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CLINICAL DATA MANAGEMENT SYSTEM

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Abstract

Clinical Data Management (CDM) is a critical phase in clinical research, which leads to generation of high-quality, reliable, and statistically sound data from clinical trials. This helps to produce a drastic reduction in time from drug development to marketing. Team members of CDM are actively involved in all stages of clinical trial right from inception to completion. They should have adequate process knowledge that helps maintain the quality standards of CDM processes.

Various procedures in CDM including Case Report Form (CRF) designing, CRF annotation, database designing, data-entry, data validation, discrepancy management, medical coding, data extraction, and database locking are assessed for quality at regular intervals during a trial. In the present scenario, there is an increased demand to improve the CDM standards to meet the regulatory requirements and stay ahead of the competition by means of faster commercialization of product.

With the implementation of regulatory compliant data management tools, CDM team can meet these demands. Additionally, it is becoming mandatory for companies to submit the data electronically. CDM professionals should meet appropriate expectations and set standards for data quality and also have a drive to adapt to the rapidly changing technology. This project report highlights the processes involved and provides the reader an overview of the tools and standards adopted as well as the roles and responsibilities in CDM.

***KEY WORDS**: Clinical data interchange standards consortium, Clinical Data Management Systems (CDMS), Data Management, e-CRF, good clinical data management practices, validation.*

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CHAPTER ONE

1.1 INTRODUCTION

Databases have become more and more indispensable in our daily life. We deal with data every day and everywhere; cellular phone contacts, medical records, logistical data and transaction records, etc. They are all stored in databases. It is hard to imagine what the world would be like without databases. Perhaps there would be no ATM, no credit card, no GIS and no airline reservation.

Databases were defined by Frawley et al. (1992) as logically integrated collections of data in one or more computer files, and organized to facilitate the efficient storage, change, query, and retrieval of contained relevant information to meet the needs of its users. A database can be viewed as a repository of data that is defined once and then is accessed by various users. A database has the following properties:

- It is a representation of some aspect of the real world; or perhaps, a collection of data elements (facts) representing real-world information.
- A database is logical, coherent and internally consistent.
- A database is designed, built, and populated with data for a specific purpose.
- Each data item is stored in a field,
- A combination of fields makes up a table.

However, a Database Management System (DBMS) is a collection of programs that enable users to create, maintain databases and control all the access to the databases. The primary goal of the Database Management System is to provide an environment that is both convenient and efficient for users to retrieve and store information. DBMSs provide various functions that allow management of a database and its data which can be classified into four main functional groups:

- Data definition; Creation, modification and removal of definitions that define the organization of the data.
- Update; Insertion, modification, and deletion of the actual data.
- Retrieval; providing information in a form directly usable or for further processing by other applications. The retrieved data may be made available in a form basically the same as it is

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stored in the database or in a new form obtained by altering or combining existing data from the database.

- Administration; Registering and monitoring users, enforcing data security, monitoring performance, maintaining data integrity, dealing with concurrency control, and recovering information that has been corrupted by some event such as an unexpected system failure.

Both a database and its DBMS conform to the principles of a particular database model. "Database system" refers collectively to the database model, database management system, and database.

With the database approach, we can have a healthcare center patient portfolio management system which is able to track their patients' medical history. This system is to facilitate the center to retrieve, update, and report the patient information efficiently, in turn helping the doctors make timely, effective diagnoses. At the same time, the center can utilize this system to monitor their medical and financial management.

Currently, different departments in the healthcare center have their own separated systems leading to the lack of communications and the inefficient data sharing. For example, the finance department uses simple EXCEL spreadsheets to record the pay check information of the employees which is inconvenient to retrieve and update employees' information; in the clinic department, the doctors have to write down the prescriptions for the patients and keep paper documents, and also do not have any information about the patients' insurance plans; the medicine department has to keep the prescription and inventory records on their own computer system. While each system serves a distinctive purpose, there is no coordinating, assimilating and representing of data. The systems may have duplicate data which is a waste of space. The different systems also may have different application programs which cause incompatible files.

Due to these disadvantages of the current system, a healthcare management system is proposed. Healthcare management system is a database management system (DBMS), which is based on computer networks, using the advanced database technology to construct, maintain, and manipulate various kinds of data in a database system (DBS). The DBMS can track and update all the information of recorded patients in the healthcare center during a particular time span. The major advantages of the

DBMS are easy to retrieve and update information, efficient data sharing and communication, and reliable backup and security.

CHAPTER TWO

2.0 BACKGROUND

The history of database can be traced back to the earliest days of electronic computing. Over the years, there have been a number of database types emerged, such as hierarchical database, relational database, object database, XML database. They differ in hardware requirements, efficiency, and how data is stored, organized and accessed. There have been six distinct phases in data management. Initially, data was manually processed. The next step used punched-card equipment and electro-mechanical machines to sort and tabulate millions of records. The third phase stored data on magnetic tape and used stored program computers to perform batch processing on sequential files. The fourth phase introduced the concept of a database schema and online navigational access to the data. The fifth step automated access to relational databases and added distributed and client-server processing. We are now in the early stages of sixth generation systems that store richer data types, notably documents, images, voice, and video data. These sixth generation systems are the storage engines for the emerging Internet and Intranets.

St. Mary's Health Care was established as a not for profit organization in 2001, to respond to the growing need for corporate HIV / AIDS programmes within Zambia and it's a community hospital and thus strives to understand and meet the community's health needs. Initially St. Mary's Health Care focused on private and public sector organizations workplace policies and programmes, giving particular emphasis on care, support and access to treatment. After working with key businesses within the country, a strategic and innovative model was developed that was then used as a baseline for other business partners. St. Mary's Health Care started with an initial staff of 2 and with its success has grown to a team of over 70 staff. St Mary's health care Services Limited currently has vast experience and technical know-how on successful implementation of USAID and other partner projects.

With an emphasis on building knowledge in all areas of HIV and adding service delivery to a population that understands the needs and benefits of accessing these services, St Mary's health care developed models for the implementation of a wide variety of services that include awareness training and capacity building, fixed and mobile counseling and testing and mobile HIV treatment provision. Their vision is to be "a sustainable, vibrant learning organization in the delivery of health systems and services embracing partnerships with organizations and communities".

The health center has faced good news and bad news, this is due to the fact that the population in which it operates has grown more than its initial expectations and this has led to inefficiency in the providing of health care to the community. However, the hospital's market share had declined, too many staff members were leaving, and many health workers such as the doctors felt dissatisfied. The Joint Commission, an organization that accredits healthcare facilities and others were demanding better patient safety and quality.

Incorporating a database approach to cope with the ever-changing needs of the societies may enable the health center to be able to provide to community quality health services, keep their workers and grow their market share. In some sense, these DBMSs, with their accompanying data communications or online transaction processing systems, enabled users in all industries to construct both online and batch applications in a far more timely and cost effective manner. These database and data communications systems became the foundation for building many of the core applications in every industry and government agency. Database Management Systems software products are so important from both a business and organizational standpoint because;

- Self-Describing Nature of a Database System; a Database System contains not only the database itself but also the descriptions of data structure and constraints (meta-data). This information is used by the DBMS software or database users if needed. This separation makes a database system totally different from the traditional file-based system in which the data definition is a part of application programs.
- Insulation between Program and Data; In the file based system, the structure of the data files is defined in the application programs so if a user wants to change the structure of a file, all the programs that access that file might need to be changed as well. On the other hand, in the database approach, the data structure is stored in the system catalog not in the programs. Therefore, one change is all that's needed.
- Support multiple views of data; A view is a subset of the database which is defined and dedicated for particular users of the system. Multiple users in the system might have different views of the system. Each view might contain only the data of interest to a user or a group of users.
- Sharing of data and Multiuser system; a multiuser database system must allow multiple users access to the database at the same time. As a result, the multiuser DBMS must have

concurrency control strategies to ensure several users access to the same data item at the same time, and to do so in a manner that the data will always be correct – data integrity.

- Control Data Redundancy; in the Database approach, ideally each data item is stored in only one place in the database. In some cases redundancy still exists so as to improve system performance, but such redundancy is controlled and kept to minimum.
- Data sharing; the integration of the whole data in an organization leads to the ability to produce more information from a given amount of data.
- Enforcing Integrity Constraints; DBMSs should provide capabilities to define and enforce certain constraints such as data type, data uniqueness, etc.
- Restricting Unauthorized Access; Not all users of the system have the same accessing privileges. DBMSs should provide a security sub system to create and control the user accounts.
- Data Independence; System data (Meta Data) descriptions are separated from the application programs. Changes to the data structure is handled by the DBMS and not embedded in the program.
- Transaction Processing; The DBMS must include concurrency control subsystems to ensure that several users trying to update the same data do so in a controlled manner. The results of any updates to the database must maintain consistency and validity.
- Providing multiple views of data; a view may be a subset of the database. Various users may have different views of the database itself. Users may not need to be aware of how and where the data they refer to is stored.
- Providing backup and recovery facilities; if the computer system fails in the middle of a complex update process, the recovery subsystem is responsible for making sure that the database is restored to the stage it was in before the process started executing.
- Managing information; managing information means taking care of it so that it works for us, and is useful for the work we are doing. The information we collect is no longer subject to “accidental disorganization” and becomes more easily accessible and integrated with the rest of our work. Managing information using a database allows us to become strategic users of the data we have.

St Mary often needs to access and re-sort data for various uses. These may include:

- Creating mailing lists
- Writing management reports
- Generating lists of selected news stories
- Identifying various client needs

The processing power of a database allows it to manipulate the data it houses, so it can

- Sort
- Match
- Link
- Aggregate
- Skip fields
- Calculate
- Arrange

So a database tracks data, finding the bits you need and processing them in the way you arrange for them to be processed. Because of the versatility of databases, we find them powering all sorts of projects. A database can be linked to:

- A web site that is capturing registered users
- A client tracking application for social service organizations
- A medical record system for a health care facility
- Your personal address book in your e-mail client
- A collection of word processed documents
- A system that issues airline reservations.

Because of the critical importance of database technology to the smooth running of the health center it is important to incorporate it.

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CHAPTER THREE

3.0 PROBLEM DEFINITION AND REQUIREMENTS ANALYSIS

Databases typically store huge quantities of data representing the historical records of an organization. These databases grow by accretion. It is important that the old data and applications continue to work as new data and applications are added. The systems are in constant change. Indeed, most of the larger database systems in operation today were designed several decades ago and have evolved with technology. A historical perspective helps to understand current systems .Databases are being called upon to store more than just numbers and text strings. They are being used to store the many kinds of objects we see on the World Wide Web, and to store relationships among them. The distinction between the database and the rest of the web is being blurred.

3.1 STATEMENT OF THE PROBLEM

Traditionally, health care management systems use a file-based system to manage the organization's data. This means that forms are given to the receptionist at the health center which they give to the patients to fill those using pens. Afterwards, the receptionists give these filled forms to the health center administrators to process them manually and complied on large bulky file cabinet. In health centers there are different departments, each of them has their own application that manage and manipulate different data files. Hence, using the file-based system makes the linking and sharing of data among these departments to be almost impossible. The primary complaint of the health center administrators with this system is the tiresome task of searching through records just to verify your query data. But, because of the mechanical nature of databases, they have terrific power to manage and process the information they hold. This can make the information they house much more useful for the work at the health center.

3.2.0 OBJECTIVES OF THE PROJECT

3.2.1General Objectives

The objective of this project is to develop a health management system that will be able to facilitate the center to retrieve, update, and report the patient information efficiently, in turn helping the doctors make timely, effective diagnoses. And at the same time, the center can utilize this system to monitor their medical and financial management.

3.2.2 Specific Objectives

The developing of this system specifically attempts to satisfy the following objectives:

- To have a system that should be able to keep the records of the patients and the diagnosis allotted to them.
- To enable patients to be able to know their date and time of the appointment with the doctor.
- To allow online registration of new patients to the health center.
- The system should be able to generate the bill for patients.
- To print out reports immediately.
- To maintain readily accessible all of the relevant data for each patient served; and
- To provide a resource for the systematic retrieval of all relevant data from all patients' records for any desired primary purpose, or for a secondary administrative or a research purpose.

3.3.0 BASIC REQUIREMENTS

In order to computerize a clinical data management, these are the basic requirements;

- Adequate collection
- Financial assistance
- Hardware
- Software
- Trained staff
- User training
- Maintenance & development

CHAPTER FOUR

4.0 DATABASE DESIGN AND IMPLEMENTATION

4.1 DATABASE DESIGN

4.1.0 NEEDS ANALYSIS

The following components of the St Mary health care's information that were identified in the Needs Analysis section:

4.1.0.1 Patient

When a patient arrives, the receptionist interviews him or her to gather a small amount of personal data that is entered into the client's record. If the client has visited the St Mary before, the receptionist simply verifies the information in the existing record. The receptionist is then responsible for scheduling the client with one of the health, first serve basis. Any emergency cases would immediately be diverted to the local emergency professionals. All appointments are for the current day (this is a walk-in clinic) and are set up on a first come room and not dealt with in the clinic.

4.1.0.2 Doctors

After the client has waited for the health professional to be free, the health professional interviews the patient to find out a brief medical history and the type of test(s) sought. The health professional fills out a form that is a record of the clinic visit and the discussion. The form has space for "chart" information as well as check boxes for the tests to be given, including an "exceptional" situation. If tests are ordered by the health professional (i.e. one or more check boxes have been checked) then a specimen (urine, blood, etc.) will be collected from the client to be sent to the lab. A label must be generated to attach to the sample. The label must include the pertinent information about the test and the person requesting it. To assure privacy a tracking number is used whenever a client must be identified outside the clinic. The number is not randomly generated, but neither is it easily identifiable with a particular client.

4.1.0.3 Lab Manifests

Each day the lab test samples will be gathered together. An employee compares all the specimens against a computer generated "lab manifest" listing all of the requested tests by tracking number. After making sure that all specimens are accounted for, each set of test specimens is then grouped (Aids, HepB). The same employee will print each individual test manifest, check that all specimens exactly

match, and ship them to the appropriate lab with that paper manifest (e.g. Aids). An electronic version of the manifest may also be sent to the lab.

4.1.0. 4 Payment

When a patient has made his or her payment, the receptionist and the other departments concerned should be aware of. The receptionist should verify the payment by comparing the patient's account with the invoice. The administrators should ensure that their update the system so as they sort out the total debts.

