

Waithaka Health Centre Immunization Information System

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Abstract- Immunization protects us from many harmful diseases that can have very serious complications or even cause death. More than 30 million children are unimmunized either because vaccines are unavailable, because health services are poorly provided or inaccessible, or because families are uninformed or misinformed about when and why to bring their children for immunization.

The main purpose of this project is to develop a computerized system that will transform the vaccination booklet to an immunization information system in Waithaka Health Centre. 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 booklet, the system will facilitate better record keeping and enable quick access to immunization records

The system is simple and easy to use. It has functionalities to facilitate registration of children and their parents, scheduling of immunization, searching and data retrieval and report generation. Observation and interviewing are the two methods used for collecting data. Tools for data analysis used are DFD's, flowcharts, Entity Life History Diagram (ELHD) and Entity Life History (ELH). Development tool is PHP and the database management system is MYSQL.

The system is made up of several modules which include:- registration module and immunization module. The major constraints are budget and time constraints and the main risk in this project is the possibility of not meeting the estimated project schedule.

I. INTRODUCTION

Immunization 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 diseases. For example, the launch of the Global Polio Eradication Initiative in 1988, led to the near eradication of the disease; saving millions of people from paralysis (WHO,2011). Since the launch of the campaign, polio infections reduced by near 99%. It's therefore evident that immunization is one of the greatest undertakings in disease prevention, and maintenance of a healthy population.

Waithaka Health Centre is a medium sized hospital located in Dagoretti South. It was started in 1996 by the City Council of Nairobi. It serves a population of 400,000 people who live around Waithaka town and its environs. The health Centre has two doctors, 4 clinical officers and 6 nurses. It has several

departments which includes:- Administration, Maternity, Laboratory and child Health. This system will automate the Child Health department where immunization of children takes place. The current immunization process at the health centre is manual. A booklet is issued to every parent, where the child details are manually filled by the health workers.

1.2. Problem Statement

The Immunization process at Waithaka Health Centre is currently Manual. Every parent is issued with a booklet where the child details about immunization are manually filled by the health workers. The book contains recordings of all immunizations; those that their children had already undergone and those planned in the future. However, this system is very erroneous because the booklets sometimes get lost leaving no records for the particular child about their immunization history. The manual system also makes it very hard for effective data collection regarding the effectiveness or the demand for vaccination within Waithaka, which is vital for planning. It is also very difficult to do periodic reports on immunization using the manual system, this is because the booklets are kept by the parents and not the health centre.

This project therefore, addresses the shortcomings of the manual system. It intends to develop a computerized system that maintains the immunization records, thereby making data collection and reporting to be undertaken easily.

1.3.Objectives of the Study

The objectives of this project are:-

- (i) To develop a computerized system that will transform the vaccination booklet to an immunization information system in Waithaka Health Centre. The project will help automate the entire process of immunization at the Health Centre.
- (ii) To develop a searchable database that records all immunization doses administered to children residing within Waithaka and its environs.
- (iii) To develop a system that will enhance periodic report generation on immunization in Waithaka Health Centre.

1.4.Justification of the Study

- (i) The proposed system will be more efficient compared to the current manual system which is tedious and time consuming.
- (ii) The process of data collection, regarding immunization in the current system is very cumbersome, since records

are maintained by the parent and not the health institution.

- (iii) Periodic Report generation on immunization in the current manual system is almost impossible but this will be very efficient in the new system.
- (iv) The system will help prevent spread of infectious diseases e.g polio by administering vaccinations in a timely manner and maintaining accurate immunization records.

The above mentioned reasons justify the need for a new system in order to curb the problems encountered in the current system.

1.5 Scope of the Project

The study entails designing and implementing an immunization information system that will capture and maintain Child details which includes immunization details. It will also capture parent and health workers details and also generate reports.

