

**ELECTRONIC HEALTH RECORDS SYSTEM: AUTOMATION OF
HEALTH RECORDS AT JUSTICE AND MERCY COMMUNITY
PROJECT OYUGIS.**

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**A PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS OF THE AWARD OF THE FELLOWSHIP IN
HEALTH INFORMATICS OF THE UNIVERSITY OF NAIROBI.**

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DECLARATION

This Research Project is my original work and to the best of my knowledge has not been presented for any academic award in this or any other university.

Augustine Gatimu Njuguna. Signature.....

Date.....

Declaration by University Supervisors

This research project has been submitted for examination with our approval as university supervisors.

Dr. Christopher Chepken Signature:

Date:

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LIST OF ABBREVIATIONS AND DEFINITION OF TERMS

- EHR: Electronic Health Records System
- JAM: Justice and Mercy Community Project Oyugis

PROJECT SUMMARY

The medical sector is a critical area in any country and always grows as the population grows since everyone needs access to medical services. As a result, there comes a challenge in handling patient data and utilizing the data for planning purposes. In addition, since most of the times facilities do not grow by area coverage, they only grow by patient volume there is a great need for an efficient way of handling the turnout in a timely and quality adhered manner. To address this, an Electronic Health Records System was developed that automates health records at Justice and Mercy Community Project Oyugis Health Centre. This provides a platform to manage data and provide access to it when needed. It reduces time taken to share information between departments, time taken to retrieve patient data on a revisit, time taken to compile data for reports, and reduce loss of patient data. Patients are able to experience personalized service as a result.

1. INTRODUCTION AND BACKGROUND

Automation of health records is a developing area it is organized collection of electronic health information about each patient or populations (McDonald. 1997). It captures the details in digital format allowing sharing across diverse health care settings, by being rooted in network-linked enterprise-wide information systems. These records may consist of a whole range of data in comprehensive or summary form. The data may include immunization status, demographics, radiology images, medical history, medication and allergies, personal stats like age and weight, laboratory test results, vital signs, and billing information. (You can also include diagnostics and pharmaceutical information)

The medical sector is a critical area and it is always growing as population increases since everyone needs access to medical services. As a result, there comes a challenge in handling patient data and utilizing the data for planning and budgeting purposes. In addition, since facilities do not grow by area coverage, they only grow by patient volume there is thus great need for an efficient way of handling the turnout in a timely and quality adhered manner (Rao et al, 2008).

There is great need for consistency of data used at various decision-making levels by the health facilities and government. To ensure this, an Electronic Health Records System (EHRS) that will be able to automate operations in a health facility, manage data and provide access to it when needed is a necessity. Such a system reduces time taken to share information between departments, time taken to retrieve patient data on a revisit, time taken to compile data for reports, and; reduce loss of patient data. The system puts in place patient care at its core, patients are able to enjoy secure storage and integrity of their data and, have a clear medication record stored that will be useful for medical practitioners in telling the patient's medication history useful in disease prevalence in each patient.

To solve the problem identified, a review of the current system in use at the facility was carried out. Organizational capacity assessment was done at the facility, the health practitioners (including management) were interviewed too on how they were carrying out day to day operations at the workplace, if they were contented with the system of operation, and, if not, what improvements they would suggest to be implemented. The system developer had time to observe how they were carrying out the operations at the facility and transformed the flow in a data flow model. They all agreed to have an EHR adopted to better the operations and bridge the gaps identified above.

2. STATEMENT OF THE PROBLEM

Most public hospitals in Kenya maintain manual health records. Data entry is done manually making it susceptible to human error. Cases have been recorded where files were misplaced and others lost altogether. Other patients fail to remember their patient numbers making it difficult to trace their files. Tracing files becomes time consuming and lead to loss of workman hours. With the prevailing shortage of staff, health care workers are left to perform administrative work instead of focusing on health provision. (Tomasi et al., 2004).

Operations in any given health facility are critical to quality of service delivered. Health services being so basic to people's living, there is therefore great need to better the services as much as possible. As population increases, the health facilities in county and national governments need patient data for decision-making and planning functions (Shortliffe.,et al, 2001). However, on the contrary, most health facilities do not deliver consistent and reliable data due to poor/manual data handling methods they employ (McDonald, 1997). The facilities are not able to offer quality and timely service due to manual data handling and sharing. There is therefore great need to come up with an Electronic Health Records System (EHR) that will aid in bridging the gap, help health facilities deliver quality service to patients; aid in easy capturing, storing and access to reliable data. This will ease the work of health practitioners, improve their service delivery capabilities and provide reliable data for use by relevant authorities.

