.* The article goes on to highlight the need for interoperability and cooperation. Medical information is usually scattered in

many different places. To receive the best possible health care, people are often encouraged to gather information in one place and create a personal medical record

The U.S. Department of Health & Human Services web site [11] presented the Medical Information Bureau (MIB) as central database of medical information shared by insurance companies. Approximately 15 million Americans and Canadians are on file in the MIB's computers. About 600 insurance firms use the services of the MIB primarily to obtain information about life insurance and individual health insurance policy applicants. When you apply for life or health insurance as an *individual*, you are likely to be asked to provide information about your health. Sometimes you are required to be examined by a doctor and/or to have your blood and urine tested. If you have medical conditions that insurance companies consider significant, the insurance company will report that information to the MIB. The information contained in a typical MIB record is limited to codes for specific medical conditions and lifestyle choices. Examples include; codes to indicate high blood pressure, asthma, diabetes, or depression. A code can signify participation in high-risk sports such as skydiving. A file would also include a code to indicate that the individual smokes cigarettes. The MIB uses 230 such codes.

In January 2005, the Bush administration called for the creation of a nationwide network of Electronic Health Records (EHR) within 10 years. There were both benefits and very real pitfalls to such a grandiose scheme. Certainly, access to electronic records would have greatly assisted emergency health teams in the aftermath of Hurricane Katrina in August 2005. And most individuals can easily envision the benefits to hospital emergency rooms when assisting unconscious patients. But the challenges regarding security and confidentiality are profound.

More recently, in 2006 Microsoft announced plans for its Heath Vault Web site. Health Vault is a new service for storing, managing, and accessing a patient's medical information. www.healthvault.com is to operate as an online encrypted service. The service will have a voluntary opportunity for medical records to be collected by aggregating information from various sources including health-care providers, insurance companies, and compatible medical devices such as blood pressure monitoring devices. Google intends to offer a similar service.

2.5 Legal Aspects

According to Cohen-Cole (1998) [1] Medical records are the key to providing legal proof of care. If they become the focus of a personal inquiry, malpractice or liability suit (toxic tort), without those records attorneys face an uphill battle that may prove difficult to win. Health-care professionals have a legal obligation to maintain medical records, but sometimes that does not translate into orderly record keeping. In some cases once the medical record is obtained, it's mired in additional medical jargon and nearly impossible to decipher. A Certified Legal Nurse Consultant (CLNC) can help decrypt complex medical terminology.

The U.S federal Health Insurance Portability and Accountability Act (HIPAA) [15] set a national standard for privacy of health information, in April 14, 2003. But HIPAA only applies to medical records maintained by health care providers, health plans, health clearing houses and only if the facility maintains and transmits records in *electronic* form. A great deal of health-related information exists *outside* of health care facilities and the files of health plans, and thus beyond the reach of HIPAA.

The extent of privacy protection given to your medical information often depends on where the records are located and the purpose for which the information was compiled. The laws that cover privacy of medical information vary by situation. And, confidentiality is likely to be lost in return for insurance coverage, an employment opportunity, your application for a government benefit, or an investigation of health and safety at your work site. In short, you may have a false sense of security. Medical information that is not covered by the federal privacy rule might be found in your financial records, your child's school records, and or your employment files.

The U.S federal Gramm-Leach-Bliley Act (GLB) allows financial companies such as banks, brokerage houses, and insurance companies to operate as a single entity. GLB gives you the right to be notified about the information-sharing practices of financial institutions. And you must be given an opportunity to opt-out of third-party information sharing. But GLB does not keep information from being shared among affiliated companies. Your credit card account and checking transactions are likely to include information about where you go for health care. Insurance applications and medical

claims also contain health-related information. So it is possible for such medical information to be shared among affiliates of financial institutions. Such information is *not* protected by HIPAA. Some financial companies promise extra protection for medical information, and insurance companies may be prohibited from giving information to an affiliated bank by state insurance laws.

According to Education records web site [17], education records maintained by a child's school contain vaccination histories, information about physical examination for sports, counseling for behavioral problems, and records of visits to the school nurse. Privacy of education records is under the control of the US Department of Education and the Family Educational Rights and Privacy Act (FERPA).

The U.S federal Family and Medical Leave Act (FMLA) [13] gives most workers the right to 12 weeks of unpaid leave a year for personal and family health. If the leave given by FMLA is because of a serious illness, your employer may request a doctor's certification of the illness. But the employer cannot make you produce medical records.

2.6 National medical system perception in Uganda

In a Ugandan situation evidence points towards the need to have a centralized medical records management, however no clear solution is being pointed out.

An article titled "The Best Health Resources" [18] on the Internet published May 27, 2008 revealed that, even the world's biggest *medical* library sometimes seems lacking when it comes to health information by and about Africans. The reason: even though Africa faces some of the world's biggest health challenges, it lags behind in *medical* research and publication. In fact, 90 percent of what is written in recognized health journals deals with chronic diseases like high blood pressure – afflictions much more common in the developed world than here – even though these diseases represent only 10 percent of the overall disease burden in the world.

There are some efforts to correct this imbalance. In an attempt to give people online access to information published in or related to Africa and to encourage local publishing, the World Health Organization, in collaboration with the Association for Health Information and

Libraries in Africa (AHILA), has produced an international index to African health literature and information sources.

In this article Dr. Monica Musenero Masanza, epidemiologist in the Ministry of Health, and Dr. Mbabazi, said the media also can be part of an early warning system for epidemics. Any time, reporters hear about unusual deaths or sickness, it never hurts to pass the word along to experts, who can investigate. "We believe in rumors," Dr. Masanza said. "We would rather hear a rumor and prove it wrong, than not know about it."

In an article titled "what works case study" [19] published in 2003, Health Net Uganda is an NGO with a vision to transform the healthcare system in Uganda through the use of handheld computers and or Personal Digital Assistants (PDAs). The organization hopes to provide services that will not only bridge the technology gap, but also create social value by enabling health workers to access up-to-date *medical* information, communicate with peers throughout the country, and record and analyze sensitive patient data electronically. The organization has several goals focused on advancing the use of Information and Communications Technology (ICT) in the healthcare industry.

Keisha et al. 2003) [19] emphasize the fact that, the Ministry of Health has undergone reform in recent years, including the decentralization of districts health facilities which gives autonomy to health centers on a district/sub-district level. While decentralization allows for immediate and local responses to health problems, there remains an opportunity to link work being done at the national level to work being done at the district level. The use of ICT represents an opportunity to fill that gap. The use of telemedicine has enabled remote diagnosis of disease and rapid response to contagious disease, resulting in better medical care for patients. Despite the use of telemedicine by the Ministry of Health, an urgent need for the full adoption of ICT persists. Modes of data collection throughout the country are not standardized and processes remain almost entirely manual—from the initial signing-in of a patient, to diagnosis and referral to the appropriate doctor or facility, to the actual healthcare delivery, and finally to the release of a patient. Further, very few health facilities store patients' records electronically. At Mulago hospital, patient files dating back 40 years are stored in boxes in a large room at the back of the hospital. Mulago hospital has recently begun the process of digitizing *medical* records. Similarly, communication between district facilities and the Ministry of

Health remain primarily manual; currently, district hospitals prepare weekly reports which are faxed to the Ministry. A consequence of this system is that epidemics are hard to identify in their nascent phase.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The chapter provides a detailed description of selected methodology that is the step-by-step methods of how we achieved the objectives of this project.

It comprises of a research/project design which describes the tools, approaches, processes and techniques, data collection, analysis, implementation, testing and validation.

3.2 Data collection tools

The section explains the tools that were used in collecting data to support the proposed system development. The tools that were used include the following:

3.2.1 Questionnaire

Questionnaires were used as a supplementary tool mainly to gather information from respondents who were difficult to come by. We anticipated that Doctors would claim to be too busy for an interview; in this case questions were mailed to them or dropped by their offices. The major challenge with this approach was that respondents tended to relax in the absence of the researcher and failed to deliver information on time. This prolonged the projects time. We tried to overcome this by continuously reminding the respondents over telephone and email.

3.2.2 Document Review

Here we reviewed the existing documents to get ideas about how the system could be implemented.

The documents that were reviewed include; medical literature over the internet, hospital patient records, insurance patient records and government health policies. The major challenge to this was that in some cases we were prevented from examining some documents for purposes of confidentiality. In this situation, we tried to convince the respondents that this was just an academic research.

