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and

School of Public Health

M.Sc in Health Informatics

**Design and Development of a Records Management System for Immunization
In Addis Ababa The Case of Nefase Silke Lafto Sub-City Woreda Health
Center.**

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I declare that the project “Design and Development Record Management System for Immunization in Addis Ababa the Case of Nefase Silke Lafto Sub-City Woreda Health Center” is my original work and has not been presented for a degree in any other university.

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DEDICATION

This piece of work is dedicated to my wife Bethlehem Achenefe, for being my pillar of strength and for her patience when I devoted long time in my work.

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ABBREVIATIONS AND ACRONYMS

CASE	Computer-Assisted Software Engineering
CSS	Cascading Style Sheets
DVD	Optical Compact Disk
EPI	Expanded Program on Immunization
E-R	Entity Relationship
EHR	Electronics Health Record
HTML	Hyper Text Markup Language
HIS	Hospital Information System
IIS	Immunization Information System
LAN	Local Area Network
LCD	Liquid Cristal Display
NF	Normalization Form
OOP	Object-Oriented programming
PHP	Hypertext Preprocessor
RAD	Rapid Application Development
RDBMS	Relational Database Management System
RAM	Random Access Memory
RMS	Record Management System
RW	Read Write
UID	Unique Identifiers
QL	Structured Query Language
UML	Unified Modeling Language

Abstract

Keeping a record of immunizations helps make sure child gets all the vaccines they need at the right times. All child need a record of their immunizations before they go to child care, school, camp, long-term care facilities, or for travel abroad.

The main purpose of this project is to design and develop a computerized record management system for immunization in case of Nifase Silek Lafto Sub-City Woreda One Health Center. The project will automate the entire process of immunization at the Health Centre by capturing all immunization details. Besides reducing paper work and use of immunization preformatted registry form.

In a computerized record management system data was presented using business process modeling, use case diagram, use case description, sequence diagrams, class diagrams, deployment diagram. Hyper Text Markup Language(HTML) and Cascading Style Sheets(CSS) were used as the languages of preference for the design of user input and output interfaces and PHP(Hypertext Preprocessor) used as a scripting language for linking the interfaces to the SQL(Structured Query Language) database(s)

The system is simple and easy to use. It has functionalities to facilitate registration of children and their parents, searching and data retrieval and report generation. This computerized record management system for immunization is therefore recommended for use not only in Nifase Silke Lafto Woreda One Health Center but also in all Woreda Health Center found in Addis Ababa City Administration.

CHAPTER ONE - INTRODUCTION

1.1 Introduction

Today, immunizations are one of the success stories of modern medicine. It is a very important tool for disease prevention in human beings. Vaccines protect against disease by inducing immunity. According to the World Health Organization (WHO), immunization is not only a vital tool in preventing diseases, but it's an effective way to eradicate some (1).

Immunizations are the single most important way you can protect your child against serious and sometimes deadly diseases. Many of the diseases that vaccines prevent can't be treated or cured. Many of them are especially dangerous for infants and young child. These diseases spread easily from person to person. Even one infected person can cause an outbreak of disease(2).

Lack of access to or knowledge of full immunization information directly affects patient care, leading to inappropriate vaccination (incorrect dose timing or over-immunization) and misuse of vaccines, which are a valuable and costly resource (3).

Keeping a record of immunizations helps make sure child gets all the vaccines they need at the right times. All child need a record of their immunizations before they go to child care, school, camp, college, the military, long-term care facilities, or for travel or employment. Immunization records are also helpful if you change clinics. It tells your new doctor or nurse which vaccines your child has had so they don't get more doses than needed(4).

Records Management system as a discipline involves records keeping. Record keeping is an important aspect of every organizations/ institution's day to day operations. There cannot be a records management system without records and neither can there be efficient record keeping without a good records management system. Therefore, record keeping is the systematic procedure by which the records of an organization are created, captured, maintained, and disposed of(5).

This system also ensures their preservation for evidential purposes, accurate and efficient updating, timely availability, and control of access to them only by authorized personnel(5).

In the early 1990's the Centers for Disease Control and Prevention (CDC) established an objective for public health agencies to implement population-based data systems to capture immunization events. The goal of the data systems was to increase the vaccine coverage levels of school-aged children. An immunization record should be available to a provider during a patient visit regardless of where that patient had received prior immunizations (6).

An Information System can be defined technically as a set of interrelated components that collect, process, store and retrieve, and distribute information to support decision making, coordination and control in an organisation. An information system is an organisational and management solution, based on information and communication technology(7). In this sense, the term is used to refer not only to the information and communication technology (ICT) an organization uses, but also to the way in which people interact with this technology in support of business processes and is therefore relevant to the development of a records management system. Therefore design and develop a good and efficient records management system for immunization should be able to incorporate specific aspects of the systems mentioned above in order to provide and efficient means of records storage and management.

1.2 Statement of the problem

The current record management system, which is managed manually is paper based and faces many problems, such as difficulty in data storage and retrieval, data inconsistency, data insecurity, risk of data loss, wastage of time in maintaining paper work and many more. All the information about the child treatment is maintained on the child immunization card and on the preformatted registration form. When the child visits the health center for treatment, child family is given a card indicating the date of visit, name of the Nurse giving the treatment, check-ups done, name of the vaccine and proper prescription. Thus the card contains complete history of the child. When the child visits the health center his family has to carry child card with them.

Disadvantage of this manual system is that the child family needs to carry his card with him every time. It may be the case that the child gets ill on the way, when he is out of city and may not carry the card with him. In that case he may have to undergo all the tests again. Thus the treatment may be delayed. Hence the traditional record management systems are not efficient.

The requirement analysis discovered that computerization of record management of the child immunization information would result in reduction of paper work, faster access to the entire contents, easy and durable storage, ease in the process of handling data, capability of the software to maintain child details, etc. To overcome all these drawbacks, the web based Record Management System has been developed. The purpose of this project is therefore to design and develop a web based records management system to allocate the above stated problems.

1.3 Objectives of the project

General objectives

The general objective of the project is to design and develop a computerized record management system for immunization.

Specific objectives

To achieve the general objective, the following specific objectives are drawn:

- ✚ Provide a web based system that can be run using a web browser for the electronic capture and confidential management of demographic and vaccine information of child.
- ✚ Provide secured functional database that records all immunization doses.
- ✚ Provide for Expanded Program on Immunization (EPI) users with the ability to update the demographic and immunization information in the system.
- ✚ Provide for Expanded Program on Immunization (EPI) users with the ability to generate official immunization records for their child.
- ✚ To evaluate and test the system that maintains immunization related records.

1.4 Significance of the project

Better data is not a goal in itself. Design and development of a record management System for immunization are only valuable to provide efficient and effective service by avoiding data redundancy and inconsistency that was exist in woreda one health center manual record management system. The importance of this project is the development of a web-based system that can be accessible using web browser. For the Health Center this project significantly reduced operational costs and increased productivity. For example, automation can speed recordkeeping and other tasks, allowing Nurses to see more Childs. Other operational savings may come from eliminating the need to store paper records, reducing the costs of requirements and other mandates by organizing information more effectively for auditing purposes.

Nurses who provide care will have better access to child information, and therefore better resources with which to make clinical decisions. Scheduling office visits and obtaining Child information in advance of an appointment will also be possible. Computer based record management systems also completely eliminate the need to perform tasks such as re-entering data from handwritten notes.

Nurses should also find it easier to retrieve electronic record than paper records, by using a simple computer interface rather than searching through physical files. Children benefit from better care that comes with accurate, clear medical records. Immediate access to information also benefits children because they are less likely to be subjected to unnecessary delayed treatment that can occur when Nurses don't have access to current treatment history.

1.5 Scope and limitation of the project

This project focuses on the design and development of a records management system for Immunization in Addis Ababa the case of Nifse Silke Lafto Sub-City Woreda One Health Center Department of Expanded Program of Immunization (EPI) in particular. This application will be functional to other woreda health centers. The EPI department is responsible for keeping child detail information, medical immunization, Growth monitoring and related records of children under the age of five and keeping track of this information. The records management system for immunization is developed in a way that makes it possible to access it through any web browser. This serves as the user interface. The web browser supported interface is dynamic and as a result backed by a database system that enables users to have the ability to input, access, manipulate and delete data from the database.