4.1.0.5 Results Returned and Diagnosis

The lab will return the manifest. The results of each test will be filled in. The outcomes are: positive, negative, failed (must be repeated), inconclusive, and exceptional. When the results of all tests requested on a particular visit are available, a letter to the patient is generated. In the case that the test failed, the client is encouraged to return to provide another specimen, which will produce a separate visit transaction. Once the letter is generated, the visit is "closed". To assist the health's administration and public health officials, summary statistics are generated each quarter. These include the number of clients visiting, and summaries of the outcomes, such as number of positives, negatives, in each category.

4.1.0.6 Prescription

After the results are out, the patient is prescribed with certain medicine which he or she is supposed to collect from the pharmacy at the health center. The patient is given a prescription form which is filled by the health professionals. To help the health's administrators, this will be done automatically because they will be auto update of information in the database system.

4.1.0.7 Medicine

When a patient is prescribed with the medicine, the form is taken to pharmacy department which will give the patient the prescribed medicine or if at that moment they do not have that prescribed medicine, they will advise the patient to go and buy that medicine in the drug store. To assist the administrators, the system will be able to show them electronically what the patient's prescription and their medicine inventory. And also enable them communicate with the drug store in cases where they lack certain kinds of medicines.

4.1.1CLINICAL DATA MANAGEMENT SYSTEM

Clinical Data Management (CDM)is the process of collection, cleaning, and management of subject data in compliance with regulatory standards. The primary objective of clinical data management processes is to provide high-quality data by keeping the number of errors and missing data as low as possible and gather maximum data for analysis. This has been facilitated by the use of software applications that maintain an audit trail and provide easy identification and resolution of data discrepancies.

Many software tools are available for data management, and these are called Clinical Data Management Systems (CDMS). It is a tool that supports data collection (Remote Data Capture), data coding, data management (discrepancy, delinquency, communication, correction) and preparation of data for analysis. This software promotes efficient and accurate data entry using a common intuitive or user-friendly interface and has minimum training and implementation cost. The system can be self-contained or part of functionality of a CTMS. A CTMS with this system can help the health center with validation of the clinical data as well as the help, the site employ data for other important activities like building patients registries and assist in patient recruitment effort.

4.1.2DATA MODELING

Since a clinical database usually operated within a clinical database-management system, the database needed to be compatible with the information system of the enterprise of which it was a part; and it also needed to be operationally and structurally independent of all subsystems and applications programs. According to Johnson (1996) asserts that it is necessary to first develop a model of the database that defined its functional requirements, its technical requirements, and its structural design. Hence, the database model needs to produce a formal description, a conceptual schema of all the data generated in the enterprise, and how all of the data were related. Thus, the users of a medical database needed to define its functional requirements as to exactly what they wanted the database and its database-management system to do. Whether a clinical database served as the primary electronic medical record (EMR), or served as a secondary medical database, such as a clinical research database with its data derived from the EMR, both had some similar basic functional requirements.

A data model is a conceptual representation of the data structures that are required by a database. The data model focuses on what data should be stored in the database and it is used to design the relational tables. The first step in designing a database is to develop an Entity-Relation Diagram (ERD). The

ERD serves as a blue print from which a relational database may be deduced.The ER-diagram depicts the various relationships among entities, considering each object as entity. Entity is represented as rectangle shape and relationship represented as diamond shape. It depicts the relationship between data object. The ER-diagram is the notation that is used to conduct the data modeling activity. Every data element is logically accessible through the use of the names of its table and its column; and data transformations resulted from following defined logical rules. In a relational database the data were organized into files or tables of fixed-length records; each record was an ordered list of values, one value for each field. Information about each field's name and potential values was maintained in a separate meta-database.

4.1.2.0 Components of the ER-Diagram

- Entity: Entity is the things which we want to store information. It is an elementary basic building block of storing information about business process. An entity represents an object defined within the information system about which you want to store information. Entities are distinct things in the enterprise.
- Relationship: A relationship is normal connection or association between entities used to relate two or more entities with some common attributes or meaningful interaction between the object.
- Attributes: Attributes are the properties of the entities and relationship descriptor of the entity. Attributes are elementary pieces of information attached to an entity.

Figure 1 shows the ERD for the project

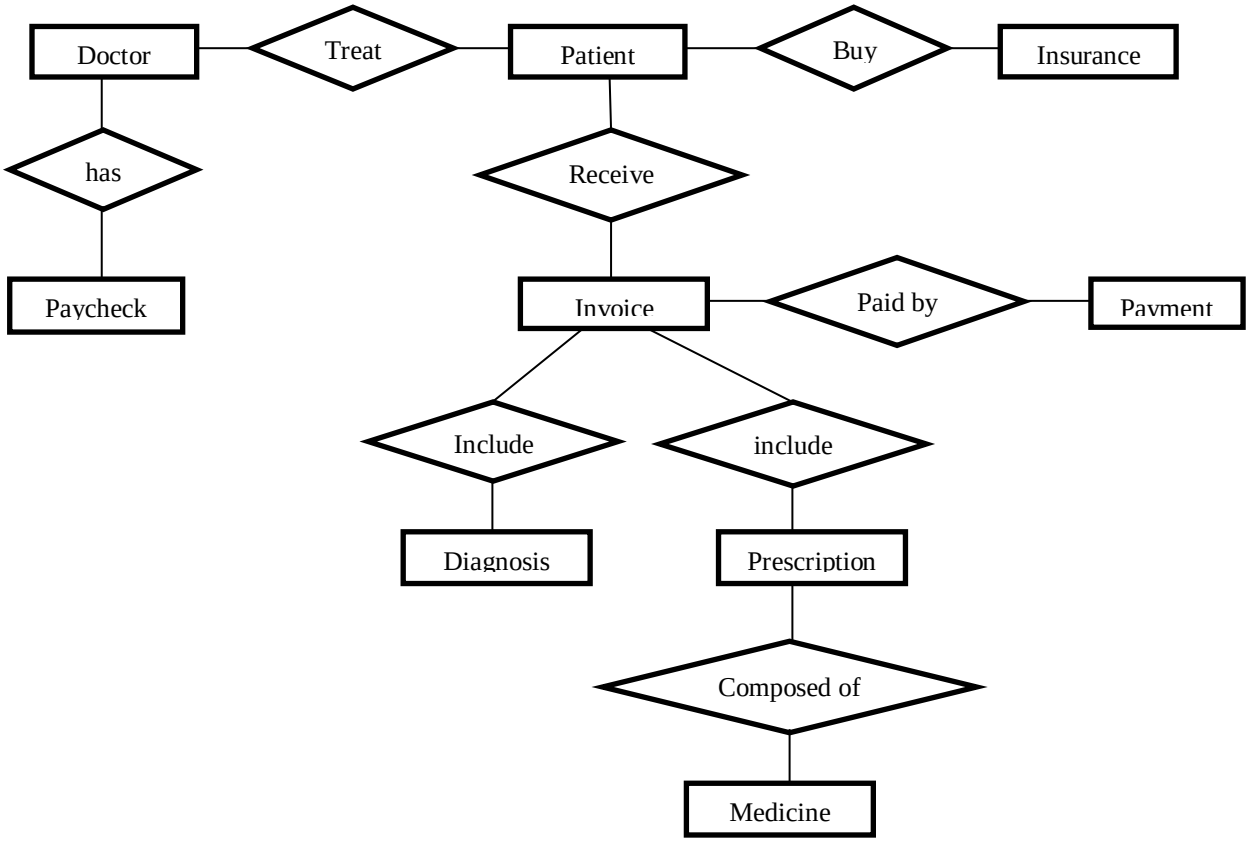

Figure 1; Entry Relationship Diagram

4.1.2.1 The Database Schema

The one technical concept which is central to database management systems is the schema. A database schema is a formalized description of the data that are contained in the database, available to the programs that wish to use the data. There are three different types of schema in the database and these are defined according to the levels of abstraction. At the highest level, we have multiple external schemas (also called sub schemas) that correspond to different views of the data. At the conceptual level, we have the conceptual schema, which describes all the entities, attributes, and relationships together with integrity constraints. At the lowest level of abstraction we have the internal schema, which is a complete description of the internal model, containing the definitions of stored records, the methods of representation, the data fields, and the indexes and storage structures used. There is only one conceptual schema and one internal schema per database.

The DBMS is responsible for mapping between these three types of schema. It must also check the schemas for consistency. The DBMS must check that each external schema is derivable from the conceptual schema, and it must use the information in the conceptual schema to map between each external schema and the internal schema. The conceptual schema is related to the internal schema through a conceptual/internal mapping. This enables the DBMS to find the actual record or combination of records in physical storage that constitute a logical record in the conceptual schema, together with any constraints to be enforced on the operations for that logical record. It also allows any differences in entity names, attribute names, attribute order, data types, and so on, to be resolved. Finally, each external schema is related to the conceptual schema by the external/conceptual mapping. This enables the DBMS to map names in the user's view on to the relevant part of the conceptual schema (Connolly and Beggy).

Figure 2 shows the Database Schema diagrams for the St Mary's Health care center.

DOCTOR

Doctor's Name	Doctor's security service No.	Gender	Age	Position	Phone No.	Address	Office	Town

PAYCHECK

Check number	Doctor's security service No.	Salary	Bonus	Pay date

PATIENT

Patient name	Patient's security service No.	Doctor's security service No.	Gender	Age	Phone No.	Address	Town

INSURANCE

Insurance company name	Insurance company ID	Patient's security service No.	Category	Phone No.	Address	Town

INVOICE

Patient security service No.	Invoice No.	Diagnosis ID	Prescription ID	Amount	Invoice date	Due date

PAYMENT

Pay transaction No.	Invoice No.	Pay method	Pay status	Paid date

PRESCRIPTION

Prescription ID.	Medicine quantity

MEDICINE

Medicine name	Medicine inventory ID	Manufacturer	Price	Quantity	Expiry date

DIAGNOSIS

Diagnosis ID	category

Figure 2; St Mary's Database Schema Diagrams

4.1.3 APPLICATIONS

In this project, Microsoft Access, Structured Query Language (SQL), and Microsoft Visual Basic (VB) were used to implement the applications. Tables, forms, queries, reports, and menus were created.

4.1.3.0 Data Definition

The SQL Data Definition Language (DDL) allows database objects such as schemas, domains, tables, views, and indexes to be created and destroyed. It also allows the creation of character sets, collations, and translations. And SQL identifiers are used to identify objects in the database, such as table names, view names, and columns. The characters that can be used in a user-defined SQL identifier must appear in a character set. The ISO standard provides a default character set, which consists of the upper-case letters A - Z, the lower-case letters a - z, the digits 0-9, and the underscore ( ) character. It is also possible to specify an alternative character set.

For instance in this project, the fields in database table have a data type used in database table and are explained below.

- Integer: one optional sign character (+ or -) followed by at least one digit (0-9). Leading and trailing blanks are ignored. No other character is allowed.
- Varchar: It is used to store alpha numeric characters. In this data type we can set the maximum number of characters up to 8000 ranges by defaults SQL server will set the size to 50 characters range.
- Data/time: Data/time data type is used for representing date or time.
- Text: Text data type is used for representing alpha only.

Database name: Doctors

Field Name	Data Type	Size	Descriptions
Doctor's name	Text	50	Not Null
Doctor's security service number	Number		Primary key
Gender	Text	50	Not Null
Age	Memo	50	Not Null
Position	Text	50	Not Null
Phone number	Memo	50	Not Null
Address	Memo	50	Not Null
Office	memo	50	Not Null
Town	Text		Not Null

Table 1; Data definition for Doctors

Database name: Paycheck

Field Name	Data Type	Size	Descriptions
Check Number	Number		Primary Key
Doctor's security service number	Number		Foreign key
Salary	Number		Not Null
Bonus	Number		Not Null
Pay date	Date/Time		Not Null

Table 2; Data definition for paycheck

Database name: Patient

Field Name	Data Type	Size	Description
Patient name	Text		Not Null
Patient's security service number	Number	1-9	Primary Key
Doctor's security service number	Number	1-9	Foreign Key
Gender	Text		Not Null
Age	Memo	50	Not Null
Phone number	Memo	50	Not Null
Address	Memo	50	Not Null
Town	Text		Not Null

Table 3; Data definition for Patients

Database name: Insurance

Field Name	Data Type	Size	Description
Insurance company name	Text		Not Null
Insurance company ID	Number	1-9	Primary Key
Patient's security service number	Number	1-9	Foreign Key
Category	Memo	50	Not Null
Phone No.	Memo	50	Not Null
Address	Memo	50	Not Null
Town	Text		Not Null

Table 4; Data definition for Insurance

Database name: Invoice

Field Name	Data Type	Size	Description
Invoice number	Number	1-9	Primary Key
Patient's security service number	Number	1-9	Foreign Key
Diagnosis ID	Memo	50	Foreign Key
Prescription ID	Memo	50	Foreign Key
Amount	Number	1-9	Not Null
Invoice date	Date/time		Not Null
Due date	Date/time		Not Null

Table 5; Data definition for Invoice

Database name: Payment

Field Name	Date Type	Size	Description
Pay transaction number	Number	1-9	Primary Key
Invoice number	Number	1-9	Foreign Key
Pay method	Text		Not Null
Pay status	Text		Not Null
Paid date	Date/time		Not Null

Table 6; Data definition for Payment

Database name: Prescription

Field Name	Data Type	Size	Description
Prescription ID	Number	1-9	Primary Key
Medicine quantity	Number	1-9	Not Null

Table 7; Data definition for Prescription

Database name: Medicine

Field Name	Data Type	Size	Description
Medicine name	Text		Not Null
Medicine inventory ID	Number	1-9	Primary Key
Prescription ID	Number	1-9	Foreign Key
Price	Memo	50	Not Null
Quantity	Memo	50	Not Null
Expiry date	Date/time		Not Null

Table 8; Data definition for Medicine

Database name: Diagnosis

Field Name	Data Type	Size	Description
Diagnosis ID	Memo	50	Primary Key
Category	Memo	50	Not Null

Table 9; Data definition for Diagnosis

Furthermore, relations and other database objects exist in an environment. Among other things, each environment consists of one or more catalogs, and each catalog consists of a set of schemas. A schema is a named collection of database objects that are in some way related to one another (all the objects in the database are described in one schema or another). The objects in a schema can be tables, views,

