AN INFORMATION SYSTEM FOR ENHANCING MONITORING OF IMMUNIZATION SUPPLIES AT CLINIC LEVEL

CASE STUDY: ITOJO HOSPITAL IMMUNISATION CLINIC

NTUNGAMO DISTRICT

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Master's Dissertation

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DEDICATION

I dedicate this research paper to my beloved parents Canon. Dr. William Nyehangane and Mrs. Nyehangane Alison Olive for the love, care and encouragement they have showed me throughout my life especially during my school times.

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ABSTRACT

This thesis discusses the analysis and implementation of an information system for enhancing monitoring of immunisation supplies at Itojo Immunisation clinic. The system is meant to track the supply and use of all the items and vaccines used by the clinic and how they are used.

The study was done at Itojo Hospital, immunisation clinic located in Ntungamo district. The main objective of the study was to understand how immunisation clinics monitor the flow of vaccines and other materials used in the immunisation process, establishing that causes of poor performance and developing an information system to improve the performance monitoring of the clinic.

Design science paradigm was used together with qualitative research strategy and case study method to conduct the study. The data needed for the research was collected using self administered interviews, observation and document review methods.

An information system was analyzed and designed using DEMO, UML and its prototype developed using JavaScript and PHP. The prototype was implemented to address the limitations of the current system used at the clinic. The system provides different forms for data collection, a central database for storage of data and inbuilt scripts to aid data analysis and report generation.

With the use of the implemented prototype by the clinic, the monitoring of the immunisation supplies, tracking all the vaccines and items used in the clinic, has improved monitoring of the immunisation activities in the clinic. This greatly enhanced monitoring of immunisation suppliers and will in the long run improve on the performance of the clinic.

LIST OF ACRONYMS

CD-ROM	Compact Disk Read Only Memory
DBMS	Database Management System
DEMO	Dynamic Essential Modeling of Organizations
GUI	Graphical User Interface
HTML	Hypertext Markup Language
HTTP	Hyper Text Transfer Protocol
ICT	Information Communications Technology
IS	Information Systems
IT	Information Technology
MYSQL	My Standard Query Language
PHP	Hypertext Preprocessor
RAM	Random Access Memory
RDBMS	Relational Database Management System
UML	Unified Modeling Language
UMU	Uganda Martyrs University
WWW	World Wide Web
AIDS	Acquired Immune Deficiency Syndrome
CBIS	Computer-Based Information System
URL	Uniform Resource Locator
WHO	World Health Organization

HMIS	Health Management Information Systems
HEN	Health Evidence Network
GAVI	Global Alliance For Vaccines And Immunisation
HU	Health Units
UNEPI	Uganda National Expanded Program for Immunisation
HSD	Health Sub District
TT	Tetanus Toxiode
LATH	Liverpool Associates in Tropical Health
DSR	Design Science Research
PHC	Primary Health Care
SNMP	Simple Network Management Protocol

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 INTRODUCTION

Preventable childhood diseases such as measles, polio and premature deaths still occur particularly in the developing countries due to low immunization coverage (WHO, 2005). In a study to evaluate new tendencies and strategies in international immunization monitoring, Martin and Marshall (2004) suggest that "*failure to immunize the world's children with life saving vaccines results in more than 3 million premature deaths annually".* According to Mbarika (2004), immunisation is one of the most fundamental needs for Africa especially for the young generation. Various approaches have been applied to understand and improve immunization coverage problems, however, there are still acknowledged deficiencies in these approaches and this has given rise to research efforts for alternative solutions including the need to adopt new technologies to address some of these problems. One of the many solutions that has been adopted is the introduction and steady use of strong monitoring and evalaution systems in the health sector This chapter discusses indepth the background of the immunisation supplies monitoring system, the problem statement, objectives and scope of the research. The reseach's significancy and ethical considerations are also well defined in this chapter.

1.2 BACKGROUND

Globally in the health sector, the purpose of monitoring and evaluation is to know whether the intended results are being achieved as planned in the national health plan and whether public health interventions are making positive contributions towards improving people's health. Evaluation is an important part of an organization's planning as it provides an independent and in depth Assessment of what worked and what did not work and why this was the case.

In developing countries such as Uganda, Healthcare services are provided through a decentralized system consisting of geographically spread health centres, regional hospitals which are categorized into health districts and health subdistricts with various roles (Barenzi, *et al.,* 2000). This decentralisation has created the need for information and monitoring at every stage of service provision.

Performance and results based monitoring, stimulated by unprecedented increases in development assistance and decentralisation have increased pressure on the health sector organizations to improve their performance and monitoring of services and demonstrate tangible results to their stakeholders. (Cotts, D et al. 2009)

These demands can only be met if the organizations have collected relevant data they can use to analyze and come up with correct tangible results that can be used to evaluate their performance and service delivery.

Given this environment, a premium has been placed on the existence of adequate health information of clear objectives and good quality. Health information systems are therefore called upon to enable information tracking along the continuum of inputs to the health system, processes and outputs, as well as outcomes and impact. The information collected in the IS can be used as a baseline for monitoring the performance of the system.

Few developing countries have recently secured strong and effective health information systems to meet all these diverse information need to use in monitoring and evaluating their activities. (Ritchie, L. 2002)

Immunization program managers and service providers need a continuous flow of information that enables them monitor and evaluate the performance of their units. In the same way Policy

makers, political leaders, health planners, donors, providers of technical assistance, and members of the general public also need information for decision making and prioritizing funding used for immunisation.

There are methods, and tools the health sector is using for the collection, analysis, and dissemination of information on coverage, drop-outs, and quality of services. Many of the basic monitoring tools that could benefit health workers, their supervisors, and managers throughout the system are neglected because people don't know how to use them or they require a lot of time to fill them. This is true despite the fact that many have been available for years. The most important of these are maps, patient registers, vaccination cards, tickler files, tally sheets, and immunization monitoring charts,

1.3 PROBLEM STATEMENT

The task of monitoring and evaluating the vaccine supply chain is aimed at optimizing the available resources given at a specified interval intended to help the rightful persons in need.

However, with the current system which is mainly paper based and includes the use of vaccine control forms that are attached together and stored in files that are pilled in the file cabinets. This is predominant in most health centers, about 80% in practice (FRASER H, 2007). The forms are then retrieved from the cabinets when needed to monitor and evaluate the flow of vaccines received and used. For one to make any progress report, they have to go through all the various forms that were recorded- which are usually filled in carelessly. This makes it very tiresome and in some instances, generating inconsistent, unreliable and false reporting is inevitable. (WHO, 2008)

In addition the system is inefficient and prone to errors and the data collected is not granular enough to be useful for monitoring the performance of the clinic. Furthermore it is tedious to

extract useful information for decision making at any level of the vaccine supply and the struggle In to eradicate immunisable diseases amongst the mothers and infants, the Ugandan government and UNEPI have invested into a number of vaccines that are more expensive both to purchase and store. Thus, it is essential that an improved and efficient monitoring and evaluation system is put in place to reduce waste, stock outs, overstocking, and expired stock, and to improve on factual decision making and information flow between the National Medical Stores, the regional health facilities, and every level of the vaccine supply chain (Barenzi, J. 2000)

1.4 OBJECTIVES OF THE STUDY

1.4.1 Main Objective

The purpose of the study was to understand how immunization clinics monitor the flow of vaccines and related materials used in the immunization process, establishing the causes of poor performance and develop an information system to improve the performance monitoring of the clinic.

1.4.2 Specific Objectives

1. Study the current practices of how monitoring and reporting is being done at the immunization clinic and establish the causes of poor monitoring and late reporting of the clinic.
2. Determine the system requirements for developing an information system to enhance monitoring of immunization at clinic level
3. Design an information system that will enhance the monitoring and reporting of the clinic's performance and increase information flow within the clinic
4. Develop a prototype of the system
5. Test and evaluate the developed prototype of the system

1.5 RESEARCH QUESTIONS

1. How is the immunization clinic at Itojo Hospital currently monitoring its flow of immunisation supplies as a health facility?
2. Is the current system being used by the clinic in monitoring and reporting vaccines very effective?
3. What system design requirements are needed to develop a monitoring system to help improve the monitoring of the immunisation supplies in the clinic?
4. What tools and techniques can be used to collect data from the clinic and develop an information system that can improve the clinic's monitoring process?
5. How can the developed system be tested?

1.6 SCOPE OF THE STUDY

1.6.1 Geographical scope

The research study was carried out from Itojo District Referral Hospital, immunisation clinic. Itojo hospital is located in Ntungamo District on the Mbarara-Kabale highway, approximately 52 kilometers (32 mi), by road, southwest of Mbarara town. This location lies approximately 22 kilometers (14 mi), by road, northeast of Ntungamo district headquarters.

1.6.2 Functional scope

The research studied the current system used by the immunisation clinic to monitor its performance and analysed the findings of the research. A prototype of an Immunisation monitoring system was then developed to enhance performance monitoring of the clinic. The prototype covered the vaccine and material supply and usage chain (requested, received, used/unused and reporting) to and within the clinic. The main discussion of the study are

monitoring and reporting of the vaccines and other materials used in immunisation within the clinic.

1.6.3 Time scope

The study lasted approximately 12 months; from Oct 2011 to Sept 2012.

1.7 SIGNIFICANCE OF THE STUDY

Leaders, both within the national government as a whole, and within Ministries of Health and all health units, need to show strong support for an integrated HMIS, in order to overcome both external (donor) and internal (staff) resistance to data collection routines. They also need to espouse principles of transparency and the value of good information for good governance of a health system. (Cindy Carlson, 2005). With the development of this monitoring information system, this need could be achieved and data collection made easy and more transparent.

Related to issues of leadership, health workers and managers need to understand the need for and value of having good health information to help with planning and decision making. The developed system is an ideal solution for health workers to practically test the advantages of having factual information and using it for decision making.

One way to instill an appreciation for good health information is to involve people from all levels of the data chain in determining what data is needed and how it will be used. This is particularly critical for local health workers who may be skeptical about changes to what data is collected and how it is to be collected (WHO, 2005). The system analysis and design of this system involved all the health workers of the clinic and this helped them appreciate the process of correct data collection and the importance of good quality data.

The aim of any changes in the information systems for monitoring should be to try and reduce the amount of data collected at clinic level and should focus on how data can be better used at a local level. (Cindy Carlson, 2005). With the developed system, the data collected at clinic level is greatly reduced to collecting only the data needed for monitoring the performance of the clinic.

The research study created awareness of the automation of the vaccine monitoring and reporting process and helps act as an eye opener to the other clinics in the Hospital to automate their monitoring processes as well.

The research study provided a possible ground for further and future researchers to carry out progressive research on the topic and other related topics.

1.8 JUSTIFICATION FOR THE SYSTEM

The developed system once implemented will greatly reduce the misuse and embezzlement of immunisation supplies in the clinic, mortality rates due to counterfeit or expired vaccines or lack of vaccines at all , misuse of public funds and it will insure availability of supplies to the general public.

Some developing countries in Africa like Tanzania have implemented the same systems and this has greatly improved on their general public health of the respective populations and cut down the costs of acquiring unnecessary supplies to the health centres. According to the The United Republic Of Tanzania Drug Tracking Study Final Report in August 2007, Computerisation of health supplies would improve record keeping, improve accuracy and provide a good basis for demand prediction.

All proper monitoring of the immunisation supplies is based on correct and factual information. The immunisation clinic staff spends a lot of time trying to locate and access files and this makes the process of monitoring and reporting tiresome. The developed system helps collect all the monitoring information into one place that can easily be accessed for monitoring and reporting purposes.

The developed system will improve information dissemination and sharing to all relevant stakeholders of the clinic, this will improve on the decision making processes within the clinic.

The clinic would still incur costs of purchasing and printing data collection templates and file folders to store their records. They would also continue to use valuable office space to store those records. The developed system offers electronic data processing and management that would essentially do away with such costs.

1.9 CHALLENGES AND LIMITATION

The time frame allocated for this research was limited and this affected the results of the research since it was not done intensively because of the time limit

The research paradigm used during this research was a scientific design science method which may fail to address the social economic part of the problem being solved

The data collection methods used during the study were mainly document review which in most cases does not give the real factors about the problem

All the resources needed for the research were solely the researcher's responsibility which makes the research expensive to manage.

1.10 ETHICAL CONSIDERATIONS AND ISSUES IN THE STUDY

The research conducted had quite a number of ethical considerations because of its medical background. Some information needed for the study was not easily availed to the researcher because of the high level of confidentiality of the information.

Having this in mind, the research was carried out in a private environment, keeping all the given information privately and using methods that reduce on the research bias.

1.11 CONCLUSION

This chapter looked at the background of the problem, problem statement, objectives of the study, scope of the study, research questions, significance of the study, limitations of the study and this will result into findings of the study. In the next chapter, the researcher discusses the views of other people about the system.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter reviews the literature of previously researched works in relation to the problem addresses by this study. Topics covered in this chapter include information systems review, information systems and health programs especially with health facilities, monitoring of health facilities and why monitoring is important. It also analyses the past studies carried out on performance monitoring of health facilities and how the recommendations from the studies are addressed in this study.

2.2 INFORMATION SYSTEMS REVIEW

According to Nickerson (2001), an information system can be defined as a collection of components that work together to provide information to help in the operations and management of an organization.

According to Schultheis and Sumner (1995) information systems consist of components that interact to achieve the objective of providing information about day-to-day activities that managers can use to control business operations. Information systems can also be designed to provide information to enable managers to allocate resources and establish long-range business plans. An information system contains such elements as hardware, software, personnel, databases, and procedures to accomplish its objectives.

An information system, like any other system, receives inputs of data and instructions, processes the data according to these instructions, and produces outputs. O'Brien (1998) defines Information system as an organized combination of people, hardware, software, communications

networks, and data resources that collects, transformations, and disseminates information in an organization.

2.2.1 INFORMATION SYSTEMS AND HEALTH PROGRAMS

These are simply Computer applications in medical care. Biomedical informatics is an emerging discipline that has been defined as the study, invention, and implementation of structures and algorithms to improve communication, understanding and management of medical information. The end objective of biomedical informatics is the coalescing of data, knowledge, and the tools necessary to apply that data and knowledge in the decision-making process, at the time and place that a decision needs to be made. The focus on the structures and algorithms necessary to manipulate the information separates Biomedical Informatics from other medical disciplines where information content is the focus.

2.2.2 HEALTH MONITORIG INFORMATION SYSTEMS (HMIS)

Health monitoring information incorporates all the data needed by policy makers, clinicians and health service users to improve performance and protect population health. Few countries in the world today have effective and comprehensive systems in place to gather this data. Yet there has never been a greater need for robust health information. As the world community has turned its attention to meeting Millennium Development Goal targets, and ever increasing resources are going towards preventing immunisable diseases and treating high burden diseases such as HIV/ AIDS, tuberculosis and malaria, decision-makers need to be able to monitor and measure whether policies and programs are working, and whether progress is being made towards the goals that have been set. The World Health Organization (WHO) argues that investment in health monitoring information systems (HMIS) now could reap multiple benefits, including

Strengthening the evidence base for effective health policies, permitting monitoring and evaluation of scale-up efforts, and enabling innovation through research;

Improving monitoring, governance, mobilizing new resources and ensuring accountability in the way they are used.

Helping decision makers to detect and control emerging and endemic health problems, monitor progress towards health goals, and promote equity;

Empowering individuals and communities with timely and understandable health-related information, and drive improvements in quality of services;

2.3 INFORMATION SYSTEMS AND PERFORMANCE MONITORING

2.3.1 Performance Monitoring

Performance monitoring is the systematic collection and analysis of information as an organisation runs or project progresses. It is aimed at improving the efficiency and effectiveness of a project or organisation.(Alexander, 1996) Performance monitoring is based on targets set and activities planned during the planning phases of work. It helps to keep the work on track, and can let management know when things are going wrong. If done properly, it is an invaluable tool for good management, and it provides a useful base for evaluation.(Ritchie, 2002) It enables you to determine whether the resources you have available are sufficient and are being well used, whether the capacity you have is sufficient and appropriate, and whether you are doing what you planned to do; (Ritchie, 2002) empasizes that it is important to recognise that performance monitoring is not magic words that can be waved to make problems disappear, or to cure them, or to miraculously make changes without a lot of hard work being put in by the facility or

organisation. In performance monitoring itself, they is not a solution, but they is valuable tools. Monitoring can help identify problems and their causes;

Suggest possible solutions to problems;

Raise questions about assumptions and strategy;

Push to reflect on where you are going and how you are getting there;

Provide you with information and insight;

Encourage you to act on the information and insight;

Increase the likelihood that you will make a positive development difference.

2.3.2 Why performance monitoring is needed in immunization

According to Cotts, D *et a.l.* (2009), it is very important to know the strengths and weaknesses of the facility and provide sufficient information to the decision makers to take initiatives to improve the quality of the health facility and also it allows measuring the expected objectives and outputs. In other words performance monitoring ensures that activities are on the right path by checking them, measuring progress towards objectives, identifying problems as they come up, identifying strengths that can be built up. Monitoring gathers information about beneficiary access to, use of and satisfaction with the operation outputs.

2.3.3 What is needed for performance monitoring

Effective and efficient performance monitoring system is needed for monitoring and that system should have the following components: (FRASER H *et al, 2002*)

Baseline information

Selection of indicators related to activities, outputs and objectives

Tools for collecting information

Collection of information

Process information

Analysis of information

Presenting and communication of the results in an appropriate ways

Using information

2.3.4 Monitoring Information System

The fundamental principle of a monitoring system is to allow users to capture data, process and disseminate information in a systematic way (LAWSUITS, 2003). Monitoring system enables us to measure trends of various indicators based on the data collected in the field.

Monitoring Information System (MIS) is directly linked to management by objectives and to the monitoring of key performance indicators. It can also help in processing specific information for decision-making. Management Information Systems (MIS) can be used successfully to facilitate access to a wide range of integrated data sets. They are consistent, modular and flexible tools for the systematic acquisition, analysis and archiving of data and information from a variety of sources. When socio-economic data are also included, MIS can become even more powerful tools for planning and decision-making for health facility performance improvement and proper management. Quality control, standardization and regular updating are key issues to ensure the usefulness of MIS. (Ritchie, 2002)

2.3.5 Monitoring Information Systems Capabilities

The term 'information system' is a general term for a system that facilitates access to information; however, a ' monitoring information system' refers to integrated data sources and information systems, which meet the particular needs and requirements of planning and decision-making. (Satzinger et al, 2002) In an ideal case, the major objectives of MIS are to:

Reach an understanding of the relevant processes on the basis of the available historic information. This element forms the basis for the development of models, required for forecasting and simulation.

Provide information on the current situation, especially for early warning purposes, for instance related to issues impacting on perfomance, management and planning.

Forecast the consequences of policy decisions and measures before they are implemented in reality. This implies evaluating options for several given scenarios based on the possible results and predicted consequences, and selecting the most acceptable alternative.

2.3.6 Monitoring Information Systems Designing

When you design a monitoring system, you are taking a formative view point and establishing a system that will provide useful information on an ongoing basis so that you can improve what you do and how you do it (Alexander, 1996).

Below is a step-by-step process you could use in order to design a monitoring system for the organisation or project.

Step 1:

At a workshop with appropriate staff and/or volunteers, and run by you or a consultant:

Introduce the concepts of efficiency, effectiveness and impact of proper performance monitoring.

Explain that a monitoring system needs to cover all three.

Generate a list of indicators for each of the three aspects.

Clarify what variables need to be linked.

Clarify what information the project or organisation is already collecting.

Step 2:

Turn the input from the workshop into a brief for the questions your monitoring system must be able to answer. Depending on how complex your requirements are, and what your capacity is, you may decide to go for a computerised data base or a manual one. If you want to be able to link many variables across many cases, you may need to go the computer route. If you

have a few variables, you can probably do it manually. The important thing is to begin by knowing what variables you are interested in and to keep data on these variables. Linking and analysis can take place later.

From the workshop you will know what you want to monitor. You will have the indicators of fficiency, effectiveness and impact that have be prioritised. You will then choose the variables that will help you answer the questions you think are important.

Step 3: Decide how you will collect the information you need and where it will be kept (on computer, in manual files).

Step 4: Decide how often you will analyse the information – this means putting it together and trying to answer the questions you think are important.

Step 5: Collect, analyse, report.(Ritchie, L., 2002)

2.3.7 Enterprise Architectural Framework for monitoring information systems

Enterprise architecture is a conceptual blueprint that defines the structure and operation of an organization. The intent of enterprise architecture is to determine how an organization can most effectively achieve its current and future objectives. Enterprise architecture contains four points-of-view, called the business perspective, the application perspective, the information perspective, and the technology perspective. The business perspective in our case will define the processes and standards by which the business operates on a day-to-day basis in the immunisation clinic. The application perspective will define the interactions among the processes and standards used by the

immunisation clinic. The information perspective will define and classify the raw data (such as document files, databases, spreadsheets) that the clinic requires in order to efficiently monitor the flow of supplies. The technology perspective will define the hardware, operating systems, programming, and networking solutions used by the clinic.

Zachman (1993) argues that the Framework as it applies to Enterprises is simply a logical structure for classifying and organizing the descriptive representations of an Enterprise that are significant to the management of the Enterprise as well as to the development of the Enterprise's systems. It requires an understanding of how the business and organizational structures of the enterprise integrate with the IT structures of the enterprise.

This study looked at the following areas of the immunisation clinic to understand how the enterprise is setup.