Hyper Text Markup Language (HTML) and Cascading Style Sheets (CSS) were used as the languages of preference for the design of user input and output interfaces. PHP (Hypertext Preprocessor) used as a scripting language for linking the interfaces to the SQL (Structured Query Language) database(s). PHP is a server-side scripting language that enables one the ability to insert into a web interface instructions that web server software would execute before sending a response to the web browser. Structured query is language used as the programming language for developing the database and manipulate and retrieve data from these relational databases.

CHAPTER TWO- LITERATURE REVIEW

2.1 Electronic Health Record (HER)

EHR is a systematic collection of electronic health information about an individual patient or population(8). It is a record in digital format that is theoretically capable of being shared across different health care settings. In some cases this sharing can occur by way of network-connected, enterprise-wide information systems and other information networks or exchanges. EHRs may include a range of data, including demographics, medical history, medication and allergies, immunization status, laboratory test results, radiology images, vital signs, personal statistics like age and weight, and billing information. The system is designed to represent data that accurately captures the state of the patient at all times. It allows for an entire patient history to be viewed without the need to track down the patient's previous medical record volume and assists in ensuring data is accurate, appropriate and legible. It reduces the chances of data replication as there is only one modifiable file, which means the file is constantly up to date when viewed at a later date and eliminates the issue of lost forms or paperwork. Due to all the information being in a single file, it makes it much more effective when extracting medical data for the examination of possible trends and long term changes in the patient .

2.2 Record management systems-why needed?

According to Professor Angelika Menne-Haritz, director of the archive school in Marburg, Germany, electronic office systems enable us to see clearer. "It is no longer the fear of being inundated by enormous amounts of paper, but awareness that nothing was left for appraisal, if we do not formulate fundamental principles, which make us think about a theory to guide everyday decisions." He continues to say that experience with electronic records sharpens our perception. Thus, the aim of (records management systems), is to make records eloquent and to facilitate research. In attempting to define a record Menne-Haritz stated(9).

Records are created because they are needed by those who create them, not as information collection but as intellectual working tools for the steering of cooperative decision-making processes and records are therefore reliable. The better they have served their primary purposes of initiating and controlling cooperative, purposeful, intellectual work, the more they are authentic and trustworthy in elucidating those processes for secondary purposes, be it evidential or informational. According to ARMA International, a not-for-profit professional association and authority on managing records and information, records management systems are important because Records are information assets and hold value for the organization. Effective records management ensures that the information needed is retrievable, authentic, and accurate (9).

2.3 Hospital information system

Is essentially a computer system that can manage all the information to allow health care providers to do their jobs effectively? These systems have been around since they were first introduced in the 1960s and have evolved with time and the modernization of healthcare facilities. The computers were not as fast in those days and they were not able to provide information in real time as they do today. The staff used them primarily for managing billing and hospital inventory. All this has changed now, and today hospital information systems include the integration of all clinical, financial and administrative applications. Modern HIS includes many applications addressing the needs of various departments in a hospital. They manage the data related to the clinic, finance department, laboratory, nursing, pharmacy and also the radiology and pathology departments. The hospitals that have switched to HIS have access to quick and reliable information including patients' records illustrating details about their demographics, gender, age etc. By a simple click of the mouse they receive important data pertaining to hospital finance system, diet of patients, and even the distribution of medications. With this information they can monitor drug usage in the facility and improve its effectiveness. Many hospitals have as many as 200 disparate systems combined into their HIS. Hospital information systems have become very advanced and new innovations are continuously being introduced. But a HIS is useless if it confuses the hospital employees (10).

The system must be user friendly and should include training by the vendors. A good HIS offers numerous benefits to a hospital including but not limited to the delivery of quality patient care and better financial management. The HIS should also be patient centric, medical staff centric, affordable and scalable. The technology changes quickly and if the system is not flexible it will not be able to accommodate hospital growth. Modern hospital information systems typically use fast computers connected to one another through an optimized network. These computers are programmed to collect, process, and retrieve patient care and administrative information ensuring better ROI and delivery of service. If the hospital authorities have more relevant information they can make better decisions. HIS leverage a highly optimized core library that ensures the delivery of operational and administrative information required by users. A centralized information system can be customized according to the specific requirements of a hospital. A hospital can tell the solution provider its needs and the applications can then be molded to deliver exactly what was demanded(10).

2.4 Immunization information systems

Many recordkeeping tasks, as well as patient reminder/ recall activities, can be greatly simplified by participation in a population-based immunization information system (IIS), also known as an immunization registry. An IIS is a computerized information system that contains information about the immunization status of each child in a given geographic area (e.g., a state). In some areas, an IIS is linked to a child's complete medical record. An IIS provides a single data source for all community immunization providers, enabling access to records of children receiving vaccinations at multiple providers. It provides a reliable immunization history for every enrolled child and can also produce accurate immunization records, if needed for school or summer camp entry. The Task Force on Community Preventive Services recommends immunization information systems on the basis of strong evidence of effectiveness in increasing vaccination rates. Specifically, the Task Force concluded that IIS are directly related to increasing vaccination rates through their capabilities to create or support effective interventions such as client reminder/recall systems, provider assessment and feedback, and provider reminders (11) ;

generate and evaluate public health responses to outbreaks of vaccine-preventable disease; facilitate vaccine management and accountability; determine client vaccination status for decisions made by clinicians, health departments, and schools; and aid surveillance and investigations on vaccination rates, missed vaccination opportunities, invalid dose administration, and disparities in vaccination coverage(11).

2.5 System development approaches

A system development methodology refers to the framework that is used to structure, plan, and control the process of developing a system. One system development methodology is not necessarily suitable for use by all projects. Each of the available methodologies is best suited to specific kinds of projects, based on various technical, organizational, project and team considerations (12).

System analysis and design

System analysis is the process of gathering and interpreting facts, diagnosing problems, and using the information to recommend improvements to the system. (13).

System design is the process of art of defining the architecture, component, modules, interface, and for system to satisfy specified requirement. Architecture design creates a blue-print for the design with necessary specification for the hardware, software; people and data resources. In many cases multiple architectures are evaluated before one selected. The research question such as what is currently being done, how is it being done? How well is the task being performed?(14).

Object-oriented software design

Object-oriented software design is a design strategy where system designers think in terms of ‘things’ instead of operations or functions. The executing system is made up of interacting objects that maintain their own local state and provide operations on that state information. They hide information about the representation of the state and hence limit access to it(15).

An object-oriented design process involves designing the object classes and the relationships between these classes. When the design is realized as an executing program, the required objects are created dynamically using the class definitions. Object-oriented analysis and design is more cost-effective and a faster way to develop software and systems. This technology cuts development time, overhead and enables software engineers to make reusable, reliable and easily maintainable applications. In addition, this technology offers a new and powerful model for writing software. OOP (Object-oriented programming) allows decomposition of a problem into a number of objects and then builds data and functions around these objects(15).

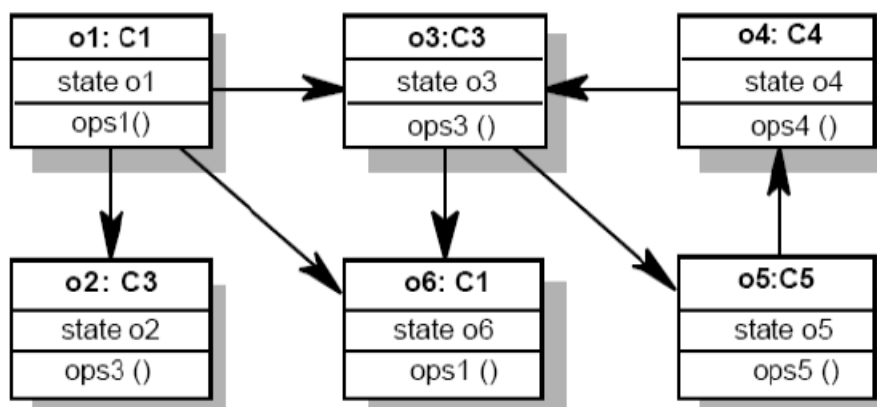


Figure2.1 System with interacting objects

Prototyping

Although the object-oriented analysis and design describe the system features, it is important to construct a prototype of some of the key system components shortly after the products are selected. It has been said "a picture may be worth a thousand words, but a prototype is worth a thousand pictures" not only is this true, it is an understatement of the value of software prototyping. Essentially, a prototype is a version of a software product developed in the early stages of the product's life cycle for specific, experimental purposes.