II. LITERATURE REVIEW

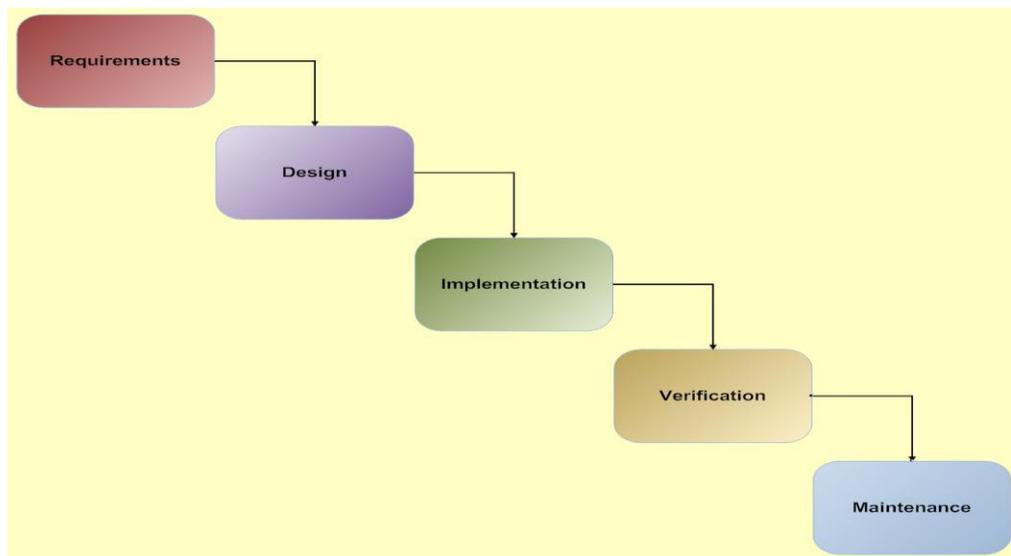
In the computing fundamentals glossary, an Information System (IS) is defined as a collection of technical and human resources that provide the storage, computing, distribution, and communication for the information required by all or some part of an enterprise. A special form of an Information System is a management information system (MIS), which provides information for managing an enterprise. Information Services

(IS), the glossary continues, is a common name for an organization within an enterprise that is responsible for its data processing and information system or systems. (Computing fundamentals, 2014)

An Immunization Information System (IIS) is a confidential, population-based, public health information systems that records immunization doses administered by participating providers within a defined geographic area. It is an important public health tool for collecting, analyzing, and acting upon relevant data to manage immunization programs. IIS provides for effectiveness in increasing vaccination rates by creating or supporting effective interventions, generating and evaluating public health response to outbreaks, facilitating vaccine management and accountability, determining client vaccination status to aid clinician decision making, and aiding surveillance and investigation of vaccination rates (ASTHO, 2014)

III. METHODOLOGY

This project will use waterfall model as the system development methodology. The Waterfall Model was the first Process Model to be introduced. It is also referred to as a linear-sequential life cycle model. It is very simple to understand and use. In a waterfall model, each phase must be completed fully before the next phase can begin. At the end of each phase, a review takes place to determine if the project is on the right path and whether or not to continue or discard the project. In waterfall model phases do not overlap. The reason why I chose waterfall model is because design errors are captured before any software is written thus saving time during implementation phase.



IV. SYSTEM ANALYSIS AND REQUIREMENT MODELING

Analysis is a phase in which the full description of the existing system and of the objectives of the proposed system that leads to a full specification of the user's requirements. This requirements specification (requirements definition) is admired

and approved before system design is embarked upon. The facts concerning the existing system once gathered are recorded. They are to be interpreted to aid in the subsequent design strategies.

The aims of analysis are:

- (i) To assess the existing system
- (ii) To evaluate possible solutions
- (iii) To identify and remove weaknesses of the new while retaining the strengths

- (iv) To ensure that the new system caters for the processing needs of the organization and generating useful information
- (v) .To model logical functions, data stores, data flows, and external entities associated with the current system.

4.1 Current System

The current vaccination process at Waithaka Health Centre is manual, parents have to attain a booklet for their child's vaccinations. The booklet is usually stamped with the date and location of the parent. It contains a list of all vaccinations that have to be administered to the child. Once a child is administered with an immunization, that particular vaccination is cancelled out and the parent is informed on the next date to take the child for the next vaccination. The parents have to produce the booklet every time they visit the Health Centre for immunization of their children.