3.2.3 Interviews

This was the main tool of data collection; interviews were conducted with doctors, insurance agencies, drug manufacturing companies and patients. The theme of the interview was on the benefits, challenges and procedures of implementation and privacy preservation. The interview method was of great benefit to this research because it enabled us to gather a lot of information in the shortest time possible. One major challenge to this approach was that some respondents did not cooperate well as they held back some information. Questionnaires were however used to cover this up.

3.3 Sampling Design

The research was based on four hospitals from each hospital five medical practitioners were selected making a total of twenty respondents. One Medicine Company where five top managers were interviewed, three insurance companies where three officials were selected from each company making a total of nine respondents, fifteen patients were also selected from different hospitals and five officials from the ministry. All these were from Kampala district: The four hospitals were selected from four different divisions and the medical practitioners were selected purposively.

The insurance companies were all from central division and were selected randomly by taking one every after five companies, the respondents here were also selected purposively.

The Medicine Company was from Nakawa division.

Among the patients, selection was random using the technique of selecting one out of every ten patients counted in the respective hospitals. The number of target respondents totaled to fifty four respondents.

3.4 System Design Tools

The following tools were used to create structure and detailed algorithms that describe major system processes. The tools will also be used in the presentation of system components and how they are related.

3.4.1 Hierarchy Chart

This tool was used to illustrate the configuration and arrangement of user interface components, it was selected because of its simplicity.

3.4.2 Data Flow Charts

Data flow charts were used to design major preliminary and detailed algorithms describing system transactions/processes, the tool was selected because it presents data and control flow more clearly and easily.

3.4.3 Entity Relationship Diagrams

This tool was used to design the database conceptual and logical design, this tool was selected on grounds that it effectively depicts the design of a relational database.

3.5 Implementation Tools

The following technologies were used to turn the system design into program modules, they included the following:

3.5.1 PHP (Hypertext Preprocessor)

A server side scripting language that was used to code the system processes (middle tier) this tool was selected by us because it is easy to learn, very flexible and could be integrated with Hyper Text Markup Language (HTML) and java script. It is also supported by 80% of web hosting companies according to current statistics.

3.5.2 Hyper Text Markup Language (HTML)

A markup language that was used to implement the user interface (front end). Html was selected because it is also very easy to use, very flexible and supported by all web browsers.

3.5.3 Java script

A client side scripting language which was used to track user errors and perform simple routine tasks so as to relieve the server, unlike Visual Basic (VB) script, java script is supported by all web browsers VB script is only supported by internet explorer that is why we selected java script.

3.5.4 MySQL

A version of Structured Query Language (SQL) that was used to communicate with MySQL database management system, during database creation and data manipulation. MySQL was selected because it has powerful record manipulation commands, a good storage capacity and provides good data security and above all it is open source. It is also supported by almost all web hosting companies.

3.6 System testing tools

The following methods were used to test and validate the system against its specified requirements.

3.6.1 The black box functional method

Here we used a number of test cases (sample data) to exercise the system while monitoring the output for errors, the test cases were carefully designed to explore all possible system eventualities.

3.6.2 Use of external experts

We invited external experts (members who were not part of the development but had good knowledge of system testing) to run and exercise the system given a set of system function requirements.

3.6.3 Prototyping

Here the system prototype was delivered to selected hospitals to be exercised by users who later make their own comments and suggestions.

CHAPTER FOUR

SYSTEM ANALYSIS DESIGN AND IMPLEMENTATION

4.1 Introduction

The chapter presents the requirements of the proposed system, its design and implementation.

4.2 The current system

We found out that the system used to manage medical information is manual and therefore hospitals and other users of medical information like insurance companies and government agencies face a number of problems that include high cost of data storage and management, difficulty high cost of information sharing and poor data security among others.

4.3 Requirements Specification

4.3.1 Functional Requirements

This section describes the services the system provides, these include the following:

- The system registers doctors, districts, diseases, patient details and medical cases
- The system allows doctors and government agencies to update system data
- The system allows the doctors to lock a medical case record and access to that record is only after obtaining permission from the doctor
- The system allows doctors to view patient bio data and medical history.
- The system also allows insurance companies to access patient medical data after obtaining permission from the patients
- The system generates and summarizes the following statistics for government agencies:

I. A summary showing the occurrence of diseases in various districts on daily basis, purpose of which is to control disease outbreak, and provide information for health policy formulation and planning.

II. A summary showing the correlation of various diseases and age

III. A summary showing which district is vulnerable to what disease over time. The structure of the summary includes; district code, district name, disease

code, disease name, number of cases. A summary that tracks response to immunization in the country

4.3.2 User Requirements

The users of this proposed system include; hospitals, government agencies and insurance companies. This section presents what these users expect from the system and the characteristics they must possess to effectively interact with the system. We discovered that users were interested in the following:

- The users wanted a system that responds to user requests in an acceptable time range.
- Users wanted a system that can recover data in case of an error.
- The user wanted an interface which is friendly, clear and based on user terms not technical terms.
- Users wanted a system that minimizes user data entry errors and efforts.
- The users must be computer literate with basic knowledge of the internet.

4.3.3 System Requirements

The section describes the operation environment of the proposed system, the proposed system runs under an environment that satisfies the following:

- The hosting server must be a secure server (must implement the https protocol).
- The server must have sufficient Memory (Random Access Memory) that is 4 Gigabytes (GB) and above.
- The server must have sufficient storage space that is 1000 GB and above.
- The web server shall be apache version 4.0 and above.
- The database server shall be MySQL version 4.0 and above.
- Data encryption and decryption is based on *mod_ssl/2.0.52 OpenSSL/0.9.7e.*

4.4 System Design

This section presents major algorithms that implement the functional requirements stated above. It also illustrates the design of the database (back end) used to store system data.

4.4.1 System context

This illustrates the system in terms of user perspective. It identifies major system components, the input and output from each component. The symbols below were used:

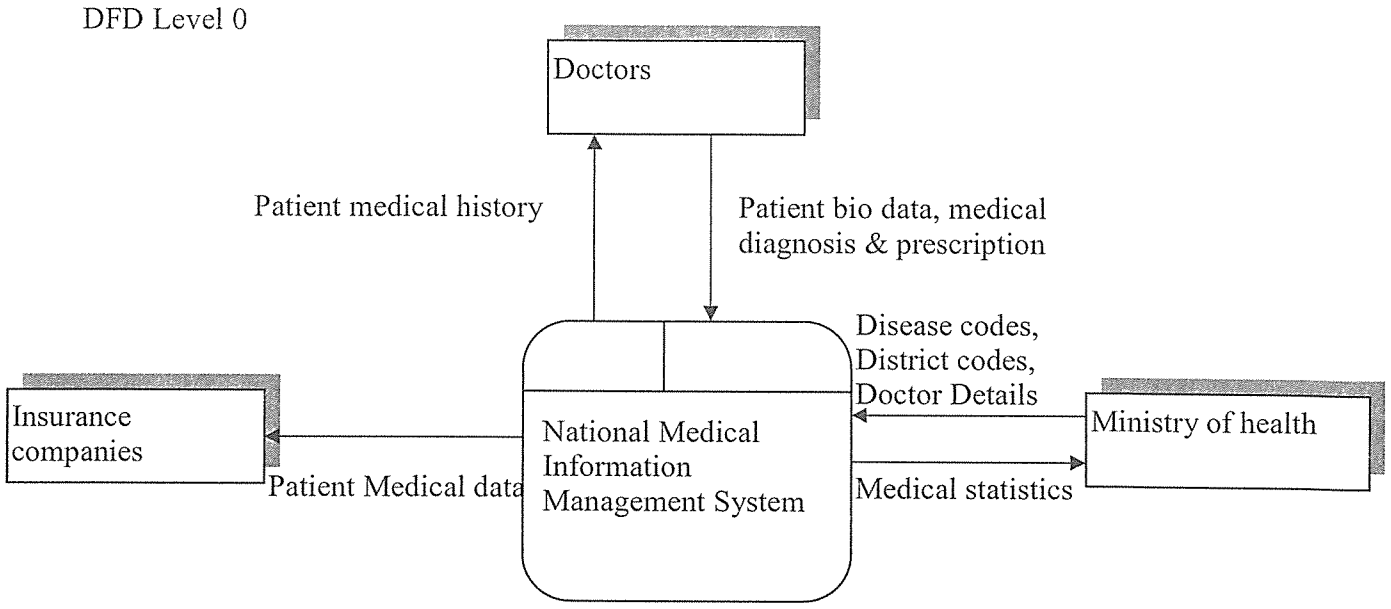


Figure 4.1 National Medical Information Management System design

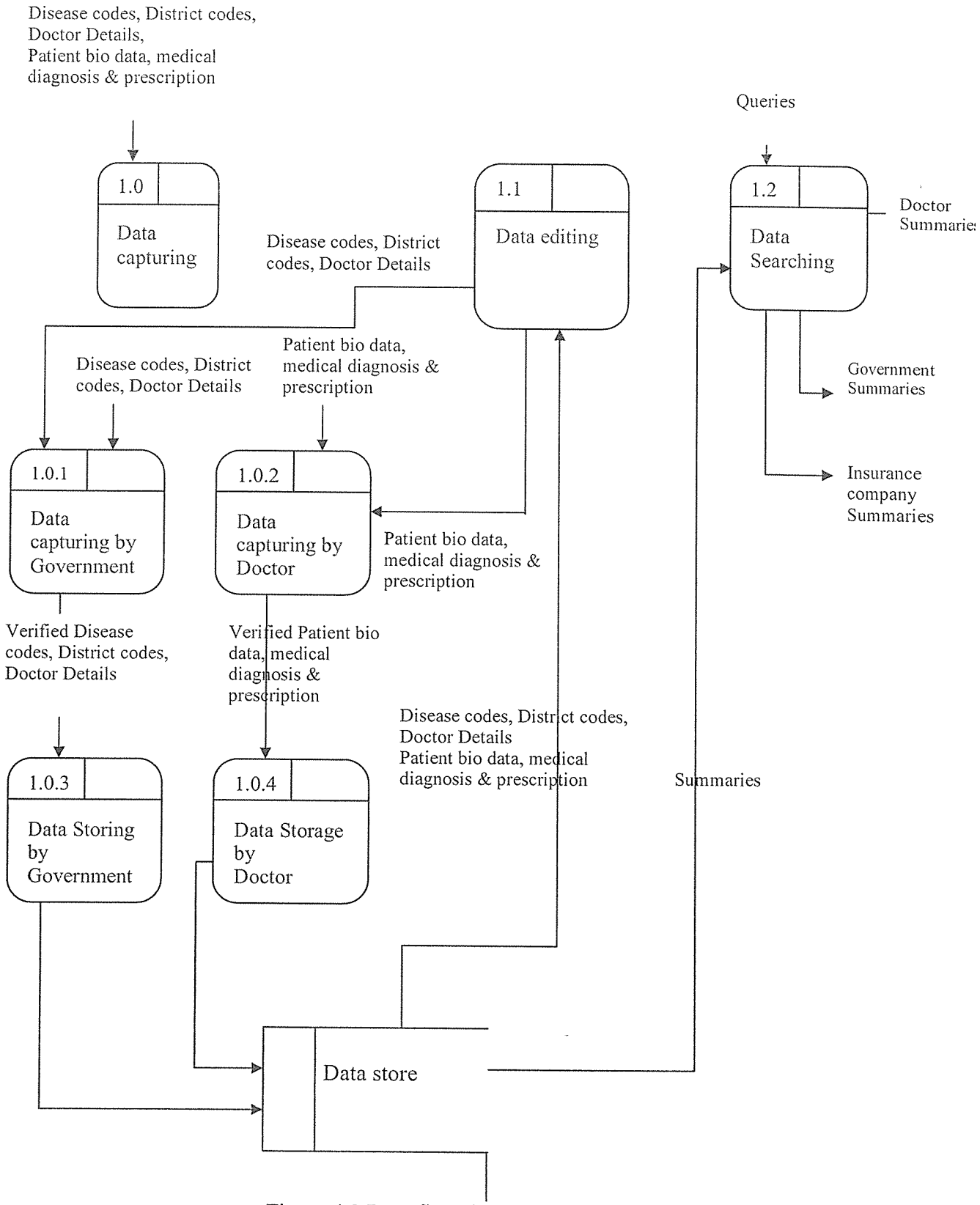
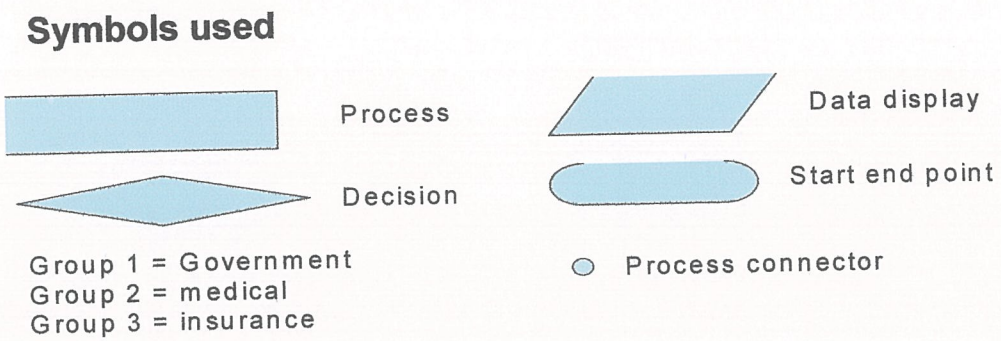