A prototype enables you to fully understand how easy or difficult it will be to implement some of the features of the system. It also can give users a chance to comment on the usability and usefulness of the user interface design and lets you assess the fit between the software tools selected, the functional specification, and the user needs. Additionally, prototyping can further define the use cases, and it actually makes use-case modeling much easier(16).

Building a prototype that the users are happy with, along with documentation of what you did, can define the basic courses of action for those use cases covered by the prototype. The main idea here is to build a prototype with uses-case modeling to design systems that users like and need. Traditionally, prototyping was used as a "quick and dirty" way to test the design, user interface, and so forth, something to be thrown away when the "industrial strength" version was developed. However, the new trend, such as using rapid application development, is to refine the prototype into the final product. Prototyping provides the developer a means to test and refine the user interface and increase the usability of the system. As the underlying prototype design begins to become more consistent with the application requirements, more details can be added to the application, again with further testing, evaluation, and rebuilding, until all the application components work properly within the prototype framework' (16).

2.6 Related Works

Related research project on design and development of a record management system for immunization could not be found directly as far as the researcher's knowledge. Therefore, Electronic medical record (SmartCare) was considered as a related work.

The project conducted by Federal Ministry of Health in collaboration with Tulane University by customizing EMR to the context of Ethiopian public health facilities. Electronic Health Record is responsible for automating a range of data, including demographics, medical history, medication and allergies, immunization status, laboratory test results, radiology images, vital signs, personal statistics like age and weight, and billing information. Immunization is included as a package in this application. The objective is to improve the effectiveness and efficiency of the health services and the day to day activities of health care. The assessment done in 2013 by health informatics students shows that SmartCare in Addis Ababa public hospitals are not currently functional

CHAPTER THREE – METHODOLOGY

Methodology is a term used to describe a process, technique or manner in which an action is performed. Under the development a system, a methodology refers to the process that was taken to ensure that a system is effectively and efficiently developed.

In designing the records management system for Woreda One Health Center, the following system development methodology was used.

3.1 System development methodology

System development methodology is a standard process followed in an organization to conduct all the steps necessary to requirements analyze, design, development, and test.

Rapid application development was used as the methodology of choice in developing a records management system for woreda one health center.

Rapid application development

Rapid Application Development is a software development methodology that involves techniques like iterative development and software prototyping. RAD is designed to take advantage of powerful development software like CASE tools, such as prototyping tools and code generators. The key objectives of RAD are: High Speed, High Quality and Low Cost. RAD is a people-centered and incremental development approach. Active user involvement, as well as collaboration and co-operation between all stakeholders are imperative. Testing is integrated throughout the development life cycle so that the system is tested and reviewed by both developers and users incrementally.

RAD compresses the step-by-step development of conventional methods into an iterative process. The RAD approach thus includes developing and refining the data models, process models, and prototype in parallel using an iterative process. User requirements are refined, a solution is designed, the solution is prototyped, the prototype is reviewed, user input is provided, and the process begins again(17). The figure1 below shows RAD is iterative development task into sequential phases.

Written documents, and on-site-observation analysis were used as a main tool to capture the business system requirements. Unified modeling language (UML) approach applied in the process of requirements capture, model business process and design. Netbeans5.5, StarUML and Visio Software were employed in analysis and design models /diagramming.

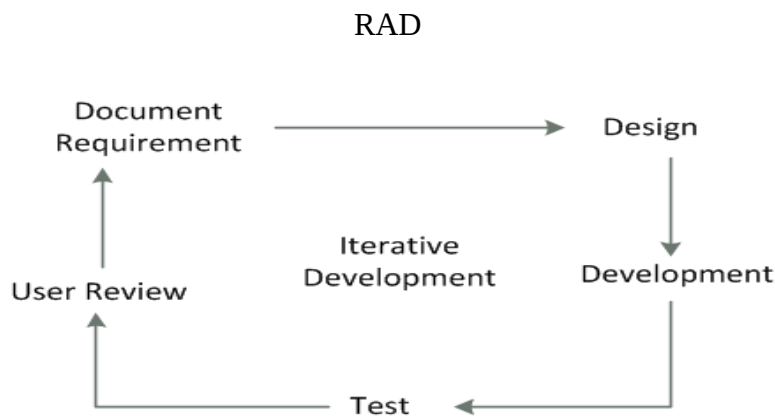


Figure 3.1 Rapid Application Development: [source:IMM006 RAPID APPLICATION DEVELOPMENT note chapter 1] .

3.2 The Study Setting

The research project focuses on the design and development of a record management system for immunization in case of woreda one health center .Which is located in the Nifase Silke Lafto sub-city, within 15 minutes of the sub-city Administration .

Woreda One Health Center is one of the twelve's health center found in Nifse Silke Lafto sub-city. It started operation in 2013. It serves a population of 37,650 people who live around Nifse Silke Lafto sub-city woreda one and its environs. Services offered include Emergency, Maternity, Laboratory, Pharmacy, family planning, Pediatrics and Expanded Program of Immunization (EPI) departments. The health Centre has 20 clinical nurses diploma level, 12 health officers, 19 with Bsc.degree nurses, 5 Laboratory technician,8 midwife (18). In short, woreda one health center is representative of many similar health centers found in Addis Ababa City Administration.

3.3 Study population

The study includes the Nifase Silke Lafto Sub-City Woreda One Health Center, particularly Expanded program of Immunization (EPI). Staffs members work at EPI department are three. All are selected purposively for interview because on the researcher observation they are small in numbers, homogeneity of their qualification, no work division and respondents willingness.

3.4 Data collection tools

Data was collected through written documents ,interview and on-site-observation. Infant immunization card, Growth monitoring and promotion chart, EPI(expanded program on immunization) vaccines and injection materials stock record form, tally sheet ,reports form and organizational charts are used as document in this project.

3.5 Data analysis and design

In the requirement analysis and design phase Data presented were made business process modeling, use case diagram, use case description, sequence diagrams, class diagrams, deployment diagram, interface design. To help users critically examine the current state of systems and processes, identify exactly what needs to change, and develop a concept for a new system significant change on the existing system.

3.6 Evaluation technique

The developer and users evaluate the new system developed based on the predefined objectives and requirements of the user.

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CHAPTER FOUR- MODELING AND ANALYSIS

The aims of this chapter for requirements gathering and then analysis using UML functional analysis models use cases to describe the basic functions of the information system and activity diagram to support the logical modeling of business processes and workflows. Both logical models support to understand the function or external behaviors that serve to model the problem domain of the system.

4.1 Requirement gathering

This is a process where by the system analyst collects requirements about the system to be developed. Data was collected using the following tools:

Written documents: The analyst collects the information/data from written documents available and from manual-files of the organization. This method of data gathering is normally used if one wants to computerize an existing manual system or upgrade the existing computer based system.

In this project, during data collection the analyst found written documents regarding Infant immunization card, Growth monitoring and promotion chart, EPI(expanded program of immunization) vaccines and injection materials stock record form, tally sheet ,reports form and organizational charts. The written documents provide valuable information about the existing system.

Interviews: Interview is another requirement gathering technique. The analyst in this project used interviews as requirement gathering technique to acquire information about the system. All three nurses who work at the health center selected for interview because they are small in number and homogenous in their qualification. The analyst in this project used structured interview. The questions asked were precise, relevant and to the point. Structured interview is formal fixed questions to collect specific information whereas unstructured interview is more or less like a casual conversation where in-depth areas topics are covered and other information apart from the topic may also be obtained. Interview questions and answers attached on the appendix.

Preparation for interview:

Before the analyst started designing interview questions and process, clearly articulate what problem or need is to be addressed using the information to be gathered by the interviews.

This helps the analyst keep clear focus on the intent of each question.

Approaches the analyst used in this interview:

1. Introduced myself.
2. Explained the purpose of the interview.
3. Explained the format of the interview and the type of interview I was conducting.
4. I told them how long the interview takes.
5. I asked them if they have any questions before I get started with the interview.
6. I asked for permission to record the interview.
7. Interview is conducted
8. Last I said thanks for the time they had give me for the interview.