In the unfortunate event that the booklet is lost, it becomes very hard to retrieve the history of immunization of the affected child. In such a case, a parent has to request for another booklet and together with the health practitioner, they try to fill the booklet to cancel out the already administered doses, by checking on the immunization attendance register, which is maintained by the health workers. The process of generating reports, regarding immunization in Waithaka Health Centre is very cumbersome, since records are maintained by the parent and not the health institutions. The health providers only maintain the register that assists in identifying children who missed some scheduled immunization.

Problems/ shortcomings of the current system

The current system presents a number of shortcomings that makes it ineffective. This include;

- (i) Storage of the records is problematic especially due to volume of data
- (ii) Report generation is very difficult and inaccurate since some files get misplaced.
- (iii) The system uses too many papers to maintain the records
- (iv) The system is time wasting
- (v) Data is not converted easily to information
- (vi) Readiness of the information.
- (vii) Data handling is a problem

4.2 Proposed System

With the development of the new computerized system, a number of improvements are expected to occur. The processes at the Waithaka Health Centre will be simplified since the information formally held in papers and immunization booklets will be held in a searchable database, where the health providers can easily access histories of the patients or children. In terms of data conversion to usable information, the system will facilitate mining of data and analysis to transform it to usable information, that is vital in planning and assessing the effectiveness of the immunization within Waithaka.

The system will also provide improvement in terms of notifying parents of the upcoming or scheduled immunizations and those that have been missed. With these features, the system will facilitate timely immunization through constant reminders to parents. The system will also provide improvements from the manual system in terms of clinical decision support, where the health providers can easily access the records and plan ahead; mainly on the medical supplies required for immunization. The goal of the Immunization Information system project is to create a system that will help prevent spread of infectious diseases by administering vaccinations in a timely manner and maintaining accurate immunization records.

Other improvements that are directly linked with the development of the new system will include;

- (i) Ease of data maintenance.
- (ii) Large volumes of data can be maintained.
- (iii) No paper work required hence saving on cost
- (iv) Data can be converted easily to information
- (v) The integrity of the data is preserved
- (vi) Reports on immunization are generated with ease

4.3 System Modelling

4.4.1 Process Modelling

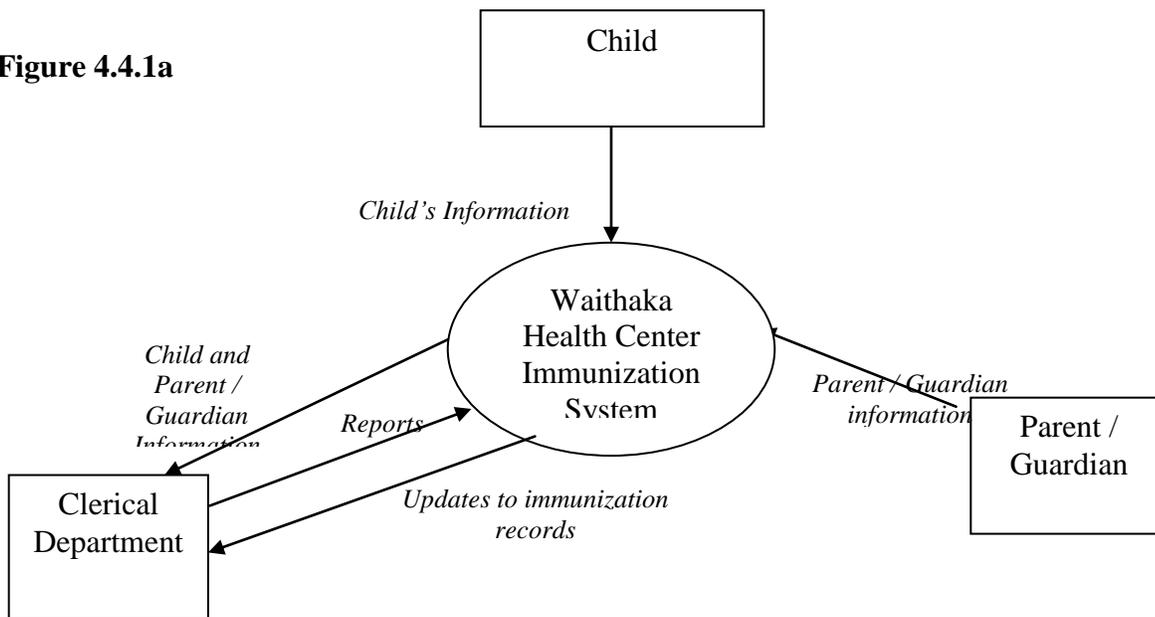
Data flow diagram (DFD)