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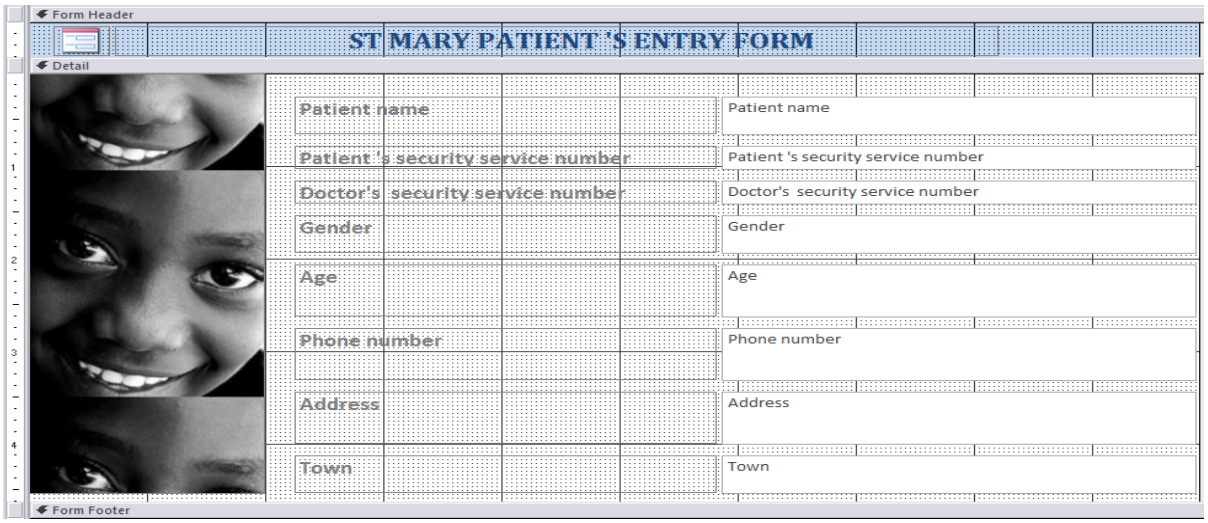
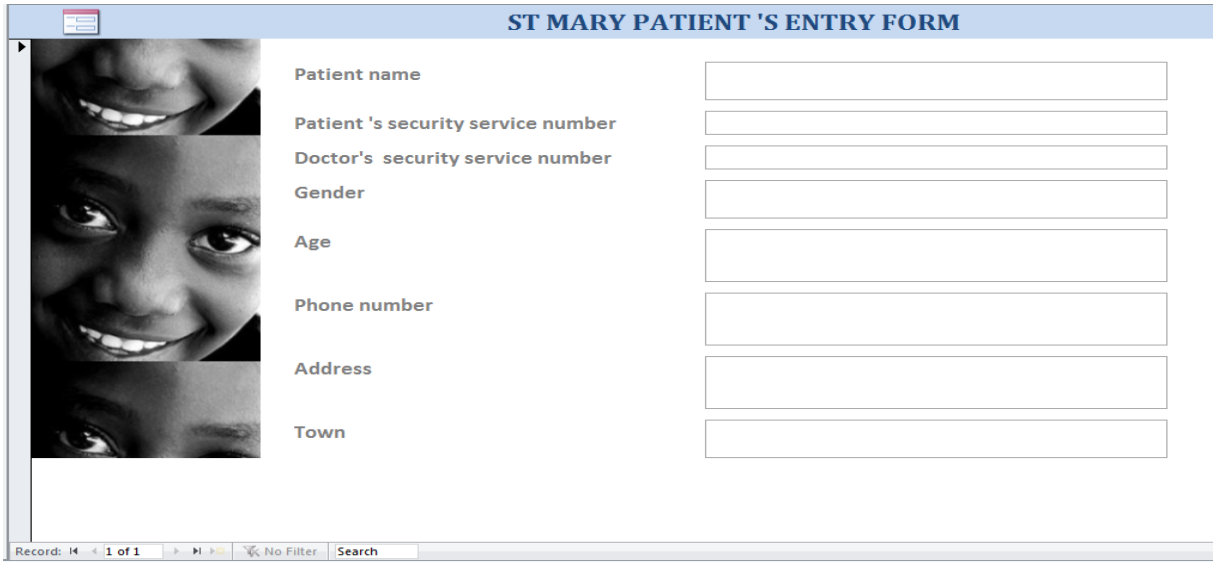
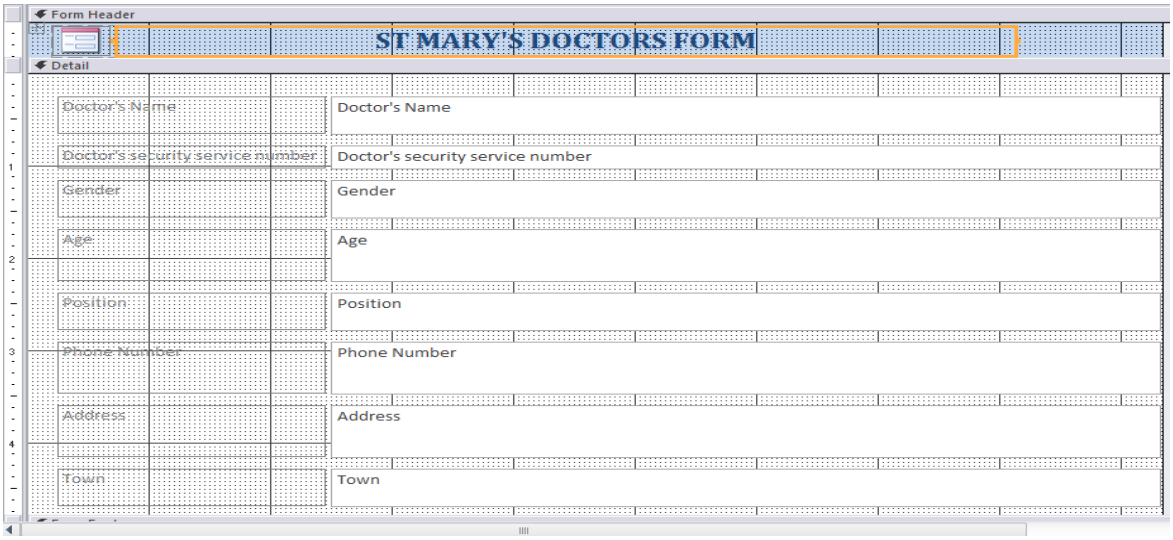
domains, assertions, collations, translations, and character sets. All the objects in a schema have the same owner and share a number of defaults.

Forms were designed as follows;

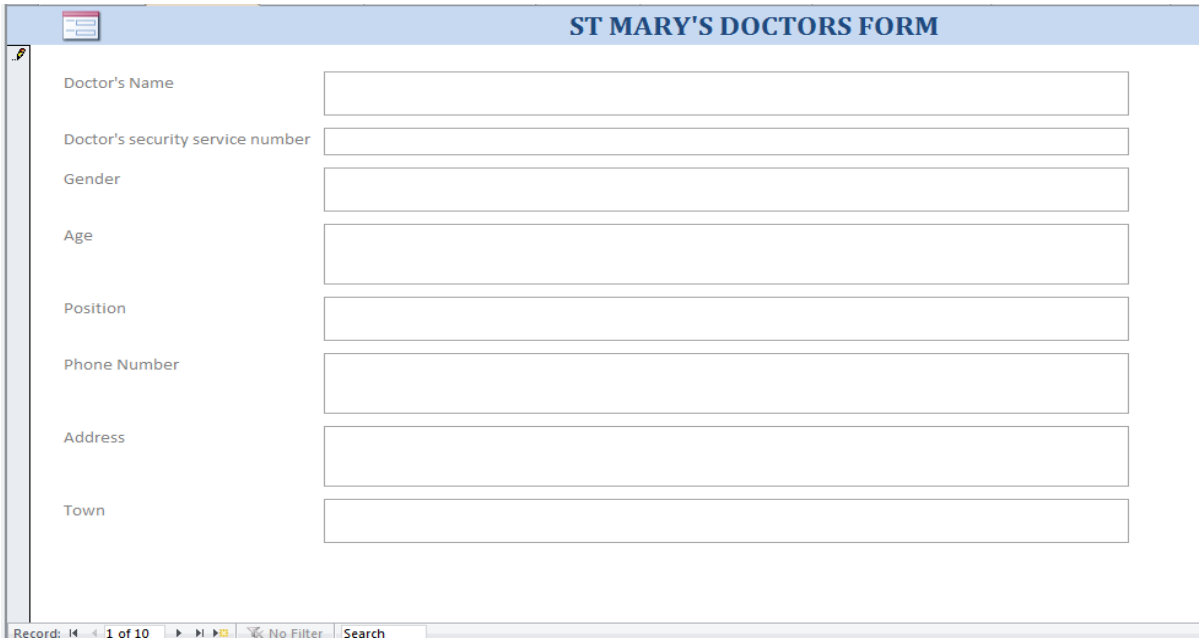


The form was saved and switched to Form View;





The form was saved and switched form view;



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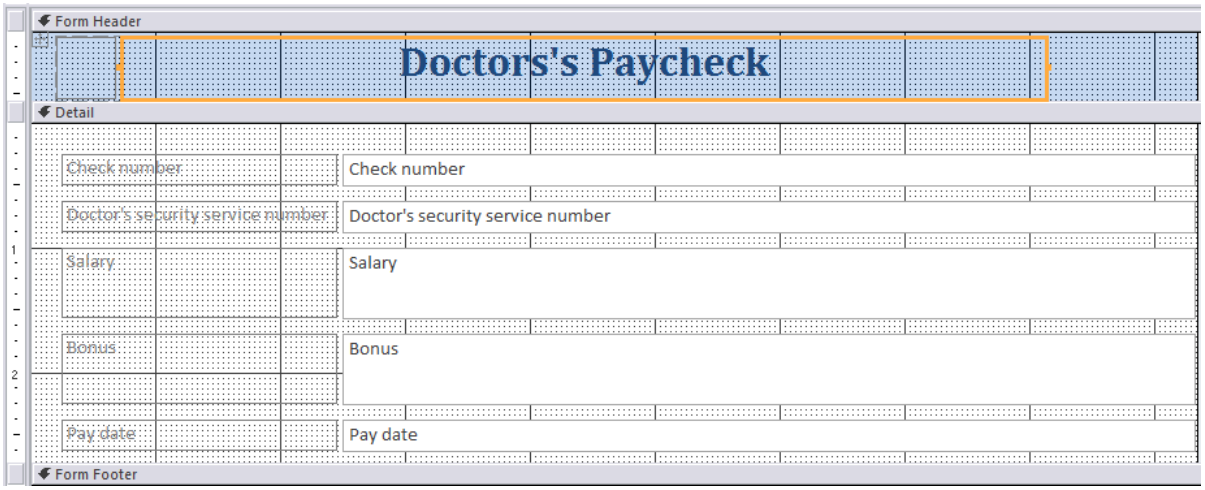
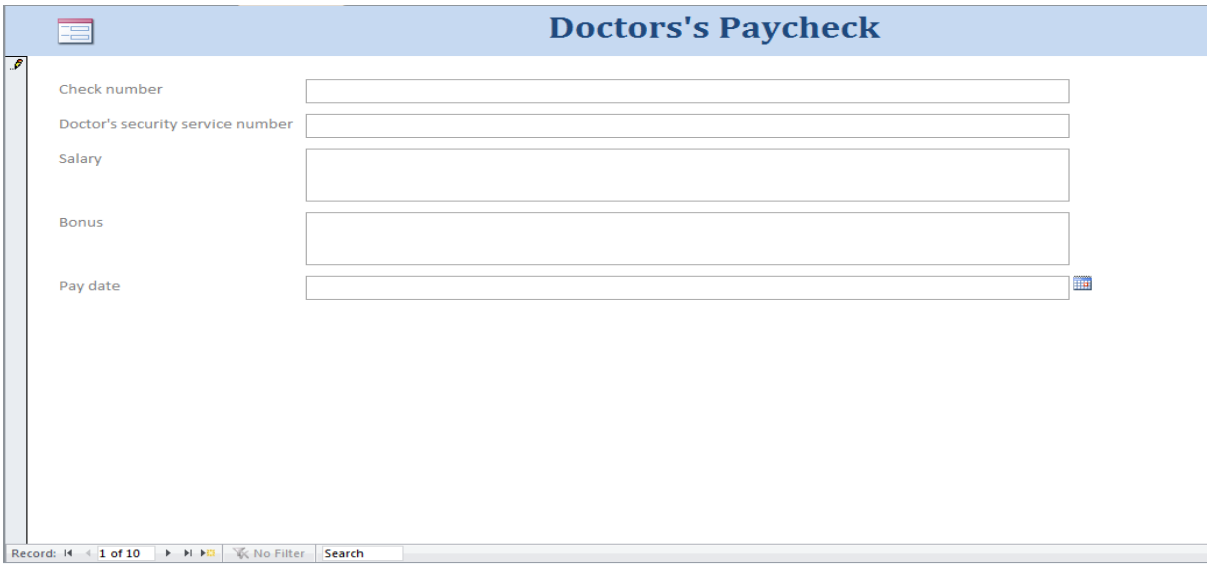
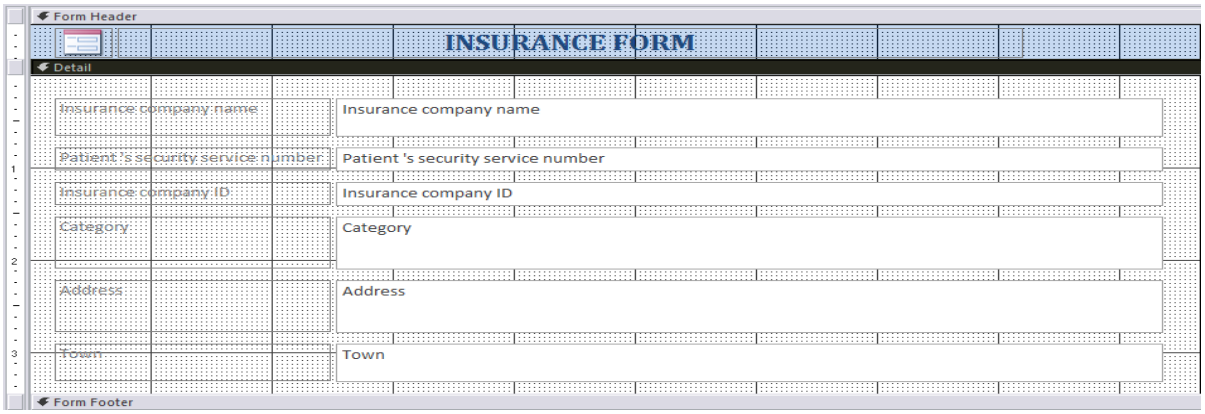