Figure 4.2 Data flow diagram

4.4.2 System control flow

Provides a detailed description of how the system performs its functions



Main entry program

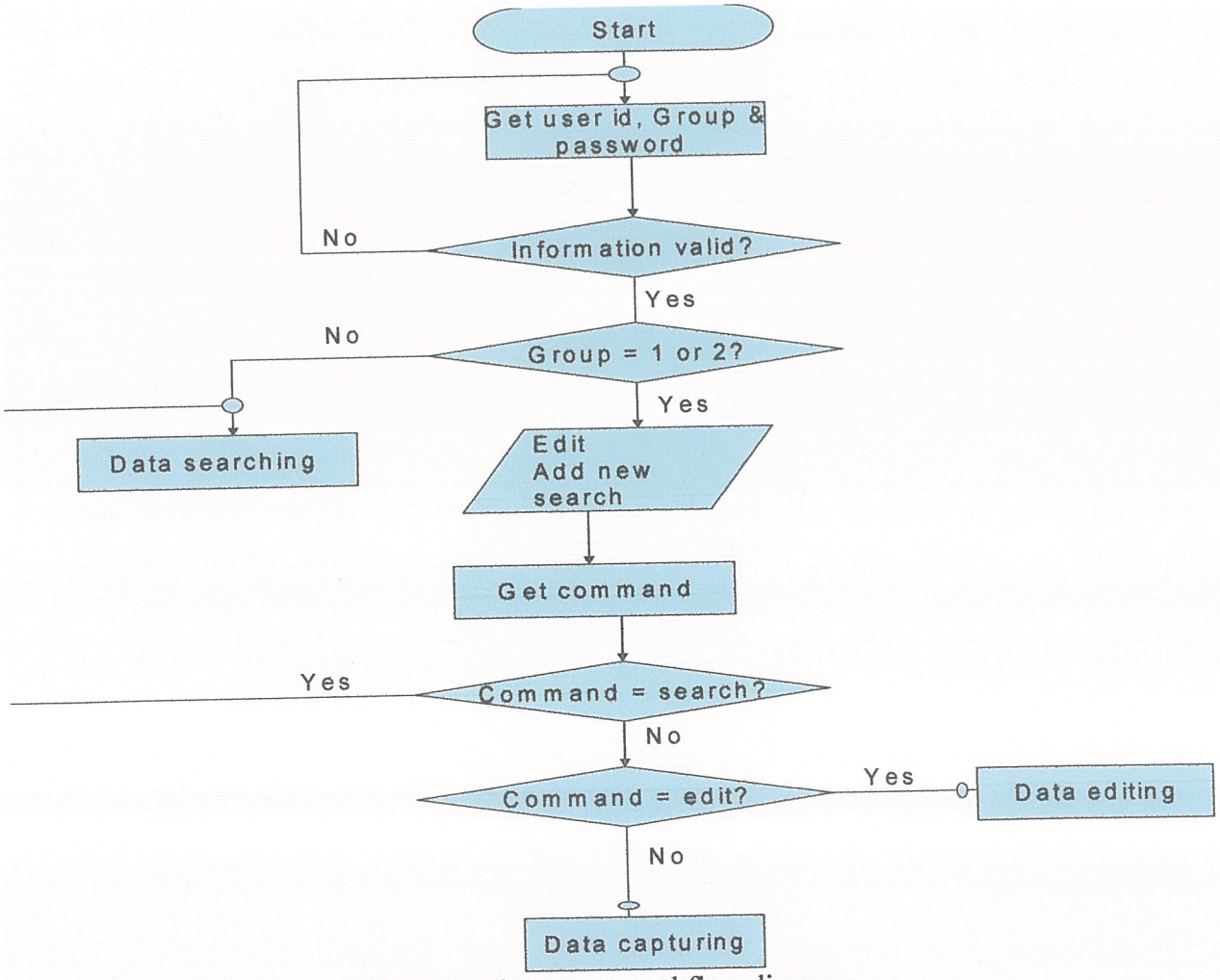


Figure 4.3 System control flow diagram

Data capturing and editing routines

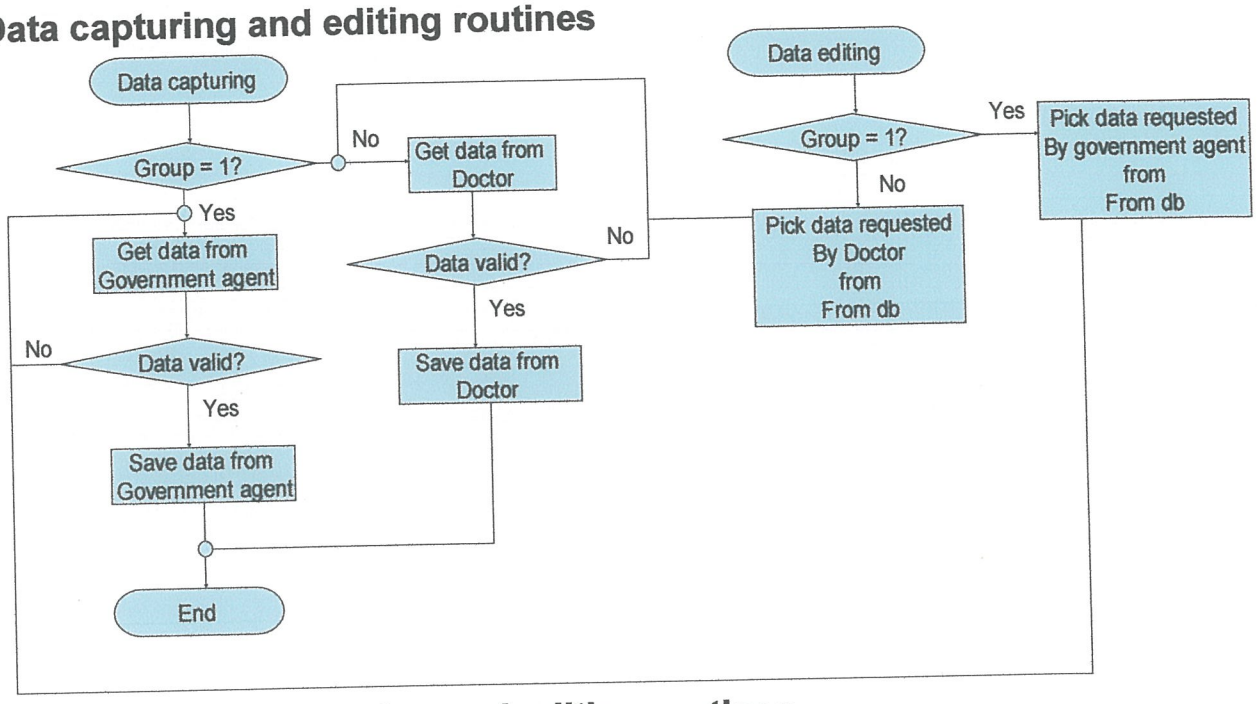


Figure 4.4 Data capturing and editing routines

Data search routine

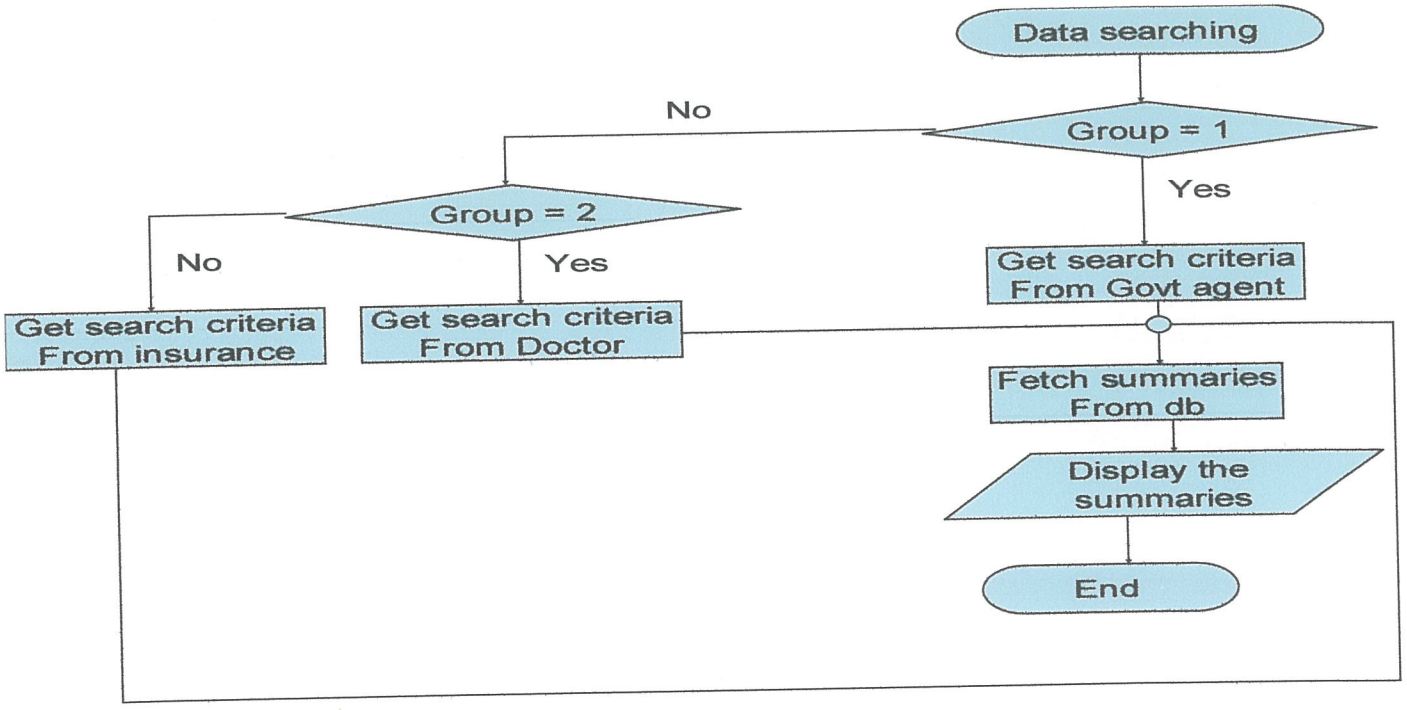


Figure 4.5 Data Searching routine

4.4.2 Database design

It is an illustration of the data models used by the system, it presents a conceptual, logical and physical design of the database.

Conceptual design

This represents the data entities used in the system and the relationship between these entities. They represent database objects in the database. The symbols below were used to develop the design