The reason for using Data Flow Diagram in process modeling is because it is a good tool for breaking down the system processes

Context Diagram

The diagram below shows the external entities that interact with the system and data flows between this external entities and the system. The diagram is the **0 Level DFD**

Figure 4.4.1a



**DATAFLOW
DIAGRAM FOR THE PROCESS EXECUTION IN THE
PROPOSED SYSTEM**

This diagram on the other hand shows an advanced view of the system with keenness to the flow of instructions and information in the various sections of the system involved.

Processes

- 1) A parent is received and their details recorded, alongside those of those of the child. The parent's and child's health records are also taken and stored. The child records are stored in the *Child records store(D1)*
- 2) Health Information which is very important in the immunization and medical processes is recorded and stored in the *health file (D2)*. It pertains to the parent of the child and also the child
- 3) Immunization records are stored in the *Immunization records file (D3)*. These records are used to know which immunizations the child has already received to avoid repetition.
- 4) On request for service, the records are scanned for a history of immunizations. If required criteria are met, the child is immunized else, the request is rejected
- 5) When the child has been immunized, necessary receipts or reports are issued to the guardian which can be used to confirm the immunization and be used in the next request.

DATA STORES

- D1 – Children's file
- D2 – Health Records file
- D3 – Immunization records file

4.4.2 DATA MODELLING

Flowcharts

A flowchart is an aid to a systematic process of analyzing problems and developing suitable computer based solutions. It is a diagrammatic or pictorial representation of the plan of solution of a problem. It indicates the process of solution, the relevant operations and computations, the point of decision and other information which is a part of the solution. Flowcharts are of particular value for documenting a program.

Reasons for using the flowcharts are:

1. They give the designer a good visual reference of what the program will do. They serve as programs or systems documentation.
2. They allow programmers to test alternative solution problems over coding the problem.
3. They are good communication tools.

V. DATA DESIGN

Database

A database is a common data pool, maintained to support the various activities taking place within an organization. Input is made to a common data pool. It reduces duplications of the stored data records unlike the integrated file systems, in which case several interdependent files are maintained for the different user requirements. The integrated file systems have the problems of data duplication and in carrying out any file processing task(s) all the related files are to be processed. Further the information derived from several files may lack giving the overall state of affairs of the system. The type of database used for the proposed system is relational database. The proposed system uses the **RELATIONAL DATABASE**. This is because; data is related using logical conclusion inherent in the data rather than two physical pointers. Hence, it combines data from different sources. The data is represented in form of tables made up of columns and rows i.e. relations. The entire file of data can be processed with a single statement. The logical manipulation of

data makes feasible the creation of query languages which makes the access of database realistic for a much larger group of users. Information is produced from different tables as long as they share common data elements.

Reasons for using a relational database

1. Very flexible with regard to ad hoc queries
2. Simple to design and maintain
3. Easy to program and application in a relational environment
4. Simple to add new data and records without disturbing existing programs
5. They are neat and accurate.