The vision and mission of the clinic and the hospital in general

Current IT infrastructure in the Force

The existing information organs in the clinic

The transaction and business processes in supply process

2.4 MONITORING INFORMATION SYSTEMS RESEARCH AND DEVELOPMENT METHODOLOGIES

2.4.1 System Development Methodologies

Several techniques have been designed to analyze organizations and build information systems. Some of these include systems development life cycle, prototyping, joint application development and rapid application development. The researcher will use system development life cycle.

Systems Development Life Cycle

According to Satzinger, et al 2002, Systems Development Life Cycle (SDLC) is a conceptual model used in project management that describes the stages involved in an information system development project. The development of an information system normally requires three major sets of activities: analysis, design and implementation activities.

Analysis activities provide a thorough understanding of the business's information needs and requirements.

Design activities define the architecture and structure of the new system to satisfy the business's requirements.

Implementation is the actual construction, testing and installation of a functioning information system.

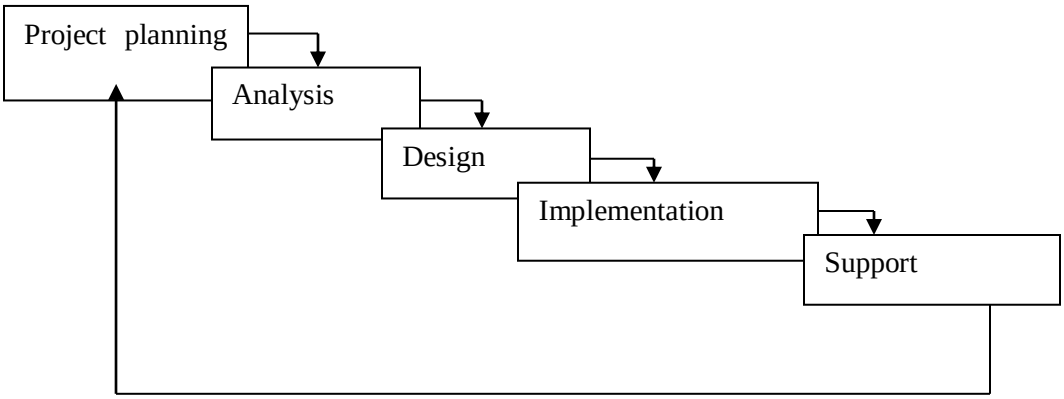


Figure 2.1 showing systems development life cycle

System Development Life cycle

- The planning phase. In this phase the analyst identifies the scope of the new system, ensures that the project is feasible, and develops a schedule, resource plan and budgets for the project.
- Analysis. The primary objective of this phase is to understand and document the business needs and the processing requirements of the new system.
- Design. The objective of this phase is to design the solution system. This phase uses the information obtained during the analysis phase as its input.
- Implementation. During this phase the final system is built, tested and installed. The objective of the activities of this phase is not only to have a reliable, well-working information system but also to ensure that the users are all trained and the organization is benefiting as expected from the use of the system.
- Support. The objective of this phase is to keep the system running productively during the years following the initial installation. This phase is normally not included as part of the SDLC since it begins only after the system has been installed and put into production.

2.4.2 System development tools

GIMP

GIMP is a very powerful tool that can be used for creating the banners and logo for system. This tool actually poses some advantages for example it's easy to use, easily available, and also it's affordable. For the reasons Gimp poses it was used in this project as well.

PHP

PHP is a server-side, cross-platform, HTML-embedded scripting language. Much of PHP's syntax is borrowed from C, Java and Perl with a couple of unique PHP-specific features thrown in. The goal of the language is to allow web developers to write dynamically generated pages quickly. PHP eliminates the need for numerous small programs by allowing one to place simple scripts directly in your HTML files. It also makes it easier to manage large web sites by placing all components of a web page in a single html file.

Some of the strengths of PHP include:

- Supports database connectivity. PHP can access over 20 different databases including MySql, Oracle, and MS Access.
- Supports sessions. PHP can generate unique session IDs. The ID follows the user during a single session on a web site. This simplifies creating shopping cart applications and tracking user's behaviors.
- Eliminates client configuration problems. With PHP there is no need to worry if the client has the appropriate software installed, since the application is executed on the server.
- Reduces development time. Even a newcomer can begin developing PHP applications in hours. Yet PHP contains many advanced features for professional programmers.
- Maintains source code security. The user does not see your source code as they do with JavaScript.

Some of the weaknesses of PHP include:

- Client side scripting. Since PHP is a server side language, the programs cannot be executed on the client. Thus the server might be slowed down while multiple PHP applications are executed.
- Error Handling. Error handling in PHP is still primitive. However you can code your way around most problems.

Text editors

A text editor is a type of program used for editing plain text files. Text editors are often provided with operating systems or software development packages, and can be used to change configuration files and programming language source code.

The most commonly used text editors include word pad, notepad++ and KATE

Notepad++

Notepad++ is a source code text editor with syntax highlighting (C, C++, Java, C#, HTML, PHP, JavaScript, ASP, SQL, Objective-C, etc), multiple document handling using tabs, auto-completion of keywords (customizable), regular expressions in the search and replace function, macro recording and playback, brace and indent highlighting, collapsing and expanding of sections of code (to zoom in and out of pieces of code such as to provide an outline overview of your text/code).

Kate

This text editor is commonly found with Linux operating systems it is easy to learn and use. It can be obtained at no cost since it is inbuilt in all the Linux operating systems.

Cascading style sheets

These are used to specify the look of web pages. This technology dates far back as the internet explorer 3.0.they are used to manage and control foreground and background images through positioning.

MySQL

MySQL is an open source relational database management system that offers excellent performance, portability and reliability, a moderate learning curve and a little or no cost (Ullman, 2003).

A relational database adds speed and flexibility, by sorting data in separate tables rather than putting all data in one area. MSQL is open source software and it is freely available. The MYSQL runs under various versions of UNIX, Windows and Mac

Advantages of mysql

- It is fast, reliable to use.
- It also has a very practical set of features developed in close cooperation with users.
- It is also open sources and therefore freely accessible.
- It is used to access database on the Internet due to its connectivity, speed and security.

Disadvantages of mysql

- Not many Graphical User Interfaces.
- Requires a high IT skill base to manipulate for end users.

Prototyping

According to Satzinger, et al 2002, a prototype is an initial, working model of a larger, more complex entity.

A prototype can be used for different purposes. It can either be a throwaway, design, discovery or an evolving prototype.

During analysis prototypes can be used to test feasibility and identify processing requirements.

2.4.3 Information gathering techniques/fact-finding techniques

Focus group discussions

A focus group discussion (FGD) is a group discussion of approximately 6 - 12 persons guided by a facilitator, during which group members talk freely and spontaneously about a given topic. Its main purpose is to obtain in-depth information on concepts, perceptions and ideas of the various people in a group.

A FGD aims to be more than a question-answer interaction. The idea is that group members discuss the topic among themselves, with guidance from the facilitator.

The benefit of Focus Group Discussion is;

- FGDs can be a powerful research tool which provides valuable spontaneous information in a short period of time and at relatively low cost.

However, the Focus Group Discussion has some weaknesses which include;

- In case of very sensitive topics, such as sexual behavior or coping with HIV/AIDS, FGDs may also have their limitations, as group members may hesitate to air their feelings and experiences freely.
- It can be risky to use FGDs as a single tool. In group discussions, people tend to centre their opinions on the most common ones, on 'social norms'.

Observation

Observation is way of gathering data by watching behavior, events, or noting physical characteristics in their natural setting. Observations can be overt (everyone knows they are being observed) or covert (no one knows they are being observed and the observer is concealed). The benefit of covert observation is that people are more likely to behave naturally if they do not know they are being observed. However, you will typically need to conduct overt observations because of ethical problems related to concealing your observation.

Advantages of observation

- Observation provides firsthand experience of the way the current system operates.
- Data are collected in real time and can have a high level of validity if care is taken in how the technique is used.
- Observation can be used to verify information from other sources or to look for exceptions to the standard procedure.
- Baseline data about the performance of the existing system and of users can be collected.

Document review

A technique of data collection involving the examination of existing records or documents

This involves investigating the data flowing through the system,

Collecting documents that show how information is organized.

Such information might include reports, forms, and organization

Charts or formal lists

Advantages of document review

- Can be used to gather quantitative data, such as average number of lines on an invoice.
- Can be used to find out about error rates in paper documents
- Provide supporting evidence for the information gathered from interviews or observation

Interviewing

According to Satzinger, et al 2002 interviewing is the most effective way to understand business functions and business rules. In this method, the researcher meets the individuals or group of users. A list of detailed questions is prepared and discussion continues until all the processing requirements are understood and documented by the project researcher.

This method has the following advantages that include:

- It is the most effective way for understanding business functions and business rules.
- Allows the interviewee to feel part of the project.
- Allows interviewer to adapt or re-word questions during interview.
- Interviews provide first hand information,
- It is easy to determine if a respondent is telling the truth or lying.
- Easy to interpret interviews response through the body language and the tone of their voice.

Questionnaires

Questionnaires are of great value to a research due to the following advantages that they poses and these include; they are less biased in the interpretation of their results, they are given to many people simultaneously, are not expensive to administer per respondent, open-ended questions are used as a preliminary investigation to help direct further fact-finding activities, closed-ended questions such that respondents provide direct response to the questions asked, is an economic

way to gather data from a large number of responds in a relatively short period of time, it is easy to analyze the results if the questionnaire is well designed.

2.4.4 Quality of the Monitoring Information Systems

An important issue for users is the reliability of the data used for generating information products: The quality of decisions depends on the quality of the underlying information (Myers, 2010). How then can the reliability of information obtained through information systems be judged where there is no control, no quality mark, and no verification of content? Often it is not clear what procedure the provider applied to generate the information provided from basic ('raw') data. In some cases, information may have a cultural, political or strategic bias, which is difficult to detect.

In some cases it is known that the source can be trusted, but in other cases, not enough is known and therefore the information must be used with great care. One way to better estimate the quality is to compare information from different sources, if available. A user's own knowledge and experience may in many cases be the only reliable tool.(Alexander, 1996)

Especially important for the providers of information, is the liability for mistakes in the information generated. Who is responsible for the quality of the information provided to the users? How far does this responsibility reach? What are the legal procedures when information proves to be wrong and damage has resulted from its usage? Can an information provider be sued for the damage done? What are the legal precedents in such cases? Should this issue be a part of the organisation’s data policy?

2.5 LITERATURE RELATED TO PERFORMANCE MONITORING AND DATA QAULITY IN HEALTH FACILITIES

2.5.1 WHO Regional Office for Europe's Health Evidence Network (HEN)

WHO Regional Office for Europe's Health Evidence Network (HEN) (August 2003) in the study to address how hospital performance can be measured and monitored carried out an intensive research using different research methodology. The difference in the methods used was to eliminate any baises associated with some research methods. The methods used in this research were Inspection, Surveys, Third party assessments, Statistical indicators and internal assessments The following were the findings of this study;

Data about structure, activities and effectiveness can be used to study the link between organization and performance, and to inform planning and system development.

Purchasers and provider managers need data on performance, costs and volume of activity in order to decide on the best use of resources.

Politicians and the public increasingly demand transparency, protection and accountability for performance.

Performance failures are more often a result of failures in systems and processes rather than of individual competence or knowledge.

Performance assessment requires reliable methods of measurement against validated standards.

The reliability of indicators is determined primarily by the accuracy, completeness and timeliness of performance-based data collected at institutional level.

Valid comparisons of performance between institutions demand rigorous standardization of assessment criteria and methods, especially if they are to be used between countries.

The finding of this study were directed to answer the question of how hospital performance can be measured and monitored and to some extent the finding answer the question. However the study identified some gaps that need to be bridged for the measure of performance to be standadised for factual data needed for decision

Some of the gaps that need to be addressed were;

The system should not rely on single sources of data but should combine a range of informants.

All approaches to performance measurement suffer from behavioral and technical problems, and a general lack of robust evidence to define their active ingredients.

The design of performance measurement systems should aim to manage and improve hospital performance, rather than to generate unreliable rankings and comparisons.

2.5.2 The LATH Consortium Global Alliance for Vaccines and Immunisation

The LATH Consortium Global Alliance for Vaccines and Immunisation (GAVI) carried out a research in October 2007 on how the country's system for recording and reporting immunization data can be improved. The research was designed to assist the countries receiving GAVI support to improve the quality of their information systems for immunisation data. In addition, it calculates a measure of the accuracy of reporting, the country's 'verification factor' for reported vaccinations given to children under one year of age.

The research was carried out using surveys on randomly sampled health centres (HU), document review, observation and questionnaires to collect data in four districts of Uganda namely Kabale, Masindi, Mukono and Jinja. The districts were ramdomly selected and Six HUs plus one "reserve" HU were selected randomly based on reported DPT3<1 for the audit year at District level. The "reserve" HU was to be visited only in the event that one of the first six was unreachable due to impassable roads.

The team were able to present their findings at a briefing meeting, held at the MoH on 1st October 2007 and chaired by the UNEPI Programme Manager. Major points of discussion concerned the following:

lack of information on completeness of reporting at national level even though the district reports contain this information (the measures availability but not completeness at national level), different paces of development of UNEPI and HMIS where UNEPI is constrained by the slower rate of development within HMIS partly due to the limited funds and resources of HMIS, financial implications of the audit, long term plans for the costs of stationary and allocation of a budget for these costs to the districts.

The HMIS system is generally well followed, however it is very much dependent on the availability of forms (for collection of primary data and reporting to the higher levels) and the 'databases' for recording information at the HU and district levels. When these forms are not available HU revert to previous reporting formats (UNEPI tally sheet) or no recording at all.

Various electronic computerised systems are being used in the districts to capture HMIS data including EPI INFO 2000, SPSS, Access, Lotus 123, etc. Problems will arise if data need to be

transferred electronically from the district level to the national level and neither have compatible software systems

Districts are still not receiving regular adequate feedback from the central level on their performance but are receiving on the timeliness and availability of reporting from HMIS.

An integrated reporting system (HMIS) exists for reporting immunisation data with other health data from the health unit up to national level. Guidelines which are incorporated into the district and HU 'databases' have been disseminated widely

The UNEPI vaccine control ledgers were found at all HUs visited and although nearly all units monitor batch numbers and expiry dates, less than half of the units were up-to-date in their inventories

The findings of the research were so informative and guiding in terms of the answering the research question set at at the start of the research and recommendations were made highlighting what more can be done to improve the reocrding and reporting of immunisation data in the country. Some of the reccomendations made include;

Data inconsistencies arise if the database is not updated systematically with late and updated reports. The districts and HU should devise means of regularly updating their data to avoid inconsistencies in the database

There needs to have written procedures and guidelines for data handling between the computers handling raw data including the identification of master files, consistent timing of different versions of generated reports and archived files as well as systematic back-up procedures

Reports are filed well with each district having its own file but the reports are incomplete. For the four districts audited, one or two of the monthly reports (hard copies) were missing even though the UNEPI database has data on all 12 months.

There should be a specific TT template in either the district or HU database

Some areas need to be strengthened e.g. recording and reporting from HSD, reporting of updates to the monthly report, reporting wastage, AEFI reporting, etc.

Health units should develop a means of monitoring vaccine commodities (AD syringes, safety boxes, etc).

2.5.3 Tropical Medicine and International Health (January 2009)

Tropical Medicine and International Health conducted a study on Accuracy and quality of immunization information systems in January 2009. The main objective of the study was to measure the accuracy and quality of immunization information systems in arange of low-income countries eligible to receive GAVI support.

The study was carried out using the WHO validated, standard methodology to compare data collected from health unit (HU) records of immunizations administered with reports of immunisations at central level and to collect quality indicators of the reporting system that can be tracked down to the HU.

The DQA is a diagnostic tool to reveal a number of crucial problems that affect the Quality of immunization data in all tiers of the health system. It identies good performance at HU and

district levels which can be used as examples of bestpractices. The DQA methodology brings data quality issues to the top of the agenda to improve the monitoring of immunization coverage.

Vaccine ledgers to manage vaccine stocks could be found in the majority of national immunization programs, in district, however, a smaller proportion were updated. Vaccine wastage calculations could be confirmed in almost one-third of national programs, district and HUs

Guidelines and training manuals on immunization, which include monitoring and data management ,are easily available in many districts (Mutabaruka *et al*. 2005)

Many determinants of performance at sub national and local levels have been described (Mays et al. 2006), including remuneration, working conditions and factors directly related to health workers performance (Rowe *et al*. 2005)

These findings from the study unveiled the state and quality of data in the immunsation systems and identified gaps that need to be bridged to have the best quality data from the systems that can be used for monitoring performances and decision making.

Sources of bias in the estimation of immunization coverage have been widely described elsewhere and include inconsistencies in the reporting systems

Vaccine wastage need to be calculated

There is need to take into account the practices and look in detail at the organizational environment needed to translate knowledge into effective routine practice.

All the above studies have tried to address the problems assocaited with immunisation monitoring in health facilities and how performance can be enhenced. Howerver there are gaps that still exist in the monitoring systems and this study is maining focusing on the gaps identified by these studies analysed above to address the problem of monitoring performance in the health sector.

This study addresses the problem of strengthening recording and reporting from the clinic, reporting of updates to the monthly report and reporting wastage as a gap in the HU identified by The LATH Consortium Global Alliance for Vaccines and Immunisation (Octomber 2007) in the study on how the country's system for recording and reporting immunization data can be improved

The study was aimed at designing of an information system to enhence monitoring which is aimed at managing and improving clinic performance, rather than to generate data only. This objective addresses the recommendetion made by WHO Regional Office for Europe’s Health Evidence Network (HEN) (August 2003) in the study to address how hospital performance can be measured and monitored.

2.6 CONCLUSION

This chapter discussed all the necessary related literature to information systems and how monitoring is essential in imrpoving performance of a clinic.

The next chapter explains the various development and research methodologies that were used to come up with the proposed system.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter discusses the proposed methodology that was used during data collection, analysis and presentation, and the tools and techniques employed right from systems analysis to deployment stage. This is presented in two parts; research methodology and development research. Aspects of research design, data collection, analysis and presentation are under research methodology, while development methodology, techniques and tools of analysis, design and implementation are discussed under development methodology.

This chapter also presents project management tools which were used to successfully manage and implement the project

3.2 PHILOSOPHICAL PARADIGM

This study was conducted using the design science research (DSR) approach. This approach was thought appropriate because of its important characteristic of the prescriptive nature of the research outcome and being motivated by solving problems at the end of the study.

In DSR the typical research product is the heuristic prescription, technological rule or solution concept. Although the research was driven by and take place around local problems, the applicability of the solution concepts will be non-local. This means that the solutions can be used to solve similar problems in similar contexts.

In addition to the important characteristic, the artefacts within DSR are perceived to be knowledge containing. This knowledge ranges from the design logic, construction methods and tool to assumptions about the context in which the artefact is intended to function (Gregor, 2002).

The creation and evaluation of artefacts thus forms an important part in the DSR process which was described by Hevner et al, (2004) and supported by March and Storey (2008) as revolving around "build and evaluate".

3.3 RESEARCH STRATEGY

The strategy used in this study was qualitative research strategy. This strategy was used mainly because the research paradigm used was design science and products from this are prescriptive models, methods, constructions and instantiations. These products need a qualitative strategy to analyze and develop and this dictated on the strategy to use for this study.

3.4 RESEARCH METHODS

Having selected design science as the paradigm and qualitative strategy for this research, the typical research method to use was the case-study. The case study serves a specific purpose within the overall scope of inquiry and therefore follows a replication logic (Yin, 2003). Through the case-study, one can accumulate supporting evidence which continue until “theoretical saturation” is obtained’ (Aken, 2004). The case study operated as a learning system and was analyzed until sufficient supporting evidence was obtained for development of the research model to solve the research problem.

3.5 DATA COLLECTION METHODS

During the research, the main data collection methods used were interviews, observation and document reviews. These methods were used interchangeably throughout the study.

Purposive sampling was used to select the legible participants for the interviews during the study. This sampling method was selected because with information channels and systems with health related issues, not all the persons in the immunization clinic have access to the information flows and systems and more so the knowledge about how performance monitoring is done.

3.5.1 Interview

According to (Kvale, 2009), interviewing is a careful questioning and listening approach with the purpose of obtaining thoroughly tested knowledge. Saunders et al (2007) identifies that qualitative methods such as interviews and similar methods are more suitable for examining highly subjective attitudes and behavioral researches which will enable the collection of a rich and detailed set of data. Face-to-face interview technique was preferred for collecting data from the hospital superintendent, clinic in-charge and the store manager because there was need to probe for a deep and wide understanding of the current system from the users' perspective in order to identify the requirements for the design of a new system

Interview guide

An interview guide helped in carrying out a focused interview to determine the responses of sampled persons exposed to the system being studied. An interview guide is a set of topics and/or questions about which the interview is conducted (Kakinda, 2000). It was preferred for its ability to un-cover information on the significant aspects of the total situation and its magnitude.

This study used structured questions for the reasons that the interviewer asks questions as written on the form and record answers as given; it reduces the bias; questions are ordered and the respondent is quickly engaged in the interview and maintained a focused discussion during the interview.

3.5.2 Observation

Observation was found an appropriate technique for collecting information on key activities and processes used in the clinic. Visits were made to the clinic to observe how information flows and are exchanged on normal working days. The observation guide was used to focus on areas relevant for the study

Observation guide

This was a list of general topic areas of the research problem that were intended to be observe in the process of investigation and this aided in identifying the problems that existed. It also provided first hand information about the procedures and events that occurred in the clinic.