3. PROJECT OBJECTIVES

Impact of the project

Introduction of EMR resulted in-

- Effectiveness (Access to Care)
- Effectiveness (Quality of Care)
- Efficiency
- Equity

Purpose

Developed an electronic health records system that:-

- Improves quality of health care, safety and efficiency
- Reduces operational costs
- Improves care coordination between clinicians other healthcare practitioners (e.g. Laboratory, pharmacy, clinicians, etc.)

Electronic Health Record keeps:

- Patient Demographics
- Progress Notes
- Currently prescribed /Past Medications
- Medical History
- Laboratory
- Reports
- Electronic Health Record can automatically share and update information among different offices at justice and mercy.
- Through Electronic Health Records (EHR) system, standardization of medical health service was made possible

4. JUSTIFICATION/ SIGNIFICANCE

The EHR, is a platform where clinicians and staff members document interactions with their patients, view existing medical histories as well as insurance information, refer patients to other departments or facilities, through the platform clinicians and other health workers are able to interact and communicate while giving care to their patients. This is through sending lab requests, prescribing medication, booking for specialized care among other services

Funding for the health sector keeps dwindling in Kenya; as a result, hospitals consider efficient and effective methods of operating if they are to keep afloat. They may need to consider measures that assist health workers come up with appropriate methods for health care delivery.

Upon arrival at a health facility, the first point of contact is the records section where files are kept. The time taken here can vary depending on the information given by the client and the physical position of the file. In the event that it is lost, more waiting time is required. A patient has to move back and forth different departments and physically wait for their results. Therefore, whereas nurses and doctors greatly benefit from of EHR, patients are the greatest beneficiaries.

5. Development Methodology

5.1. Introduction

A system development methodology captures the framework used in structuring, planning, and controlling the process of development of an information system (Centers for Medicare & Medicaid Services, 2008). There are a number of methodologies acceptable in the development of health information systems as suggested by Centres for Medicare & Medicaid Services namely: Waterfall methodology, Prototyping, Incremental and Spiral, Rapid Application Development (Centers for Medicare & Medicaid Services, 2008). But, Rapid Application Development (RAD) methodology serves best as it is structured in an iterative format where requirements are well known but can be modified as per end-user input.

5.1.1 Rapid Application Development Methodology (RAD)

This approach to development of information systems promises improved and cheaper systems and rapid deployment through collaboration between systems developers and end users. The collaboration happens in real time (Jeffrey A. Hoffer, 2014).

It was the most suitable for this project since it actively involves end users assuring highly acceptance by end users. Most systems fail due to rationality-reality gaps (what is rationally conceived as best approach in relation to the real behavioural operations of health facilities), public private sector gaps (where systems developed for public sector are assumed to be right for private sector and vice versa), and, country gaps (application developed in one country assumed as right for another country) (Richard Heeks, 1999). Thus, RAD considers this risk through concise user input that achieved good end system.

To effectively implement this methodology in this project, user and system requirements were collected from the healthcare stakeholders and data derived from the reviews of the existing health information systems. Thereafter, design of the system was developed and presented to healthcare users to check if it matched the requirements. If it did, the next stage (developing the system through code) preceded, if not, the process was to be repeated iteratively. After coding, the system was presented to the end-users to check if it matched the design. If it did, it proceeded to implementation, if not, the process was to be repeated iteratively. This is shown below in a figure.

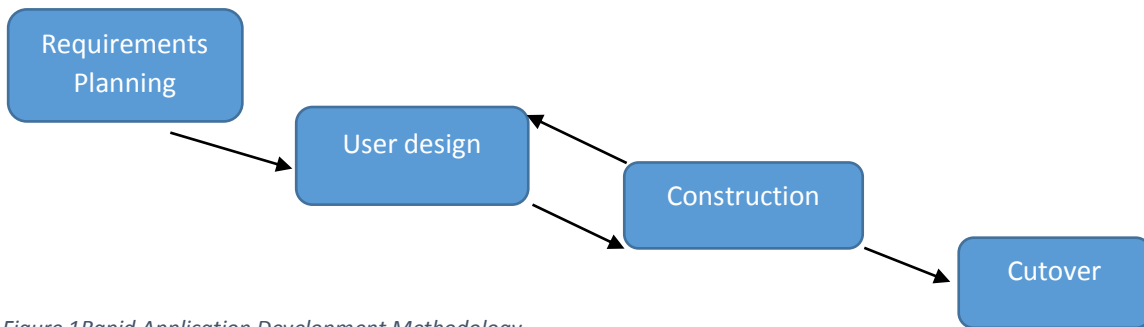


Figure 1 Rapid Application Development Methodology

5.2. Requirements

These are what the system should be based on in the entire development stages. They include functional (what the system does) and non-functional (perceived requirements for judging the system performance and suitability).