TABLES CHILDREN TABLE Table 5.3.1a

Field Name	Data type	Size	Description
Registration No	Number	8	Identity card number
Surname	Text	12	First name
Other name	Text	12	Second name
Date of birth	Date/time	8	Birth date
Parent ID/Passport	Number	8	Parent's Identification

PARENTS (Mother) TABLE Table 5.3.1b

Field Name	Data type	Size	Description
ID / Passport No	Number	8	Identity card number
Fathers ID / Passport No	Number	8	Fathers Identification
Surname	Text	12	First name
Other Name	Text	12	Second name
Date of Birth	Date/time	8	Birth date
Address	Number	8	Residence address
Town	Text	12	Residence town
Street	Text	12	Residence street
Country	Text	12	Resident country
Postcode	Number	4	Country postcode
Telephone No	Number	10	Telephone
Mobile No	Number	10	Mobile phone number

STAFF TABLE Table 5.3.1c

Field Name	Data type	Size	Description
ID / Passport No	Number	8	Identity card number
Surname	Text	12	First name
Other Name	Text	12	Second name
Date of Birth	Date/time	8	Birth date
Address	Number	8	Residence address
Town	Text	12	Residence town
Street	Text	12	Residence street
Country	Text	12	Resident country
Telephone No	Number	10	Telephone
Mobile No	Number	10	Mobile phone number
Job Description	Text	10	Staff Job Description

Table 5.3.1d

USERS TABLE

Field Name	Data type	Size	Description
User ID	Number	8	User's Unique Id
Username	Text	12	User's Access N
Password	Text	12	Log in password
User Level	Date/time	8	User Authentica

IMMUNIZATIONS TABLE Table 5.3.1e

Field Name	Data type	Size	Description
Immunization Type	Number	8	ID card number
Immunization No	Text	12	First name
Child Registration No	Number	10	Child Registration Number
Immunization dose No	Text	12	Immunization Dose Number
Immunization Desc	Text	100	Immunization Description

Normalisation

It is the process of removing duplication and grouping related data to minimize interdependence between data groups. The aim of normalization is to ensure that each fact is only recorded in one place so that facts cannot be inconsistent and the performance of updates cannot produce anomalies by updating one copy of the fact but not another.

UNNORMALISED DATA

REGISTRATION NO, SURNAME, OTHER NAME, DATE OF BIRTH, PARENT ID/ PASSPORT, ID / PASSPORT NO, FATHERS ID / PASSPORT NO, SURNAME, OTHER NAME, DATE OF BIRTH, ADDRESS, TOWN, STREET, COUNTRY, POSTCODE, TELEPHONE NO, MOBILE NO, ID / PASSPORT NO, SURNAME, OTHER NAME, DATE OF BIRTH, ADDRESS, TOWN, STREET, COUNTRY, TELEPHONE NO, MOBILE NO, JOB DESCRIPTION, USER ID, USERNAME, PASSWORD, USER LEVEL, IMMUNIZATION TYPE, IMMUNIZATION NO, CHILD REGISTRATION NO, IMMUNIZATION DOSE NO, USERNAME, USER TYPE, PASSWORD

FIRST NORMAL FORM (1NF)

A table is said to be in first normal form if and only if it contains no repeating groups, i.e. it has no repeated values for particular attributes in a single record. If there are repeating groups and attributes they should be isolated to form a new entity.

CHILD DETAILS

(Registration No, Surname, Other name, Date of birth, Parent ID/ Passport, Immunization No, Immunization Dose No, Immunization Description)

PARENT DETAILS (ID/

Passport No, Surname, Other Name, Date of Birth, Address, Town, Street, Country, Telephone No, Mobile No, Job Description, Child Registration No,

Surname, Other name, Date of birth, Immunization No,
Immunization Dose No, Immunization Description)

STAFF DETAILS (ID / Passport No, Surname, Other Name, Date of Birth, Address, Town, Street, Country, Telephone No, Mobile No, Job Description, Username, Password)

SECOND NORMAL FORM (2NF)

A table is said to be in 2NF if and only if it is in first normal form and every non-key attribute is fully dependent on the key attribute. All non-key attributes that are not dependent on the key attribute should be isolated to form a new entity.