3.5.3 Document review

Documents review was another method of data collection used in this study. Documents such as clinic profile, strategy plan, monthly and annual reports, supply and logistics reports were reviewed to deeply understand how monitoring is done at the clinic level.

3.6 DATA ANALYSIS

The data collected was analyzed using qualitative methods of analysis. The observation results were analyzed using judgmental analysis and narrative data was analyzed using the quantitative methods. The analysis of results is discussed in detail in chapter four under analysis of research findings.

3.7 DEVELOPMENT OF THE SYSTEM

3.7.1 Development methodology

The proposed system was developed following the systems development life cycle and the water fall model was used for designing and development.

The waterfall model is a sequential design process used in software development processes, in which progress is seen as flowing steadily downwards (like a waterfall) through the phases of Conception, Initiation, Analysis, Design, Construction, Testing, Production/Implementation and Maintenance. The model was selected because it is simple to implement and the amount of resources required for it are minimal. In addition the output in this model is generated after each

stage and is highly visible.

3.7.2 Techniques for system analysis and design of the system

This section discusses the proposed techniques for analyzing and designing of the system.

Planning

A project plan was developed to cover all the stages and activities involved during the study and development of the prototype. The project plan assisted in allocating activities that needed time to be covered. The activities inputs and deliverables are also easily brought out with a project plan.

In addition to the project plan, a ghatt chart was plotted to help with scheduling activities and allocating the duration each activity had take. The activities that can be carried out in parallel were also easily identified with a ghatt chart.

DEMO

The DEMO modeling technique was used for Requirement definition and analysis; DEMO was used because it provides the method components for the graphical representation of the transactional structure of organisations. DEMO was used to study the business processes and carry out processes reengineering to come up with the structure of the new system.

System analysis

System analysis and design was done using Unified Modeling Language (UML). UML is a standardized general-purpose modeling language in the field of object-oriented software engineering. UML offers a standard way to visualize a system's architectural blueprints, including elements such as: activities, actors, business processes, database schemas, (logical) components, programming language statements and reusable software components. The technique was used because it uses object oriented design concepts and it is independent of specific programming

language. It represents the system with structural and behavioral language models and those designing models include the architectural and mechanical designs.

Development and programming

PHP/HTML and java scripting were used for designing and developing the user interface and server side scripting. The languages were selected mainly because they are used with a large number of relational database management systems, runs on all of the most popular web servers and are available for many different operating systems. Most of the langueges are fully object oriented and are platform independent.

MySQL database management system was used for designing and developing the database. This technology suite delivers a complete, stable environment for building and deploying database-driven applications for the Internet. In addition, it runs for Linux, Unix, and Windows and allows for development and deployment on any choice of platforms. MySQL is flexible and its multiple-platform environment brings unity and scalability to development of Web applications.

3.7.2 Techniques for unit and system testing

Unit and integration testing was used for testing the application. Unit testing is a software development process in which the smallest testable parts of an application, called units, are individually and independently scrutinized for proper operation. Unit testing is often automated but in this case it was done manually.

Deployment; pilot deployment approach was used for the deployment plan.

3.7.3 Tools for design and development

This section presents the tools that were used to develop the proposed system. The tools discussed are mainly software tools since the system is an information system

CASE (Computer-aided Software Engineering)

These are automated software tools used to develop information systems. These were used because they improve the quality of the systems developed and they ease the development of complex systems since they have pre coded scripts and utilize the concept of code reuse. There are many types of CASE Tools but a few were used for this specific research.

Diagramming Tools

These tools enable the representation of a system and components visually. They are effective for representing process flows and data structures. The diagramming tools were used to make diagrams like Data Flow Diagrams, Entity Relationship Diagrams, conceptual diagram and many other diagrams.

Form and Report Generator Tools

These tools supported the creation of system forms that are used to capture data in the system. These tools were used because they produce professional forms in few minutes and have an option of customizing each form produced.

3.8 PROJECT MANAGEMENT

3.8.1 Techniques for managing the project

Project plan showing the activities and deliverables of every activity and time required for each activity to be completed in the allocated time.

Project plan

Research Activity	**Input**	**Deliverable from the activity**	**Planed Duration (In months)**
Research Planning	None	Project Plan	2 months
Data collection, Analysis	Questionnaires, interview guides, analysis	Field report presenting field findings and their analysis	1 months
Requirements Definition/ Analysis	Project Plan Requirements Specification	Draft Requirements Specification report Draft Design Specification report Requirements Specification (final Report)	2 month
Design (Functional & System)	Requirements Specification (final) Draft Design Specification report	Program and Database Specifications Design Specification (final Report)	1 months
Development/ Programming	Program and Database Specifications Design Specification (final Report)	Software (front-end and backend) System Test Plan User's Guide Operating Documentation	1 months

Integration & Testing	User's Guide System Test Plan Operating Documentation	Test Reports Training Plan (final Report) Acceptance Checklist User's Guide (final Report) Maintenance Plan Acceptance Test Report	I months
System maintenance	Design Specification report Operating Documentation Maintenance Plan	Maintenance report	System's life time

Table 3.1: Project plan

3.9 CONCLUSION

This chapter presents the different techniques and tools that were used in data collection, analysis and presentation and a detailed development methodology of the proposed performance monitoring system. It further explains why different tools and techniques were preferred to others and ends with tools that the researcher used to manage the project to end in the time frame.

CHAPTER FOUR

PRESENTATION OF FINDING AND SYSTEM ANALYSIS

4.1 INTRODUCTION

In this chapter, a close assessment of the current monitoring system used by the immunisation clinic was conducted. The requirements of the proposed information system, its target users, processes and data modeling, business benefits and the costs of the proposed system are also discussed in this chapter.

According to Hoffer et al (1999), in the analysis phase, a model of the real-world application is developed showing its important properties. It abstracts concepts from the application domain and describes what the intended system must do, rather than how it will be done. The model specifies the functional behavior of the system, independent of concerns related to the environment in which it will be finally implemented.

4.2 DESCRIPTION OF THE CURRENT SYSTEM.

This section discusses the current system being used for monitoring and reporting at the immunization clinic. It discusses the program's vision and mission, organization structure and system being used for monitoring and reporting.

4.2.1 The Vision of the Immunization program.

The clinic has a vision to Increase the percentage of fully immunized children under 5 years of age to 80% by 2015

4.2.2 Mission Statement

By 2015, the whole country to have achieved 90% coverage for fully immunized children nationally and at least 80% coverage in every district. This mission was set by UNEPI and is adopted by the immunization clinic at Itojo hospital.

4.2.3 Broad objective

The broad objective of the clinic is to make immunization complementary to other Primary Health Care (PHC) services in order to reduce morbidity, mortality and disability from the vaccine preventable diseases of childhood

4.2.4 Objectives

- Provide immunization against the 8 targeted diseases and tetanus toxiode for pregnant women or women of children bearing age.
- Promote immunization programs, including vaccine production and quality control.
- Intensify implementation of the immunization activities and sustainability within the framework of the maternal and child health services

4.2.5 Strategies:

- Immunization should function through the integrated health service system.
- Immunization is a continuous program that should continue indefinitely once started.
- Immunization should be economically possible, socially acceptable, operationally feasible and professionally rewarding.
- Immunization should have legislation; however persuasion and education should be the first choice.
- Surveillance, recording, monitoring and reporting system should be an integral part of the program.

4.2.6 Organizational structure

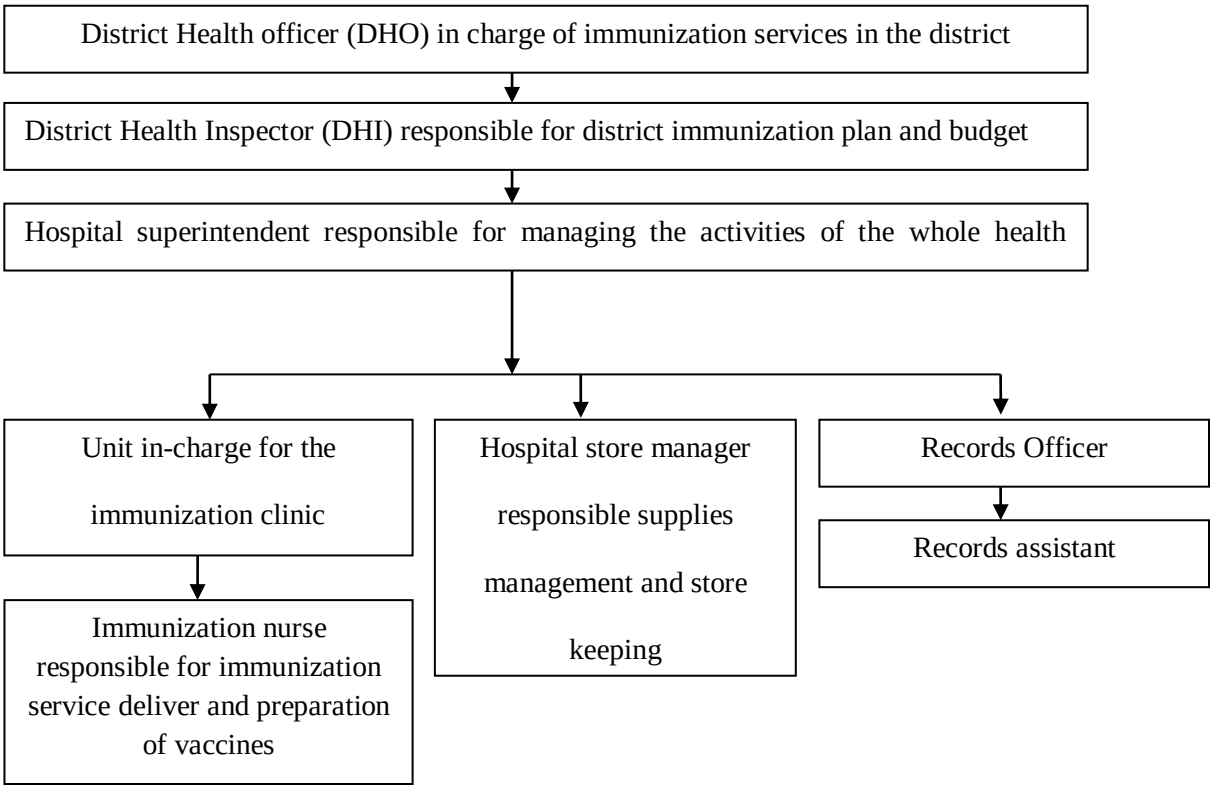


Figure 4.1: organizational structure of Itojo hospital immunisation clinic

4.3 CURRENT MONITORING SYSTEM AT THE CLINIC

Currently the immunization clinic is using vaccine control books, supply sheets and tally sheets to collect and store monitoring records collected within the immunization clinic, monitor the usage, inflow and outflow of vaccines.

The clinic also uses supply request form, immunization monitoring register and performance monitoring reports to monitor the flow of vaccines and the performance of the clinic.

The supply of the vaccines to the clinic directly depends on the requests made. The immunization clinic in charge makes a request for the vaccines and equipment needed to the hospital main store and if the vaccines requested are available, delivery is made to the clinic. In instances where the

vaccines not available, the request is forwarded to the district health office which then forwards it to the procurement and supply office which either procures the requested vaccines or forwards the request to the national medical stores.

The supply of the vaccines takes the same course as the requests. All the supplies made are recorded in the vaccine supply form and then stored in the hospital main store. For all supplies made to the immunization clinic, the records are taken and stored in the control book.

At the immunization clinic, for every round of immunization, the vaccines and equipment taken from the store are recorded in the vaccine control book. These usually include powder, diluents, droppers and syringes. The whole process of monitoring the vaccine flow during a round of immunization is done using tally sheets that are used to capture the use of the vaccine and the number of people vaccinated during a given session.

An immunization register is used along with the tally sheet to keep track of the number of clients immunized per session and the amount of vaccines used during the session. There are vaccines that are pre mixed and some are packed separate. The separate vaccines need to be diluted before they are administered and the diluents are also recorded and monitored as part of the vaccines. The syringes and droppers needed for the sessions are recorded in the control book and the surplus if any are tallied backwards on the tally sheet at the end of the session.

4.3.1 The Vaccine control book

This is a single log book that is used to control the flow of vaccines in the clinic. It is used to record the vaccines, Diluents, syringes, droppers received by the clinic.

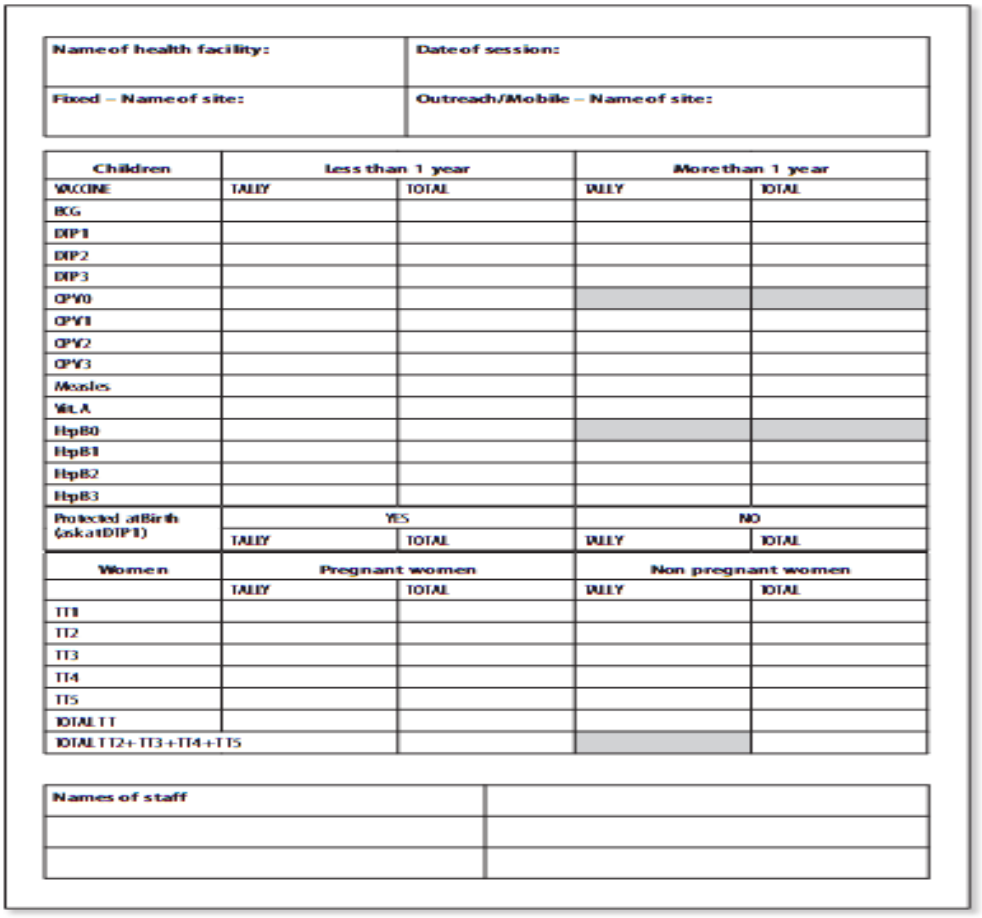
The control book is also used to record the outflow of the vaccines and all the other equipment needed for immunization. This is done when the vaccines are used for community out reaches, outbreaks immunizations and any other necessary movement of the vaccines

The staff responsible for the immunization session estimates the vaccines they will need and all the other equipment needed and all that is supplied is recorded into the control book. At the end of the immunization session, the balances of the vaccines are recorded in the control book too.

4.3.2 Tally sheets

Tally sheets are used to record and report the number of vaccinations performed by dose. For each round of immunization both clinic and outreach immunization, a tally sheet is used to record the doses taken out of the store or refrigerator, the actual doses used and what was returned. The vaccines that are used for more than one round are recorded and at the end of one round, dozes left to be used next round are also recorded.

Tally sheets are also used to record the number of clients immunized each round and the type of vaccines used. This helps the immunization staff in estimating the average of vaccines to prepare for a similar session the next round of immunization.



Name of health facility:	Date of session:
Fixed – Name of site:	Outreach/Mobile – Name of site:

Children	Less than 1 year		More than 1 year	
VACCINE	TALLY	TOTAL	TALLY	TOTAL
BCG				
DPT1				
DPT2				
DPT3				
OPV0				
OPV1				
OPV2				
OPV3				
Measles				
VitA				
HepB0				
HepB1				
HepB2				
HepB3				
Protected at Birth (ask at DPT1)	YES		NO	
	TALLY	TOTAL	TALLY	TOTAL

Women	Pregnant women		Non pregnant women	
	TALLY	TOTAL	TALLY	TOTAL
TT1				
TT2				
TT3				
TT4				
TT5				
TOTAL TT				
TOTAL TT2+TT3+TT4+TT5				

Names of staff	

Figure 4.2: sample of a tally sheet used to collect data in the immunisation clinic

4.3.3 Ordering for vaccines

At the beginning of every month the in charge for immunization clinic reviews the available stock of vaccines and materials, complete two copies of the request form and submits one of them to the store manager to request supplies needed for the next month. The form remaining at the clinic is used to track the request and amount actually received. The Hospital store manager uses the same form for reordering vaccines and materials from the district health office.

Form I-7

Vaccine and Supply Request Form

Governorate ..... District ..... Health facility .....

Date: For period: .....(month) .....(year)

NO.	Item	Average no. of doses used per month in the previous 3 months	Current balance in doses	Expiry Date	Amount requested	Amount actually received	Notes
		[A]	[B]		[C]=(1.5 x A) - B		
	BCG						
	Pentavalent						
	OPV						
	Measles						
	Vit A (100,000 IU)						
	Vit A (200,000 IU)						
	TT						
	AD syringes						
	BCG syringes						
	Mixing syringes						
	Safety boxes						

Keep one copy of the request form at the facility

Figure 4.3: sample vaccine and supply request form

4.3.4 Vaccine and supply monitoring register

The vaccine and supply monitoring register (Form D-5) is designed to continuously track the supply, distribution, and remaining stock of vaccines, syringes, and safety boxes. Each material (including each type of vaccine) has its own page (or multiple pages) in the register.

Vaccine flow is registered in the monitoring register by recording when a vaccine is received, distributed, used or written off/destroyed. When registering vaccine flow, the nurse has to indicate the mount of vaccine in doses in all columns. On each new page of the monitoring register, the name of the item i.e. vaccine, syringe, or safety box – is written in the second row next to the item. The lot number and expiration date are entered in the table as appropriate to the type of item. In addition to regularly recording the receipt, issue, and usage of the vaccines, syringes, and safety boxes, the clinic in charge calculates the balance of remaining vaccines, syringes, and safety boxes in order to be aware at all times (not only at the end of a month) of the type and quantity of vaccines that are in stock. The in charge is responsible not only for tabulating the

quantity of vaccines but also for their proper storage and for ensuring that vaccines with the shortest shelf life are issued first.

At the end of every month the in charge makes an inventory of the vaccines left in the refrigerator (cold room) and checks whether the amount corresponds to the balance of vaccines in the monitoring register (Form D-5). Vaccines that have an expired date, are of bad quality, or are left over must be destroyed/written off according to the existing regulations.

The immunization clinic receives, along with new vaccine lots, instructions on the use of those vaccines. The clinic keeps these instructions for every type of vaccine. The "Use of vaccines" section of the Summary Report on Immunization Performance is completed using data from this register and from the Monthly Immunization Reports submitted by the clinic.

Vaccine And Supply Monitoring Register

Form D-5

Item: ..... Unit: .....

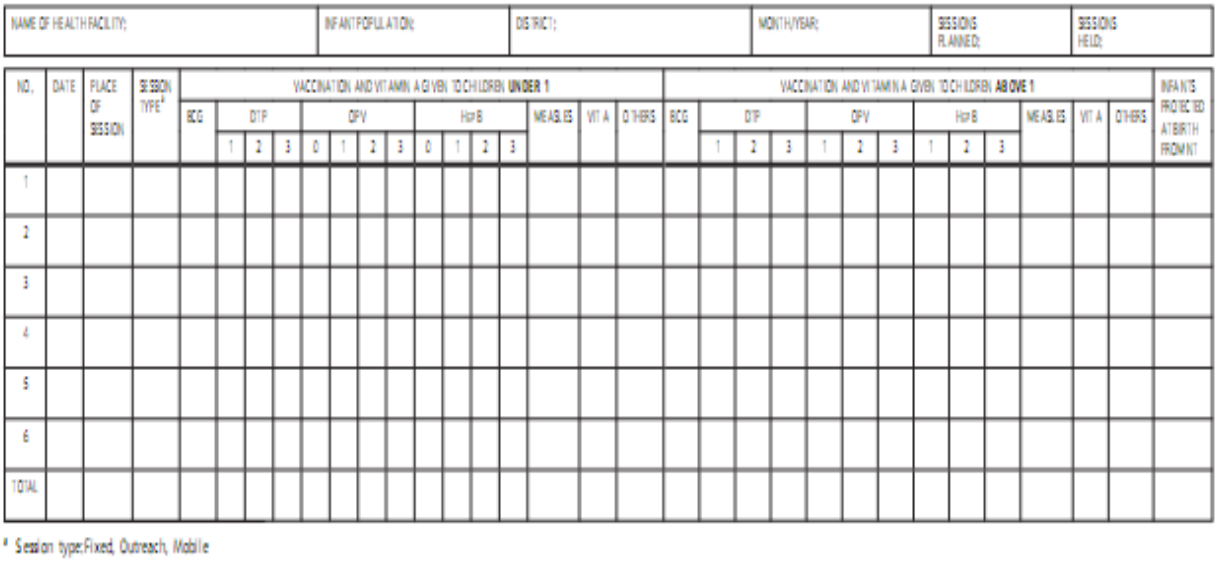
DATE	Permission no.	RECEIVED				GIVEN OUT				DESTROYED / WRITTEN OFF	BALANCE
		From	Amount (in doses)	Lot #	Exp. date	To	Amount (in doses)	Lot #	Exp. date	(in doses)	(in doses)

Figure 4.4: sample of a vaccine and supply monitoring register

The section on vaccine use in the register reflects the flow of vaccine and materials at the clinic during the reporting month. The balances of vaccines/materials at the beginning of the month are supposed to equal to the balance of respective vaccines/materials at the end of the previous

month. The number of doses remaining in an open vial is estimated based on visual inspection of the vial. The clinic staff finds it convenient to record the information on the number of doses of vaccines received immediately upon the receipt of vaccines/materials. The information about the balance of vaccines/materials at the end of the month is accurate only if the data are recorded promptly after the end of the month. Clinic staff are also required to complete the sections of the report related to obstacles to vaccination during the report month, such as unavailability (even for a single immunization session) of a vaccine or immunization related material, absence of vaccinators, cold chain problems, a large number of refusals, etc.