3.2.1 Functional and non-functional requirements

The Outpatient Health Information System has the following functional requirements:

- i) Structured information sharing between related and coordinating departments (cash point, clinical department, laboratory, pharmacy)
- ii) Medical service billing (patient profile fees, consultation fees, clinical medication, drugs, laboratory tests, other services) and generation of cash receipts
- iii) Setup and maintain patient and healthcare worker profile
- iv) Pharmacy drugs inventory management
- v) Maintain patient medication history
- vi) Generate operations reports
- vii) Better medical staff knowledge management
- viii) Comprehensive care clinic follow-up

The non-functional requirements include:

- i) **Security:** Access control through login username and password and, password protection with md5 encryption technology. Also, modules for designated users are developed to be accessed based on user rights
- ii) **Scalability:** The system is open to further changes and edits come need be.

- iii) Usability: The system's interface is simple for the end users. Thus, easy to use and cutting on training costs
- iv) Reliability: The system is reliable in service since it provides real-time data of patients and better reporting tools. It implements real operational behaviour of organizations rather than rational and conceived requirements
- v) Cost effective: The system requires lower minimum system requirements; thus, no expensive software needs to be procured to facilitate its running. Also, the methodology used for development is proven to be cost effective with minimal overhead budgetary costs (Centers for Medicare & Medicaid Services, 2008).

5.3. Analysis

Under this stage, the system was analysed for feasibility with the aid of use cases and data flow diagrams. This object-oriented form of analysis is best since it outlines a simulation of real system as objects, entities and actors. Therefore, system actors and entities were drafted in use cases and data flow diagrams to achieve the analysis stage.

5.4. Design

Systems design refers to the process of determining the architecture, modules, components, data and interfaces for a system to meet the specified requirements. In this stage, the system structural information flow in the organization was drawn in graphical presentation as per the requirements collected with the aid of graphic design tools. Also, different modules with the systems actors was drafted in graphics. The most appropriate user interface was also graphically represented. Upon completion, the graphical designs were presented to users for verification of requirements being met.

6. System Analysis and Design

6.1 Introduction

JAM Electronic Health Records system is a web-based information system that runs on any operating system with the aid of a web browser. It has several modules namely finance/cash point module, patient registration/admission module, appointment module, the triage, clinical and comprehensive care clinic, laboratory and pharmacy modules. The system generates time-flexible reports for all operations that are exportable to excel for further manipulation.

6.2 System Narrative

The patient walks into a health facility where he/she comes across the receptionist who also acts as the cashier, he pays for registration fee plus consultation fee. The patient automatically enters triage queue after payment. Thereafter, the patient proceeds to the triage where important vitals such as weight, height, temperature, pulse rate, blood pressure are taken and recorded in the system. The patient automatically enters clinician/doctor queue. At the clinician/doctor section, the patient's chief complaints and case history is recorded and most appropriate judgement given by the clinician. If a lab request is needed, a laboratory request is made and thereafter, the system enters the patient into lab queue. At the lab, the patient test results are recorded and the patient is fed back to the doctor's/clinician's laboratory queue. For prescription, which is for both those that get lab requests and don't, the doctor gives the patient drug prescription and this automatically assigns the patient to the pharmacy queue. The pharmacy then dispenses the drugs exiting the patient from the facility. In all the above instances where a patient enters a new queue, the patient also exits an old queue.

6.3 Use case

The use case refers to how the user interacts with the system and the activities that are performed by this user to achieve particular results. This is an approach used in system analysis for identifying, clarifying, and organizing system requirements. The use case comprises of a set of probable sequences of interactions between a system and its users in a certain environment and related to a specific goal. It involves a cluster of elements (for instance, interfaces and classes) that can be used jointly in such a way that it will have an effect greater than the sum of the multiple elements put together. It captures all system activities that are important to users (Rouse, 2007).

The figure below is a use case diagram for Outpatient Hospital Information System which describes how different users in the health facility interact with the system to achieve the desired goals of the healthcare sector.