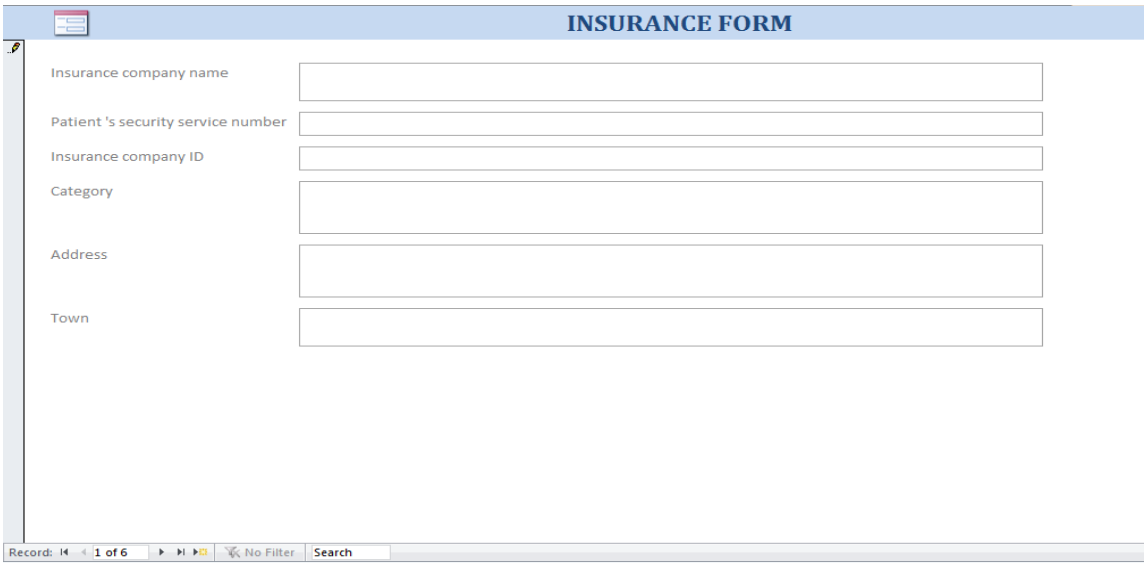
Then, the design form was saved and switched to form view;

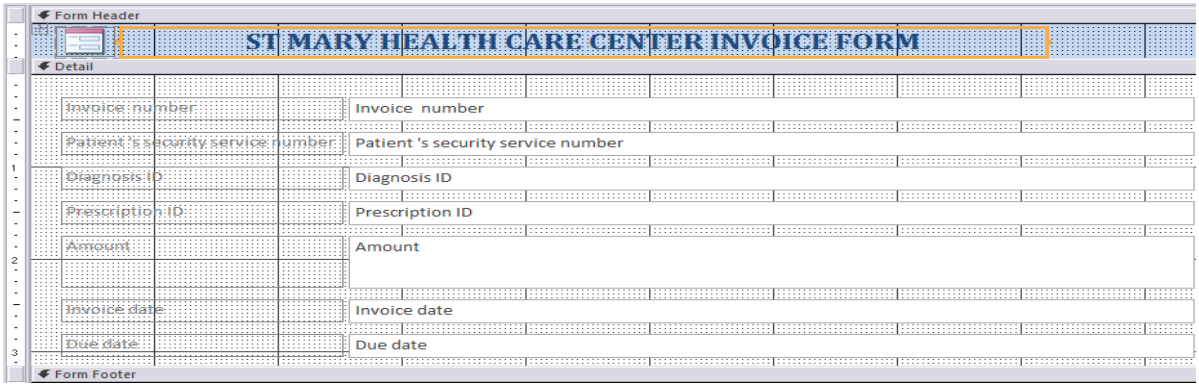




ISSN: 3471-7102, ISBN: 978-9982-70-318-5

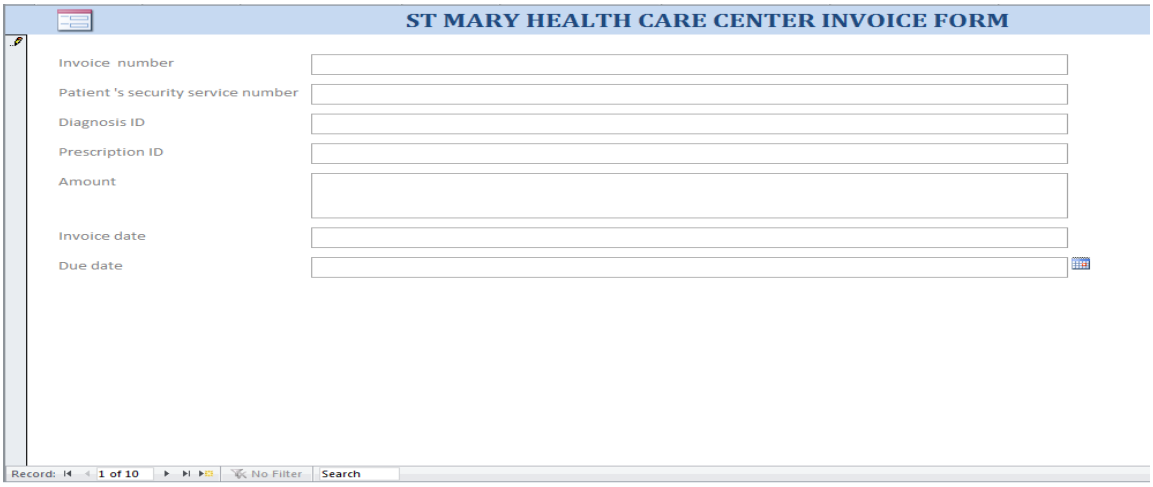
The form was saved and switched to form view;

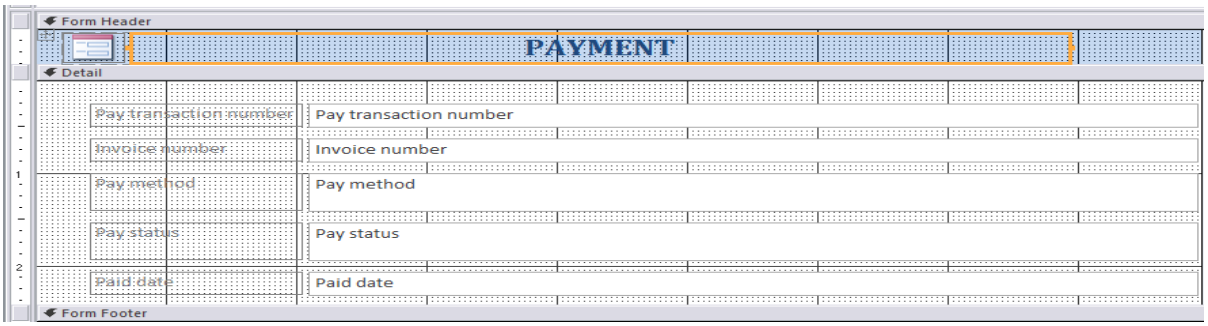




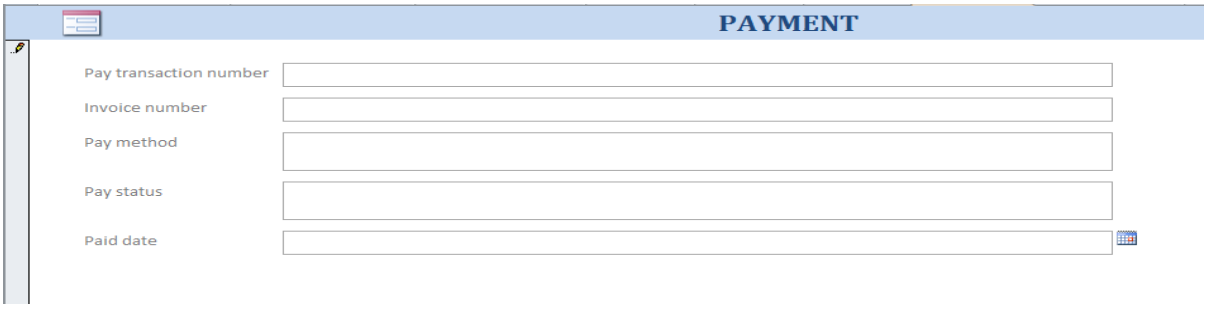
The form was saved and switched to form view;

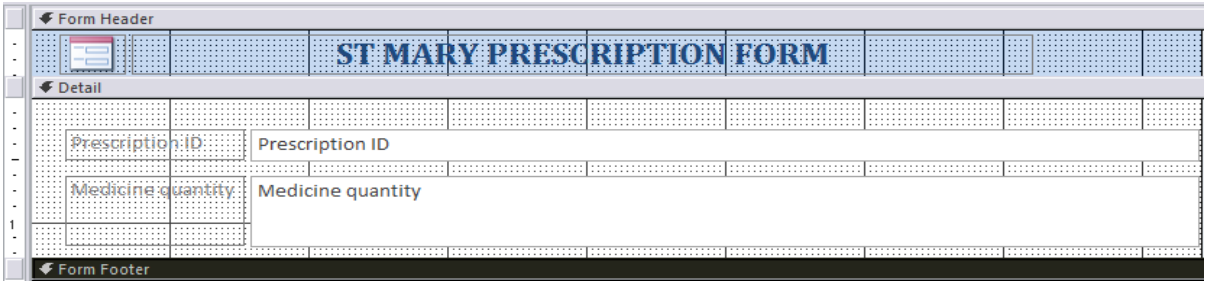
ISSN: 3471-7102, ISBN: 978-9982-70-318-5





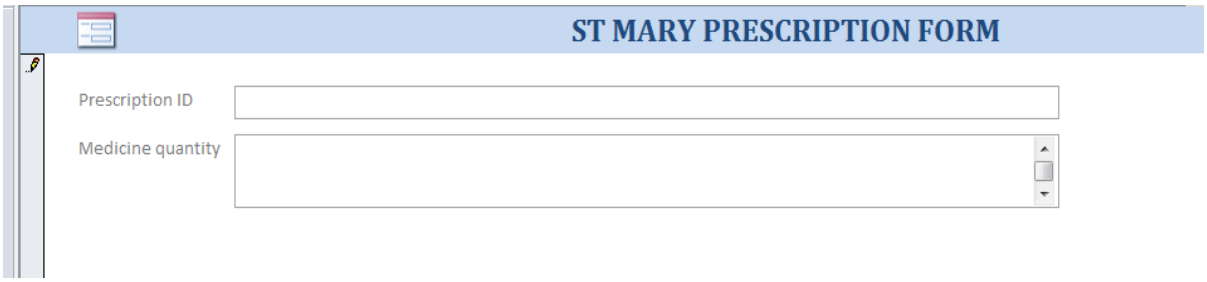
The form was saved and switched to form view;

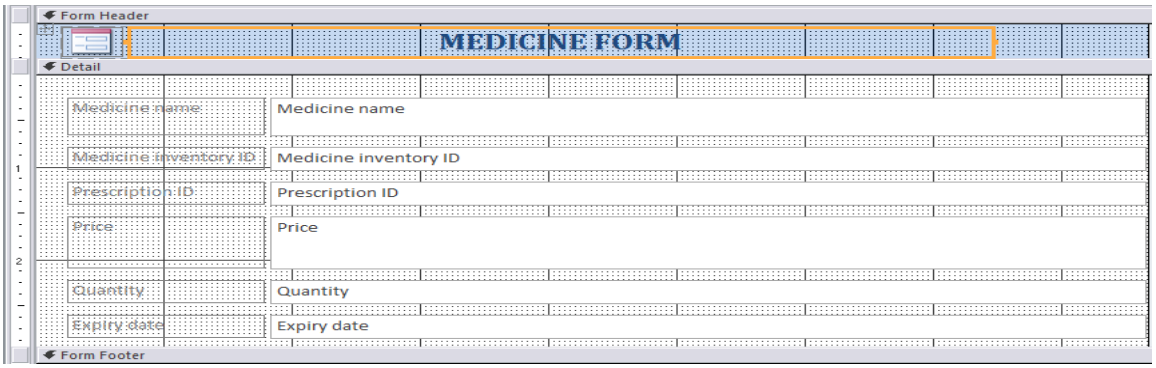




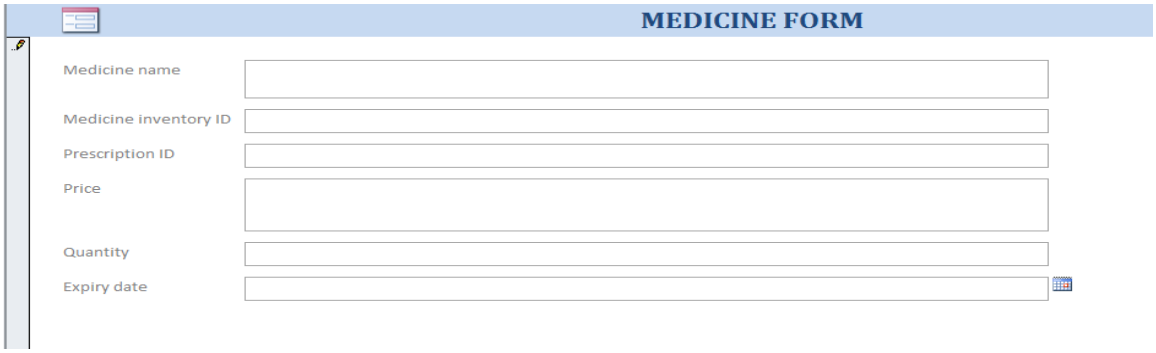
ISSN: 3471-7102, ISBN: 978-9982-70-318-5

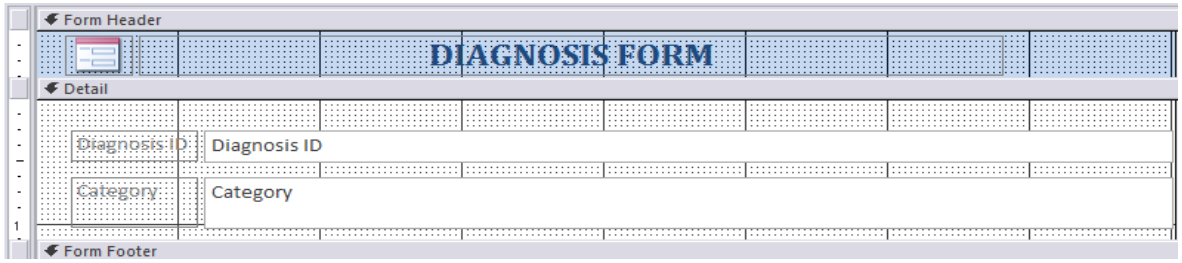
The form was saved and switched to form view;



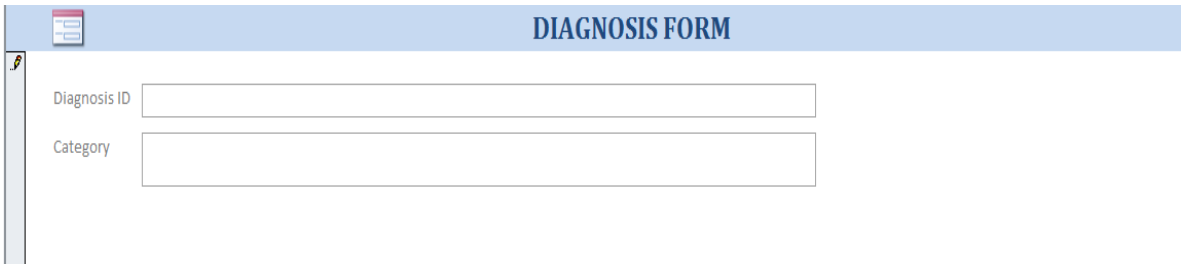


The form was saved and switched form view;





The form was saved and switched to form view;



4.1.3.1 Relationships

A relationship is a connection between two entities. It connects data (in tables) together in meaningful ways. For instance, knowing the information of a patient is meaningless without knowing the doctor who will treat that patient. Hence, we would relate the patient and doctors tables to obtain complete information about a transaction.