Reports are prepared in duplicate immediately at the end of the month. One copy is received by the hospital superintendent not later than on the 7th day of the following month. The other copy is retained at the clinic. At the time of report submission, the store manager completes the data accuracy verification checklist at the bottom of the form. Clinic staff are encouraged to review the checklist themselves to ensure the reports they are submitting are as accurate as possible.



NAME OF HEALTH FACILITY:		INFANT POPULATION:		DISTRICT:		MONTH/YEAR:		SESSIONS PLANNED:		SESSIONS HELD:	

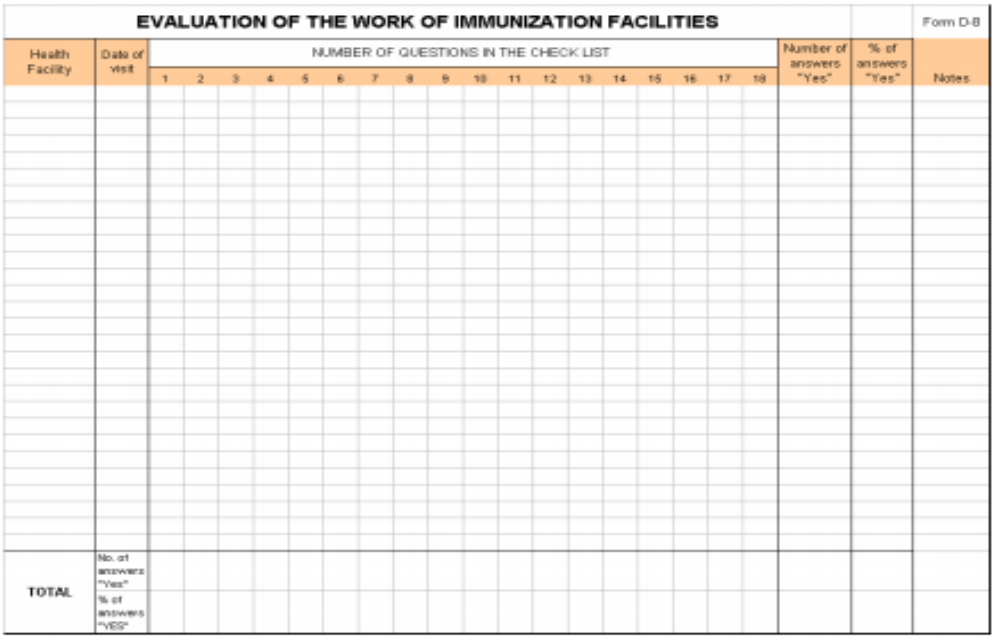
NO.	DATE	PLACE OF SESSION	SESSION TYPE*	VACCINATION AND VITAMIN A GIVEN TO CHILDREN UNDER 1														VACCINATION AND VITAMIN A GIVEN TO CHILDREN ABOVE 1												INFANTS PHOTOED AT BIRTH FROM NT
				BCG	DTP			OPV				Hep B				MEASLES	VIT A	OTHERS	BCG	DTP			OPV			Hep B			MEASLES	VIT A	OTHERS	
					1	2	3	0	1	2	3	0	1	2	3					1	2	3	1	2	3	1	2	3				
1																															
2																															
3																															
4																															
5																															
6																															
TOTAL																															

* Session type: Fixed, Outreach, Mobile

Figure 4.5 showing a sample of a performance report template

4.3.5 Evaluating Work at Immunization Points

The Immunization clinic Performance Checklist (Form D-7) contains simple questions that district health inspector uses to monitor and supervise vaccination points or that clinic staff use to self-monitor their work. The checklist allows for clear and objective evaluations. Periodic monitoring helps the clinic staff and in charges to identify problem areas and plan appropriate interventions to solve the problems. The person doing the monitoring is supposed to carefully consider each question in the checklist and respond as to whether the condition has been met or not. Where the condition has been met ("Yes"), no further clarification is needed. If a condition has not been met or has been only partially fulfilled ("No"), one indicates exactly what is wrong and recommends how to correct the problem. Depending on the difficulty of meeting certain conditions, one decides whether advisory assistance from district is needed and when the next evaluation will take place.



EVALUATION OF THE WORK OF IMMUNIZATION FACILITIES

Form D-8

Health Facility	Date of visit	NUMBER OF QUESTIONS IN THE CHECK LIST																Number of answers "Yes"	% of answers "Yes"	Notes
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
TOTAL	No. of answers "Yes" % of answers "YES"																			

Figure 4.6: An evaluation report template used in the immunisation clinic

4.3.6 Summary reports on immunization performance

The Summary Report on Immunization Performance (D-1) is completed monthly using data from the monthly reports submitted by immunization clinics. Data on vaccines and materials given at each round of immunization must be presented as those given to the inspector from the district to enable accurate calculation of coverage for the district.

At the time of report submission, hospital superintendent performs a basic verification of clinic reports data accuracy to verify that;

Targets look realistic

Number of doses of vaccine used (plus wasted plus destroyed) is higher than the number of immunizations given for ALL vaccines

Totals are computed correctly; Obstacles to vaccination are indicated if there are any;

Stock-outs of vaccines and materials are indicated if there are any; and Blank spaces in the report (if there are any) are explainable.

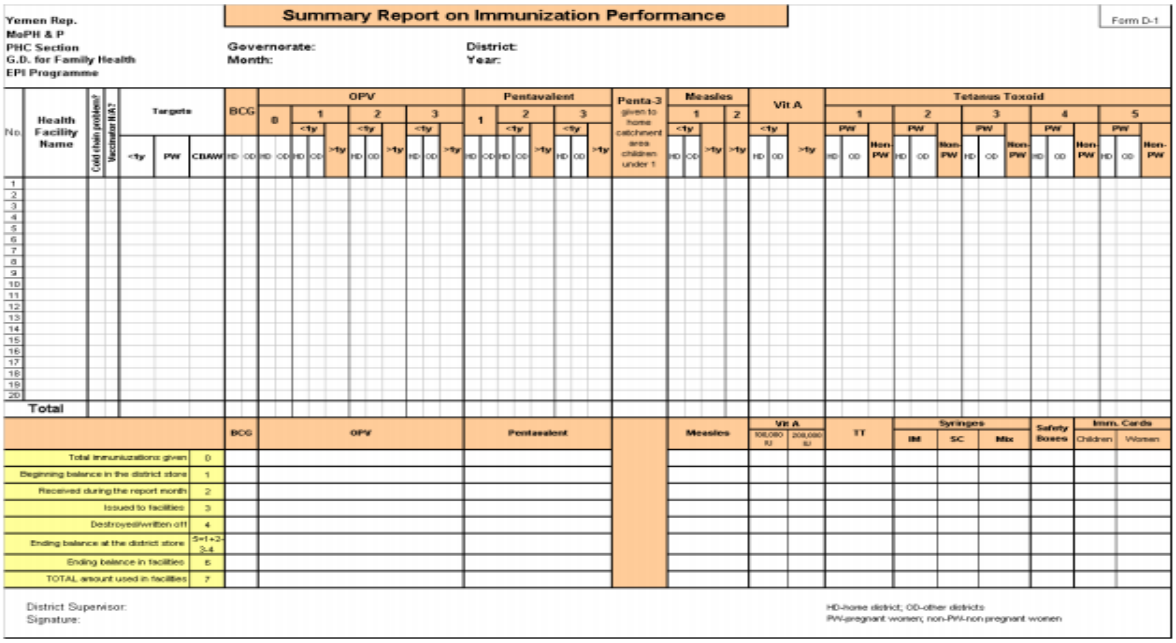


Figure 4.7: Template of immunisation performance

4.4 ANALYSIS OF THE CURRENT MONITORING SYSTEM USED BY THE IMMUNIZATION CLINIC

This section discusses the strengths and weaknesses of the current system, the description and requirements of the proposed system, target users and data modeling for the proposed system

4.4.1 Strengths of this system

The current system of vaccine usage and performance monitoring is done using control books, tally sheets, registers and reports forms. This is the only system that has been in use for monitoring since the establishment of the immunization clinic to date.

Data collection tools are available. The vaccines control book, tally sheets and supply and monitoring registers are all available at the clinic and are used for collecting data that is used for monitoring the flow of vaccines in the clinic and the clinic's performance.

Data needed for assessing the performance of the clinic is collected at all stages and activities of the clinic. The clinic staff collects all the information needed for performance monitoring on a daily basis

At the end of each reporting form, analysis of the data filled into the form is done. For example at the end of each monthly immunization performance form, simple analysis of the amount of vaccine used, what was wastage and what is in stock is computed. This gives a tentative quick result on the performance of the clinic

The current monitoring and reporting systems at the clinic is well established. The reporting tools are available and reporting channels are well established. The immunization nurses report to the clinic in charge who then reports to the hospital in charge for performance reporting. For vaccine flow reporting, the nurses report to the clinic in charge who then reports to the store manager.

Performance charts are available. The performance charts are used to monitor the performance of the clinic. These charts are filled in, showing trends of performance mainly in a curve format and they are displayed on the notice boards of the clinic. This helps all the staff of the clinic monitor their performance and in cases of low performance every one of them notices the trend of the curve and works to improve their performance.

Policies for proper monitoring are in place. The ministries of health Uganda, UNEPI and other bodies responsible for monitoring health services in Uganda have established policies that govern the monitoring of the immunization clinic. Example of the guiding principles and policies are *Guidelines for Safe Immunization Practices and Monitoring Immunization Programs at the Facility and District Levels in Uganda, Monitoring Your Performance Using Your Own Data* and *Monitoring The Building Blocks Of Health Systems.*

Supervisions are carried out and at well defined intervals. The clinic is daily supervised by the in charge, weekly by the hospital superintendent and monthly by the health inspector from the district. This keeps the clinic performance lively flowing and the main objective of provision of the immunization services achieved.

4.4.2 Weaknesses of the current system

These are the shortcomings of the current file system of information management that is currently used by the immunization clinic.

Vaccine control books, tally sheets and Registers are found in the clinic but were not always filled in properly i.e. the data was filled in with the correct and this always reproduced consistently in the collected data, which leads to problems in recording of the vaccine flow in the

Storage and filing of tally sheets continues to be a major problem in spite of a circular from UNEPI on the subject. Complete individual records of tally sheets are rarely found in the clinic and yet Without all the tally sheets it is impossible to verify reported figures

Only a few of the performance charts are displayed to monitor the progress of the clinic and in many of the cases the charts are maintained in the records room and not used by the staff carrying out the services. This is important to build a culture of performance monitoring into the clinic staff's activities.

The performance reports prepared by the clinic are not submitted to the unit in charge on time and the missing data in the report forms make the assessment of the clinic's performance impossible. In some un usual cases the clinic does not submit its monthly report for analysis.

Feedback is extremely weak and a culture of sharing information is lacking amongst the hospital staff, only one written feedback from the unit in charge on level of performance of the clinic was received in the last four months. No feedback that includes some analysis or discussion of data was received in the same period

Although the district staff is actively involved in carrying out supervisory visits, supervision related to immunization activities continues to be weak. The clinic has received supervisors from district only once within the last four months where written comments were made. Although visits may have been made to other clinics in the hospital, written records of the performance monitoring visit in the clinic could not be found.

some members of staff claimed not to be aware of the existence forms especially the reporting forms and this hinders accurate reporting and assessment of the clinic's performance at the end of the month

Although the UNEPI vaccine control are available at the clinic to monitor batch numbers and expiry dates, nearly less than half of the data needed were up-to-date in their inventories. Without up-to-date and complete vaccine control books, it is not possible to calculate usage and wastage of the vaccines.

The availability and use of tally sheets is a problem. Tally sheets for outreach sessions were missing in many rounds of immunization. Some of the staff had resorted to other means of recording the information, i.e. on the reverse of the child health cards or directly into the register. In some cases this information was not captured at all.

The immunization staff are instructed to use one tally sheet per immunization session, however for smaller sessions and outreach, this instruction results in a high wastage of the tally sheets.

There is a lot of work involved when generating reports. The clinic in charge and the store manager have to visit each page in the registers and the control book to produce accurate monthly and annual reports.

Information stored by this system can easily get lost. Paper files, sheets and other materials of that kind can easily be spoilt by water, fire and mishandling and all this leads to loss of information.

There is wastage of space. The clinic has a room for storing all the files and this space could be used for something different.

4.5 DESCRIPTION OF THE IMMUNISATION MONITORING SYSTEM

4.5.1 Description of the new monitoring system for the immunization clinic

The proposed system is designed to perform to the expectations of the hospital in charge, store manager, the records officer and the immunization clinic staff.

The application will be able to record information about the request, supply, reception and monitoring of usage and storage of the vaccines and materials used during immunization session. The data captured creates an information base that is to be used for monitoring performance of the clinic. For monitoring to be effective, there must be factual information which is analyzed to come out with fact based results to be used for monitoring and decision making.

The main ability of the proposed system is to facilitate and ease the monitoring and reporting of the activities of the immunization clinic. The system is able to capture the information needed for the monitoring and it automatically generates monitoring reports. In addition, it is user friendly because graphical user interfaces used to help the users navigate through the whole application.

The users of the system are requested to register before they start using the system and then log onto the system using their registered usernames and passwords.

The hospital superintendent logs into the system to generate and view reports about the performance of the clinic. He/she can edit the format of the report but is not be able to edit the content of the report.

The store manager logs into the system to feed in information about the vaccines dispensed to the clinic, to view requests by the clinic and view and generate reports about the flow of vaccines in the immunization clinic.

The clinic in charge logs into the system to feed in information about the vaccines/materials available and not, the vaccines requested for and supplied, vaccines used/unused, wasted or disposed off at the clinic. He/she can also be able to view or edit reports about the flow of vaccines and performance of the clinic.

The immunization nurses log into the system to feed in information about the vaccines requested for, used, not used, wasted and why. They will also capture information about the number of client's immunization and give comments about the immunization sessions carried out.

The hospital records officer and/or records assistant is responsible for maintaining the system and debugs any bugs from the system. They are also responsible for backing up the information from the system database on a daily or weekly basis.

4.6 REQUIREMENTS FOR THE PROPOSED INFORMATION SYSTEM

The requirements of the proposed system are divided into sections, the functional requirements, non function requirements, technical requirements and organizational requirements. These are

what the system needs or should have in order to achieve the objectives for which it was developed.

4.6.1 The function requirement of the system

Functional requirements are tasks or responsibilities the system is expected to fulfill. These are the main objectives for which the system was developed. The functional requirement of the proposed system are;

The system should allow registered users to log into the system and perform their specified tasks in line with the type of user they are.

The system should be able to store all the captured data from the time when the vaccines/materials were requested to when it's used or disposed off by the immunization clinic.

The system should allow the authorized users to display and retrieve the information that was previously captured about the vaccines flow and performance of the clinic.

The system should enable specific users (clinic in charge) to edit the information contained within the database if need arises.

The system should be able to generate reports based on the captured and stored information for monitoring, evaluation and reporting for example the number of new vaccines received and used by the immunization clinic.

The system should enable the users to search for specific information from the database.

The system should enable specific users to delete a record in case an error has been made during entry of editing the record.

The system should enable specific users to analyzed the information in the database and generate summary reports about the clinic's performance.

4.6.2 Non-functional requirements

The non functional requirements are the semantic qualities that define the system properties. These are additional properties that aid the proper functionality of the system.

The system is expected to provide security to the data and information that is stored in the database from unauthorized users. It does this by the use of passwords and the usernames for all users who access the system.

The system is expected to have enough capacity and memory to store the data which is captured for the immunization clinic to be able to monitor the flow of vaccines and its performance.

The system will be able to operate on different platforms, that is, different operating systems. This is to enable the system to accommodate new technology. The programs scripts should be able to run on the most common operating systems.

The system should have good response time in order to save time.

4.6.3 Technical requirements

The desired monitoring information system is designed to run on any type of computer. Laptop, desktop and palmtop computers all should be able to run the system.

The following are the minimum software requirements;

Windows XP, Linux, Macintosh or Ubuntu operating system

MySQL database or SQL server for both Windows and the open source operating system

Text editor application like notepad, Dreamweaver or open source Kate editor

Antivirus software like AVG, Avast, Avira and Norton for the windows run platforms.

A web browser for example Google chrome, Mozilla Firefox or Internet explorer. This is required because the system designed is a web based application.The following are the minimum hardware requirements;

CPU Pentium 4 or above

RAM of 512MB and above

Monitor with resolution of 800*600

Hard disk space of 80GB and above

An external hard disk drive, tape or DVDs for back up

Un interruptible Power Supply (UPS) or strong battery for the portable computers

A printer most preferably with photocopier should be connected to the main computer since some reports need to be printed.

4.6.4 Organizational requirements

All the authorized users will have to be trained on how to effectively use the system. This is meant to reduce or avoid the likely operation/functional and machine errors from misuse of the system.

4.7 TARGET USERS

These comprises of the technical and non-technical users. Technical users are the sophisticated users who will be working from the back end of the system and the non-technical users of the system are the naïve users and they operate from the front end of the system by use of graphical application programs.

4.7.1 Technical users

Technical users are directly responsible for the establishment and maintaining the system. Technical users include

The hospital records officer who is responsible for maintaining the system and debugging any errors in the system

Clinic's records assistant who is responsible for data backups and hardware maintenance making the system function effectively and efficiently.

4.7.2 Non-Technical Users

The non technical users of the system include;

The hospital superintendent who will view and analyze the reports generated by the system

The store manager and the clinic in charge who will enter, update, delete and modify any information on the system and generate reports from the system

The immunization nurses who will enter and update information in the system

4.8 DATA MODELING

Data modeling is the identification of entities that make up the system and their associated attributes. To conceptualize the functionality of the new system at a higher abstract level, UML was used to diagrammatically visualize and specify the functionality of the new system

Data modeling presents the use of cases in relation to the requirements of the desired system. It explains the relationship between the users and the system requirements and this can best be done using CASE tool diagrams.

The main functions of the system for which the data modeling is based on are;

Add new record, update record, delete record, analyze records, generate a report, retrieve reports, and view all the required information. The actors/users involved are the hospital superintendent, the store manager, the clinic in charge, immunization nurses, records assistant and records officer.