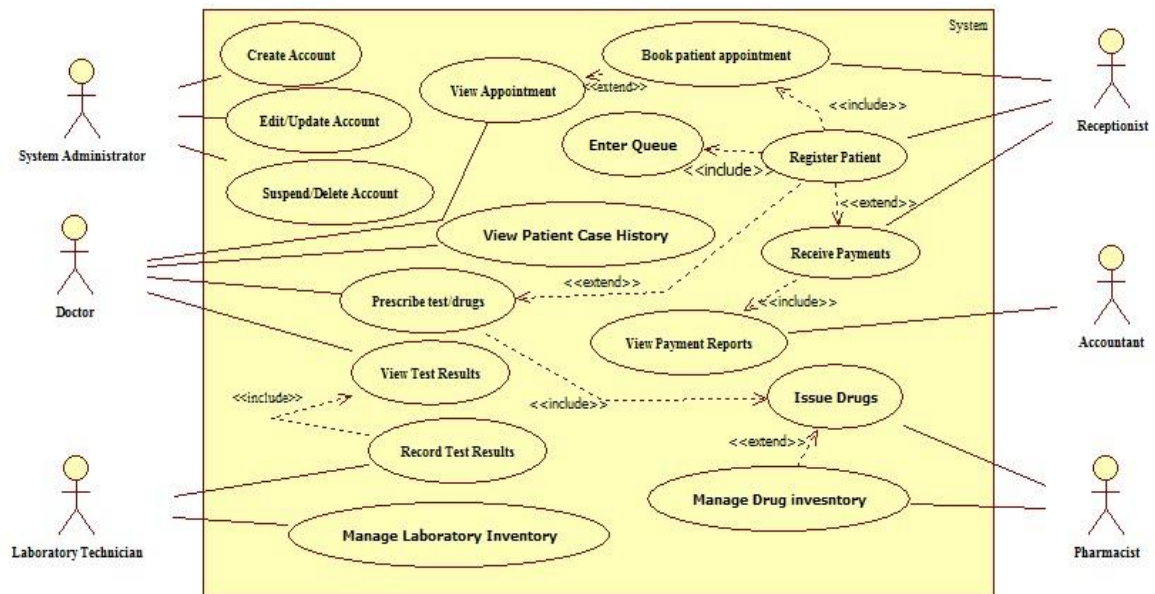


Figure 2: Use case diagram

6.4 Class diagram

Class diagrams are graphics of relationships and source code dependencies amongst the classes in the Unified Modelling Language (UML). A class identifies the methods and variables in an object. This is a specific unit in a program or the unit of code that represents that entity (Rouse, 2007). Class diagrams are crucial in all forms of object-oriented programming (OOP).

Below is a class diagram for the system entailing how the code will be organized to create objects and functions that will aid the users to perform their desired functionalities.