On-site observation: Unlike the other fact finding techniques, in this method the analyst himself visits the organization and observes and understand the flow of documents, working of the existing system, the users of the system etc. For this method to be adopted it takes an analyst to perform this job as he knows which points should be noticed and highlighted. The analyst may observe the unwanted things as well and simply cause delay in the development of the new system(19). Observation was used as a research methodology of choice in designing the records management system for woreda health center because; Observations give additional, more accurate information on child immunization.

4.2 Requirement analysis

After completion of requirement gathering the collected data about the system is analyzed to ensure that the data is complete. The requirements are determined and defined below.

Functional Requirements

These describe the interaction between the system and its users, and between the system and any other systems, which may interact with the system by supplying or receiving data.

The main functionalities available in this system are :

1. Maintain child /parent detailed. Entity should contain the following attributes .

child_mrn_, first_name, father_name, grandfather_name, sex, date_of_birthdate, date_of_registration,sub_city, woreda, house_no, date_of_birth, cell_phone, home_phone, religion.

2. Maintain child immunization records . Entity should contain the following information for vaccine administered:

child_mrn_, vaccine_type, body_site, admin_method, age_at_vaccine, next_appointment, vaccinated_date, staff_id

3. Immunization information accessed by authorized persons who require maintaining.

4. Maintain Growth monitoring. Entity should contain the following attributes.

child_mrn_, current_height, weight, head_circumference, development_status, recommendation.

5. Maintain Staff members record. Entity should contain the following attributes.

staff_id_, first_name, father_name, grandfather_name, qualification, gender.

6. Maintain vaccine stock management. Entity should contain the following attributes.

batch_no_, vaccine_type, date_received, received_from, received_doses, issued_doses, discarded_doses, balance_doses, presentation_doses, manufacturer, manufactred_date, expiry_date.

7. Immunization information report generates.

Non-functional requirements

Any requirement that does not fall in the functional requirements. Such requirements include response time, reliability, performance, supportability, security and recovery. Sometimes, there may be considerations that place restrictions on system development; these may include the use of specific hardware and software and budget and time constraints.

- ☐ The system should be a web-based application.
- ☐ Modules organized in a tab on a main window (usability)
- ☐ The system must be password-protected.(Security)

4.3 Business process model for immunization

Business process models focus on a dynamic view of information processing. The concepts used are activities and their chronological and logical order.

Typical questions to be answered with business process models are:

- Which activities are executed with regard to a given enterprise function?
- Who is responsible and which tools are used in a given process?
- Which activity is the pre or post condition for a given activity?

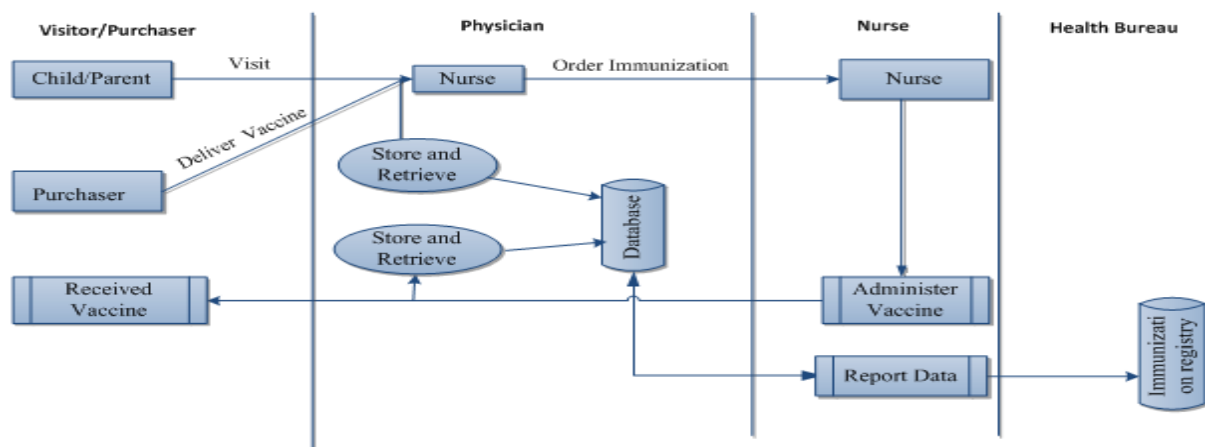


Figure4. 1 Business process model for immunization

Description of the business process model for immunization

- 1.The child information record is entered on the child record form(database)
- 2.Parents information is registered on the child detail form.
4. Immunization records are entered in the immunization record file.These records are used to know which immunizations the child has already received to avoid repetition.
5. On request for service, the records are searched for a history of immunizations. If the required criteria are met, the child is immunized else the request is rejected.
6. When the child has been immunized, or child card is issued to the parents which can be used to Confirm the immunization and be used in the next request.
7. Purchaser deliver vaccines when nurses order.
- 8.According to the schedule nurse send report to woreda health bureau.

Use cases: Use cases are scenarios for understanding system requirements. A use case is an interaction between users and a system. The use-case model captures the goal of the user and the responsibility of the system to its users. In this project requirements analysis, the use cases are described as text, easy to read and a clear flow of events to follow(20).

Business (Essential) use cases (business process)

- ✓ General sequences of events that describe all the possible actions between an actor and the system for a given piece of functionality.
- ✓ An essential use-case is a simplified, abstract, generalized use case that captures the intentions of a user in a technology free description.
- ✓ An essential use case is a structured narrative, expressed in the language of the application domain.

4.4 Functional model

The functional model represented in UML with use case diagrams, describes the functionality of the system from the user's point of view

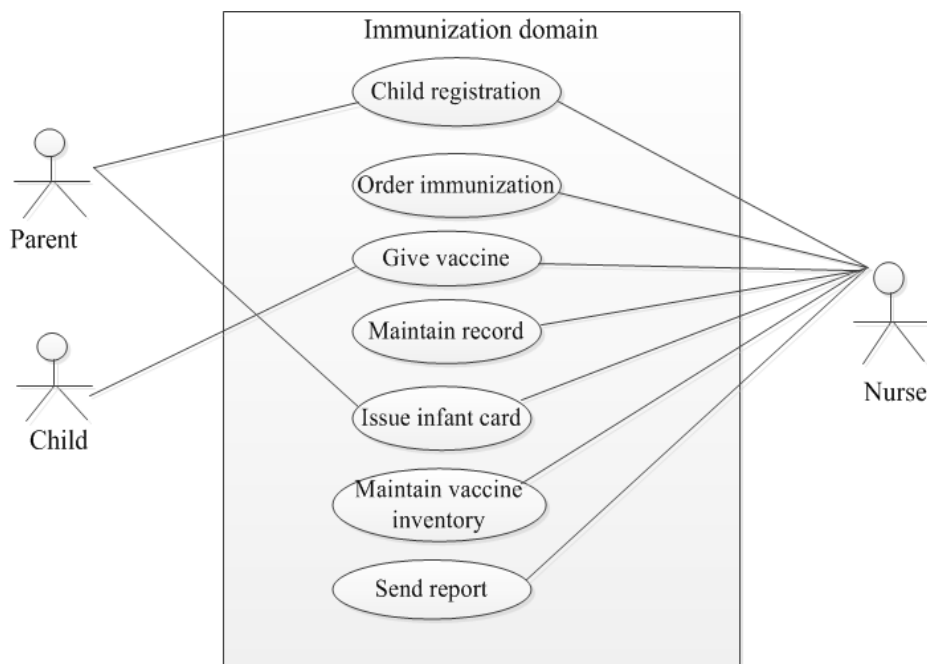


Figure4.2 Use case model

4.5 Business use case description

Use Case Name	Registration
Actors	Child's mother/parent, Nurses
Flow of event	- Child's mother comes with her child to Nurse for registration. - Nurse request child's detail information - Mother give child detail information - If child comes for the first time ,Nurse register child information on a child card and registry file - If child comes for appointment visit, Nurse no need to register child detail information - Nurse see child card appointment - Nurse order vaccine
Exit condition	Child detail Registry

Table 4.1 *The registration business use case*

Use Case Name	Immunization
Actors	Child, Nurse
Flow of event	-Child comes to Nurse for due immunization -Nurse sees child history from his /her card what kind of vaccine taken before . -Nurse order an immunization to child -Nurse administer immunization -Nurse record data on child card and paper file -Nurse give next appointment date -Nurse give additional advice .
Exit condition	Immunization registry

Table4.2 *The immunization business use case*

Use Case Name	Growth Monitoring
Actors	Child,Nurse
Flow of events	- Child comes to Nurse for growth measurement - Nurse measure child's weight,height and head circumference when child comes to visit - Nurse stat child's development status - Nurse record data of child growth monitoring - Nurse show development status on the graph - Nurse order Nutrition based on the standards - Nurse give additional advice
Exit condition	Growth monitoring

Table4.3 Growth monitoring use case

Use Case Name	Vaccination drug Record
Actors	Supplier, Nurse
Flow of event	-Nurse order EPI vaccine and Injection materials - Supplier deliver EPI vaccine and Injection materials -Nurse perform record on a preformatted stock record form -Nurse make balance using received,issued,discaed and present dose fields on the stock record -Nurse check available vaccines and injection materials on the stock -Nurse order supply based on the schedule.