4.8.1 Conceptual Data Model for the IMS

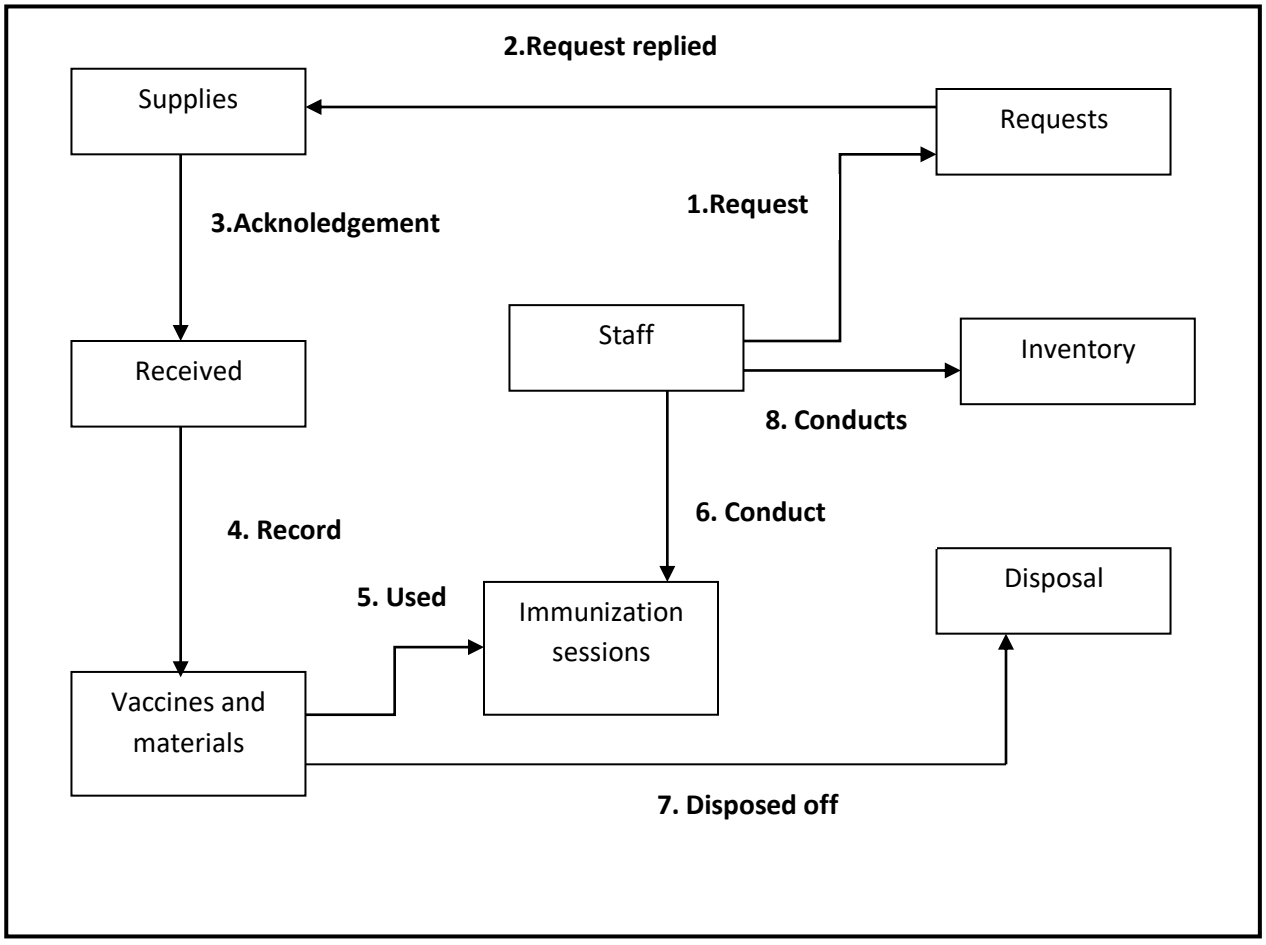


Figure 4.8: The conceptual data model of the system

4.9 SYSTEM MODELING

4.9.1 Use-case description of the proposed system

A use case diagram illustrates a unit of functionality provided by the system. The main purpose of the use-case diagram is to help visualize the functional requirements of a system including the relationship of actors (people who will interact with the system) to essential processes as well as

the relationships among different use cases. To show a use case on a use case diagram, an oval is drawn in the middle of the diagram and the name of the use case put in the center of or below the oval. To draw an actor indicating a system user on a user case diagram, a stick person is drawn connecting to the diagram.

The use-case diagram below is a summary of the use case description showing the actors and their responsibilities. The class diagram shows how the different entities (people, things and data) relate to each other.

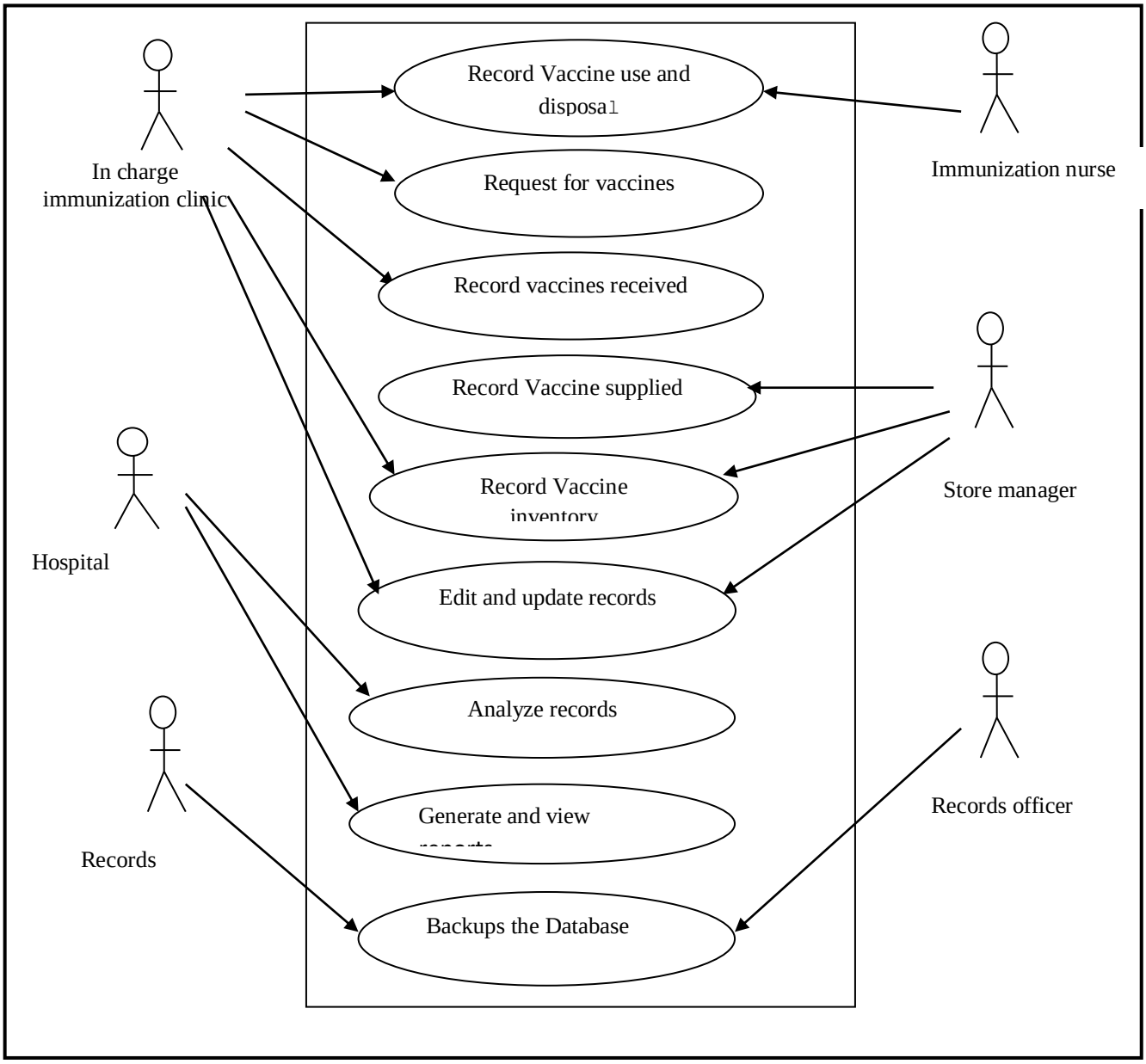


Figure 4.9: The system's use-case diagram

4.9.2 Description of the system's class diagram

It shows the static structure of the system. A class is depicted on the class diagram as a rectangle with three horizontal sections; the upper section shows the class' name; the middle section contains the attributes and the lower section shows the class operations or methods.

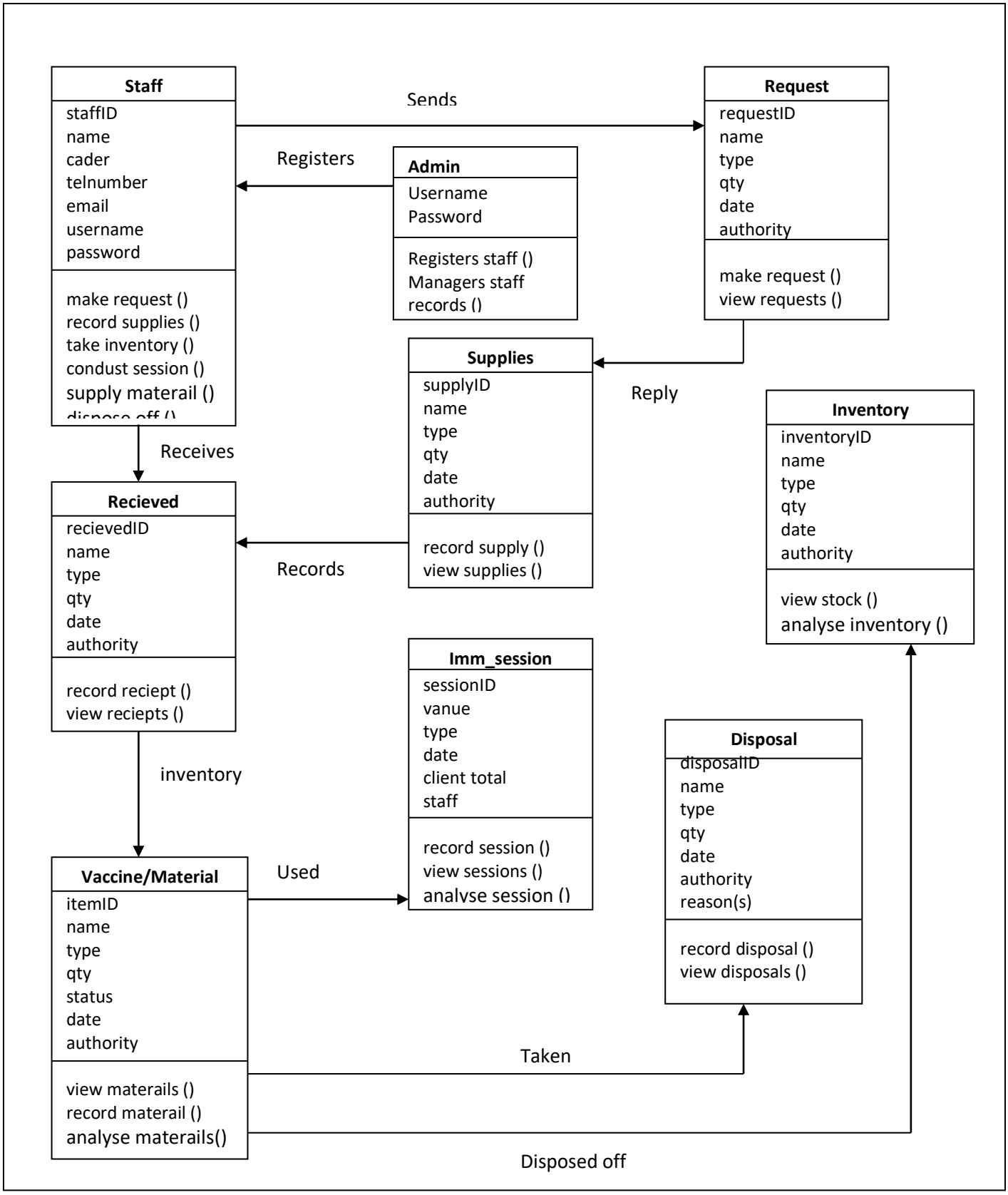

Staff
staffID
name
cader
telnumber
email
username
password
make request ()
record supplies ()
take inventory ()
condust session ()
supply materail ()
Sends
Request
requestID
name
type
qty
date
authority
make request ()
view requests ()
Registers
Admin
Username
Password
Registers staff ()
Managers staff
records ()
Supplies
supplyID
name
type
qty
date
authority
record supply ()
view supplies ()
Reply
Inventory
inventoryID
name
type
qty
date
authority
view stock ()
analyse inventory ()
Receives
Recieved
recievedID
name
type
qty
date
authority
record reciept ()
view reciepts ()
Records
Imm_session
sessionID
vanue
type
date
client total
staff
record session ()
view sessions ()
analyse session ()
Disposal
disposalID
name
type
qty
date
authority
reason(s)
record disposal ()
view disposals ()
inventory
Vaccine/Material
itemID
name
type
qty
status
date
authority
view materails ()
record materail ()
analyse materails()
Used
Taken
Disposed off

Figure 4.10: The system's class diagram

4.9.3 Activity Diagram

After specifying classes, attribute and methods, it was vital to identify the various objects and their states in the system. The activity diagram below represents the various states of objects in the OSIS module and the models of relationships between the various action states of the objects.

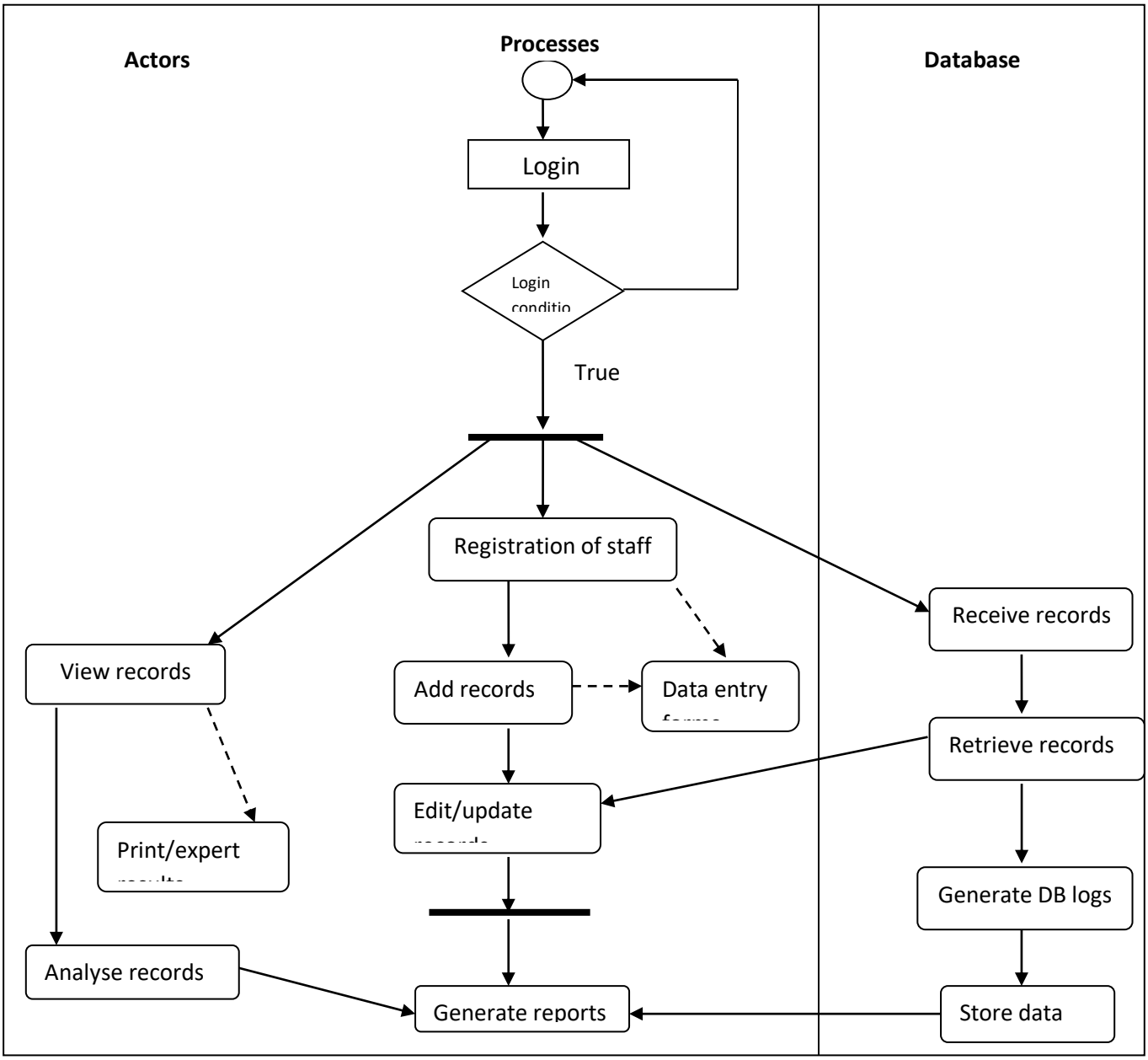


Figure 4.11: The system's activity diagram

4.10 COST BENEFIT ANALYSIS OF THE PROPOSED SYSTEM

4.10.1 Benefits

After the system prototype is designed and implemented, it will be installed at the immunization clinic servers and will be accessed by all the authorized users. This will help the clinic achieve the following benefits;

Information accuracy and consistency, the developed system has inbuilt quality checks that ensure accuracy and consistency of the collected information. This improves the quality of the information that is used in monitoring the clinic's performance and decision making.

Improved Information security, the information system is only accessed by authorized used and this ensures information security and privacy of all the monitoring information system collected by the clinic.

Easy and quick process to access and update information, the system's user interface is easy and user friendly. This quickens the process of information access and updating.

Easy and fast information analysis process, the developed system has inbuilt query scripts that will ease the information analysis process. This will speed up the process of monitoring and reporting of the clinic to high administration levels and will ensure timely reporting

Easy and fact based monitoring and efficiency in data storage and management. The system will give all the staff a chance to get involved the in the use of their own data to monitor their performance and this in the long run improve the clinic's performance.

The system will improve the productivity of the staff by reducing the time taken to analysis data and produce reports.

4.10.2 Costs of the proposed system

These are some of the costs that are most likely to be incurred;

User training costs. For efficient use of the system, the users have to be trained and this will cost the hospital training fees.

Implementation, operational and maintenance costs; to ensure that the system is installed and efficiently running

4.11 CONCLUSION

This chapter looked at the organizational structure, current system focusing on the current practice, strengths and weaknesses of the monitoring system, the proposed system looking at the system requirements, target users, data modeling and the cost benefit analysis of the system. The next chapter covers the information system design and implementation.

CHAPTER FIVE

SYSTEM DESIGN

5.1 INTRODUCTION

The previous chapter discussed the findings and system analysis. It also set the transition from analysis of the system to its design. This chapter therefore builds from the analysis done to the designing of a system which includes the database design, system architecture, user interface design and structure design. It brings out a clear and complete understanding of how the complete system operates.

5.2 FUNCTIONAL DESIGN SPECIFICATION

Functional design is the aspect of system design concerned with the system's set objectives and functions, rather than its specific components. It’s a level of the design process in which subtasks are specified and the relationships among them defined, so that the total collection of subsystems performs the entire task of the system.

The system should allow the users to perform the following functions

For the immunization nurses, the system should have perform these functions

1. Add immunization session details
2. View registration details
3. Add inventory details
4. Add disposal details

For the immunization in charge, the system should have perform the following

1. Add vaccine/material received details
2. Add vaccines/materials requested
3. Analyze requests

4. Analyze vaccine/materials used and wasted
5. Analyze vaccines disposed of

Records officer/assistant

1. Manage other users
2. Backup data

Hospital superintendent

1. View monthly reports
2. View performance reports
3. Print reports
4. View vaccines usage reports

Hospital store manager

1. View requests
2. Add supply details
3. View vaccine use report

5.3 DATABASE DESIGN

Databases and database management systems are important components of modern information systems. Databases provide a common repository for data so that it can be shared by all the system users. Database management systems provide the system designers, developers and end users with capabilities to store, retrieve and manage data.

5.3.1 LOGICAL DATABASE DESIGN

This section discusses and shows the attributes of every relation of the database design. This is discussed in relation to the relations/tables and the specific data they are supposed to accept and

store. The underlined and bold are primary keys and the simply broken line underlined are the foreign keys.

The details of the logical model for the immunisation monitoring system is shown below;

Staffinfo (staffID, names, address, telephone, cadre, username, password1, password2)

Request (requestno, date, name, type, qty, reauthority, staffID)

Received (recievedno, datereceived, name, qty, rauthority, supplyno)

inventory (inventoryno, datedone, type, state, staffID, receivedno)

supplies (supplyno, datesupplied, , name, type, qty, sauthorithy, requestno)

session (sessionno, location, purpose, date, clients, immauthorithy, staffID)

disponsed (disponsalno, qty, datedisponsed, reason, authority, vaccineID)

item (itemID, name, type, qty, status, expiredate, inventoryno)

5.3.2 ENTITY RELATIONSHIP DESIGN

Entity relationship is a technique used in UML to describe how the different relations of the database relate or are connected to each other. The relationships are based on the primary keys and foreign keys of the relations/tables. These are used to link the tables together to form a relational database.

Description of entity relationships

1. Each staff is supposed to register before logging into the system
2. On registration the staff is given an ID that uniquely identify each staff
3. Staff uses ID to send a request for vaccines and immunization materials
4. The request is replied by supplying the requested items and this is done using a supplyID
5. All items supplied are received and recorded in the received entity using recievedIDs

6. The received items are used during immunization sessions and the sessions are recorded using sessionIDS
7. After the session is carried out, inventory is taken to keep track of the remaining items and details are stored in the inventory table.
8. Vaccines and materials that are expired or spoilt are disposed off. The disposed materials are recorded in the disposal table and uniquely identified using the disposalID.