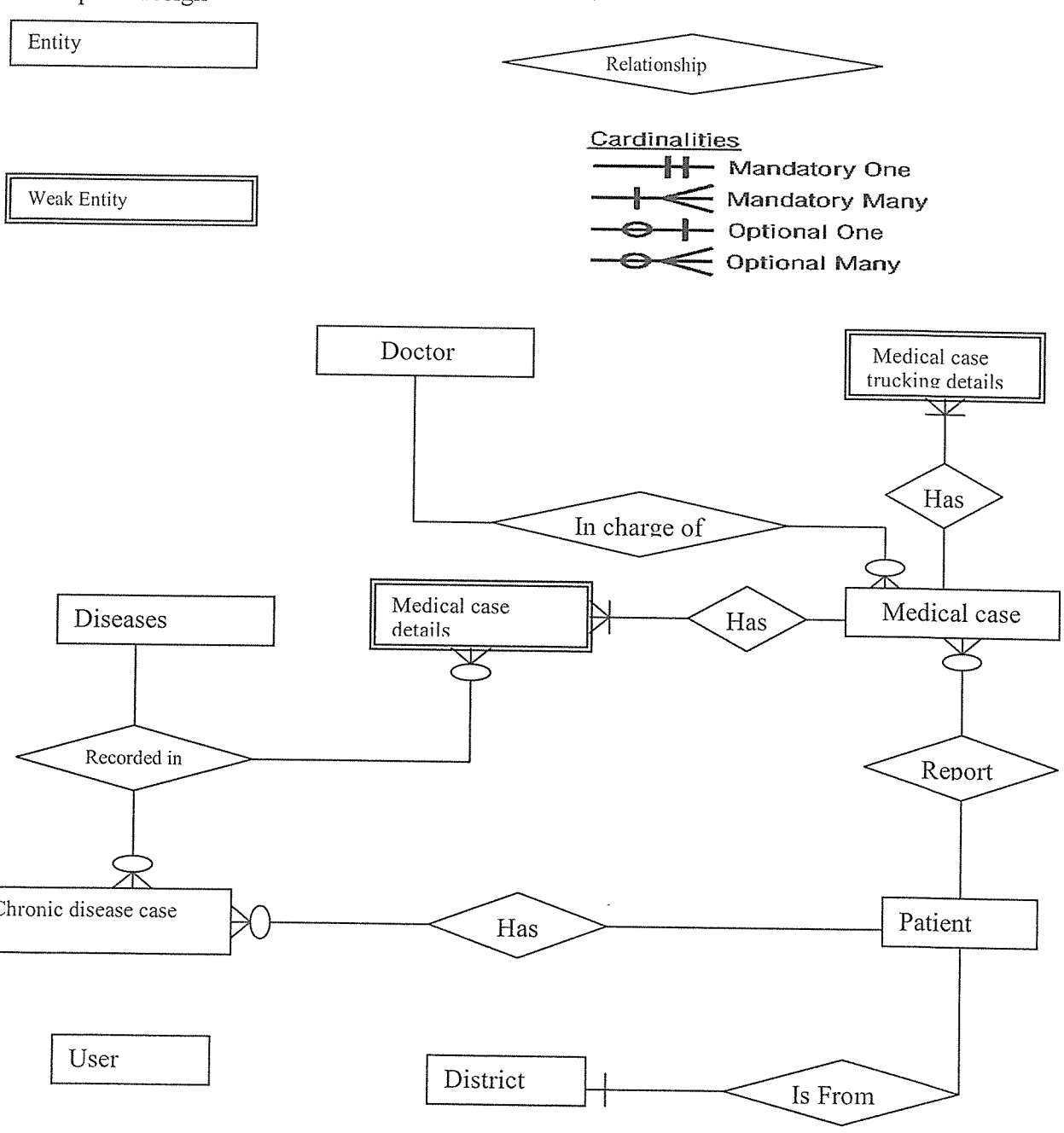


Figure 4.6 Entity Relationship diagram

Logical design

A logical design presents data entities and their attributes identifying the key fields that enforce relationships between entities. The logical design is independent of any database management system

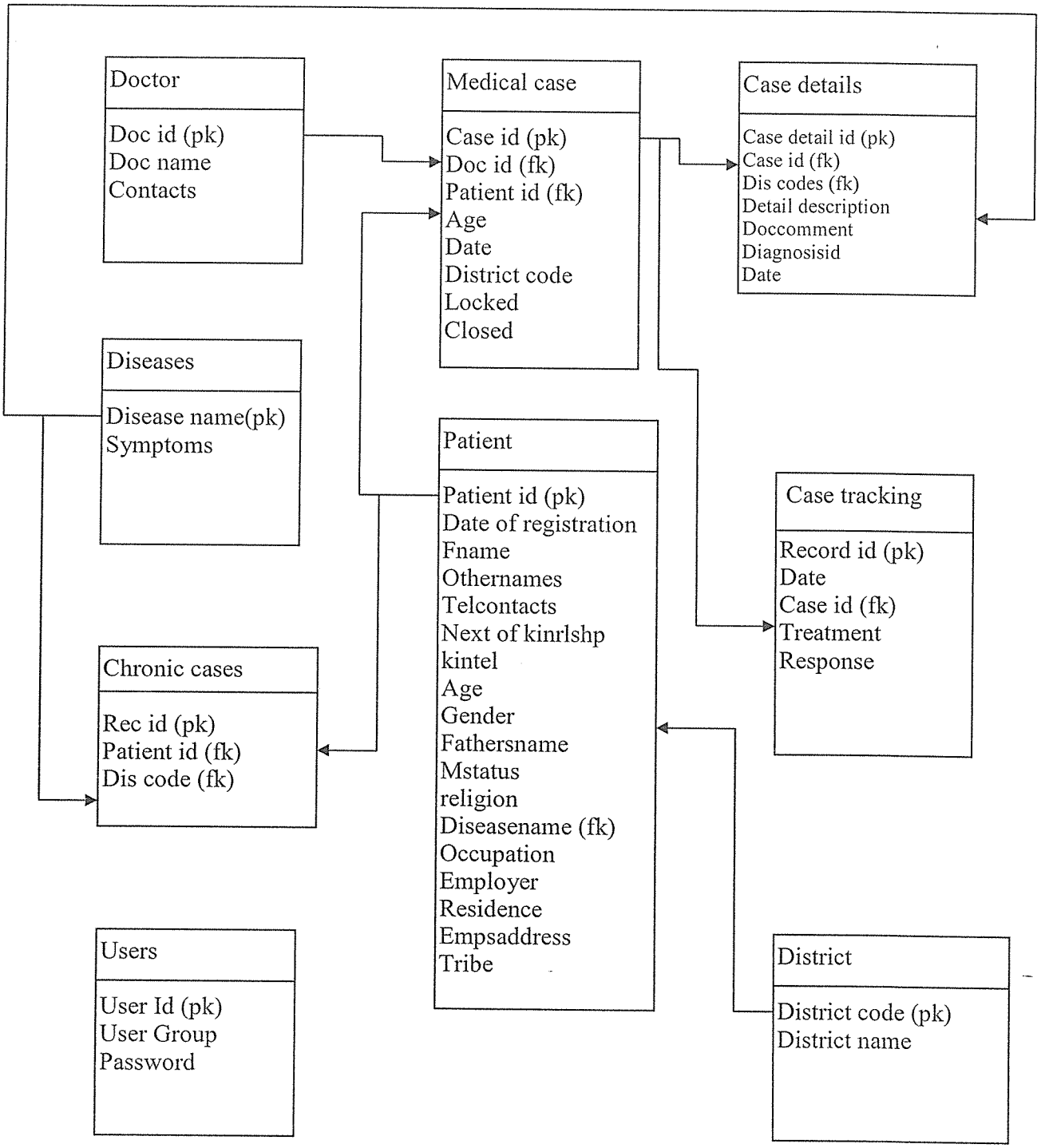


Figure 4.7: Logical design

Physical design

A physical design is an implementation of a logical design basing on a specific database management system in this case, the MySQL database management system. It describes the attributes data types and the constraints enforced on the attributes

Table 1 - Doctors Table

Field name	Data type	Constraints	Description
Doc id	Int (11) autoincrement	Unique, primary key	The unique identifier in the doctor table
Doc name	Varchar (30)	Not null	Combines first and second name
Contacts	Int (11)	Not null	Contains telephone number

Table 2 - Medical case Table

Field name	Data type	Constrains	Description
Case id	Int autoincrement	Unique, primary key	The unique identifier in the medical case table
Doc id	Int	Not null	A foreign key that relates doctors and medical cases
Patient id	Int	Not null	A foreign key that relates patients and medical cases
Date	Date	Not null	Date of registration
Age	Varchar (15)	Not null	The age bracket with in which the patient falls
District code	Varchar(15)	Not null	A code identifying the district where the case has occurred
Locked	Varchar(10)	Not null	Case is locked to prevent accesses to case details
Closed	Varchar(5)	Not null	Medical case is open or closed

Table 3 - Medical case details Table

Field name	Data type	Constrains	Description
diagnosisid	Int(11)	Unique, primary key	The unique identifier in the medical case table
tdate	Date	Not null	A foreign key that relates doctors and medical cases
caseid	Int(11)	Not null	A foreign key that relates patients and medical cases
discord	Varchar(30)	Not null	The diagnosis results of the case
doccoment	Text	Not null	Comment about the patient's illness
docid	Int(11)	Not null	Id to identify the doctor

Table 4 - Medical case tracking Table

Field name	Data type	Constraints	Description
Record id	Int autoincrement	Unique, primary key	The unique identifier in the case trucking table
case id	Int	Not null	A foreign key that relates cases and case trucking
Date	Date	Not null	Date of trucking
Treatment	Text	Not null	The treatment prescribed by the doctor
Response	Text	Not null	Patient response to the prescribed treatment