Table 4.4 The vaccine inventory record business use case

CHAPTER FIVE – SYSTEM DESIGN

5.1 System design

According to (21), system design is the process of defining the architecture, component, modules, interface, and for system to satisfy specified requirement. Architecture creates a blueprint for the design with necessary specification for the hardware, software, people and data resources.

5.2 The unified modeling language

The Unified Modeling Language (UML) is a graphical language for visualizing, specifying, constructing, and documenting the artifacts of a software-intensive system. The UML offers a standard way to write a system's blueprints, including conceptual things such as business processes and system functions as well as concrete things such as programming language statements, database schemas, and reusable software components (22).

Unified modeling language (UML) is a standard used by developers to model the application domain. UML is a language of graphical symbols that are used in depicting and describing:

- A system in general system architecture
- System components
- The interaction of the system components

UML models

- The **functional model**, represented in UML with use case diagrams, describes the functionality of the system from the user's point of view
- The **object model**, represented in UML with class diagram, describes the structure of the system in terms of objects, attributes, associations, and operations
- The **dynamic model**, represented in UML with activity diagrams, describes the internal behavior of the system .

System use case diagram

- ✓ Describes the use case in a graphical way
- ✓ That is, what a system does from the standpoint of an external observer (actor).
- ✓ The emphasis is on what a system (functions) does rather than how

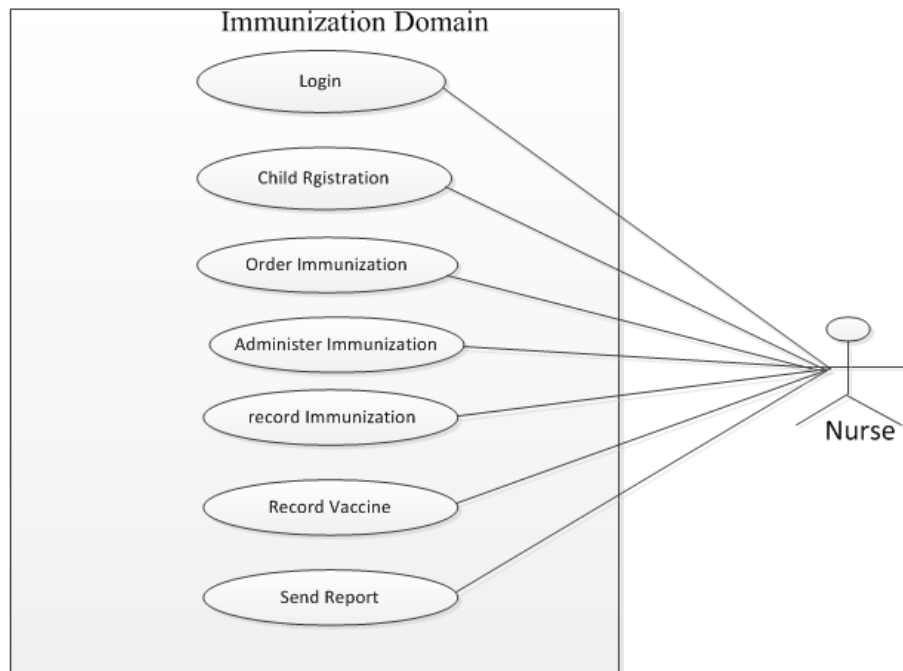


Figure5.1 System use case diagram

System use case description

Use case analysis is a case-based way of describing the uses of the system with the goal of defining and documenting the system requirements. It is essentially a narrative describing the sequence of events (actions) of an external agent (actor) using the system to complete a process. It is a powerful technique that describes the kind of functionality that a user expects from the system. Use cases have two or more parties: agents who interact with the system and the system itself(23).

Actions performed by the actor	Responses from the system
1.The user Start the system 3.The user enter password 5.The user do their activity	2.The system request user password 4.If the user name and password are correct working modules open based on their privilege else return to login dialog.

Table1 5.1 Login system use case

Actions performed by the actor	Responses from the system
1.The Nurse fill child information 2 The Nurse issues a request to add a new Child detail. 4. The Nurse enters the data (which is MRN or Name of child) into the system. 6.If the child was not registered before the Nurse enter child detail information 7.Nurse click add button to enter a new child information	3. The system asks for data about the child. 5. Reads in data, and if the child already Added , generates a child information else it says Not registered 8.The system display one record added.

Table5.2 Child register system use case

Actions performed by the actor	Responses from the system
1.The nurse give vaccine 2. The Nurse issues a request(by child MRN) to add vaccine record. 4. The Nurse enters the data (which is the type of vaccine given to child) into the system. 5. Nurse click add button to enter vaccine information. 7. Nurse click Exit button	3. The system asks for data about Child vaccine. 6. System display one record added. 8.The system logout.

Table 5.3 Immunization record system use case

Actions performed by the actor	Responses from the system
1.Nurse measures child weight, head circumference, Current height and Development status. 2. The Nurse issues a request (by child MRN) to add vaccine record. 4. The Nurse enters the data (which is the type of vaccine given to child) into the system. 5. Nurse click add button to enter vaccine information. 7. Nurse click Exit button	3. The system asks for data about Child vaccine. 6. System display one record added. 8.The system logout.

Table 5.4 growth monitoring record system use case

Actions performed by the actor	Responses from the system
1. Nures enter criteria to find lower quantity vaccine. 2. Nurse fined lower quantity vaccine type. 4.Nurse select purchase vaccine report to be printed 5. Nurse click print command 7.Nurse confirm order vaccine type 8. Nurse order vaccine types to purchaser 9. Nurse click exit command	3. System display search result. 6. The system prints the report. 10.The system logout.

Table 5.5 Vaccine inventory record system use case .