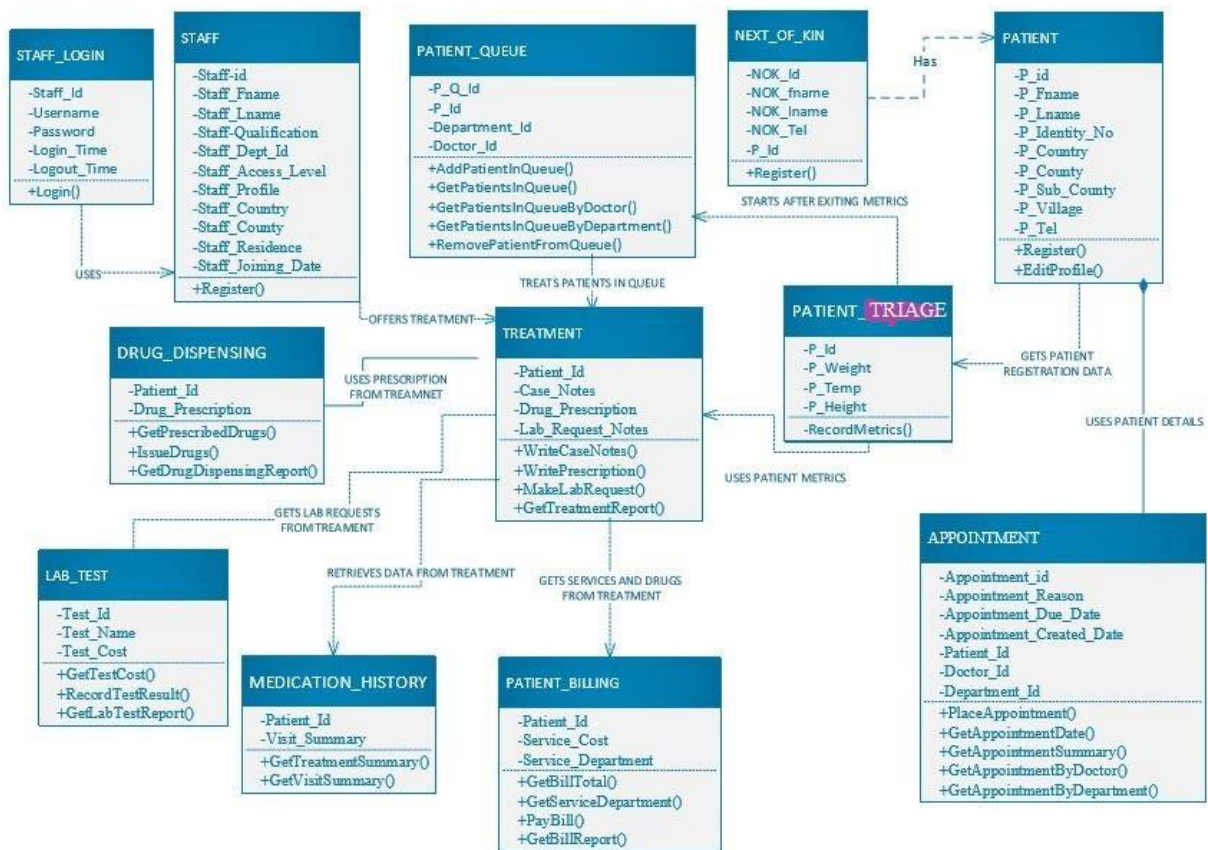


Figure 3: Class Diagram

6.5 Database Schema

A database schema refers to the frame structure representing the logical view of your entire database. It defines the organization of data and how to associate these relations. The schema formulates all the restrictions that are to apply to the data.

The schema for the system was drawn and is as shown in the figure below