Entity relationship diagram

An entity relationship (E-R) diagram is used to visualize the system and represent the user requirements. This is used to represent entities and how they relate to one another. The ER diagram also shows the relationships between the entities and attributes

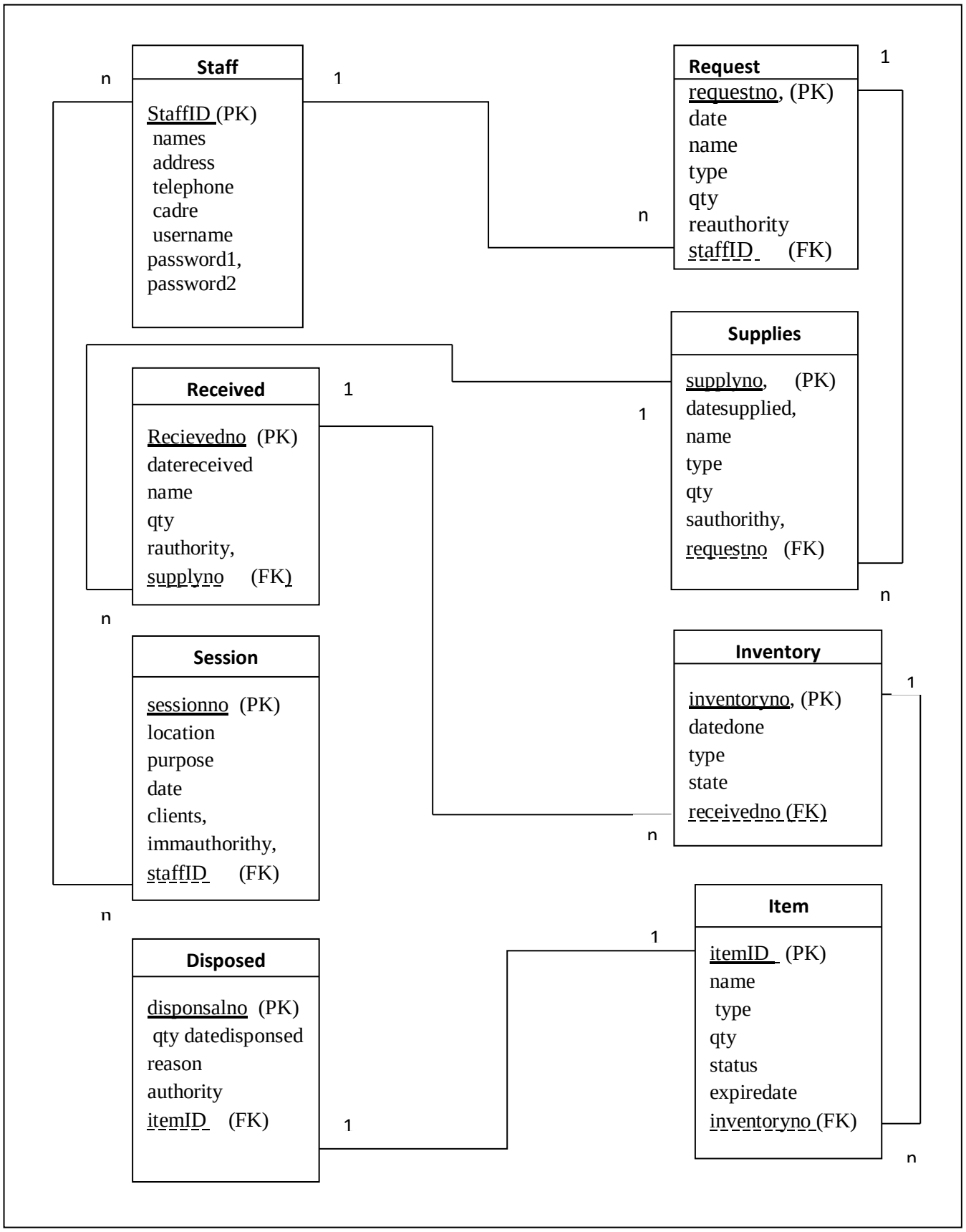


Figure 5.1 showing Entity relationship diagram of the system

5.3.3 PHYSICAL DATABASE DESIGN

Physical database design translates the logical data model into a set of SQL statements that define the database for a particular database system. It is the process of producing a description of the implementation of the database on secondary storage. The design describes the base relations and the storage structures and access methods used to access the data effectively, along with associated integrity constraints and security measures. MYSQL is a Relational Database Management System (RDBMS) that uses Transact-SQL statements to send requests between a client and the Server.

The scripts used for creating the database is attached in Appendix III

5.4 SYSTEM ARCHITECTURAL DESIGN

The system architecture design describes the environment in which the system will operate. This section focuses on the architectural framework with the minimum software and hardware specifications for the effective functioning of the system.

System architecture

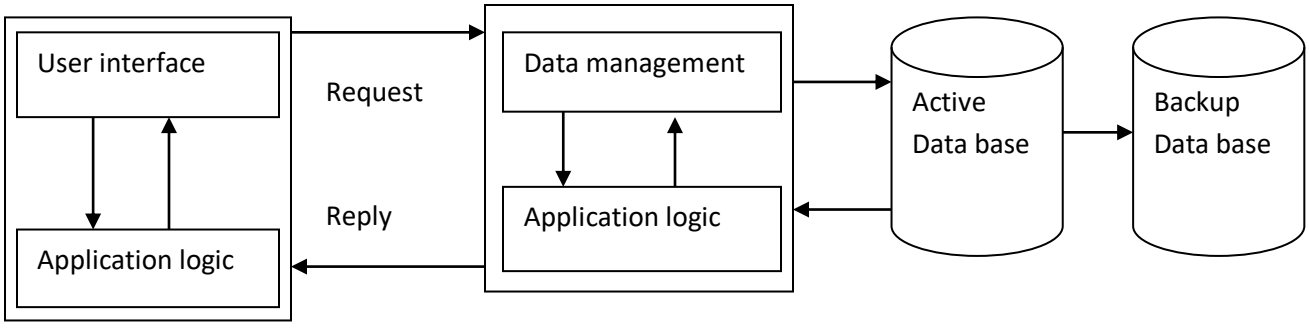


Figure 5.2: The architectural design of the system

This system is a web-based Information System that uses 3-tiers architecture where the user interface is the client that sends queries and requires some resource.

The server is the data manager which responds to the queries by providing the resources. Client-server technology provides the means for distributing work across machines and coordinating the results. The backup database is used for archiving the database and data ware housing for the historical data.

Level 1 the user interface through which users interact with the system

Level 2 handle HTTP-request and give the response after the request is processed by web server.

Level 3 handle database, directory, mail server, and SNMP (Simple Network Management Protocol) and

For the Front end tool, PHP programming language was used for developing the code. The motivation for choosing this language was the need for a platform independent language that could be used to create software to be embedded in various consumer electronic devices.

MySQL was used for Back end tool. MySQL is a relational database management system for maintaining the database. MySQL was used to formulate the system database because it offers more reliability, data integrity, scalability and high level security for the stored information. It is free open source software, easy to use, fast, and accommodates large amounts of data.

5.5 HARDWARE AND SOFTWARE SPECIFICATION

The designed system has a range of specifications needed for its proper functionality. It is very important to have all the specifications in place for the best functionality of the system. More so it makes the system more friendly, ease accessible and interaction.

The following are the minimum software requirements;

Windows XP, Linux operating system and Macintosh

MySQL database management system, phpmyAdmin for both Windows and open source operating system

Antivirus software for the windows platform

A web browser like Mozilla Firefox, Google chrome and internet explorer

The following are the minimum hardware requirements;

Computers and printer most preferably with photocopier should be connected to the computer since some reports will need to be printed.

RAM of 512MB and above to enable the computer respond fast to the application requests

CPU Pentium 3 or above for good and reliable performance

Monitor with resolution of 800*600

Hard disk space of 10GB or more for the computer hosting the database

An external hard disk drive, tape or DVDs for back up

Uninterruptible Power Supply for the database server and a application host computer

5.6 USER INTERFACE DESIGN

A most critical aspect of the information system is the quality of the user interface. The design of the user interfaces defines how the user will physically interact with the system. With the differences in the type of users within the immunization clinic, the interfaces have been designed to satisfy all the users' expectations taking care of their diversity in capabilities and needs.

5.6.1 INPUT AND OUTPUT DESIGN

With consultation from the designed system users, the design of the input and output user interfaces for the system was developed. Putting in consideration the user type, the layouts is designed in a style that triggers the users to complete filling of the input forms. For the output forms, the required fields for filling in to specify the data needed for display have also been catered for.

The login interface

The login page is the first page of the system. Its main purpose is to act as a security check and to validate and verify the users getting to use the system. The user's username and password are required to be fed into the system and if correct, the user is logged in and can navigate through some parts of the system that he is authorized to.

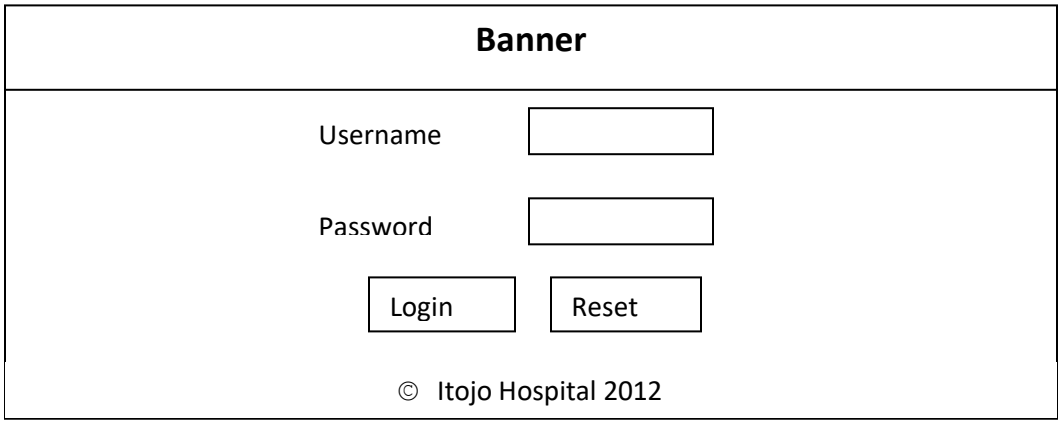


Figure 5.3: The design of the login page

Index page

The index page is the "switch board" of the system, the logged in user selects what exactly they want to do with the system from this page. Depending on the type of user logged in, they can proceed to the different sub systems to perform the intended activity.

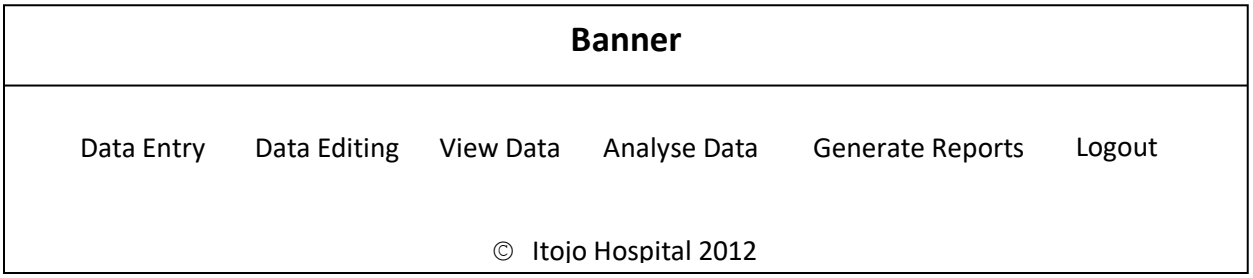


Figure 5.4: First page of the system

Data entry page

This form is a guide to the different data entry forms where data is capture into the application data base. The data entry forms include the request forms, supplies form, vaccine use form, received

supplies form, inventory form and disposal form. All the entry forms are designed in the same way with a difference in the data fields each form is designed to cover.

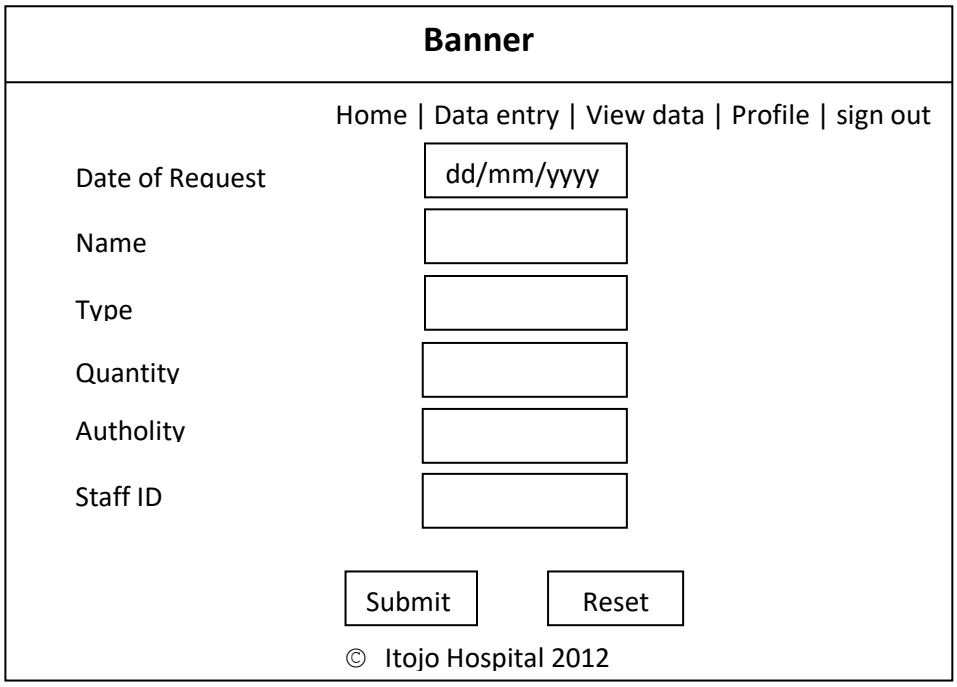


Figure 5.5: Design of a sample request form

Analyse data page

The data analysis page guides the users to the different analysis pages of all the subsystems. Using the different links from this page, the user can access analyse the requests made, the vaccines used, clients immunized, sessions held, vaccines wasted, vaccine disposed off, inventories done and much more.

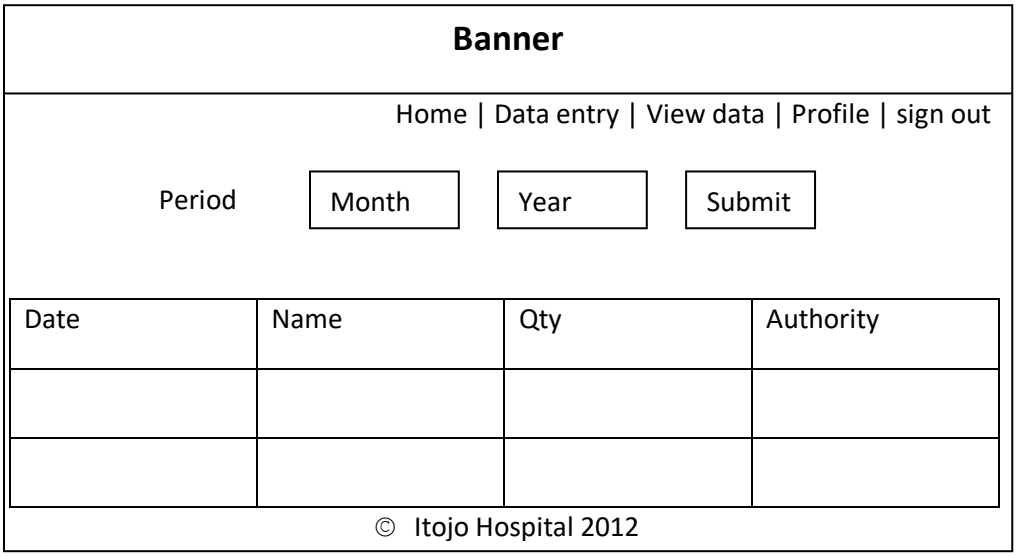


Figure 5.6: Design of an analysis page

Edit data page

The edit data page is used by the clinic in charge to correct some errors that are done during data entry. This should only be used when the mistake is confirmed and has to be corrected. The editing of the data that has been entered is discouraged because constant change of data leads to loss of originality of the data. This may in the long run lead to loss of factual data.

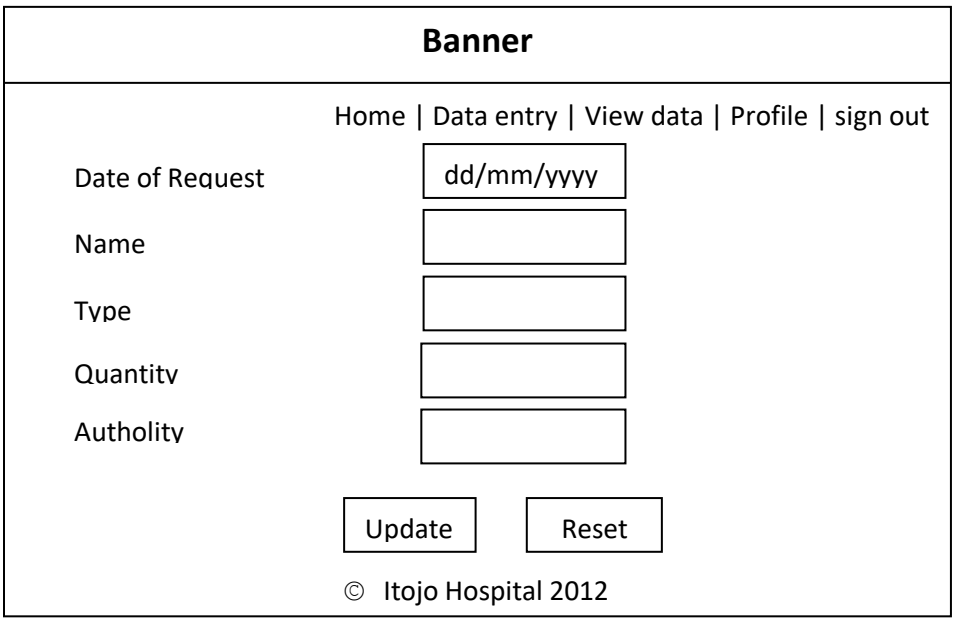


Figure 5.7: The design of edit request form

View reports page

This page is a guide to the different reports generated by the system. It's the index page in this subsystem of reporting where depending on what report a users wants to generate, it has different links to the different report forms. The report forms have fields that help the use specify the data they need and query the database for the report.

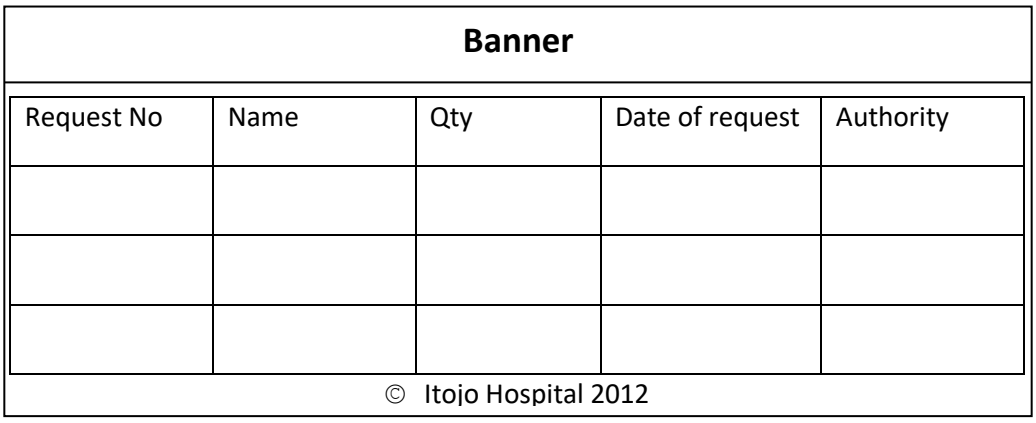


Figure 5.8: The design of a view request report page

5.5.2 INTERFACE STRUCTURE DESIGN

This section discusses the different links between the interfaces and how they connect to fulfill their functionality. This structure makes the system self evident, easy to navigate, and visually compelling to the users. In addition it helps the users to understand what is available to be done and how to find it.

Structure design for the immunization nurse

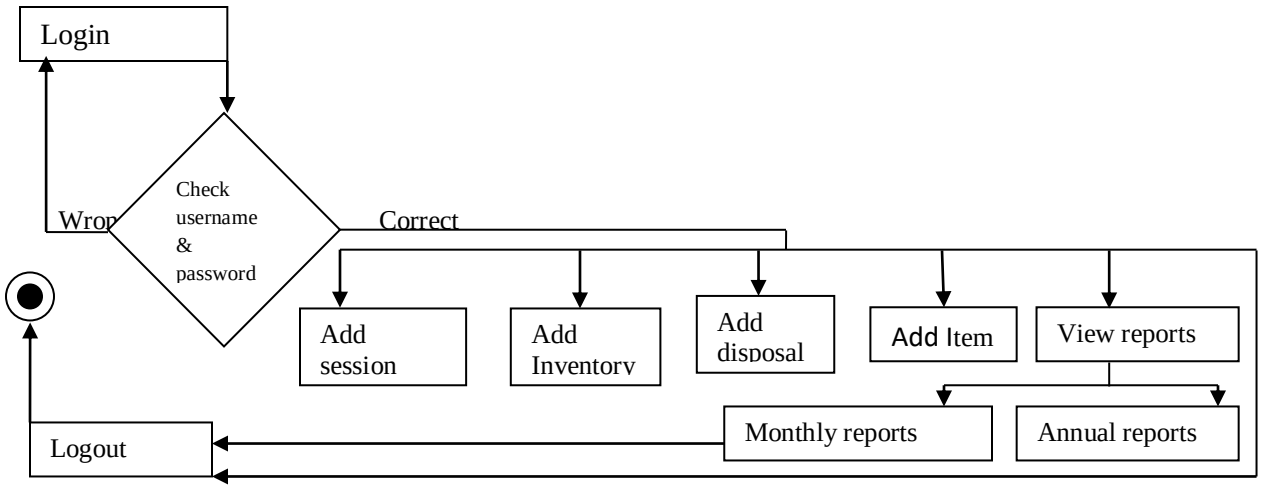


Figure 5.9: The system structural design for the immunisation nurse

Structure design for the clinic in charge.