CHILD DETAILS

(Registration No, Surname, Other name, Date of birth, Parent ID/ Passport, Immunization No, Immunization Dose No, Immunization Description)

PARENT DETAILS (ID / Passport No, Surname, Other Name, Date of Birth, Address, Town, Street, Country, Telephone No, Mobile No, Job Description, Child Registration No, Surname, Other name, Date of birth, Immunization No, Immunization Dose No, Immunization Description, Username, Password)

STAFF DETAILS (ID / Passport No, Surname, Other Name, Date of Birth, Address, Town, Street, Country, Telephone No, Mobile No, Job Description, Username, Password)

USERS DETAILS (Staff Id, Username, Password)

THIRD NORMAL FORM (3NF)

A table is said to be in 3NF if and only if it is in second normal form and every non-key attribute is not dependent on any other non-key attribute. All other non-key attributes that are not dependent on other non-key attribute should be isolated to form a new entity.

5.3.2 Input Design

It involves all forms that are used to input data to the system

FORMS

CHILDREN 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 and therefore determine whether the client is eligible for another.

PARENTS FORM

This form allows for the addition and manipulation of parent details in the system. The parent details are taken against every child record and used when there is need to communicate to the parent, or identify a child.

Figure 5.3.2b

PARENT DETAILS		ID No	<input type="text"/>	<input type="button" value="SEARCH"/>	<input type="button" value="—"/>	<input type="button" value="□"/>	<input type="button" value="X"/>
PARENT'S RECORDS SUMMARY							
ID No	<input type="text"/>	ADDRES	<input type="text"/>				
SURNAME	<input type="text"/>	TOWN	<input type="text"/>				
OTHER	<input type="text"/>	PASSWOR	<input type="text"/>				
LICENCE	<input type="text"/>						
MOBILE NO	<input type="text"/>						
<input type="button" value="ADD"/>		<input type="button" value="EDIT"/>		<input type="button" value="DELETE"/>			

STAFF FORM

This form is used to record staff details and assign a password to the staff member, who is allowed to edit and update these passwords, besides other dynamic sections of their records.

Figure 5.3.2c

STAFF DETAILS		<input type="text"/>	<input type="button" value="SEARCH"/>	<input type="text"/>	<input type="text"/>	<input type="text" value="X"/>
STAFF RECORDS SUMMARY						
ID No	<input type="text"/>	ADDRE	<input type="text"/>			
SURNAME	<input type="text"/>	TOWN	<input type="text"/>			
OTHER	<input type="text"/>	PASSWOR	<input type="text"/>			
JOB TITLE	<input type="text"/>					
PHONE	<input type="text"/>					
	<input type="button" value="ADD"/>	<input type="button" value="EDIT"/>	<input type="button" value="DELETE"/>			

VACCINATION FORM

This form allows for that addition and updating of immunization records in the system. The Immunization records are then appended to the child records for each immunization the child undergoes.

Figure 5.3.2d

VACCINATION DETAILS		<input type="text"/>	<input type="button" value="SEARCH"/>	<input type="button" value="—"/>	<input type="button" value="□"/>	<input type="button" value="X"/>
VACCINATION RECORDS SUMMARY						
Vaccination No	<input type="text"/>					
Vaccination	<input type="text"/>					
Dosage	<input type="text"/>					
Description	<input type="text"/>					
<input type="button" value="ADD"/>		<input type="button" value="EDIT"/>		<input type="button" value="DELETE"/>		

5.3.3 Output Design

It involves all reports that result from data stored in the system.

CHILDREN IMMUNIZATION REPORT

This report will be displaying all immunizations that a child has undergone

Figure 5.3.3a

WAITHAKA HEALTH CENTER IMMUNIZATIONS REPORT				
CLIENTS REPORT				
<i>Child Registration No</i>	<i>Names</i>	<i>Immunization No</i>	<i>Immunization Title</i>	<i>Immunization Description</i>

IMMUNIZATION REPORT

This report will be displaying all immunizations that a child has undergone within a period of time specified by the system user

Figure 5.3.3b

WAITHAKA HEALTH CENTER PERIODIC IMMUNIZATIONS REPORT				
CLIENTS REPORT				
<i>Child Registration No</i>	<i>Date From – Date To</i>	<i>Immunization List</i>	<i>Immunization Title</i>	<i>Immunization Description</i>

VI. SYSTEM IMPLEMENTATION

Systems implementation is the construction of the new system and the delivery of that system into production. System implementation commences after the users have accepted the new system.