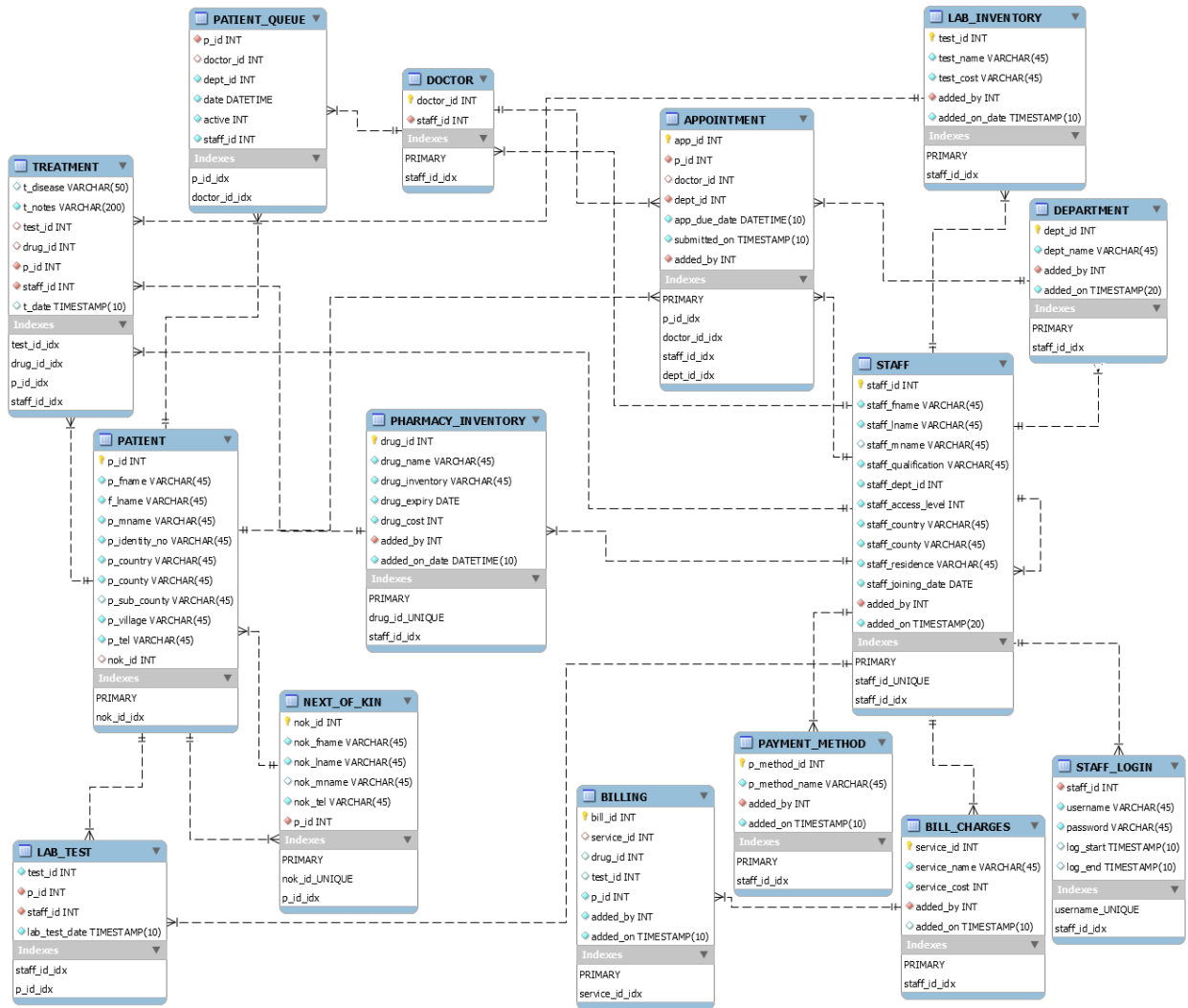


Figure 4: Database Schema

7. System development

7.1 Introduction

This section entails description of how the system was developed, tools used in the development process, its implementation and some testing done on the development methodology to guarantee adherence to requirements and meeting user needs.