Table 5 - Diseases table

Field name	Data type	Constraints	Description
Disname	Varchar(20)	Not null, unique	A unique name for the disease
Symptoms	Text	Not null	The basic symptoms of the disease

Table 6 - Chronic cases table

Field name	Data type	Constraints	Description
Recid	Int auto increment	Primary key	The unique identifier of chronic cases
Discord	Varchar(15)	Not null	Foreign key that associates the chronic diseases table to diseases
Pid	Int	Not null	Foreign key that associates patients with chronic cases

Table 7 - Users table

Field name	Data type	Constraints	Description
Username	Int auto increment	Primary key	The unique identifier of the user
User group	Varchar(15)	Not null	Can be doctors, insurance or government agent
Password	Int	Not null	A unique phrase that identifies the user to the system

Table 8- Districts table

Field name	Data type	Constraints	Description
District code	Varchar(10)	Primary key	The unique identifier of the district
District name	Varchar(15)	Not null	The name of the district

Table 9: Patients table

Field name	Data type	Constraints	Description
Patient Id	int(3)	Primary key	The unique identifier of the district
Date of registration	timestamp	Not null	
First Name	varchar(30)	Not null	
Other Names	varchar(30)	Not null	
Diseasename	varchar(20)	Not null	
telContact	varchar(10)	Not null	Code For the home district
kinTel	varchar(10)	Not null	
age	int(3)	Not null	
gender	enum('male', 'female')	Not null	Patient home village
fathersName	varchar(30)	Not null	
nextKinRltsp	varchar(50)	Not null	Like smoking, alcoholism
mStatus	enum('single', 'married', 'other')	Not null	Like sky diving, car race, foot ball etc
religion	varchar(30)	Not null	
occupation	varchar(30)		
empsAddress	varchar(30)		
residence	varchar(20)		
tribe	varchar(20)		
employer	varchar(50)		

CHAPTER FIVE

PRESENTATION OF FINDINGS

5.1 Introduction

This chapter presents a summary and analysis of the findings on which the design and implementation of the proposed system was based.

5.2 Data gathering / Requirement determination

In the five hospitals visited only one had a computer based information system and the information system was basically handling general hospital management. Medical records were manually maintained.

Table 10 - Information System used

Type of system used	Number of Hospitals	Percentage
Manual system	4	80%
Computer based	1	20%
Total number	5	100%

Among the five hospitals non of them maintained medical records electronically

Table 11-Medical records maintained

Type of system used	Number of Hospitals	Percentage
Manual system	5	100%
Computer based	0	0%
Total number	5	100%

5.2.1 Privacy issues

The general opinion of the patient's concern about privacy.

Of the 30 patients interviewed, 8 approved access to their medical records by government without their permission, 18 disagreed and 4 were indifferent.

Table 12- Privacy issues

Opinion about privacy	Patients	Percentage
Agree	8	27%
Disagree	18	60%
Indifferent	4	13%
Total	30	100%

5.2.2 The importance of central medical data system

Evidence strongly pointed out data sharing and generation of health statistics as key benefits of a central medical information system.

5.3 System Testing

5.3.1 The black box functional method

Here we used a number of test cases (sample data) to exercise the system while monitoring the output for errors. The test cases were carefully designed to explore all possible system eventualities. The following test cases were used;

Case 1

- Registered district, doctor, disease details. Check the system to see if the data has been captured.
- Registered medical cases, medical case details and treatment. Check to see if details exist
- Entered invalid data and see if the system accepts it.
- Accessed a locked case and see if the system prevents you.
- Tried to by-pass the login page by calling a specific page name and see if the system prevents it.

5.3.2 Use of external experts

We invited external experts (members who were not part of the development but had good knowledge of system testing) to run and exercise the system given a set of system functional requirements. They commented that the interface was friendly and the functionality was good, but session variable expiry duration is short this leads to unexpected errors. More to that, they said that it would be more secure if it had been implemented using Java.

5.3.3 Prototyping

Here the system prototype was delivered to selected hospitals to be exercised by users who later made their own comments and suggestions. They liked the system and accredited it for the following;

- It is easy to use
- It can solve the problems of storage space
- It guarantees data security
- It promotes data sharing

CHAPTER SIX

CONCLUSION, SUMMARY AND RECOMMENDATION

6.1 Introduction

This chapter summarizes the project and recommends the way forward.

6.2 Summary/Conclusion

The National Medical Information Management System (NMIMS) was implemented using PHP, Apache and Open SSL technology.

The system controls access using three user groups i.e. medical, government and insurance. It ensures privacy by allowing doctors to lock and unlock medical cases.

It allows data sharing among medical practitioners and also allows government to generate statistics from the medical information available.

Data security and integrity is ensured using the HTTPS protocol supported by SSL.

6.3 Limitations

Due to limited time and basing on the fact that the system was for academic purposes, system requirements were based on a narrow population, therefore the requirements might not be a true representative of user's views.

PHP and SQL technologies are not the perfect technologies to use for such a system because of security they provide. But because of lack of knowledge in appropriate technologies and time to acquaint to other technologies, we were forced to use PHP and SQL technologies.

6.4 Recommendations

We recommend to users and future researchers the following;

- Those who wish to adopt and use the system must conduct a wider base research to establish all the true requirements.
- Researchers should investigate on how to implement the system design using java technology.

- Future researchers should put emphasis on the portability and mobility of the system, to ensure timely and secure access to this system, ANYTIME ANYWHERE.

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Appendices

Appendix A: Questionnaire

The goal of this questionnaire was to help in the collection of the requirements for a project to develop an online National Medical Information Management System that would allow for real time access and sharing of patients' medical data and history by medical practitioners and government agencies

Section I

Data control section

1. Nature of institute

   Hospital ☐ Insurance ☐ Ministry ☐

2. Job title

   Doctor ☐ Nurse ☐ Medical assistant ☐ Data entry Clerk ☐

Section II

Information systems currently in use

Data entry clerks

What methods does the hospital use to capture process and store information?

Computer ☐ Manual ☐ Both ☐

If a computer or both, what type of information does the Hospital/ Insurance company/Government agents process?

General Hospital/ Insurance companies/ Government agent management data ☐

Patient medical data ☐

What problems do you face in using the system selected?

.....

.....

.....

Section III

Importance of a central medical data pool to Medical workers, Insurance companies and Government agents

Medical workers

Is the patient medical history important to a doctor who receives a new patient?

Yes ☐ No ☐

If yes how is it important?

.....

.....

.....

How can a doctor identify the medical history of a new patient?

Using patient medical documents ☐ laboratory tests ☐ patient interrogation ☐

Other methods specify

.....

.....

What problems do you find using the selected methods?

.....

.....

.....

Can you suggest possible solutions to the mentioned problems?

.....

.....

.....

Do you share medical information with other hospitals, government agencies and insurance companies?

Yes ☐ No ☐

If yes what means do you use?

Physical contact ☐ email ☐ fax ☐

Others specify

.....

.....

.....

Insurance companies

How does an insurance company obtain its clients medical information?

.....

.....

.....

What problems are insurance companies likely to face in trying to establish client's medical information?

.....

.....

.....

How does an insurance company prove the correctness of medical information provided by a client?

.....

.....

.....

Government

Of what importance is medical information to Government?

.....

.....

.....

How does government obtain medical information?

.....

.....

.....

Section IV Privacy issues

Patients

Do you see any problems in government agencies and insurance companies accessing your medical information from hospitals with out consulting you?

Yes ☐ No ☐

If yes how should they do it?

.....

.....