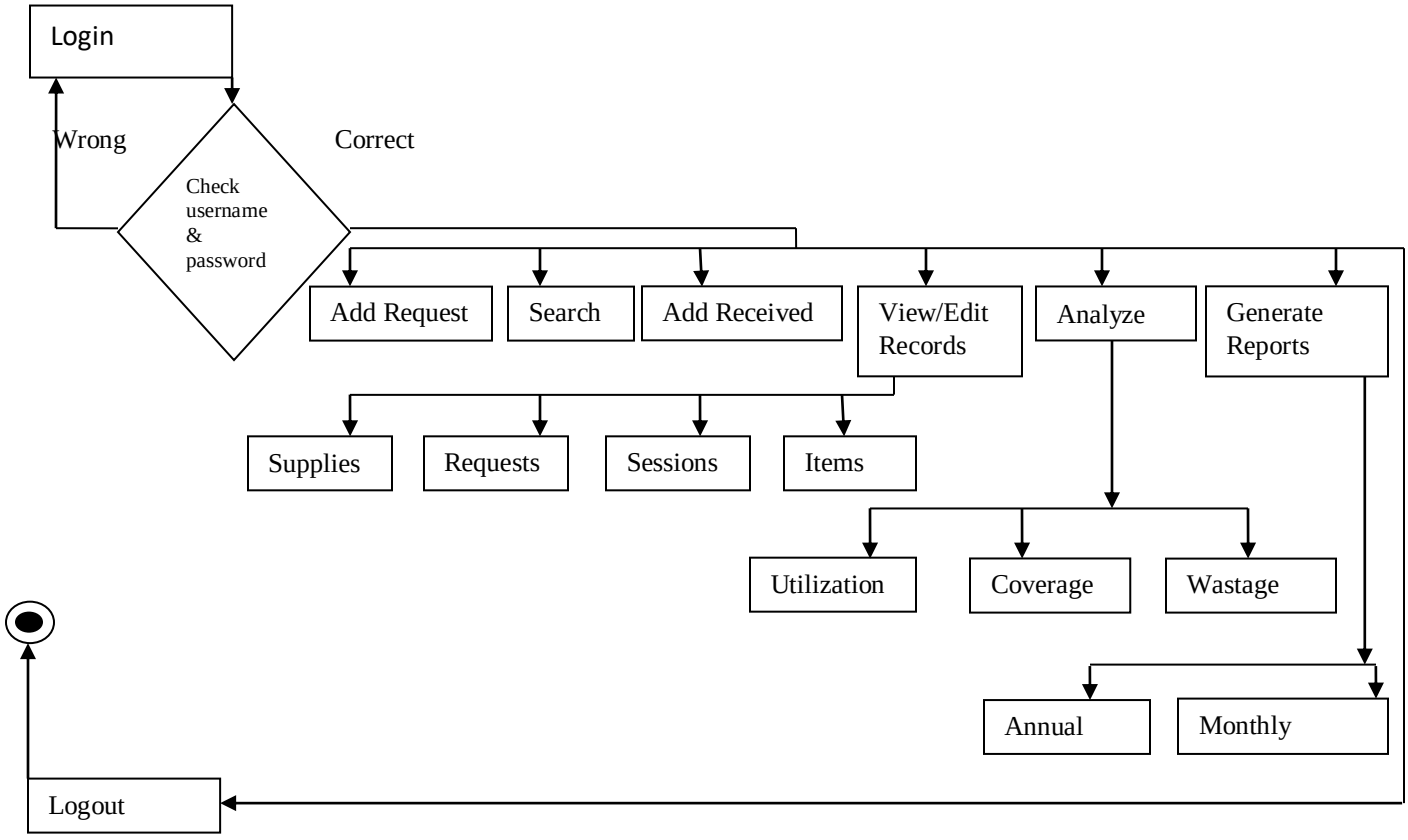


Figure 5.10: The structural design of the clinic in charge

Structure design for the medical superintendent

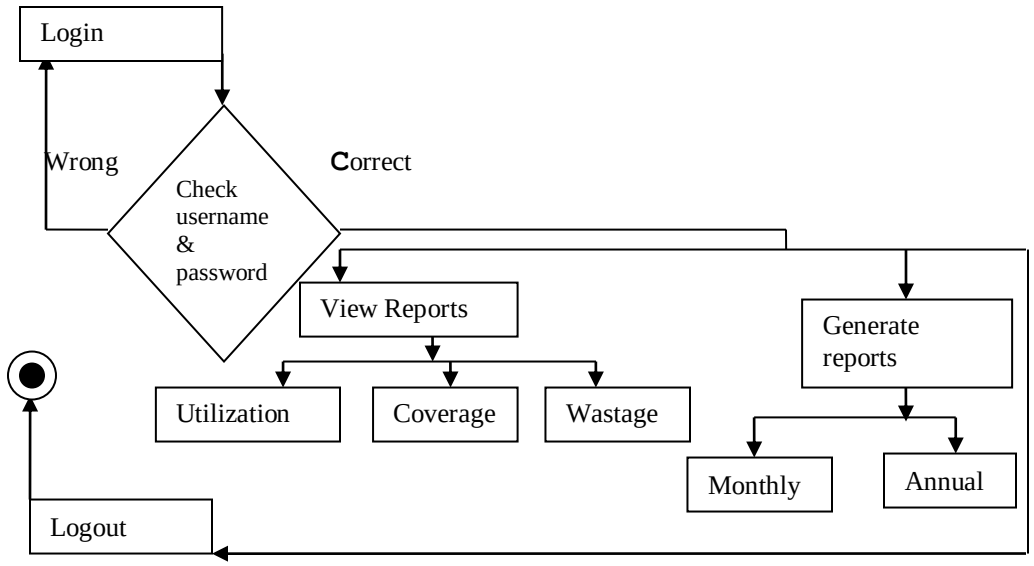


Figure 5.11: The structural design of medical superintendent

Structure design for the hospital store manager

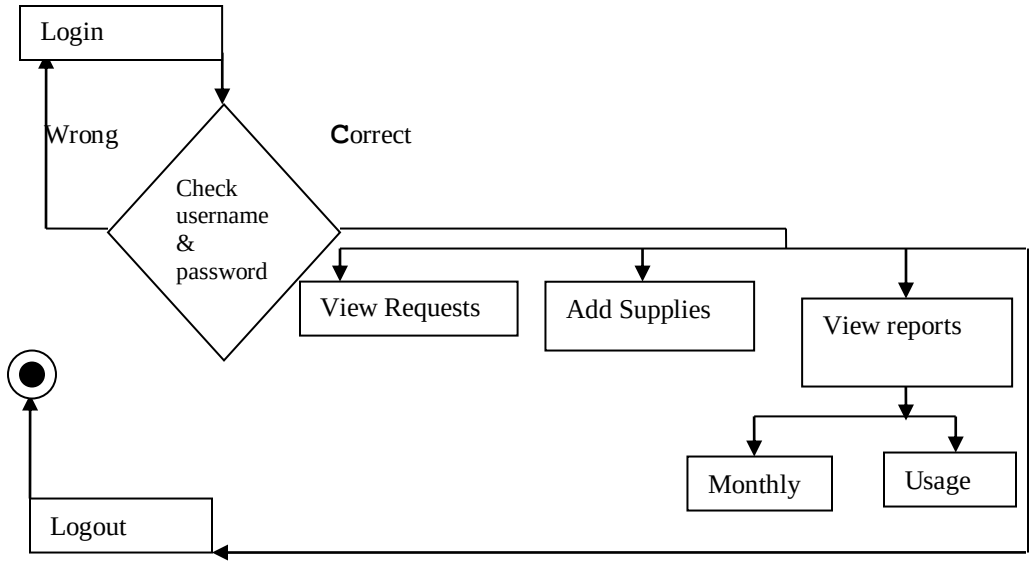


Figure 5.12: The structural design of the store manager

5.6 SECURITY DESIGN

This is an important issue to consider when developing a system. This is so because a secure system is an asset to the hospital and information being a very important resource, its security is vital.

There are various forms of securing and protecting the system from any collapse, losses or damage to the system.

Physical security; for the hardware and the system software to be secured, all the computers running the server software shall be locked in the control room to avoid any unauthorized access.

For the safety of the database and documents; access to the system is restricted to only authorized staff to access the information system. The staff authorization is left to the system administrator, who is responsible for registration and manager of system users.

A backup system is put in place to guard against complete loss of very important information in case of system failure.

Antivirus software will be installed as soon as the system is operational to protect against malicious files that may corrupt the system.

5.7 CONCLUSION

This chapter discussed the design of the immunization monitoring system. It covered the functional design, database design, architectural design, user interface design and security design. These were discussed in line with the system's case study. The next chapter looks at the implementation of the information system.

CHAPTER SIX

SYSTEM IMPLEMENTATION AND OPERATION

6.1 INTRODUCTION

This chapter presents the implementation of the system. The implementation is the actual development and support of the system after the discussion of the system design in the previous chapter. This is a stage in system development that writes the codes and scripts for the system to come up with the real product from system design. The chapter explains the overall implementation plan, the outputs (screenshots) of the system design, code used to produce the system and the user guide. The system was tested basing on the objectives and functionality requirements prior set and the lines below explain how the project was implemented.

6.1 SYSTEM CONSTRUCTION AND PROGRAMMING

System construction and programming is the basis of the whole process of system implementation. It is the most important phase in the system construction. The construction and programming enables user interaction with the system and the database using the developed graphical user interfaces (GUI).

6.2 IMPLEMENTATION PLAN

The implementation plan of the system explains the activities that were covered in this phase, the deliverables and the tools that were used to complete the activities.

ACTIVITY	**DELIVERABLE**	**TOOLS USED**
Coding	Graphical User Interfaces Database connection scripts Data analysis scripts	HTML PHP Macromedia studio

		Wamp server
Database development	Working database (itojo_clinic_DB)	MYSQL Wamp server
Testing	Implemented testing plan System test results Security tests results	Unit tests System tests Security tests
Installation	Pilot system installation results Installation of software needed • Wamp server • Macromedia studio • Antivirus software(kaspersky 6.0.4)	Running system prototype Working software
Training	Training manual User manual	MS office package
Documentation	System manual Technical reference guide	MS office package

*Table 6.1**:** The system's implementation plan*

6.3 DATABASE AND SCRIPT DEVELOPMENT

6.3.1 Database

The database of the system was developed using MYSQL DBMS. The database has eight tables that are related to each other using the primary and foreign keys. These relationships were implemented to ensure reduction in redundancy of data in the database. These tables are staff, request, supplies, received, items, inventory, sessions and disposal. The implementation of the database was based on the entity relationship diagram created in the design phase.

6.3.2 System scripts

The entire front end GUI of the system were developed using HTML scripts. HTML was used mainly because it is supported by all web browsers and since the application is web based, the interfaces will all be able to be accessed using any of the web browsers available. The back end interfaces that connect the system to the database were developed using PHP scripts. PHP is very compatible with HTML and is platform independent.

6.4 SYSTEM TESTING AND QUALITY ASSURANCE

6.4.1 System Testing

After the generation of codes, testing of all the modules was performed. All modules were than integrated together and system testing and error checking was done. As prior discussed in chapter three, this section shows how the system was tested basing on the different techniques and approaches.

Type of testing	**Description**	**Tools used**
Validation	The system was implemented to accept certain value type preset. The validation test checks if the value entered into the text field matches with the specified type. If the two don't match, then an error message warning the user of the different data type appears on the screen	Email text fields validation Date text fields Error messaging

Authentication	This is used to check user logins details. If a user logs in with wrong login particulars, the login fails with an error message “invalid username or password” and takes the user back to the login page.	User name Password
Performance testing	This was done to determine how the system performs on the range of possible environments in which it can be used.	• Windows platform using windows explorer and Google chrome • Ubuntu using Google chrome and Mozilla Firefox
System Testing	All the programs and functions of the system were brought together to test the system as one complete tests.	System debugging Script inspection
Unit Testing	Each unit of the system was tested individually to discover any errors in the code.	Script inspection Script debugging
Database Testing	This testing was done to check connectivity between the database, system function scripts and the user interfaces	Database debugging

Functional testing	The objective of this test was to ensure that each element of the application meets the functional requirements of the system as stated by the target users	System Inspection Error introduction and detection.

Table 6.2: Description of how the system was tested

6.5 SYSTEM INSTALLATION

Installation was done after the system was developed and tested. The major installation were on the hardware upgrading and software installations

6.5.1 Hardware installation

Using the system designs made earlier in chapter five, upgrading of computers will be required, network printers, UPS units, backup utilities, high speed internet connectivity, firewall system to block unwanted programs or access, Application and database Servers needed for host the system database needed to be installed as well.

All the upgrades and new installation needed to run the system prototype were installed in the immunization clinic premises before the system was installed.

6.5.2 Software installation

To have the new system up and running, some addition software needed to be installed onto the clinic computers and some old packages needed to be upgraded. The following software packages were installed or/and upgraded.

Windows 7 for the operating system

Mozilla Firefox version 3.5 and Microsoft Internet Explorer version 5.5 for web browsers

Microsoft Office suite for document creation and editing

MYSQL Server version 5.0.45 for database management

PHP 5.2.5 for script editing

Dreamweaver 8.0 for interface design and scrip editing

Apache 2.0 for Windows as server software

6.5.3 System prototype installation

Parallel installation strategy was used to install the system. The old system will continue being used at the clinic along with the new system until the new system has been thoroughly tested and determined to be error-free and ready to operate independently. This type of installation was used to install the new system because the users had a tight schedule and their training was a bit sluggish.

6.6 DOCUMENTATION

6.6.1 User documentation

User documentation provides support and acts as an immediate reference to the end users of the system. This document mainly describes routine operation and functions of the system such as data entry, analysis, report generation and system maintenance.

The immunization clinic being part of the general hospital, sometimes staffs from the clinic are transferred to other clinics and new one are brought to the clinic. This nature of working environment necessitates a continuous training of the staff of the clinic on how to use and manage the monitoring system. This document therefore serves as the purpose of ongoing training and user support needed at the clinic.

6.6.2 System documentation

System documentation serves primarily one purpose; providing information and being a reference to designers and developers who will maintain or restructure the system. The system's source code is the most important part of the documentation since it is the direct link to the system's executable software. System documentation was done throughout the system development process.

All the codes used in the script development were commented and this makes it easily to understand and edit the scripts if need arises.

6.7 SYSTEM DEPLOYMENT

System deployment started after the application scripts were fully tested for proper functionality. The wamp server software was installed and tested first on to the computer that is housing the database. This is because the application using MYSQL database management system for managing the application and MYSQL runs on a wamp server. After the installation of wamp, the application files were copied to the www of wamp. This is to allow the wamp open the system once it starts and a web browser is loaded. The URL http://localhost/itojoi-clinic opens directly the index page of the system.

6.8 USER TRAINING AND SUPPORT

Good documentation reduces training needs as well as the frequency of support requests. However sufficient training before and support after installation is always required. Without training, users simply work their way through the application however this would make the error-occurrence rate high and the system may be inefficient. Training will allow users to be productive as soon as the system becomes operational. The users will need to be trained in aspects of Use of

the system, General computer concepts, Information system concepts, System management and System installation.

A resident records officer of the hospital will completely be in charge of the ongoing user training and support to help out in the other system users.

6.8.1 Maintenance and system enhancement

The term maintenance covers virtually everything that happens to a system after delivery except total replacement or abandonment. In this case, it will involve the modification of the monitoring system after its delivery to the clinic and adaptation to the changing user requirements and to fix any errors as they occur. The main activities involved are;

Tracking modification requests and error reports.

Implementing changes

Monitoring system performance and improving performance or increasing capacity.

Upgrading hardware and system software.

Updating documentation to reflect maintenance changes.

6.9 USER INTERFACE IMPLEMENTATION.

This section the presents samples of the screen shots of the system user interfaces that were designed and implemented. The user interfaces were designed in very simple layout to enable users easily navigate through the system

a) Login page

This is the first page to be viewed by all users of the system. It is from this page that the user is validated to allow them log into the system.

Figure 6:1: screenshot of the system's login page

b) Login check page

This is a interface that check and validates if the username and password used to log into the system are correct, if the details used are incorrect, log in fails with an error message as shown below

Figure 6:2: screenshot of the system's login check page

c) Staff registration form

This is the interface used by the administrator to register new staff into the system. When the register button is clicked, then the staff can be classified according to their cadre whether clinic in charge, nurse, store manager or medical superintendent

Figure 6:3: Screenshot of the system's staff registration page

d) Managing system staff page

This is the interface used by the clinic in charge to manage staff registered to use the system. The in charge can modify or delete the details of any staff registered by the system

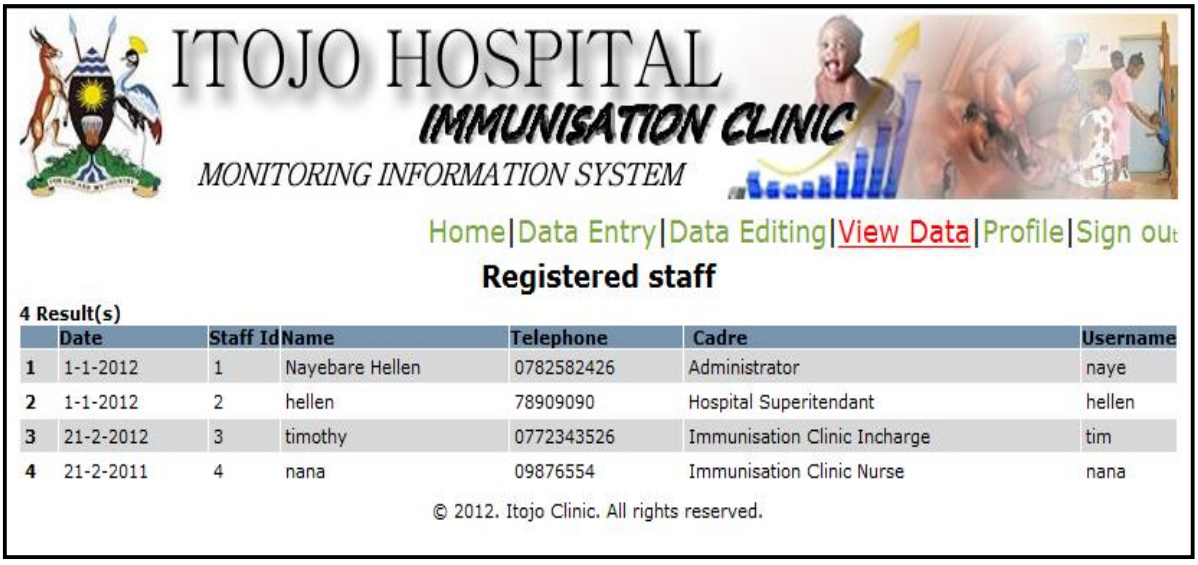


Figure 6:4: Screenshot of managing system staff page

e) The clinic in charge page

This is the interface used by the clinic in charge to view data from the database and performance by different activities carried out by the clinic. This page aids the in charge to view the different requests made, supplies, inventories and dispenses in the clinic.