This phase involved all the activities that took place to convert the old manual system to a new computerized system. The design of the system was converted into an operational system that would meet the user's requirements. These activities include program and system testing, file conversion, training of the user staff and conversion from old system to a new system.

6.1 Tools used for Coding and Testing

The tools used for coding are PHP and HTML and MYSQL as database management system.

6.2 System test plan

A **test plan** is a document detailing a systematic approach to testing a system .The plan typically contains a detailed understanding of the eventual [workflow](#).

A plan of how the testing would be done is prepared. The testing is to take twenty days and uses both historical data and dump data with every user carrying out the described duties using the system in order to test whether the system meets its purpose.

6.3 Testing

Testing is the process of verifying and validating the system for the conformance with specification and above all meeting the

user's requirements. Testing ensures that the system is error free and is achieving its goal

The testing done involved:-

Functional Testing / Functionality Testing

Functional testing is the process of confirming the functionality of the application. It ensures that the system functions the way it is intended to. The purpose of functional testing was to ensure that the program performs all the specified functions. It relates to the whole system and does not require a technical understanding of the system.

System testing

System testing is a level of the software testing process where a complete, integrated system is tested.

The purpose of this test is to evaluate the system's compliance with the specified requirements.

System testing is done after integration testing is complete. System testing should test functional and non functional requirements of the software.

Testing involved using the web application with an intention to discovering any errors. A good test approach is one that has capability of finding errors that were not yet discovered. Therefore the testing was done in order to clearly see if there were problems with the new computerized system.

Acceptance Testing:

Formal testing conducted to determine whether or not a system satisfies its acceptance criteria enable the customer to determine whether or not to accept the system. This testing

process is usually performed by customer representatives. This testing was done to determine whether the users embraced the system.

6.4 Test Data

Test data is data which has been specifically identified for use in tests, typically of a computer program.

Test data may be produced in a focused or systematic way or by using other, less-focused approaches. Test data may be produced by the tester, or by a program or function that aids the tester. Test data may be recorded for re-use, or used once and then forgotten.

It involved both correct and incorrect data. Correct data was keyed in the forms and the correct output was produced by the user while incorrect data was keyed and an error was produced. The use of correct and incorrect data is to check whether the validation and verification checks were working correctly.

6.4 Proposed change over techniques

System changeover is the process of putting the new information system online and retiring the old system.

Parallel changeover will be used where both the new and the old system are used simultaneously. In a parallel changeover, the new system runs simultaneously with the old for a given period of time. Of all the techniques, this tends to be the most popular, mainly because it carries the lowest risk. If something goes wrong at any point, the entire system can be reverted back to its original state.

By using parallel changeover, the users will have room to get acquainted with the new system. The new and the old system will be used together until it will be decided that the new system works correctly

VII. LIMITATIONS, CONCLUSIONS AND RECOMMENDATIONS

7.1 Limitations

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 a lot of money to develop, I had to take a loan from my employer to ensure the project completed successfully. Training was also a big problem since the hospital did not have any person with IT expertise who could have helped in the training.

7.2 Conclusion

This project involved the design and development of an immunization information system. The project follows a water fall model where system development undergoes five main stages; requirements gathering, design, implementation,

verification, deployment and maintenance. The development tools used are DFD's, Flowcharts and ERD. User interface is accessible online by use of a web browser, the business logic is hosted on a server and the database that runs on mysql database management system.

With this system, it's expected that there will be an improvement in health care by enabling more children to be immunized at the right time.

The process of immunization in Waithaka will be more efficient and time saving. Parents will be able to log in to the system from their homes and check the status of their child's immunization. The system will contribute towards the improvements in the quality of healthcare by reducing incidences of errors in medical records. It will also help the health workers to generate reports and access records with ease.

7.3 Recommendations

I would recommend the system to be improved further 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 thus building a healthy nation. The system should also be introduced to other hospitals.

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