The relationships are configured as follows:

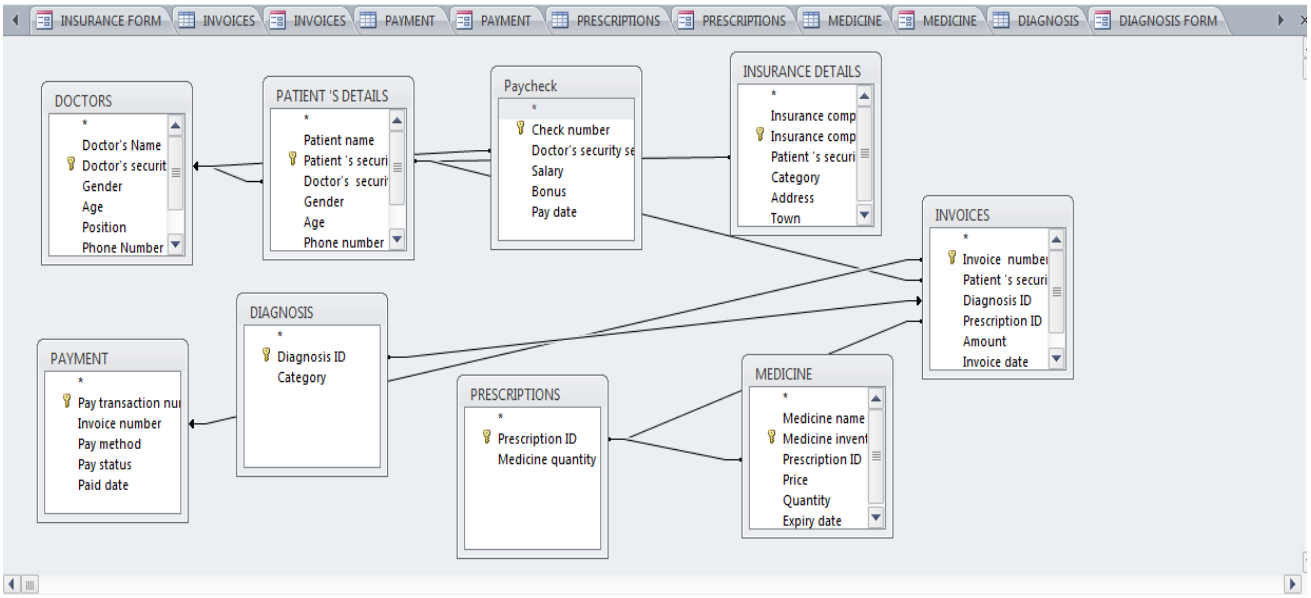


Figure 3; Relationships

Therefore, data modeling process has two main purposes are;

- To assist in the understanding of the meaning (semantics) of the data and to facilitate communication about the information requirements.
- Building a data model requires answering questions about entities, relationships, and
- attributes.

In doing so, the designers discover the semantics of the organization's data, which exist whether or not they happen to be recorded in a formal data model. Entities, relationships, and attributes are fundamental to all organizations. However, their meaning may remain poorly understood until they have been correctly documented. A data model makes it easier to understand the meaning of the data.

4.1.3.2 Functional Decomposition Diagram

A decomposition diagram shows a top-down functional decomposition of a system and exposes the system's structure. The objective of the Functional Decomposition is to break down a system step by step, beginning with the main function of a system and continuing with the interim levels down to the level of elementary functions. The diagram is the starting point for more detailed process diagrams, such as data flow diagrams (DFD).

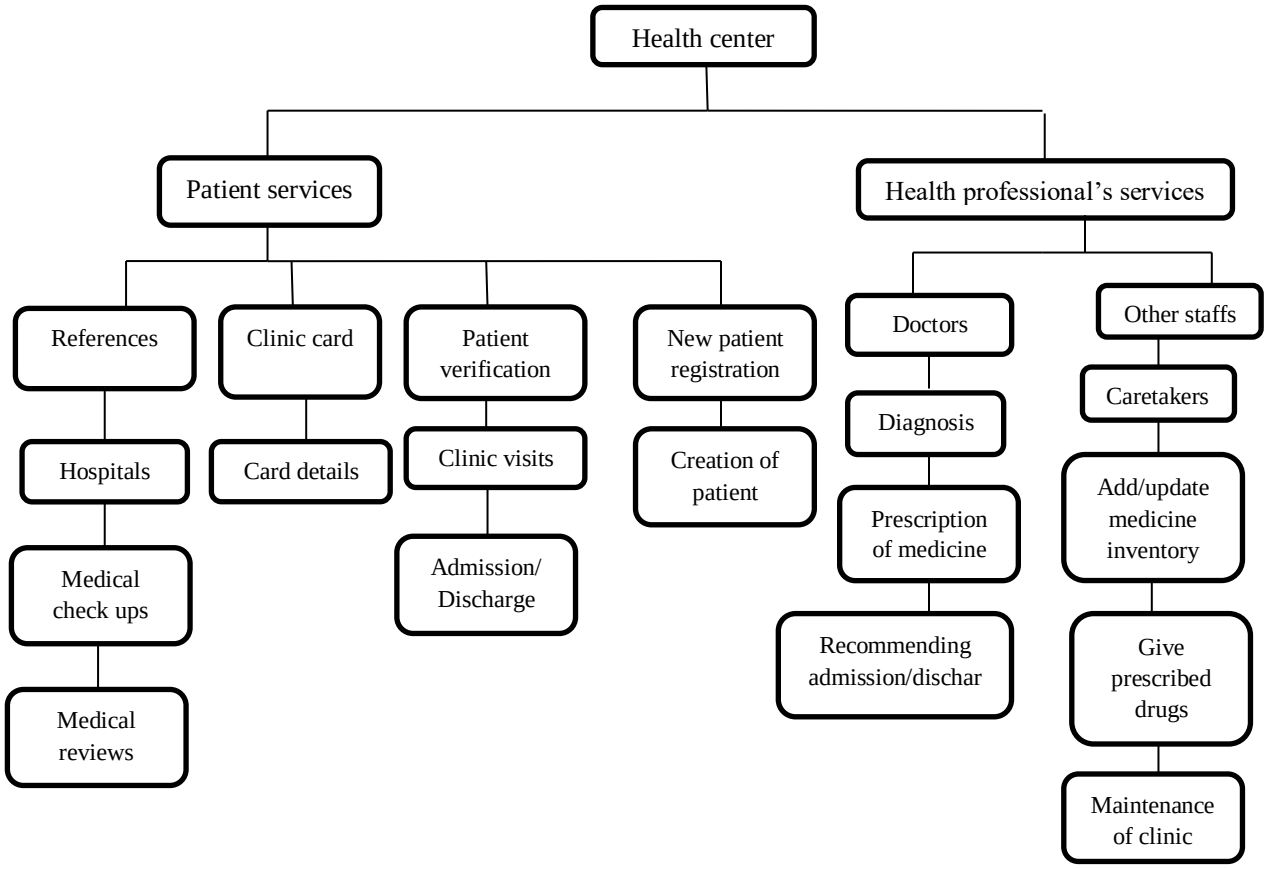


Figure 4; Functional Decomposition Diagram

4.2 IMPLEMENTATION OF THE CLINICAL MANAGEMENT SYSTEM

An implementation may then be best described in terms of transformations that are applied to the model which defines the database at a high conceptual level. Most transformations are done for reasons of operational performance and reliability. It is achieved through the use of Data Definition Language (in this case is the SQL) of the selected DBMS or a Graphical User Interface (GUI), which provides the same functionality while hiding the low-level DDL statements. The DDL statements are used to create the database structures and empty database files. Any specified user views are also implemented at this stage. The implementation phase consists of retrospective conversion, database of members, operations, statistics generation and training for staff and users.

4.2.0 Retrospective Conversion

The process of converting the patient's details or documentary details in the existing records into the machine-readable form is known as retrospective conversion. This technical processing consists of patient's details data entry and physical processing. Data is often obtained partially from sources that were in existence before a database was considered. To complete the database, so it can serve the intended broad scope, new data collection points may have to be defined. The value of adding data to the database has to be considered, since Data collection and entry is costly and susceptible to errors.

4.2.0. 1 Entering Data into the Database

The relatively high cost of data entry is a major concern. It is obvious that data that cost more to collect than they are worth should be avoided. When a certain data element is entered its utility is hard to predict: its usefulness may depend on its value, on the completeness of this patient's record, and on the patient's returning to the clinic, so that follow-up is possible. These factors are not easy to control. The actual problem of data acquisition can, however, is addressed. Much less formal attention has been given in the literature to this subject than to the topic of data retrieval.

When data is collected there are the costs of the actual collection, of the transcription to some process able form, and of the actual entry into a computer. The data collection is to a great extent the doctor's task. While automated clinical instruments can collect objective values, and the patients themselves can enter their own history, many subjective and important findings emanate from the doctor.

It may be considered desirable to minimize changes to the traditional manner of medical data recording, so that the doctors continue to collect their findings as notes in free text or by dictation. These reports are then transcribed by clerical personnel into the computer. This format presents the medical information in a way that is least affected by mechanical restrictions. To enable retrieval of such observations the specific statements or paragraphs may be categorized into functional groups as findings, treatment, plans. A system, based on these concepts has served well in a city hospital setting. Of particular importance was that patient data retrieval for emergency and unscheduled visits become possible.

Textual data are used for analysis; the problem is that the natural language text has to be parsed so that its meaning can be extracted. Both the parsers and the associated dictionaries are substantial pieces of software. But even when language understanding is achieved, consistent data for entry may not have been obtained since medical terminology varies over time and among health care providers. In general some encoding is needed. It may then be of benefit both to the doctor and to the system to choose a method of data collection which encodes data immediately into a more rigorous form. The encoding can be carried out by clerical personnel.

Numeric values are not as easily entered on a touch-screen as are choices among discrete elements. Keyboard entry may continue to dominate this part of data entry, unless the values can be obtained directly from medical instrumentation. Typed data requires much editing.

4.2.0.2 Data Storage

The cost of data storage is now much lower than cost of data entry. This means that if data entry is worthwhile, the entered data can be stored for a reasonably long time. The characteristics of medical record structures can, however, easily lead to a waste of computer storage space which is an order of magnitude greater than the actual data storage space needed. This occurs when data are stored in simple rectangular tables, since the variety of medical data requires many columns, but at one encounter only a few values will be collected, Hierarchical file organizations allow linkage to a variable number of subsidiary data elements, and in this manner provide efficient storage utilization, whereas the older tabular files dealt poorly with medical data. The encoding techniques used for data entry can also provide compaction of stored data since short codes are used to denote long keywords.

Data structures can often be compressed by suitable data encoding techniques applied to the files. Especially unobserved data elements do not need actual storage space. Data compression can reduce both the storage requirements and the access times greatly. When space considerations are no longer an important issue in data organization, an apparent tabular format can again be used, and this can simplify data analysis programs. In the clinical data bank the compressed data, after encoding to account for missing, zero, or repeating data, occupied only 15% of the original storage space.

Storage on magnetic tape is quite inexpensive and the data can be recovered, if needed for analysis, with a moderate delay. The major problems are the development of effective criteria for selection of data for archival storage and the cataloging of archival data, so that they can be retrieved when needed. Candidates for archiving are detailed records of past hospitalizations and episodes of acute illnesses.

4.2.0.3 Data Organization for Retrieval

The important point in research usage of databases is that information is not produced by the retrieval and inspection of a few values, but rather from the relating of many findings in accordance with hypothesized cause and effect relationships. When the data files grow very large, repetitive scans for data selection may become prohibitively slow, especially during the data exploration phase.

Since access to data in research is primarily by attribute field rather than by patient record, it can be profitable to transpose the database. Transposition generates one, possibly very long, record for each attribute of the database. Such a record now contains a sequence of values of this particular attribute for all patients or all visits of all patients. Many current computer systems cannot manage such long records easily but the benefits should be clear: to relate blood pressure results to dosage of an anti-hypertensive drug only two records have to be retrieved from the transposed file. In a conventional file organized by patient visit every visit record is accessed to retrieve the two fields needed to accomplish his comparison.

To avoid scanning an entire conventional file, access structures can be created which speed up the record selection process. Attributes which are expected to be used in record selection are entered into an auxiliary index file, which is then maintained in sorted order. For example if the attribute is “blood pressure” all hypertensive will appear at the beginning of the corresponding index file. With every blood pressure value a reference pointer to the corresponding visit record will be kept. Now only the data records for patient visits where the blood pressure was high have to been retrieved.

Bitmaps provide a simplified form of indexing. Whereas an index is based on the actual data values, a bitmap uses simple categorizations of these values. In a list with entries which correspond to the records in the data file a bit is set to one if the data values in the record meet a certain condition. Both indexing and bitmaps can be viewed as providing the capability of pre-selection of relevant records. If the selection of indexes or bit map definitions matches the retrieval requests well, an access to conventional files can become much faster. The maintenance of such access structures will of course require additional effort at the time of data entry.

4.2.0.4 Data Presentation

Data from databases can be presented in the form of extensive reports for manual scanning, as summary tabulations, or as graphs to provide rapid visual comprehension of trends. An extensive data analysis may lead to a printout of statistical findings and their significance, or may provide clinical advice in terms of diagnosis or treatment. When simple facts are to be retrieved the results are apt to be compact and easy to display or print. If much computation is used to generate the information then presentation of the end-results alone is rarely acceptable. Most medical researchers will want an explanation of the data sources and algorithms that led to the output results, as well as information about the expected reliability of the final values.