Sequence Diagram

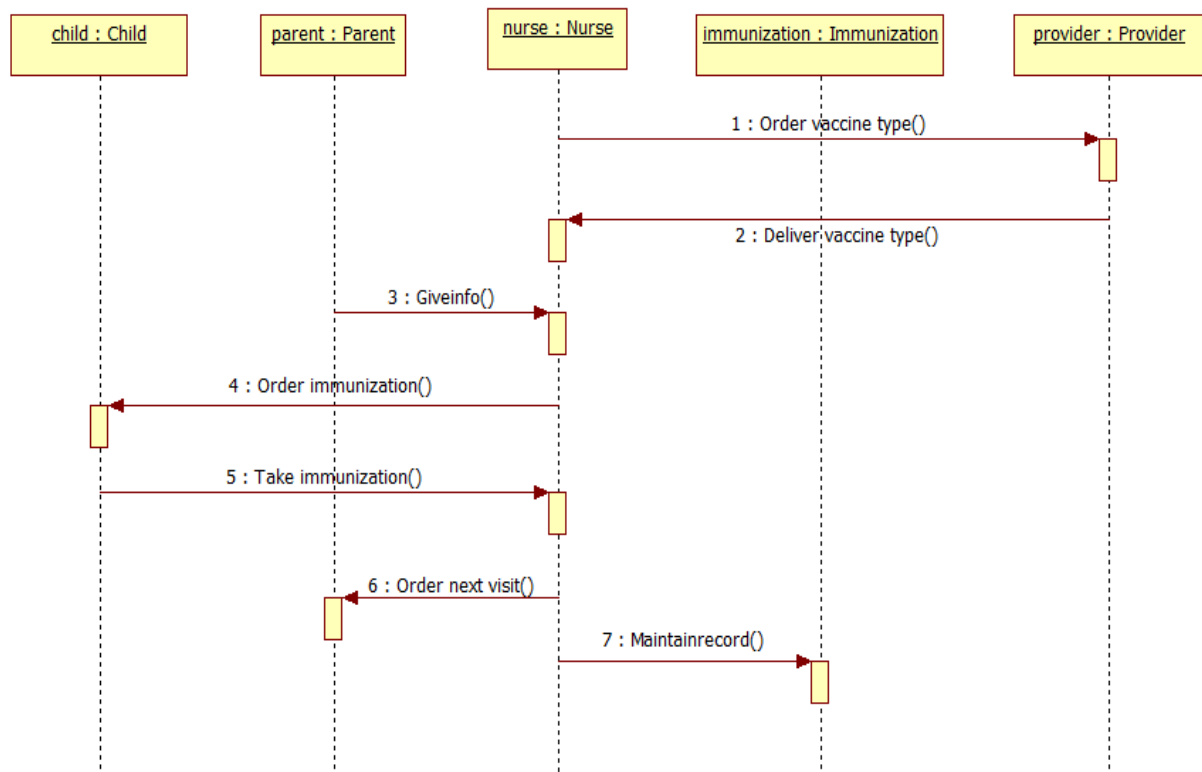


Figure5.2 Sequence diagram

Class diagram of immunization

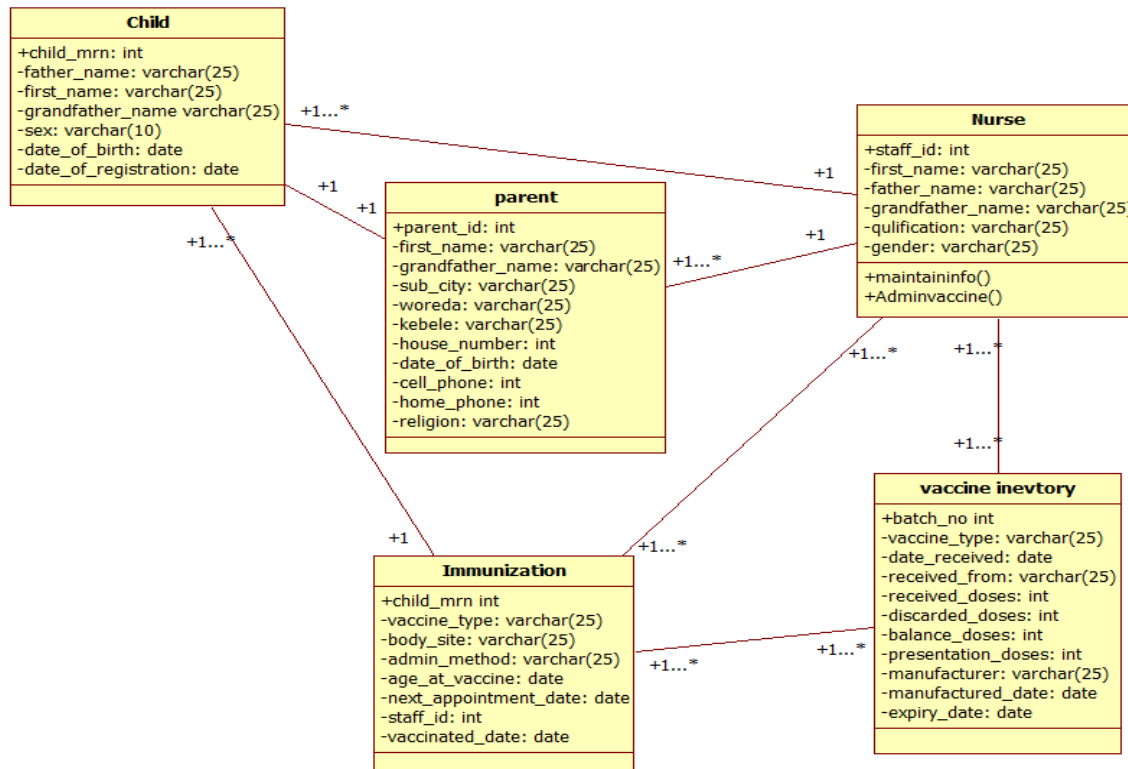


Figure 5.3 Class diagram

Activity diagram

This is somewhat like a flowchart in that it shows the sequence of events in an activity. Just as a flowchart, it uses several types of nodes such as actions, decisions, merge points, etc. It accommodates objects with suitable types that depict objects, object flows, etc.

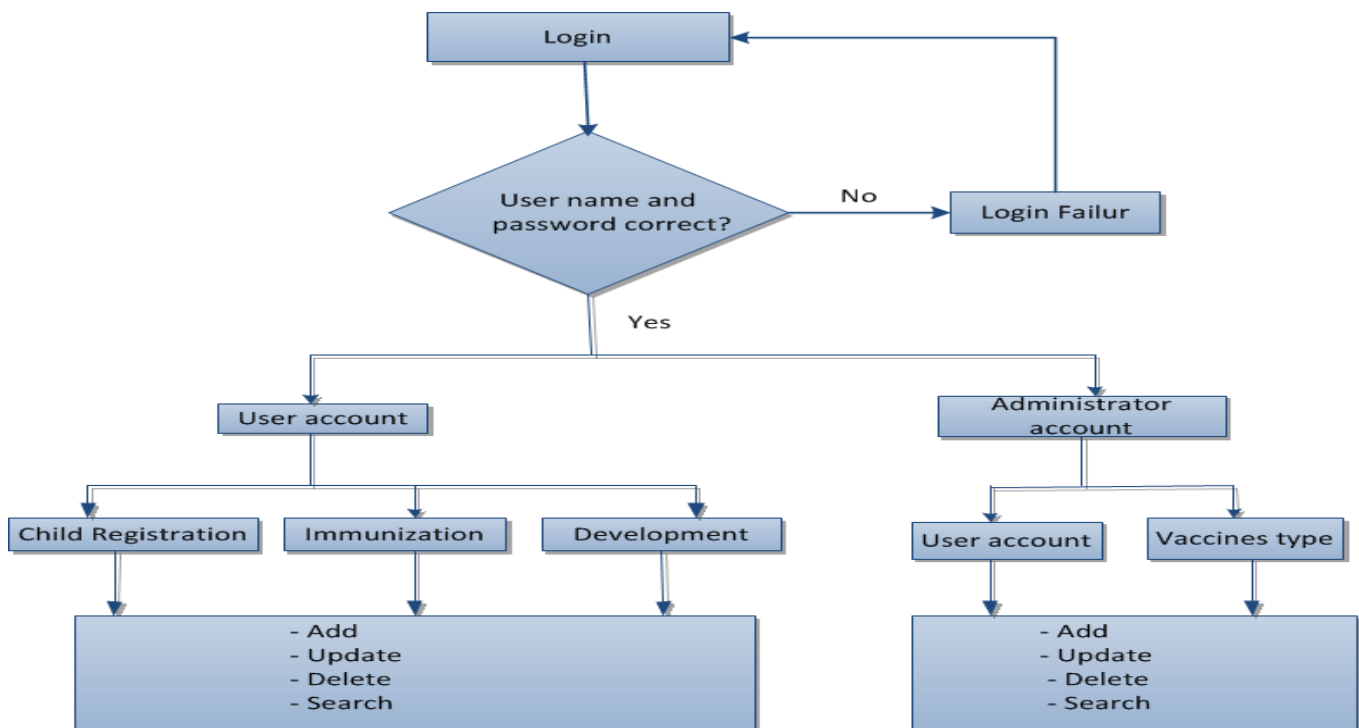


Figure5.4 Activity diagram for Immunization system

Deployment Diagram

Deployment diagrams depict a static view of the run-time configuration of processing nodes and the components that run on those nodes. In other words, deployment diagrams show the hardware for your system, the software installed on that hardware, and the middleware used to connect the disparate machines to one another.