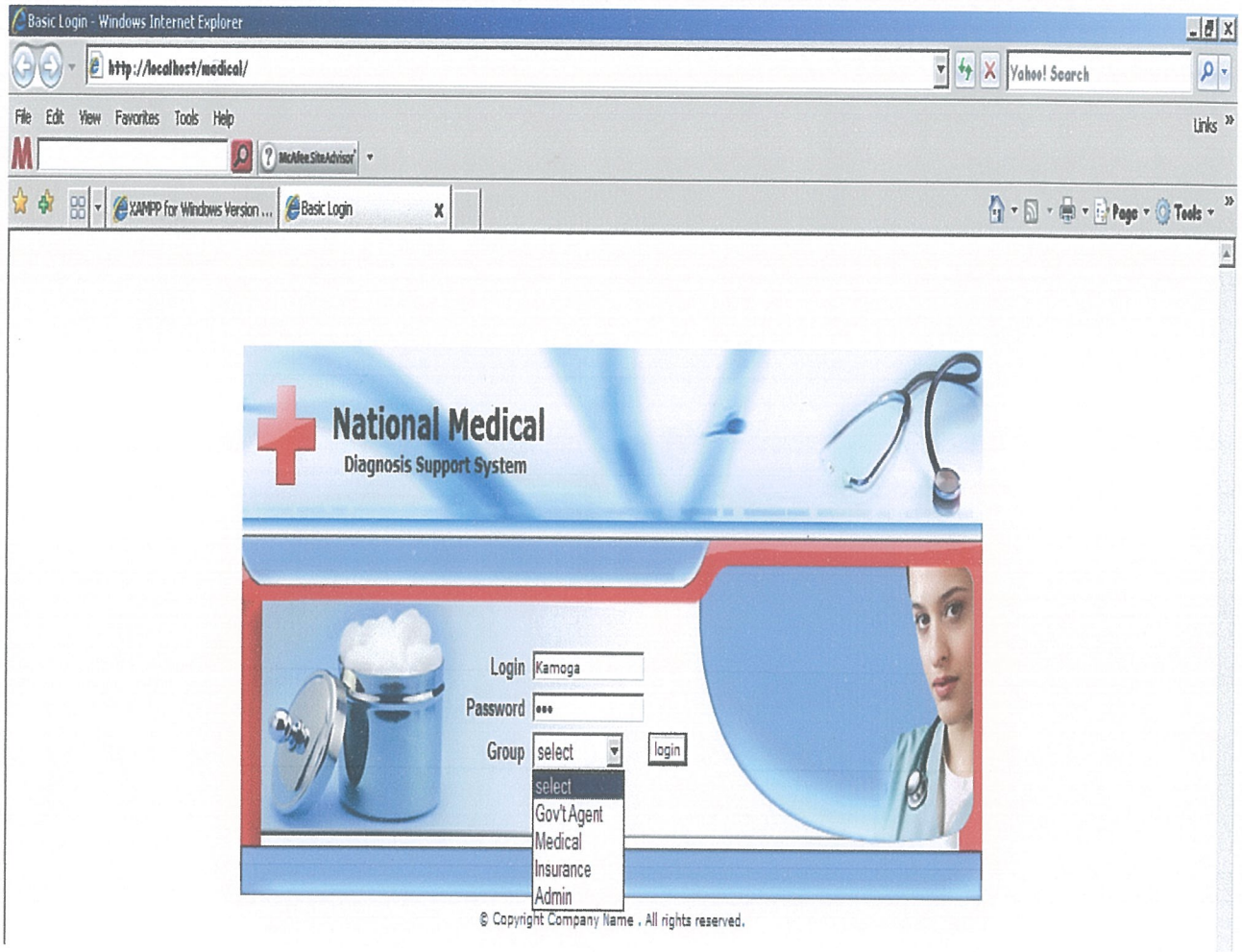
.....

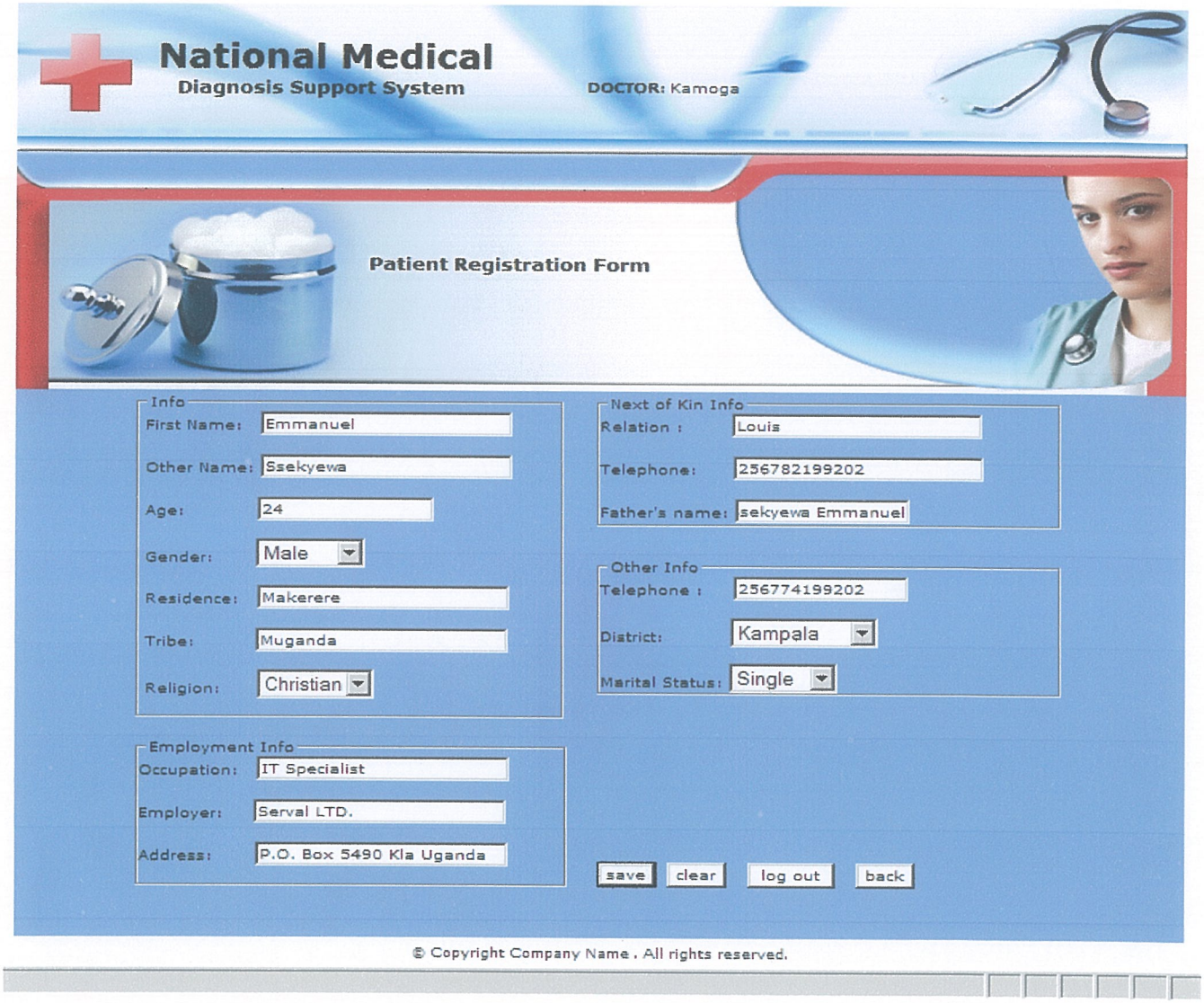
Appendix B: Budget and schedule estimate