During a routine patient encounter a paper summary is probably least distracting, but in emergency situations video terminal access can be much more rapid. Terminal access helps the researcher in the formulation of queries, and graphics provide insight to clinicians uncomfortable with long columns of numbers. As systems mature and become more accepted the user should be able to move smoothly from one form of output presentation to another, but most systems now in use do not provide many options for data presentation, and even fewer offer a smooth transition between interaction modes.

4.2.0.5 Data Administration

Even when all the right decisions have been made and a database exists, there has to be an ongoing concern with reliability, adaptation to changing institutional needs, planning for growth, and technical updating of the facilities. In many institutions a new function, that of database administrator, is defined to deal with these operational issues. The database administrator needs strong support from management and high quality technical assistance. Since the function is responsible for day-to-day operations it is not reasonable to expect a high level of innovation from the database administrator, but responsiveness to the institutional goals is essential.

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CHAPTER FIVE

5.0 FINDINGS AND OBSERVATIONS

5.1 DATA ENTRY

Data entry for the health center collection and patients records had to be classic. As examples to test the tables, forms, queries, and reports sample values were provided.

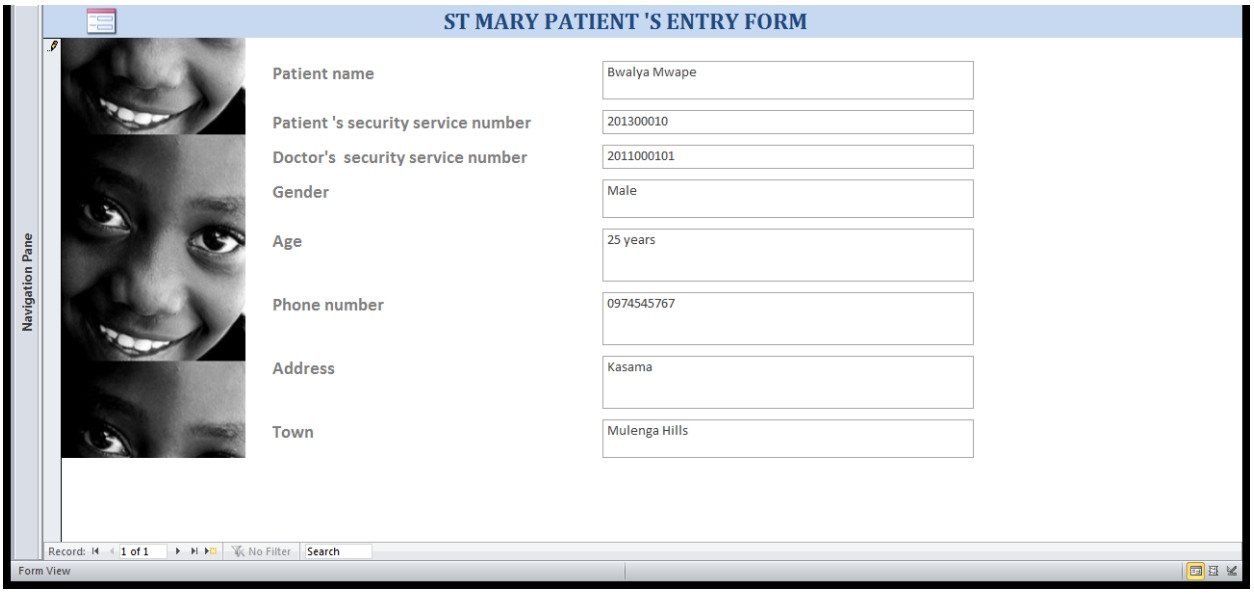
5.2 TESTING THE DATABASE

To test the database, the following records were created;

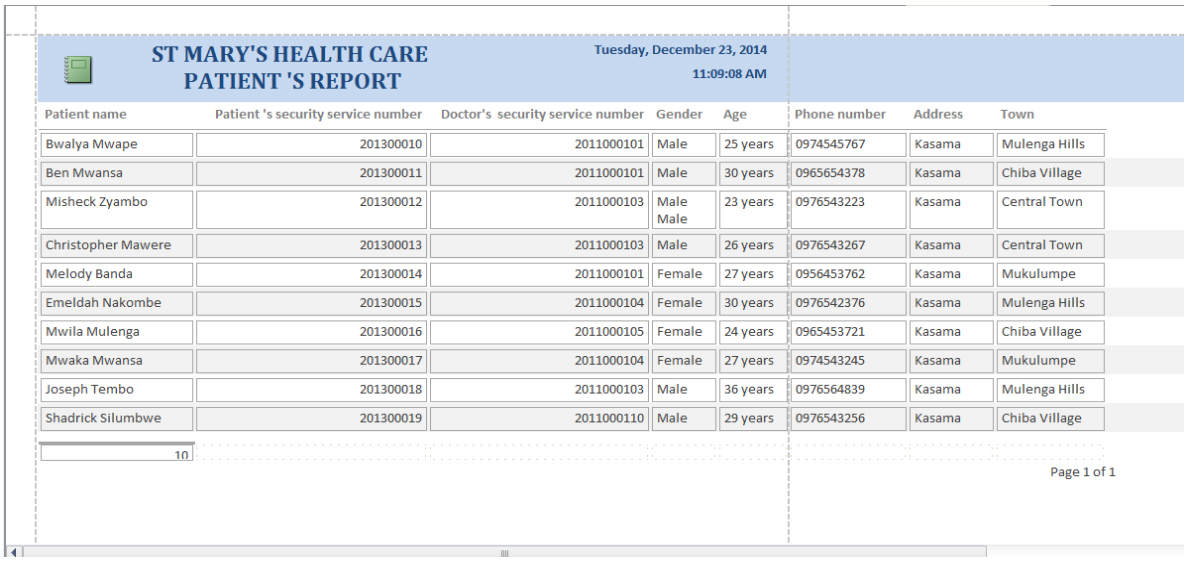
5.2.0 Database testing for patients details;

Patient name	Patient 's security service number	Doctor's security service number	Gender	Age	Phone number	Address	Town	Click to Add
Bwalya Mwape	201300010	2011000101	Male	25 years	0974545767	Kasama	Mulenga Hills	
Ben Mwansa	201300011	2011000101	Male	30 years	0965654378	Kasama	Chiba Village	
Misheck Zyambo	201300012	2011000103	Male	23 years	0976543223	Kasama	Central Town	
Christopher Mawere	201300013	2011000103	Male	26 years	0976543267	Kasama	Central Town	
Melody Banda	201300014	2011000101	Female	27 years	0956453762	Kasama	Mukulumpe	
Emeldah Nakombe	201300015	2011000104	Female	30 years	0976542376	Kasama	Mulenga Hills	
Mwila Mulenga	201300016	2011000105	Female	24 years	0965453721	Kasama	Chiba Village	
Mwaka Mwansa	201300017	2011000104	Female	27 years	0974543245	Kasama	Mukulumpe	
Joseph Tembo	201300018	2011000103	Male	36 years	0976564839	Kasama	Mulenga Hills	
Shadrick Silumbwe	201300019	2011000110	Male	29 years	0976543256	Kasama	Chiba Village	

To see the first record, the patient form was opened;



To see the report for the patients in the records, the patients report was opened;



ST MARY'S HEALTH CARE
PATIENT 'S REPORT

Tuesday, December 23, 2014
11:09:08 AM

Patient name	Patient 's security service number	Doctor's security service number	Gender	Age	Phone number	Address	Town
Bwalya Mwape	201300010	2011000101	Male	25 years	0974545767	Kasama	Mulenga Hills
Ben Mwansa	201300011	2011000101	Male	30 years	0965654378	Kasama	Chiba Village
Misheck Zyambo	201300012	2011000103	Male Male	23 years	0976543223	Kasama	Central Town
Christopher Mawere	201300013	2011000103	Male	26 years	0976543267	Kasama	Central Town
Melody Banda	201300014	2011000101	Female	27 years	0956453762	Kasama	Mukulumpe
Emeldah Nakombe	201300015	2011000104	Female	30 years	0976542376	Kasama	Mulenga Hills
Mwila Mulenga	201300016	2011000105	Female	24 years	0965453721	Kasama	Chiba Village
Mwaka Mwansa	201300017	2011000104	Female	27 years	0974543245	Kasama	Mukulumpe
Joseph Tembo	201300018	2011000103	Male	36 years	0976564839	Kasama	Mulenga Hills
Shadrick Silumbwe	201300019	2011000110	Male	29 years	0976543256	Kasama	Chiba Village

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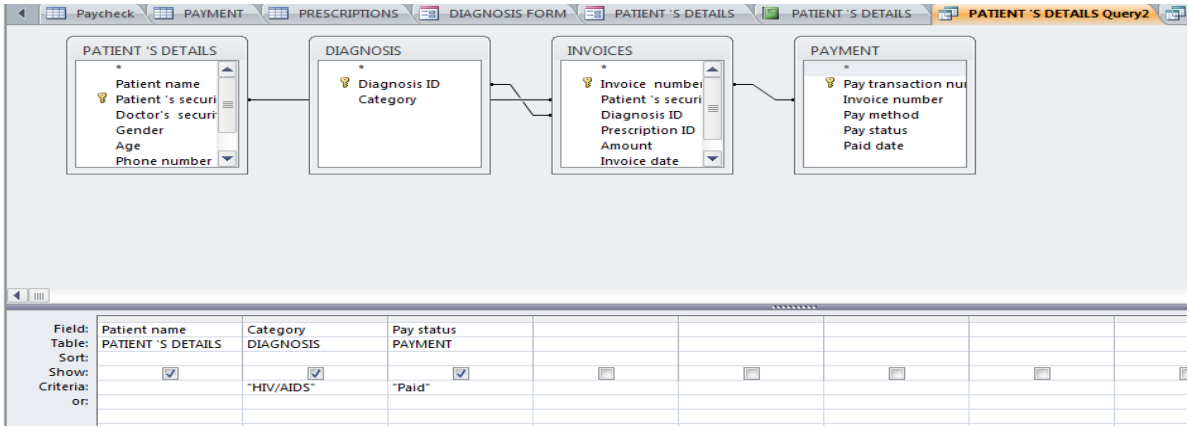
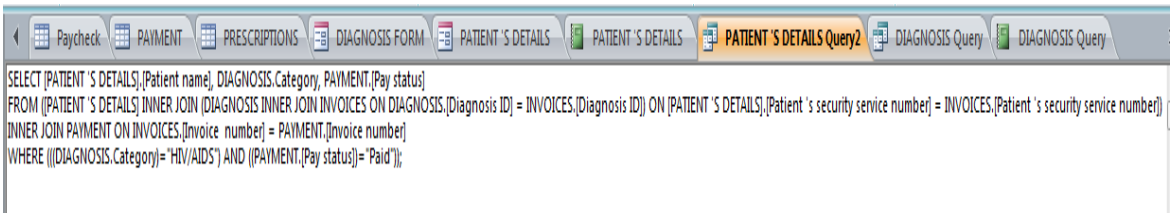
To see the patients who are on the same diagnosis category and their pay status, the query was opened;

In Design View;



In SQL View;



In Datasheet View;

Paycheck | PAYMENT | PRESCRIPTIONS | DIAGNOSIS FORM | PATIENT 'S DETAILS | PATIENT 'S DETAILS | PATIENT 'S DETAILS Query2

Patient name	Category	Pay status
Melody Banda	HIV/AIDS	Paid
Mwila Mulenga	HIV/AIDS	Paid
Mwaka Mwansa	HIV/AIDS	Paid

A report was also created and is as shown;

ST MARY'S HEALTH CARE'S HIV /AIDS TREATMENT REPORT

Tuesday, December 23, 2014
5:51:59 PM

Patient name	Category	Pay status
Melody Banda	HIV/AIDS	Paid
Mwila Mulenga	HIV/AIDS	Paid
Mwaka Mwansa	HIV/AIDS	Paid

3

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5.2.1 Database testing for doctors details;

Doctor's Name	Doctor's security service number	Gender	Age	Position	Phone Number	Address	Town	Click to Add
Sinkamba S Kazimoto	2011000101	Male	45 years	Pediatrist	+260974567891	Kasama P.o Box 410001	Kasama	
Susan Loloma	2011000102	Female	29 years	Physician	+260957698021	Kasama P.o Box 410504	Mungwi	
Tina Banda	2011000103	Female	34 years	Eye Specialist	+260974657896	Mungwi P.o Box 321782	Mungwi	
Mulenga Mutale	2011000104	Male	38 years	Physician	+260977801023	Kasama P.o Box 410789	Luwingu	
Chilufya Mwaba	2011000105	Male	57 years	Surgeon	+260961881981	Kasama P.o Box 410456	Kasama	
Mawere Rose	2011000106	Female	47 years	Medical	+260951678903	Kasama P.o Box 410897	Kasama	
James Tembo	2011000107	Male	30 years	Physiotherapist	+260964534218	Kasama P.o Box 410678	Kasama	
Linda Kabole	2011000108	Female	40 years	Phyisician	+260964567876	Kasama P.o Box 410567	Mungwi	
Lina Musonda	2011000109	Female	45 years	Surgeon	+260956789702	Kitwe P.o Box 510098	Chingola	
Chola Mulenga	2011000110	Male	45 years	physician	+260978675423	Lusaka P.o Box 610008	Lusaka	