This project architecture is 3-tier model. The 1st tier (“database tier”) will run a MySQL 5.5 database that will be accessed through Apache as web server residing in the 2nd tier (“business logic tier”). The 3rd tier (“presentation tier”) uses HTML the language used to write web pages the user interface module. The HTML will be integrated with other technologies such as Cascading Style Sheets. The system architecture is summarized in Figure.

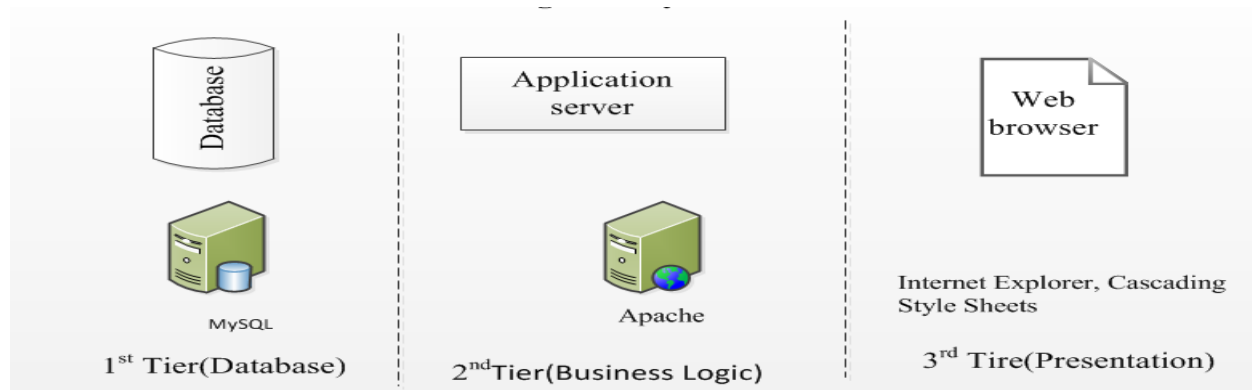


Figure 5. 5 system architecture for immunization

5.3 Accessing the system

A user starts the process by logging into the system by means of a valid username / password combination. A new user has to first be registered in order to obtain access to the system. Users with administrative privileges have authorization to register new system users. A new users can be registered with either limited (normal user) or unlimited (administrative) privileges.

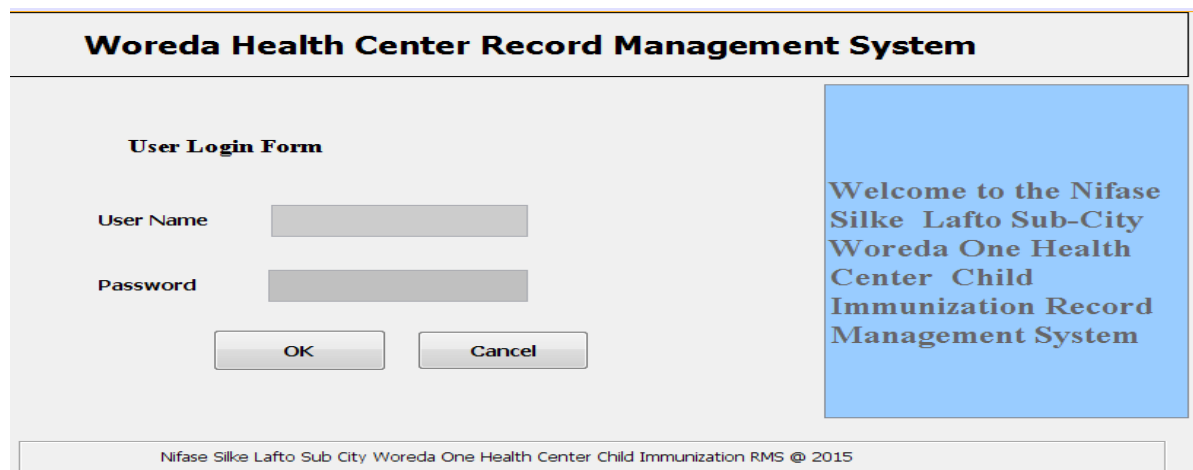
During the process of user registration, all users are issued with a unique user name and password combination as well as a specific user type (limited or unlimited). This combination is then used by the registered user to access the system resources that fall under their privilege level. A user gains access to the system resources after a username password combination has been verified as accurate after which they are redirected to the homepage.

The system homepage serves as the gateway to the entire records management system. Therefore, once a user is logged into the system they can access all system resources available to them based on their privilege level. Once logged into the system, the user can create, manipulate and truncate records. However, the amount of manipulation that a user can perform with regards to the records is dependent on user privilege levels .

5.4 User interface design

Login form

The login form is the first page that appears to a person accessing the system. It is used to gain access to the system resources and determines, based on the user type, which users should access which resource



The screenshot displays the login interface for the 'Woreda Health Center Record Management System'. The title bar at the top reads 'Woreda Health Center Record Management System'. Below this, the main area is divided into two sections. On the left, under the heading 'User Login Form', there are input fields for 'User Name' and 'Password', followed by 'OK' and 'Cancel' buttons. On the right, a blue box contains the text: 'Welcome to the Nifase Silke Lafto Sub-City Woreda One Health Center Child Immunization Record Management System'. At the bottom of the window, a footer bar states 'Nifase Silke Lafto Sub City Woreda One Health Center Child Immunization RMS © 2015'.

Figure 5.6 Login form

Data entry and manipulation forms

Data entry and manipulation forms depicted the system include the data add, delete, edit and search forms. The add and edit functions are accessible to both the administrator and normal user who is expected to be the main data entrant. However, access to the delete forms is restricted to a user with administrative privileges.

Child detail form

This form is used to collect child details and store them into the system database. The form is also useful in showing the Immunizations a child has undergone.

The screenshot shows a software window with a tabbed interface. The 'Child Detail' tab is selected. The form contains the following fields and controls:

- First Name: Text input field
- Father Name: Text input field
- Grandfather Name: Text input field
- Sex: Dropdown menu with 'Male' selected and 'Female' as an option.
- Birth Date: Date picker showing '01' for the day and a 'Cal...' button for the calendar.
- Date of registration: Date picker showing '31' for the day and a 'Cal...' button for the calendar.
- Buttons: 'Submit', 'Update', 'Delete', 'Search', and 'close'.

Figure 5.7 Child detail form

Immunization form

This form is used to record child immunization details, who are allowed to add, update and delete the record.

The screenshot shows a software window with a tabbed interface. The 'Immunization' tab is selected. The form contains the following fields and controls:

- Child-MRN: Text input field
- Body Site: Dropdown menu with 'Oral(1)' selected.
- Given Date: Date picker with fields for 'Date' (01), 'Month' (1), and 'Year' (2015).
- Next Appointment Date: Date picker with fields for 'Date' (01), 'Month' (3), and 'Year' (2015).
- Vaccine Administration: Dropdown menu with '15'(101)' selected.
- Vaccine Type: Dropdown menu with 'BCG(11)' selected and a list of other options: BCG(11), OPV0(011), OPV1(022), OPV2(033), and OPV3(044).
- Vaccination Given By: Text input field.
- Buttons: 'Save', 'Delete', 'Search', and 'Close'.

Figure 5.8 Immunization form

Staff form

This form is used to record staff details who is allowed to add, edit , update ,delete and search immunization record, besides other dynamic records.

Staff Members Detail

Staff ID

First Name

Last Name

Qualification
Diploma
Degree
Masters
Dr.

Figure 5.9 Staff form

Parent Information

Parent id

First Name Father Name Grandfather Name

Sub city
Nifase Silke
Lideta
Bole
Yeka
Arada

Woreda Religion

Cell phone Home phone

Figure 5.10 parents form

Growth Monitoring Form

Child MRN

Current height Weight Head circumference

Development status
Normal
Normal
Abnormal

Recommendation

Figure 5.11 Growth monitoring form

Figure 5.12 vaccine inventory form

Children immunization report form

MONTHLY EPI VACCINATION REPORTING FORM

Region A.A Sub-City N/S/L HF _____ Reporting Month _____ Year _____

Heal Unit _____

VACCINATION GIVEN TO CHILDREN														
BCG	OPV				IPV	DPT-Hep-Hib			PCV			Rota		Measels
	0	1	2	3		1	2	3	1	2	3	1	2	

Table5.6 Immunization report form

5.5 Implementation and Testing

Implementation

In this phase the design of the system was converted into construction of the new system .These activities include program and system testing. The tools used for coding are PHP and HTML and MYSQL as database management system. The code sample of this project is attached on appendix.