Figure 6:5: Screenshot of the clinic in charge page

f) Data entry for items in the clinic

This interface is used to register all the items received by the clinic

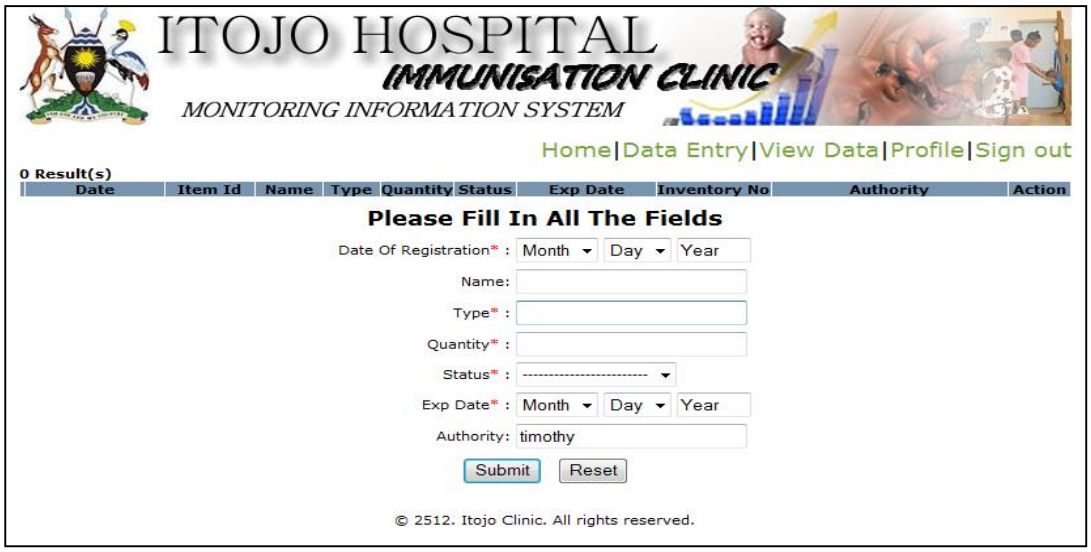


Figure 6:6: Screenshot of the data entry screens

f) Data entry check page

This interface shows an error message. This is an example of the system check, it validates if all the required fields were filled in properly

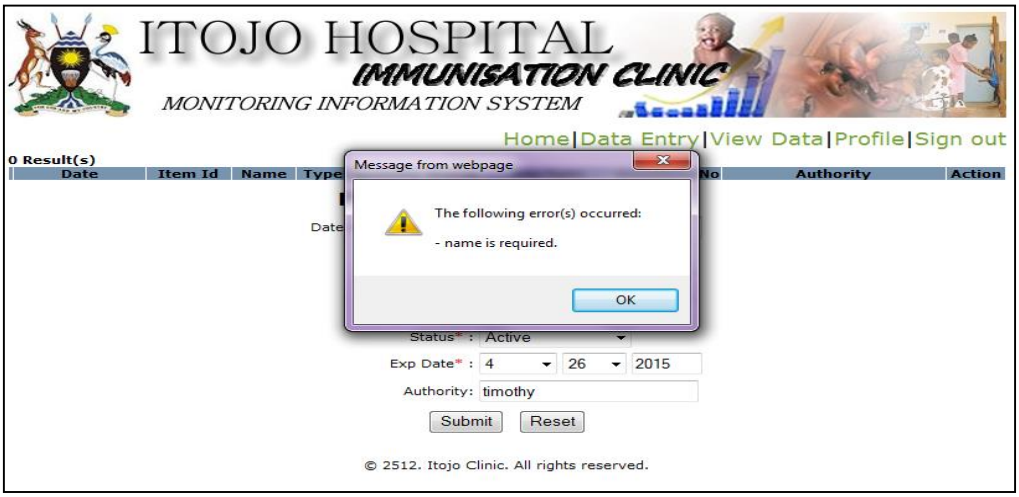


Figure 6:7: Screenshot of data entry check page

f) Managing Items

This interface is used by the in charge to check and analyze the items received from the stores by the clinic

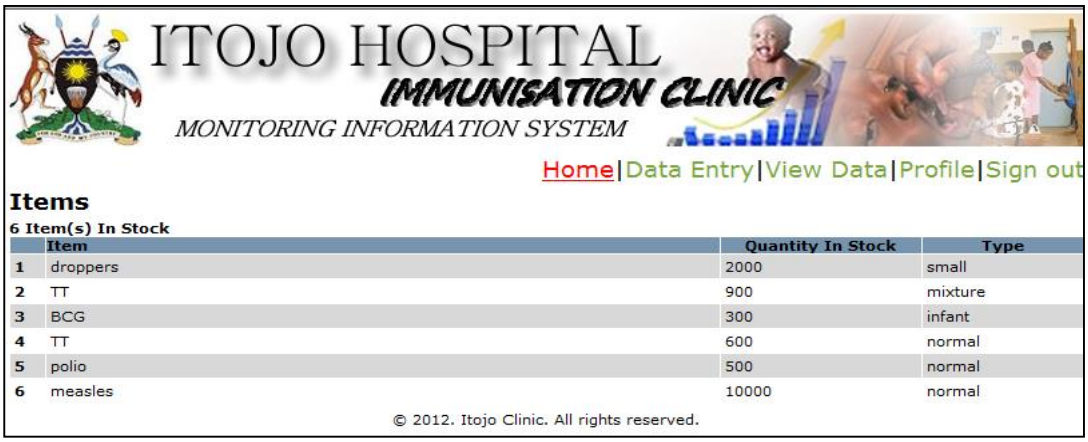


Figure 6:8: Screenshot of managing items stored in the system

g) Search form

This is a form used to carry out a quick search of the data within the database. Every user of the system can use this form to search for only the records they are accepted to view.

Figure 6:9: Screenshot of the search page of the system

h) Report request form

This is an interface used by authorized users to request for data from the system and generate reports with the data

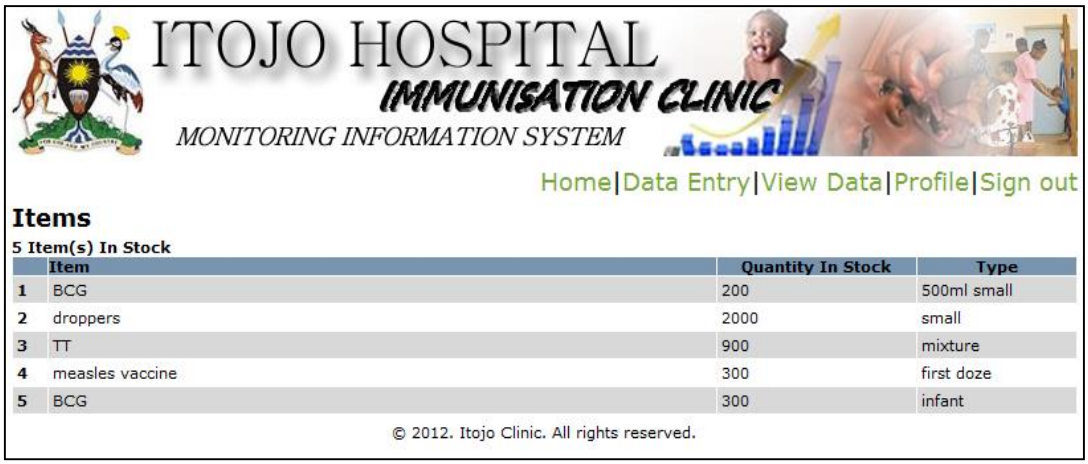


Figure 6:10: Screenshot of report output from the database

6.10 SYSTEM MIGRATION PLAN

The organizational and technical aspects that may affect the users while shifting from the old system to the new system were mainly considered during the development of the system migration plan. The plan considers the system components of data, hardware, software and human resources and how the change to the new system will affect the information management process.

Conversion Plan	**Change Management Plan**
Hardware installation	Assess the costs and benefits of the software
Software installation	Assess user training sessions
Data Transfer	Generally evaluate the human resource to carry out data transfers and backups
User training	Use detailed training guides and avail support

	documents to users

Table 6.1: conversion plan

6.11 SYSTEM CONVERSION PLAN

Conversion is the process of replacing the old system with the new system. The necessary equipment must be obtained and installed by the organization before conversion. The system components necessary include software and hardware that is needed for hosting and running the new system. Examples of the software include browsers, server software, application software and network configuration software that database management systems (MySQL)

After the installation of the system, data conversion from the old system to the new system will be done. In this case the two systems will run parallel for a period of time until an assessment is done and results confirm that the staff of the clinic can fully and comfortably use the new system. Then the old system will be phased out onto the new system.

System conversion will take a longer period of time and at some points in the process, some functions of the system may need to be adjusted to fit the user's evolving requirement of the system.

6.12 CONCLUSION

This chapter discussed various aspects of the system implementation process from system construction, testing and installing. Aspects of system conversion and maintenance after installation were also discussion.

the next chapter concludes the whole research paper giving recommendations and a general conclusion of the study.

CHAPTER SEVEN

GENERAL SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1 INTRODUCTION

This research's main aim was to study and understand how immunization clinics monitor the flow of vaccines and related materials used in the immunization process, establishing the causes of poor performance and develop an information system to improve the performance monitoring of the immunization clinics. This set off with the study and analysis of the current systems followed by the establishment of user and system requirements that aided in specifying the functional and non functional requirements that were used to design models from which the prototype for a new solution was implemented. This chapter therefore discusses the study's conclusions, recommendations and future plans after the implementation of the solution.

7.2 RESEARCH REPORT SUMMARY

The study report presents the aim of the study, objectives, and methods used to achieve the objectives. The report then concludes discussing the challenges and successes of the study.

The study's focus was at improving performance monitoring of the immunisation clinic through designing and implementing a monitoring information system. For this to be achieved, objects were set to guide the flow of the study and help understand and analysis the current system being used at the study's case study clinic; Itojo hospital immunisation clinic. The study was conducted in view of business processes and technologies to establish weaknesses in relation to the institution's goals and review methodologies to come up with the best approach and methods for executing the project; design a prototype solution and implement the solution (Chapter one).

The study reviewed literature on related works to determine the gaps in the current performance monitoring system and establish the need to bridge the gaps and give a solution to improve

performance monitoring. This was carried forward by evaluating the business processes on the information supply side through use of data collection techniques and tools discussed in detail in chapter three of report.

The finding of the study revealed that staff of the clinic faced inconveniences during their reporting period trying to put all the hand cover forms together to gather information, analysis the performance of the clinic and come up with accurate reports amidst their daily busy schedules of running the immunisation clinic. This stressing process slowly led to the poor reporting culture in the clinic which affects the monitoring and performance of the clinic. In an attempt to solve this problem, a monitoring information system was analysed based on the business processes of the clinic and the user requirements collected during the study. The details of this analysis were discussed in chapter four of the report

After the analysis of the system, it was designed and the solution implemented basing on the project objectives and requirements prior determined. (Chapter five and six)

Chapter seven concludes the study giving the challenges faces during the study's undertaking and gives recommendation for the next similar studies.

7. 3 GENERAL CONCLUSION OF THE STUDY

The Study of current practices of how monitoring and reporting is done at the immunization clinic established that the old monitoring system was handling each aspect of performance monitoring independent of the other. By providing a common platform for integration of all the monitoring aspects within the new system, the clinic can now utilize the system to access all information on the clinic performance and periodic reports at a central point.

The analysis of the research finding and system requirements for developing an information system to enhance monitoring of immunization supplies at clinic level revealed a need for a

system that would provide a central storage space for all the data collected on the immunisation supplies and reducation on the time taken by the clinic staff to produce periodic reports. As an answer to the requirements analysed, a system prototype was designed and implemented. This greatly cut back on the time taken to analyse information and coming up with clinic's monitoring reports.

Despite delays in implementation of the monitoring system, the clinic staff were excited to have a system that eased their work of analyzing their data, generating reports and improving the overall performance monitoring of the clinic.

Through the stage of testing and evaluating the implemented system prototype, there was more effort required in marketing the use of the system prototype to the traditional clinic staff who were not comfortable with the new era of computer technology. However these staff realised later that they will benefit from the convenience of a system that allows online performance analysis and reporting on the clinic's performance. This aided the acceptance and use of the system prototype by all the staff.

7. 4 CHALLENGES

During the undertaking of this research, several challenges were encountered in the process of studying the current system, designing and implementing the monitoring Information systen among which the most pressing included;

Designing the monitoring system was a challenge given that a monitoring and evaluation background was essential for one to start on the designing of a monitoring system. This necessitated the researcher to take a short course in monitoring and evaluation to be able to overcome this challenge.

Secondly, the researcher had underestimated the complexity of the whole study especially the system implementation part thinking it would take a short time to be done but it ended up taking a longer time and delaying the whole research completion

The above challenges coupled with time constraints meant that the scope of the system functionality preplanned had to be reduced to complete the project in the given timeframe of twelve months.

7. 5 RECOMMENDATIONS

Recommendations are cautions the managers and administrators of the system should do to keep the system functional and well maintained to achieve the main objective of the system.

The hospital management in collaboration with the clinic in charge and the administrator of the hospital should take some measures of security such as changing the password to make sure that the person accessing the new system are only the authorized ones.

The system should be further developed by adding other functionalities of the clinic's daily operations like managing clients' records and staff performance.

All the clinic staff should be trained on how to correctly use the new system so that it will be understandable to all the staff.

A systems administrator should be hired to manage and keep the system running effectively. This administrator should be very well knowledgeable about the databases, information systems and programming.

A backup system should be put in place and used regularly so as to help recover the information for reference in case of system failure. This can be in form of external hard disks, compact disks and tapes.

7. 6 FURTHER WORK ON THE SYSTEM

Due to the limited time and other challenges in which this project was to be accomplished, the researcher was un-able to have an adequate number of trial results by the users. Plans to carry out more trails should be put in place by the hospital stakeholders to gain more acceptances and if it is positively received, then fully launch the system once the necessary infrastructure is in place.

The designed system is for enhancing monitoring for immunisation supplies at the clinic level and the reviewed literature showed that there are other systems designed to monitor the coverage of immunisation services at clinic and hospital level. Further research can be done on how the two systems can be merged to work as one complete monitoring system for all immunisation service providers.

The implemented prototype runs on ordinary web browsers and networked computers, further work can be done to improve the prototype to implement a mobile application that can be used and compatible with the new technologies of mobile devices like mobile phones and notepad computers.

7.7 CONCLUSION

Better health care is everyone's right in Uganda, therefore an improvement in the monitoring and management system would guarantee every person access to the rightful health services and especially the most vulnerable, the children and expectant mothers. The development of a monitoring information system obviously reduces on the risk of stock outs of vaccines in the clinic and checks the proper use and handling of the vaccines and other items used in the immunisation process. This minimizes the wastage of the vaccines and improves on the services provided by the immunisation clinic.

The study has not only produced a system prototype of a monitoring information systems but has also proved the new system to be an efficient way of enhancing performance monitoring of the immunisation clinic compared to the former system.

APPENDIX I: INTERVIEW GUIDE QUESTIONS

Greeting and Introduction

Seek consent for the interview [ ] Yes [ ] No

Gender: [ ] Male [ ] Female

Job role.....

Period of time you have worked in that job role.....

1. Please tell me a brief background of the immunization clinic

   ……

   ……

   ……

   ……

2. What are the main objectives of the clinic?

   ……

   ……

   ……

3. What are the key activities of the clinic?

   ……

   ……

   ……

4. Is there any defined system in place being used to monitor the performance of the clinic and usage of the vaccines?

   [ ] Yes [ ] No

5. What information is used to monitoring the performance of the clinic?

   …….

   …….

   …….

   …….

……..

6. How is this information collected and analysed?

……

……

……

7. Is there any reporting done after the information has been analysed?

[ ]Yes [ ]No

8. How is the reporting done and who does it?

……

……

……

9. Approximately how long does it take to have data analysed and reports produced?

……..

10. How is the data stored after analysis and reporting?

……

……

11. How easy is it to access data for annual reporting?

[ ] Not done [ ] Not easy [ ] Easy [ ] Very easy

12. Are you comfortable with the monitoring system in place?

[ ] Yes [ ] No

13. What elements of the system are you not comfortable with?

……

……

……

……

14. What can be done to improve on the system in place for better results?

……

……

……

……

APPENDIX II: DOCUMENT REVIEW GUIDE

This is the list of documents to be reviewed

1. Immunization clinic monthly reports on vaccines usage

2. Drug request and delivery reports
3. Drug use and storage reports
4. Tally sheets, monthly immunization coverage report and Immunization monitoring charts
5. Drug crisis/ shortage reports
6. Unit performance reports
7. Hospital profile
8. National Immunization hand book
9. Health Service delivery manual
10. Any reports about the clinic's performance and vaccine flow in the clinic.

APPENDIX III: DATABASE CREATION SCRIPT

```
CREATE DATABASE `itojo_clinic`;
USE  `itojo_clinic`;

CREATE TABLE `staff`(
  `staffid` int(12) NOT NULL auto_increment,
  `day` int(2) NOT NULL,
  `month` int(2) NOT NULL,
  `year` int(4) NOT NULL,
  `names` varchar(40) NOT NULL,
  `address` varchar(20) NOT NULL,
  `telephone` varchar(20) NOT NULL,
  `cadre` varchar(50) NOT NULL,
  `username` varchar(25) NOT NULL,
  `password` varchar(25) NOT NULL,
  PRIMARY KEY  (`staffid`));
CREATE TABLE `request`(
  `requestno` int(50) NOT NULL auto_increment,
  `day` int(2) NOT NULL,
  `month` int(2) NOT NULL,
  `year` int(4) NOT NULL,
  `name` varchar(70) NOT NULL,
  `type` varchar(70) NOT NULL,
  `qty` int(4) NOT NULL,
  `names` varchar(40) NOT NULL,
  `staffid` int(12) NOT NULL,
   PRIMARY KEY  (`requestno`),
   KEY `staffid` (staffid));

CREATE TABLE  `supplies`(
  `supplyno` int(50) NOT NULL auto_increment,
  `day` int(2) NOT NULL,
  `month` int(2) NOT NULL,
  `year` int(4) NOT NULL,
  `name` varchar(70) NOT NULL,
  `type` varchar(70) NOT NULL,
  `qty` int(4) NOT NULL,
  `requestno` int(50) NOT NULL,
```

```
  `names` varchar(40) NOT NULL,
  PRIMARY KEY  (`supplyno`),
  KEY `requestno` (`requestno`));

CREATE TABLE `received`(
  `receiveno` int(50) NOT NULL auto_increment,
  `day` int(2) NOT NULL,
  `month` int(2) NOT NULL,
  `year` int(4) NOT NULL,
  `name` varchar(70) NOT NULL,
  `qty` int(4) NOT NULL,
  `supplyno` int(50) NOT NULL,
  `names` varchar(40) NOT NULL,
  PRIMARY KEY  (`receiveno`),
  KEY `supplyno` (`supplyno`));

CREATE TABLE `inventory`(
  `inventoryno` int(50) NOT NULL auto_increment,
  `day` int(2) NOT NULL,
  `month` int(2) NOT NULL,
  `year` int(4) NOT NULL,
  `name` varchar(70) NOT NULL,
  `type` varchar(70) NOT NULL,
  `state` varchar(70) NOT NULL,
  `receiveno` varchar(70) NOT NULL,
  `names` varchar(40) NOT NULL,
  PRIMARY KEY  (`inventoryno`),
  KEY `receiveno` (`receiveno`));

CREATE TABLE `item`(
  `itemid` int(50) NOT NULL auto_increment,
  `day` int(2) NOT NULL,
  `month` int(2) NOT NULL,
  `year` int(4) NOT NULL,
  `name` varchar(70) NOT NULL,
  `type` varchar(70) NOT NULL,
  `qtyin` int(4) NOT NULL,
  `status` varchar(10) NOT NULL,
  `xday` int(2) NOT NULL,
  `xmonth` int(2) NOT NULL,
  `xyear` int(4) NOT NULL,
  `inventoryno` varchar(70) NOT NULL,
  `names` varchar(40) NOT NULL,
  PRIMARY KEY  (`itemid`),
  KEY `inventoryno` (`inventoryno`));

CREATE TABLE `dispense`(
  `dispenseno` int(50) NOT NULL auto_increment,
  `day` int(2) NOT NULL,
  `month` int(2) NOT NULL,
  `year` int(4) NOT NULL,
  `name` varchar(70) NOT NULL,
  `qtyout` int(4) NOT NULL,
  `reason` varchar(70) NOT NULL,
  `names` varchar(40) NOT NULL,
  `itemid` int(50) NOT NULL,
  PRIMARY KEY  (`dispenseno`),
  KEY `itemid` (`itemid`));

CREATE TABLE `session`(
  `sessionno` int(50) NOT NULL auto_increment,
  `sessiondate` date default NULL,
```

```
`location` varchar(70) NOT NULL,
`purpose` varchar(70) NOT NULL,
`clients` varchar(70) NOT NULL,
`immauthority` varchar(70) NOT NULL,
 PRIMARY KEY  (`requestno`),
 KEY `staffId` (`staffId`));
```

APPENDIX IV: SCRIPT FOR CONNECTING TO THE DATABASE

```
<?php
function dbconnect() {
@mysql_connect("localhost","root","") or die(mysql_error());
@mysql_select_db("itojo_clinic") or die(mysql_error());
}
 function checklogin() {
   if (!isset($_SESSION["login"]) || !is_array($_SESSION["login"])) {
          @header("Location: ../");
          exit ();
  }
 }?>
```

APPENDIX V: DATA CAPTURE SCRIPT

```
<?php
session_start();
@include("../../functions/functions.php");
checklogin();
dbconnect();
?>
<?php
if(isset($_POST["reg"]))
{
$month = $_POST["month"];
$day = $_POST["day"];
$year = $_POST["year"];
$name = $_POST["name"];
$type = $_POST["type"];
$state = $_POST["state"];
$receiveno = $_POST["receiveno"];
$names = $_POST["names"];
@mysql_query("INSERT INTO inventory VALUES ('','$month','$day','$year','$name','$type','$state','$receiveno','$names')") or
die(mysql_error());
header("Location:../main.php");
exit ();
}
?>
```

APPENDIX VI: REPORT GENERATION SCRIPT

```
<table width="400"  border="0" align="center">
          <?php                          if(isset($_POST["submit"]))
```

```
                                {
            $month=$_POST['month'];  $year=$_POST['year'];
            $data = @mysql_query("SELECT DISTINCT name FROM dispense where month='$month'
AND year='$year'") or die(mysql_error());
            $num_results = mysql_num_rows($data);
                                        echo '<b>'.$num_results.' result(s)</b>';
            for ($i=0; $i<$num_results; $color = "#FFFFFF")
            {
             $row = @mysql_fetch_array($data);
                    {
                                                    if($i%2) {
                                $color = "#FFFFFF";
                                }
                                else {
                                $color = "#d8d8d8";
                                }
                                                    $i++;
                             $list = '
                                <tr style="padding:3px;" bgcolor="'.$color.'">
                                                                        <td width="20px"
height="15px" valign="middle"><b>'.($i+0).'</b></td>
                                        <td align=left>'.$row["name"].'</td>
                                </tr>';
                             echo $list;
                             }
            }
                                        }
        ?>
        </table>
                                <table border="0" width="500">
                                <tr>
          <td colspan="2" style="text-align:center;">&copy; 2012. Itojo Clinic. All
rights reserved.</td>
        </tr>
        </table>
        </table>
```

APPENDIX VII: DATA UPDATE SCRIPT

```
<?php
session_start();
@include("../../functions/functions.php");
checklogin();
dbconnect();
?>
<?php
if(isset($_POST["submit"]))
{
$inventoryno = $_POST["inventoryno"];
$month = $_POST["month"];
$day = $_POST["day"];
$year = $_POST["year"];
$name = $_POST["name"];
$type = $_POST["type"];
$state = $_POST["state"];
```

```
$receiveno = $_POST["receiveno"];
$names = $_POST["names"];
@mysql_query("UPDATE inventory SET
month='$month',day='$day',year='$year',name='$name',type='$type',state='$state',receiveno='$receiveno',names='$names' WHERE inventoryno =
'$inventoryno' LIMIT 1") or die(mysql_error());
header("Location:../main.php");
}  ?>
```

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