7.2 System Development tools and techniques

These are tools that were of great aid to achieve the desired outcomes of the whole project. They include:

7.2.1 Star UML

This is an open source Unified Modelling Language (UML) tool useful in drawing use case diagrams. The use case in chapter 4 was done using this tool

7.2.2 Microsoft Vision

This a powerful tool for drawing class diagrams. It supports custom creation of classes and full of many built-in diagrams and templates. The class diagram was drawn using this tool.

7.2.3 Microsoft Project

This is yet another powerful tool from Microsoft. It is great in project management, budgeting and tracking. It was used in drawing the Gantt chart below

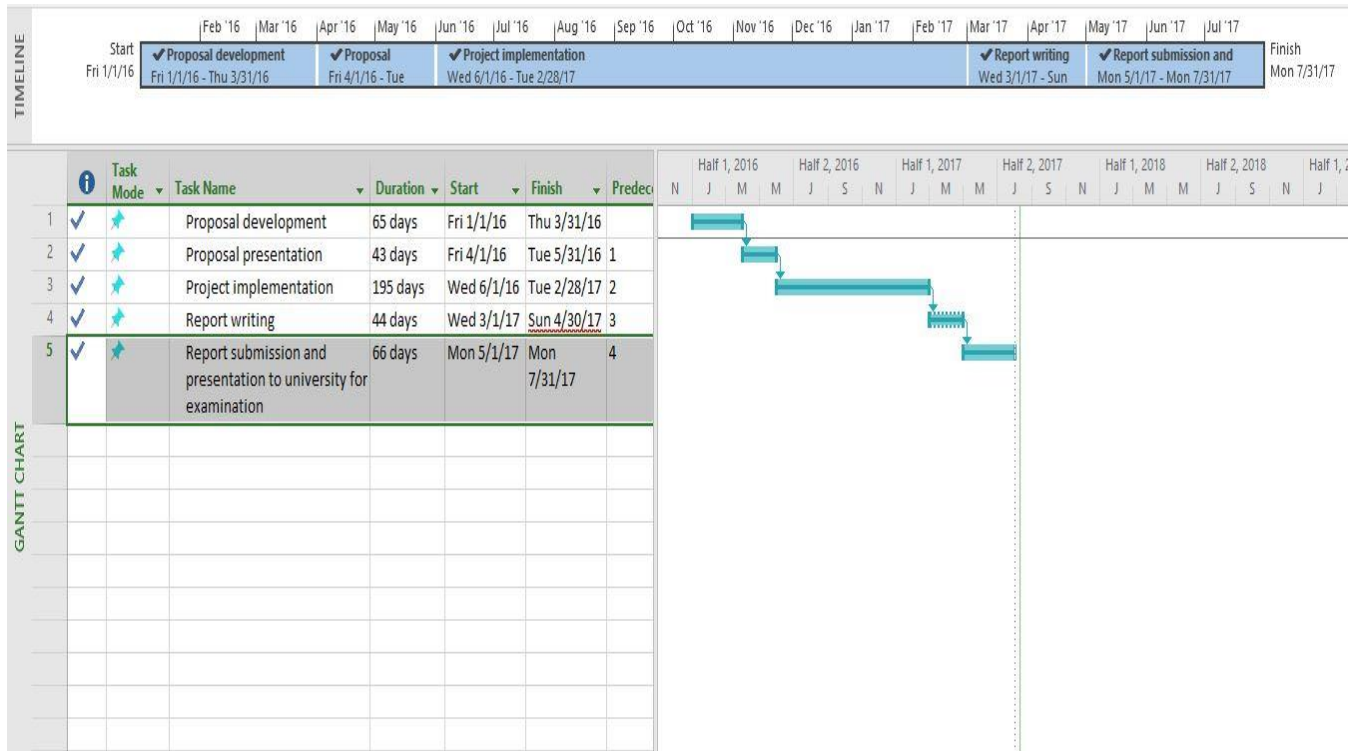


Figure 5: Gantt chart

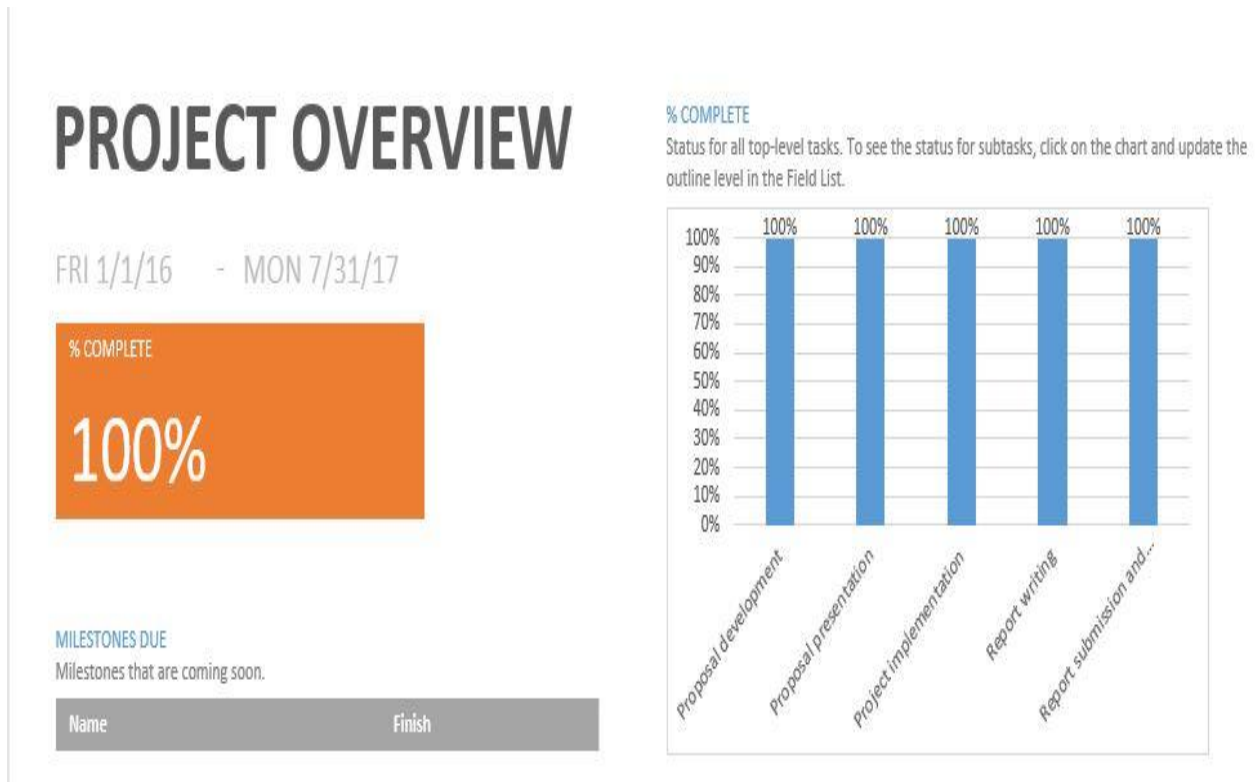


Figure 6: Project overview

7.2.4 MySQL Workbench

This is a powerful tool for database design. It comes in enterprise (paid) and community (free) versions. A community version was used in the project and the below diagram was generated.

7.2.5 Xampp

This is an open source Apache distribution with PHP, MySQL, and phpMyAdmin and apache server all in one pack. It was used to host the system files and database and its phpMyAdmin used in database administration. The figure below shows the interface provided by Xampp in database administration.