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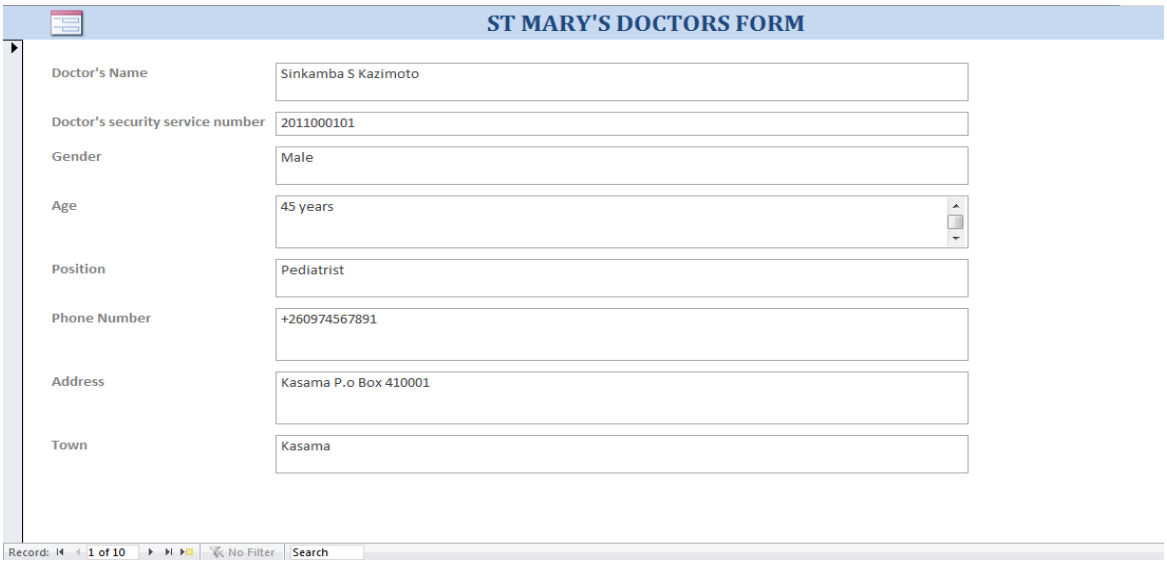
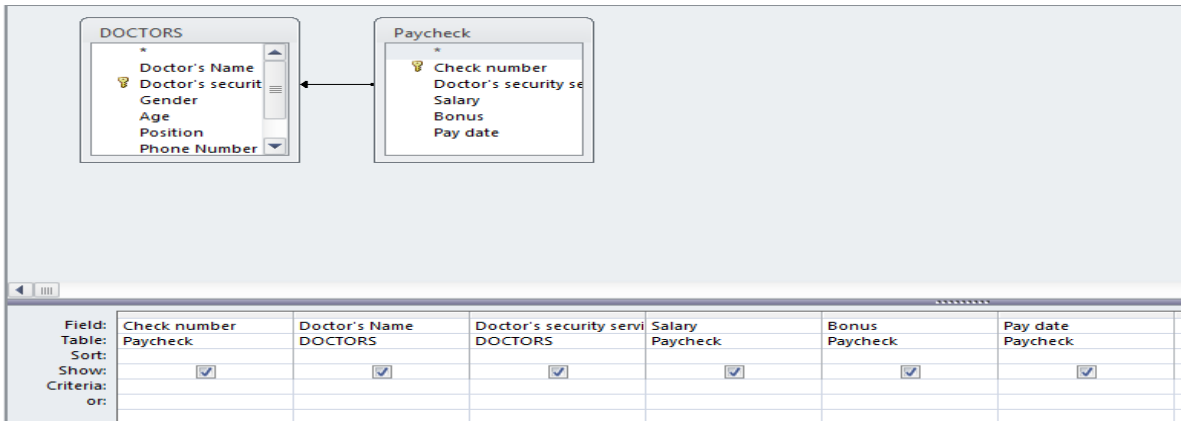
The doctor's form was opened;



To find out how much is the gross pay of each doctor and when it is due a query was opened;

In Design View;



In SQL View;

```
SELECT Paycheck.[Check number], DOCTORS.[Doctor's Name], DOCTORS.[Doctor's security service number], Paycheck.Salary, Paycheck.Bonus, Paycheck.[Pay date]
FROM DOCTORS RIGHT JOIN Paycheck ON DOCTORS.[Doctor's security service number] = Paycheck.[Doctor's security service number];
```

In Datasheet View;

Check numb	Doctor's Name	Doctor's security service number	Salary	Bonus	Pay date
5627	Sinkamba S Kazimoto	2011000101	K 9000.00	K 500.00	12/3/2014
5667	Susan Loloma	2011000102	K 10000.00	K 200.00	12/4/2014
5688	Tina Banda	2011000103	K 7000.00	K 100.00	12/3/2014
5670	Mulenga Mutale	2011000104	K 9000.00	K 150.00	12/4/2014
5609	Chilufya Mwaba	2011000105	K 6000. 00	K200.00	12/11/2014
5610	Mawere Rose	2011000106	K 9000.00	K 500.00	12/3/2014
5633	James Tembo	2011000107	K 7000.00	K 200.00	12/3/2014
5689	Linda Kabole	2011000108	K 13000. 00	K 100.00	11/9/2014
5600	Lina Musonda	2011000109	K 11000.00	K 50.00	11/9/2014
5602	Chola Mulenga	2011000110	K 6000.00	K 200.00	12/3/2014

A report was also created as shown;

DOCTOR'S PAYCHECK REPORT

Wednesday, December 24, 2014
7:17:53 AM

Check number	Doctor's Name	Doctor's security service number	Salary	Bonus	Pay date
5627	Sinkamba S Kazimoto	2011000101	K 9000.00	K 500.00	12/3/2014
5667	Susan Loloma	2011000102	K 10000.00	K 200.00	12/4/2014
5688	Tina Banda	2011000103	K 7000.00	K 100.00	12/3/2014
5670	Mulenga Mutale	2011000104	K 9000.00	K 150.00	12/4/2014
5609	Chilufya Mwaba	2011000105	K 6000. 00	K200.00	12/11/2014
5610	Mawere Rose	2011000106	K 9000.00	K 500.00	12/3/2014
5633	James Tembo	2011000107	K 7000.00	K 200.00	12/3/2014
5689	Linda Kabole	2011000108	K 13000. 00	K 100.00	11/9/2014
5600	Lina Musonda	2011000109	K 11000.00	K 50.00	11/9/2014
5602	Chola Mulenga	2011000110	K 6000.00	K 200.00	12/3/2014

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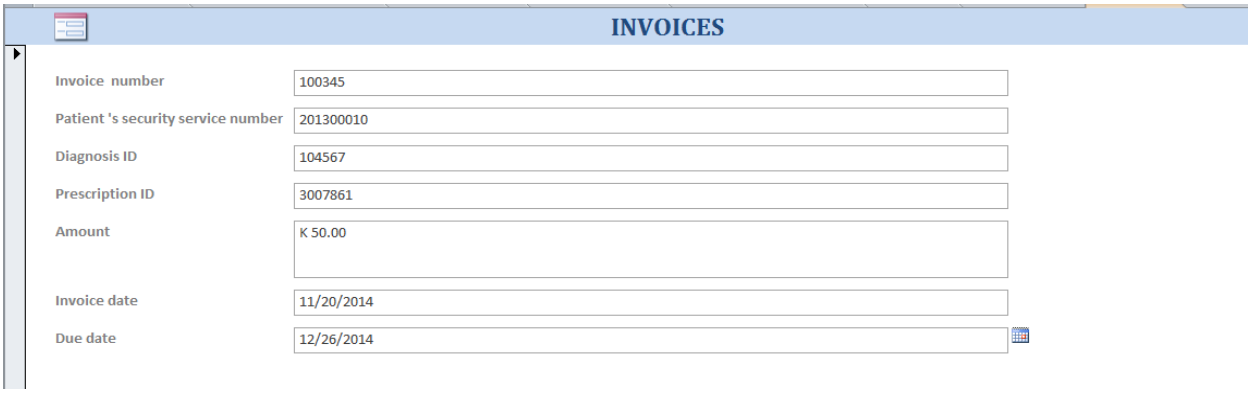
5.2.2 Database testing for Invoices;

INVOICES | MEDICINE | PATIENT 'S DETAILS | Paycheck | PAYMENT | PRESCRIPTIONS | DIAGNOSIS FORM | PATIENT 'S DETAILS | PATIENT 'S DETAILS

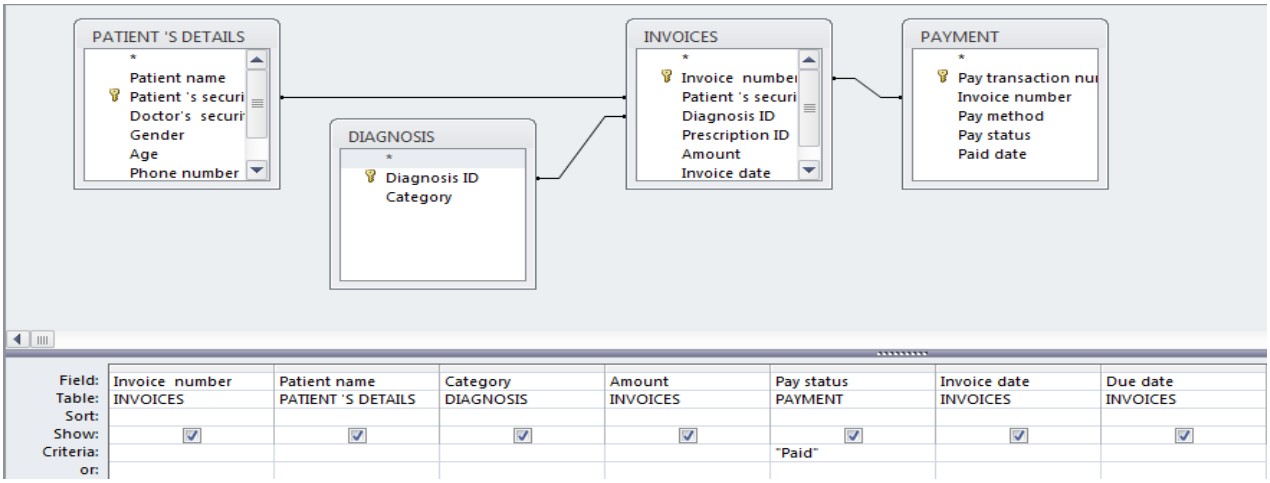
Invoice number	Patient 's security service number	Diagnosis ID	Prescription ID	Amount	Invoice date	Due date	Click to Add
100345	201300010	104567	3007861	K 50.00	11/20/2014	12/26/2014	
100346	201300011	104568	3007862	K 40.00	10/11/2014	12/20/2014	
100347	201300012	104569	3007863	K 55.00	11/20/2014	12/26/2014	
100348	201300013	104568	3007861	K 50.00	9/12/2014	12/20/2014	
100349	201300014	104560	3007864	K 25 .00	8/8/2014	12/21/2014	
100350	201300015	104561	3007862	K 35.00	9/10/2014	12/29/2014	
100351	201300016	104560	3007863	K 30.00	11/30/2014	12/30/2014	
100352	201300017	104560	3007365	K 70.00	12/1/2014	1/1/2015	
100353	201300018	104568	3007862	K 35.00	9/10/2014	12/29/2014	
100354	201300019	104560	3007861	K 50.00	11/20/2014	12/26/2014	

The form was opened;



To find out the patients who have paid for treatment a query was opened as shown;

In Design View;



In SQL View;

```
SELECT INVOICES.[Invoice number], [PATIENT 'S DETAILS].[Patient name], DIAGNOSIS.Category, INVOICES.Amount, PAYMENT.[Pay status], INVOICES.[Invoice date], INVOICES.[Due date]
FROM ([PATIENT 'S DETAILS] INNER JOIN (DIAGNOSIS INNER JOIN INVOICES ON DIAGNOSIS.[Diagnosis ID] = INVOICES.[Diagnosis ID]) ON [PATIENT 'S DETAILS].[Patient 's security service number] = INVOICES.[Patient 's security service number])
INNER JOIN PAYMENT ON INVOICES.[Invoice number] = PAYMENT.[Invoice number]
WHERE (((PAYMENT.[Pay status])="Paid"));
```

In Datasheet View;

Invoice number	Patient name	Category	Amount	Pay status	Invoice date	Due date
100346	Ben Mwansa	Asthma	K 40.00	Paid	10/11/2014	12/20/2014
100347	Misheck Zyambo	Arthritis	K 55.00	Paid	11/20/2014	12/26/2014
100349	Melody Banda	HIV/AIDS	K 25 .00	Paid	8/8/2014	12/21/2014
100350	Emeldah Nakombe	Meningitis	K 35.00	paid	9/10/2014	12/29/2014
100351	Mwila Mulenga	HIV/AIDS	K 30.00	Paid	11/30/2014	12/30/2014
100352	Mwaka Mwansa	HIV/AIDS	K 70.00	Paid	12/1/2014	1/1/2015

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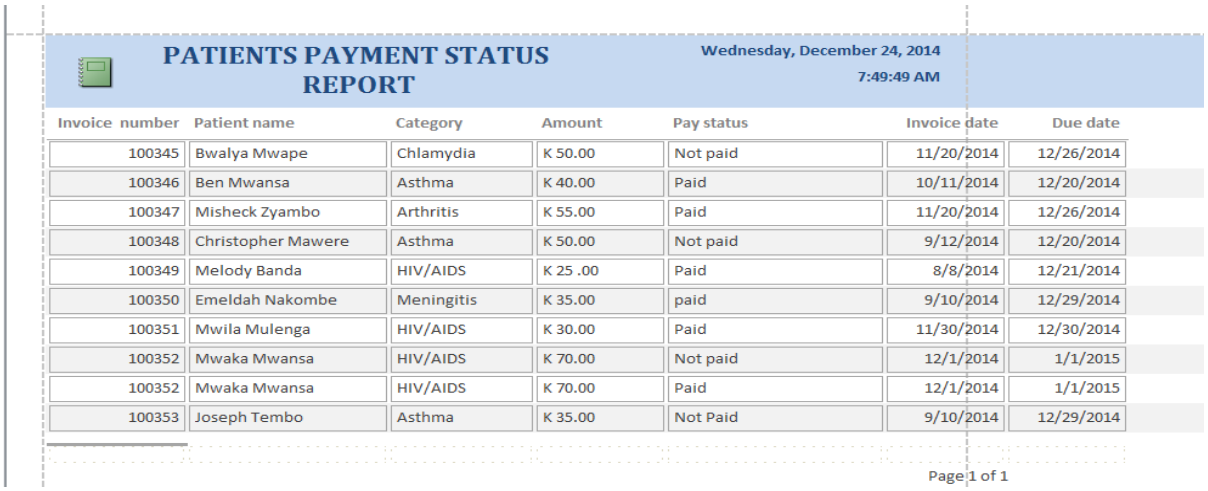
The report was also opened to show the payment status of patients as shown;