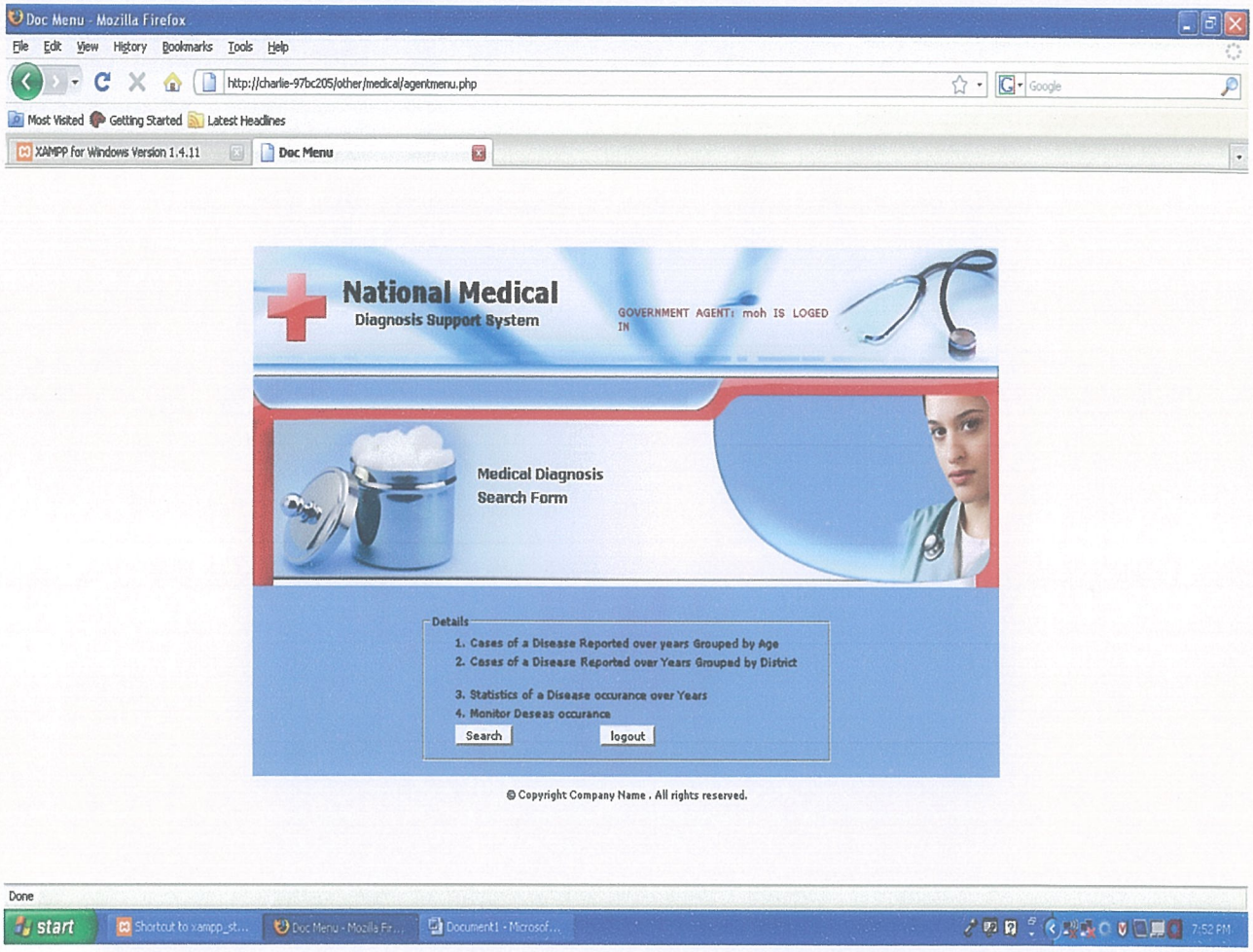
Table 13-Budget and Schedule estimate

Activities	Duration	Costs
Requirements gathering	1 week	30,000/=
System design	2 weeks	30,000/=
Implementation	2 weeks	50,000/=
Documentation	2 weeks	30,000/=
Testing	2 weeks	100,000/=

Appendix C: System Screen Shots




National Medical
Diagnosis Support System
DOCTOR: Kamoga
Patient Registration Form
Info
First Name: Emmanuel
Other Name: Ssekyewa
Age: 24
Gender: Male
Residence: Makerere
Tribe: Muganda
Religion: Christian
Next of Kin Info
Relation : Louis
Telephone: 256782199202
Father's name: sekyewa Emmanuel
Other Info
Telephone : 256774199202
District: Kampala
Marital Status: Single
Employment Info
Occupation: IT Specialist
Employer: Serval LTD.
Address: P.O. Box 5490 Kla Uganda
save
clear
log out
back
© Copyright Company Name . All rights reserved.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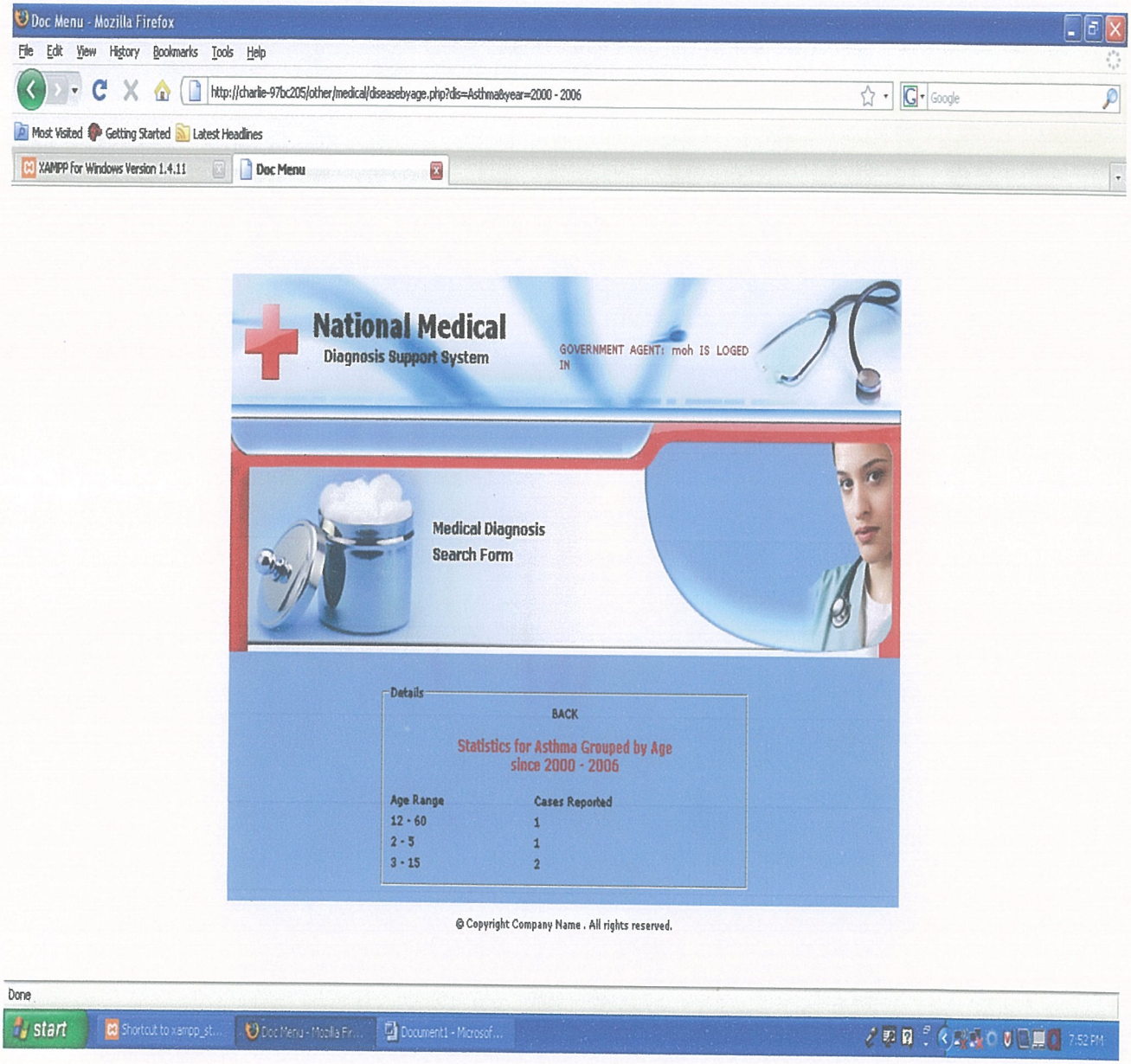
File Edit View History Bookmarks Tools Help
http://charlie-97bc205/other/medical/agentmenu.php
Most Visited Getting Started Latest Headlines
XAMPP for Windows Version 1.4.11
Doc Menu
National Medical
Diagnosis Support System
GOVERNMENT AGENT: moh IS LOGED IN
Medical Diagnosis
Search Form
Details
1. Cases of a Disease Reported over years Grouped by Age
2. Cases of a Disease Reported over Years Grouped by District
3. Statistics of a Disease occurance over Years
4. Monitor Deseas occurance
Search
logout
© Copyright Company Name . All rights reserved.
Done
start
Shortcut to xampp_st...
Doc Menu - Mozilla Fir...
Document1 - Microsof...
7:52 PM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File Edit View History Bookmarks Tools Help
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Most Visited Getting Started Latest Headlines
XAMPP for Windows Version 1.4.11
Doc Menu
National Medical
Diagnosis Support System
GOVERNMENT AGENT: moh IS LOGED IN
Medical Diagnosis
Search Form
Details
BACK
Statistics for Asthma Grouped by Age since 2000 - 2006
Age Range
Cases Reported
12 - 60
1
2 - 5
1
3 - 15
2
© Copyright Company Name . All rights reserved.
Done
start
Shortcut to xampp_st...
Doc Menu - Mozilla Fir...
Document1 - Microsof...
7:52 PM