Testing

Testing is the process of verifying and validating the system designed and developed record management system with the user's requirements. The system is found to be error free and is achieving its goal. In the process three levels of testing were conducted;

- ✚ **Component testing:** In the development of the records management system, each component was tested independently. This test was done to verify that every input of data was assigned to the appropriate tables of fields.
- ✚ **Integrated testing:** All the system components were integrated and a test was based on how they worked together. This involved observing the interaction of the database and the interfaces. Integrated testing test functional and non functional requirements of the software. Testing involved using the web application with an intention to discover any errors. Therefore the testing was done in order to clearly the proper functionality of the new computerized system.
- ✚ **Acceptance testing:** This testing is conducted to determine whether or not a system satisfies its acceptance criteria of the user.

Due to some constraints, this part of testing was not done by developer with users of the system, however, after the oral presentation of the project work, the system developer will analyze acceptability and usability and also to identify areas that may require modification before the system can fully be ready for use.

5.6 Evaluation of the system

Web based record management system provides more efficient and better performance as compared to manual health center record management system. Paper work will be reduced to a large extent. Several tasks like registration of children on register, immunization, drug inventory, which consumed more time previously are now jobs of just a few button clicks.

Computer based record management system for immunization allows for the storage of child information and electronic access to EPI users database.

The interface with user is through forms that are totally graphics oriented and user friendly. Even a layman can handle the whole work after a short-term training.

The Records Management System for immunization was evaluated based on the set of predefined objectives and expected functionalities. The Records Management System was designed and developed to facilitate efficient records management in woreda one health center by providing an efficient, reliable computerized records management system. after a careful evaluation process; it was found that it meets a considerable portion of those expectations.

The main objective was to computerized child immunization records that enable faster and more efficient storage, retrieval and updating the records. The designed and developed record management system functionality is evaluated by entering false data using a web browser, retrieve records on demand and execute important reports tasks.

Fundamentally, the effectiveness of this project depended on meeting the project's specific objectives. All the objectives were met by the system, to a certain extent. Analysis was successfully completed. This evaluation is based on the fact that data requirements were collected that successfully enabled the design and development of the system. The system design and development was carried based on user requirements defined by the end users.

The design and development objectives of creating an efficient records management system was further accomplished with the creation of add, delete, search and edit functionalities in the system that not only enable computerized but rather efficient, reliable and fast data entry.

Challenges encountered

During the development of this system, several challenges were encountered.

- ✓ The time allocated for the project was very little and this meant that I had to work extra hours to ensure timely completion the project.
- ✓ Budget was also a problem as the project required
- ✓ The limited variety of books and journals related to the research project topic in the local library.
- ✓ University's slow internet speeds that made difficult to download books and journals.

CHAPTER SIX- CONCLUSION AND RECOMMANDATION

6.1 Conclusion

Immunizations or Vaccinations play a big role in any infant's life. Health centers besides keeping child healthy, they must keep child immunization record electronically because all children need a record of their immunizations before they go to child care, school, long-term care facilities and foreign travel. Immunization records are also helpful if you change clinics. It tells your new doctor or nurse which vaccines your child has had so they don't get more doses than needed.

The current system is managed manually, it is paper based faced many problems, such as difficulty in data storage and retrieval, data inconsistency, data insecurity, risk of data loss, wastage of time in maintaining paper work and many more. Based on the finding of this study, the designed and developed record management system for immunization is a solution to the problem being experienced by the current manual method of keeping immunized child's record.

The study indentified the importance associated with using electronic data in keeping child immunization record to eliminate missing files and enhance speedy retrieval of records.

The Health Center medical director and EPI workers had agreed that the manual method of keeping child records should be changed to computerized records management system which will help them to eliminate inefficiency, and inaccuracy associated with the manual method.

The designed and developed record management system for immunization met the specific objectives of the project. This project follows a rapid application development methodolgy. The system undergoes requirement gathering and analysis, design and development phases. The system is analyzed using models/diagrams such as business use case diagram and business process model(context diagram). All modules on the user interfaces built to fit in to the system requirements. This module has been accepted by the health center users.

The application is web based and built on three -tier architecture using the latest technologies such as MySQL database server as back end, Apache as a web server, CSS and HTML as front end user interface. The application is users friendly and expandable. It covers all the required modules in relating child registration, Immunization , parent details, Staff members detail ,drug inventory and report.

6.2 Recommendation

I would recommend the system to be improved further by expanding the project scope to other department's record management system in woreda health center and develop a system for parents to be receiving alerts through their mobile phones about a scheduled immunization. This will ensure that no parent will ever miss to take their children for immunization. The system should also be introduced to other woreda health centers.

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Appendix I – System requirements

Hardware requirement

- Processor Pentium II, Pentium III, Pentium IV or higher
- Monitor (LCD)
- RAM (512MB)minimum
- DV-RW
- Hard disk capacity of 80GB minimum
- LAN Ethernet 10/100Mbps card/bus.

Software requirement

Software	Version	Description
Operating System	Windows 7 Ultimate	
PHP	5.0.x series	the server side scripting language
MySQL	5.5.x series	A database server
Apach	2.0.61	Web server
HTML(Hyper Text Markup Language)	5.0	the language used to write web pages, and the development of web servers and web clients (browsers) helped its expansion.

Appendix II –Implementation code

Sample code

Connecting child registration interface to the database

```
<?php

$dbhost="localhost";

$dbuser="root";

$dbpass="abr";

$dbname="rmsidb";

$connection=mysqli_connect($dbhost,$dbuser,$dbpass,$dbname);

//Test connection

if(mysqli_connect_error())

{die("Database connection failed:".mysqli_connect_error())

}  ?>

<?php

//child info

$firstname = $_POST["firstname"];

$middlename = $_POST["middlename"];

$lastname = $_POST["lastname"];

$sex = $_POST["gender"];

$bod = $_POST["BOD"];

$regdate = $_POST["regdate"];

$parentid= $_POST["parentid"];
```

//2.Perform database query

```
$query = "INSERT INTO childreg(first_name,
father_name,grandfather_name,sex,date_of_birth,date_of_registration,parent_id)VALUES
('{$firstname }', '{$middlename}','{$lastname }', '{$sex}', '{$bod}','{$parentid }', '{$regdate }')";
```

```
$result = mysqli_query($connection,$query);
```

```
if($result)
```

```
{echo "success";
```

```
} else{die("Database query failed." . mysqli_error($connection));
```

```
} ?>
```

```
<!DOCTYPE html>
```

```
<html lang="en">
```

```
<head><title>Databases</title>
```

```
</head>
```

```
</body>
```

```
<?php
```

```
//Release returned data
```

```
mysqli_free_result($result);
```

```
?> <?php
```

```
//5.close databse connection
```

```
mysqli_close($connection);
```

```
?> </body> </html>
```

Appendix III- Interview questions

1. Could you tell me your name and qualification?

Answer : All are Diploma in clinical nursing

2. What kind of service do you give?

Answer : Child immunization service under age five

3. What kind of child immunization form used to record all the information that needs to be documented?

Answer : A preformatted registry, child card, tally sheet, report form.

4. What are the challenges you have got when you use the manual system?

Answer : Hand writing problem, data duplication, file searching problem takes long time

5. Could you tell me your business process when the child comes to your EPI section (from coming to end of service)?

Answer : When the child's parent arrive at the EPI we ask some questions like:

-Child birth date, where the child born, what kind of vaccine did the child take etc.

6. How does immunization appointments are scheduled to prevent missed opportunities?

Answer: using immunization schedule guideline and tell child's parent about next visit time

7. How do you communicate with parents about vaccines, in a way that informs them.

Answer : By aware parents about the important of immunization for child and what are the difficulties if child missed this opportunities

8. Do you have record quality assurance tests?

Answer: No

9. What system does your practice use to ensure that all vaccinations are recorded, and that parents are properly notified when vaccinations are due?

Answer: all information properly fill at the time of child detail registration to immunization administration time.

10. What you expect if this manual system change to computerized?

Answer : my problems are solved like data duplication, re-entering data, searching file, accuracy.