PATIENTS PAYMENT STATUS REPORT

Wednesday, December 24, 2014
7:49:49 AM

Invoice number	Patient name	Category	Amount	Pay status	Invoice date	Due date
100345	Bwalya Mwape	Chlamydia	K 50.00	Not paid	11/20/2014	12/26/2014
100346	Ben Mwansa	Asthma	K 40.00	Paid	10/11/2014	12/20/2014
100347	Misheck Zyambo	Arthritis	K 55.00	Paid	11/20/2014	12/26/2014
100348	Christopher Mawere	Asthma	K 50.00	Not paid	9/12/2014	12/20/2014
100349	Melody Banda	HIV/AIDS	K 25 .00	Paid	8/8/2014	12/21/2014
100350	Emeldah Nakombe	Meningitis	K 35.00	paid	9/10/2014	12/29/2014
100351	Mwila Mulenga	HIV/AIDS	K 30.00	Paid	11/30/2014	12/30/2014
100352	Mwaka Mwansa	HIV/AIDS	K 70.00	Not paid	12/1/2014	1/1/2015
100352	Mwaka Mwansa	HIV/AIDS	K 70.00	Paid	12/1/2014	1/1/2015
100353	Joseph Tembo	Asthma	K 35.00	Not Paid	9/10/2014	12/29/2014

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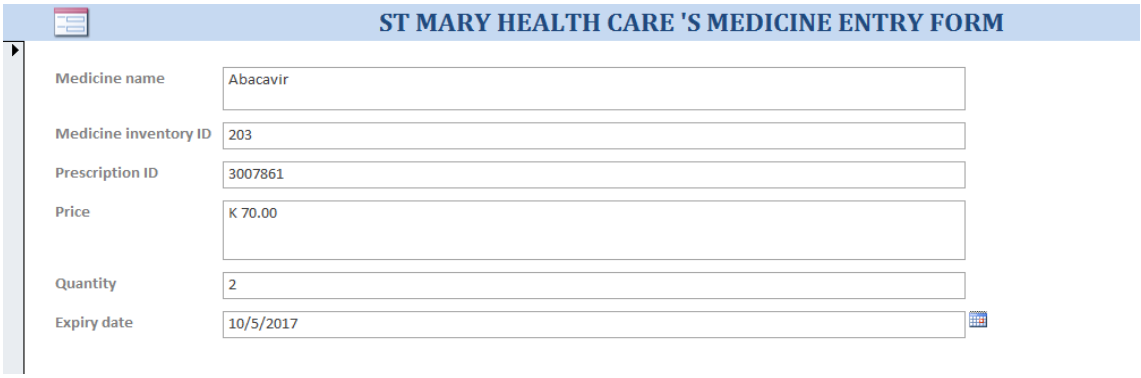
5.2.3 Database testing for Medicine

Medicine name	Medicine inventory ID	Prescription ID	Price	Quantity	Expiry date	Click to Add
Abacavir	203	3007861	K 70.00	2	10/5/2017	
Nevirapine	204	3007862	K 77.00	5	11/4/2017	
Paracetamol	205	3007861	K 50.00	10	5/5/2017	
Sulbtamol	206	3007863	K 80.00	5	6/11/2016	
Hydrocortisone	207	3007864	K 90.00	1	7/12/2017	
Amoxycillin	208	3007862	K 60.00	8	1/1/2017	
Aspirin	209	3007864	K 70.00	12	11/14/2017	
Procain penicillin	210	3007865	K 100.00	4	11/12/2016	
Cloxacillin	211	3007861	K 110.00	6	12/3/2017	
Ampicillin	212	3007863	K 40.00	10	11/13/2017	

The form was opened to show how it will be viewed by the user as shown;

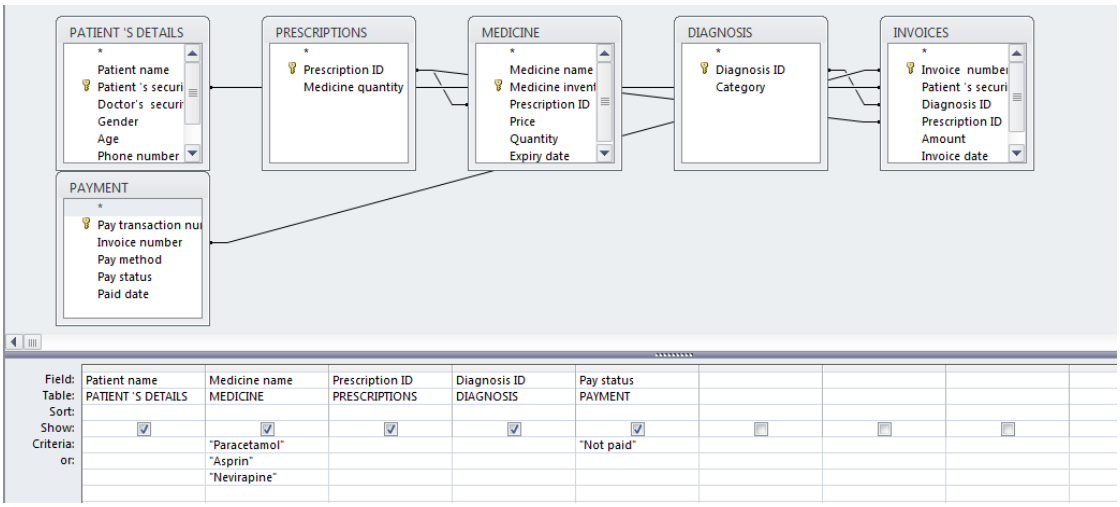


ST MARY HEALTH CARE 'S MEDICINE ENTRY FORM

Medicine name: Abacavir
Medicine inventory ID: 203
Prescription ID: 3007861
Price: K 70.00
Quantity: 2
Expiry date: 10/5/2017

To find out which medicine what medication is being taken by each patient on a query was opened;

In Design View;



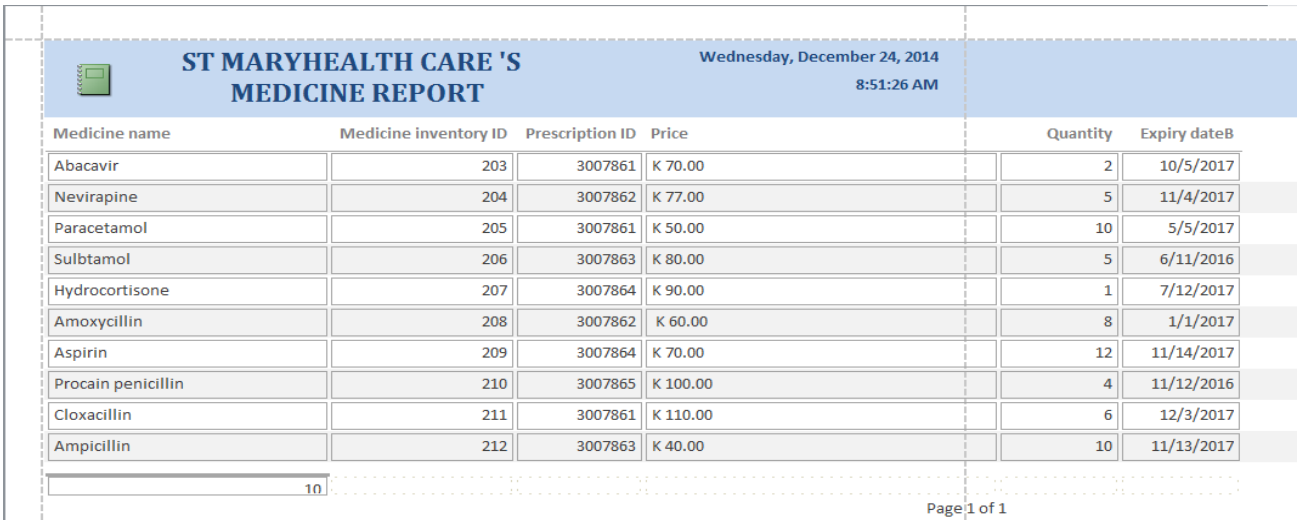
In SQL View;

```
SELECT [PATIENT 'S DETAILS].[Patient name], MEDICINE.[Medicine name], PRESCRIPTIONS.[Prescription ID], DIAGNOSIS.[Diagnosis ID], PAYMENT.[Pay status]
FROM ([PATIENT 'S DETAILS] INNER JOIN ((PRESCRIPTIONS INNER JOIN MEDICINE ON PRESCRIPTIONS.[Prescription ID] = MEDICINE.[Prescription ID]) INNER JOIN (DIAGNOSIS INNER JOIN INVOICES ON DIAGNOSIS.[Diagnosis ID] =
INVOICES.[Diagnosis ID]) ON PRESCRIPTIONS.[Prescription ID] = INVOICES.[Prescription ID]) ON [PATIENT 'S DETAILS].[Patient 's security service number] = INVOICES.[Patient 's security service number]) INNER JOIN PAYMENT ON
INVOICES.[Invoice  number] = PAYMENT.[Invoice number]
WHERE (((MEDICINE.[Medicine name])="Paracetamol") AND ((PAYMENT.[Pay status])="Not paid")) OR (((MEDICINE.[Medicine name])="Asprin")) OR (((MEDICINE.[Medicine name])="Nevirapine"));
```

In Datasheet View;

Patient name	Medicine name	Prescription ID	Diagnosis ID	Pay status
Bwalya Mwape	Paracetamol	3007861	104567	Not paid
Ben Mwansa	Nevirapine	3007862	104568	Paid
Christopher Mawere	Paracetamol	3007861	104568	Not paid
Emeldah Nakombe	Nevirapine	3007862	104561	paid
Joseph Tembo	Nevirapine	3007862	104568	Not Paid

The medicine report was also opened as shown below;



ST MARYHEALTH CARE 'S MEDICINE REPORT

Wednesday, December 24, 2014 8:51:26 AM

Medicine name	Medicine inventory ID	Prescription ID	Price	Quantity	Expiry dateB
Abacavir	203	3007861	K 70.00	2	10/5/2017
Nevirapine	204	3007862	K 77.00	5	11/4/2017
Paracetamol	205	3007861	K 50.00	10	5/5/2017
Sulbtamol	206	3007863	K 80.00	5	6/11/2016
Hydrocortisone	207	3007864	K 90.00	1	7/12/2017
Amoxycillin	208	3007862	K 60.00	8	1/1/2017
Aspirin	209	3007864	K 70.00	12	11/14/2017
Procain penicillin	210	3007865	K 100.00	4	11/12/2016
Cloxacillin	211	3007861	K 110.00	6	12/3/2017
Ampicillin	212	3007863	K 40.00	10	11/13/2017

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5.3 ADVANTAGES OF HAVING A CLINICAL DATABASE

- It provides users with timely access to clinic materials
- It eliminates routine tasks or performs them more efficiently
- It reduces the amount of time spent on material acquisition, serials management, budget administration and record keeping.
- It supports new means of information retrieval by introducing patrons to global information
- It allows patrons to use search strategies that exceed those that can be used with card catalogue
- It allows patrons to search clinics' facilities and offers from locations outside the clinic walls.
- It motivates users, equips them with problem solving and information retrieval skills, and provides them with lifelong learning experiences.

5.4 DISADVANTAGES OF HAVING A CLINICAL DATABASE

- It is long term and time consuming process
- Financial expenses
- Continuous staff training are required for it
- Security problems

- It is more depended on electricity
- Costly maintenance
- Untrained users

5.5 LIMITATIONS OF THE PROJECT

Although conscious efforts have been made to ensure that the data was valid and findings are reliable, nevertheless there could be some errors. These include the use of a sample of one clinic (St Mary's) as a case study. The short coming among others in the design and the implementing of this project lies on the scarcity of resources in the form of financial constraints, time constraint and materials needed for the project work. They were not easy to come by. Furthermore this report does not claim comprehensives, therefore the areas have been suggested as areas for further research to fill whatever gaps this project has left.

- Computerizing a clinic: there is need for inclusion of Information and Communication Technology in medicine/nursing schools, classroom design and curriculum delivery.
- Complementing Information and Communication Technologies with traditional medicineship skills for effective service delivery.
- A survey of the availability of Information and Communication Technology in academic medicinal and clinical schools on a national level.

CHAPTER SIX

6.0 FUTURE ENHANCEMENTS

6.1 CONCLUSIONS

Clinical Database Management (CDM) has evolved in response to the ever-increasing demand from pharmaceutical companies to fast-track the drug development process and from the regulatory authorities to put the quality systems in place to ensure generation of high-quality data for accurate drug evaluation. To meet the expectations, there is a gradual shift from the paper-based to the electronic systems of data management. Developments on the technological front have positively impacted the CDM process and systems, thereby leading to encouraging results on speed and quality of data being generated. At the same time, CDM professionals should ensure the standards for improving data quality.

CDM, being a speciality in itself, should be evaluated by means of the systems and processes being implemented and the standards being followed. The biggest challenge from the regulatory perspective would be the standardization of data management process across organizations, and development of regulations to define the procedures to be followed and the data standards. From the industry perspective, the biggest hurdle would be the planning and implementation of data management systems in a changing operational environment where the rapid pace of technology development outdates the existing infrastructure. In spite of these, CDM is evolving to become a standard-based clinical research entity, by striking a balance between the expectations from and constraints in the existing systems, driven by technological developments and business demands.

6.2 RECOMMENDATIONS

Arising from the findings and conclusions following are some of the recommendations;

- More generous financial support should be made available to provide the basic database infrastructural facilities,
- Since database has come to stay, clinic staffs that are not computer literate should take positive steps to remedy their deficiencies so as to flow along with the reforms. By this, clinical will become ennobled through the acquisition of adequate computer knowledge/skill and its full application in Hospitals and Clinics or else they will become irrelevant in this era of databases.

- Effective and efficient power supply supplemented with standby generators should be provided to check the menace of frequent electricity power failure. In the same vein, the government should address the problem of erratic power supply more seriously not through military order but through research and development.
- The assistant of some donor agencies such as World Health Organization (WHO) must be actively enlisted
- Every division of the academic nursing and medicine should be automated in order to facilitate and create an avenue for effective services.
- Short computer training and retraining programs should be organized from time-to-time to assist nurses and officers who do not have knowledge and computer skills. This will also aid awareness of computer potentials and capabilities.
- Orientation programs on the use of computer for information retrieval should be conducted and made compulsory for new entrants into the profession.
- Imported ICT equipment's should be tax free.

6.2.1 Inter-Clinic Resource Sharing

Databases help to know the availability of a document in the clinic through its online catalogue or through the database. So, if more clinics become automated the search for available medicine became easier. The required medicine which is not present in one clinic can be located from other clinics controlled by inter-clinic resource sharing policies. The resources such as prescriptions, services and staff can be shared in a computerized environment more easily.

6.2.2 Network of Clinics

When the clinics of a cluster or region become automated by use of databases they can be networked using LAN or WAN.

6.2.3 Link with National or Regional Clinic Networks

National Clinic Networks and Regional networks can be linked. And any internet service provider can act as a technology and resource partner.

6.2.4 Web Interface

The activation of Web/online database will facilitate the search of clinic facilities on offer through Internet. The user can request and receive a prescription through online.

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