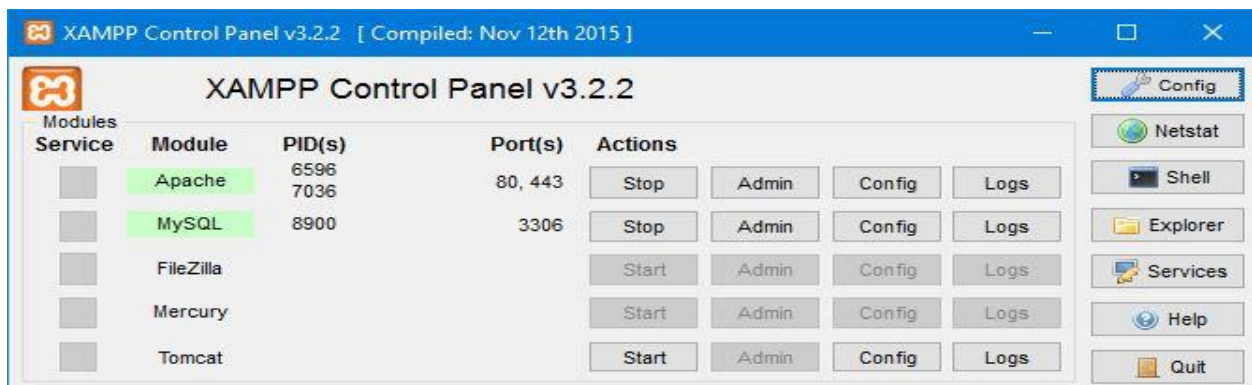


Figure 7: Xampp

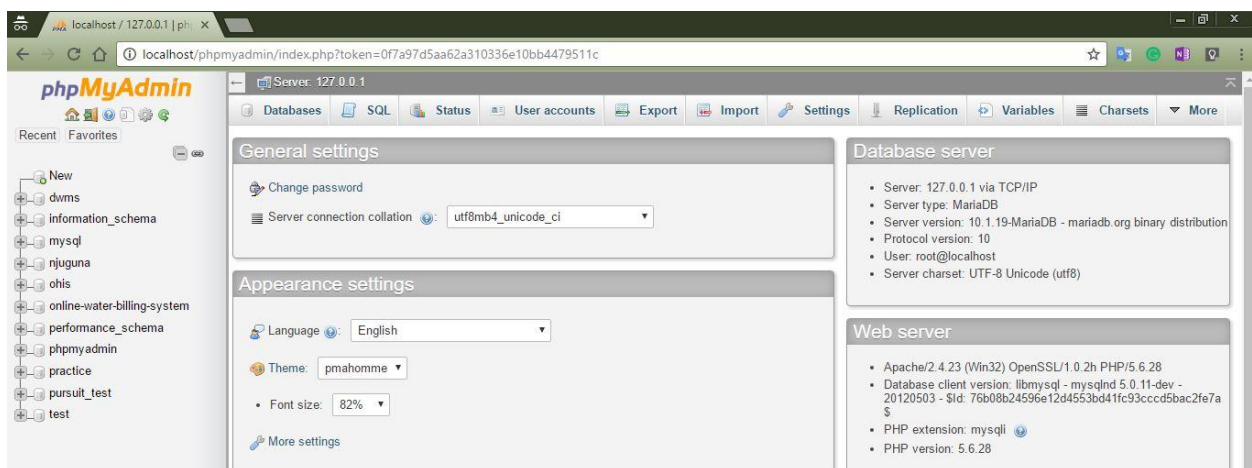


Figure 8: phpMyAdmin

7.2.6 Sublime Text Editor

This is yet another powerful code editor with great support for PHP, MySQL, html, JavaScript programming languages. Below is a screen capture of the text editor

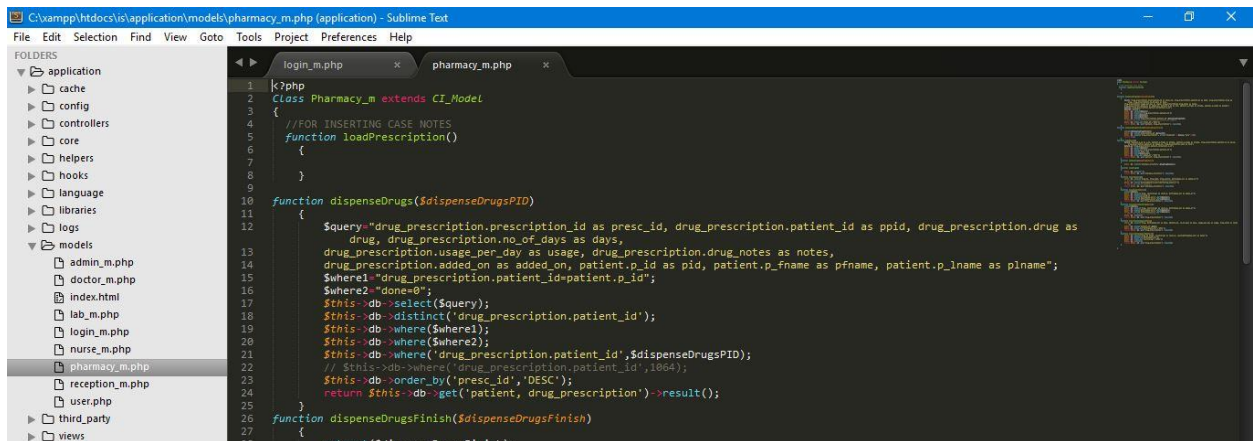


Figure 9: Sublime Text Editor

7.3 System deliverables

The system has several modules beginning from login to backend user operations. Some of the modules include:

7.3.1 Login Module

This is a security module that achieves access control to the system. Users must have unique username and password and their accounts be activated by the system administrator or health facility administrator before they can login. Users can register but their accounts have to be confirmed by the administrator before they gain access to the system. Below are screen shots for the login and register modules

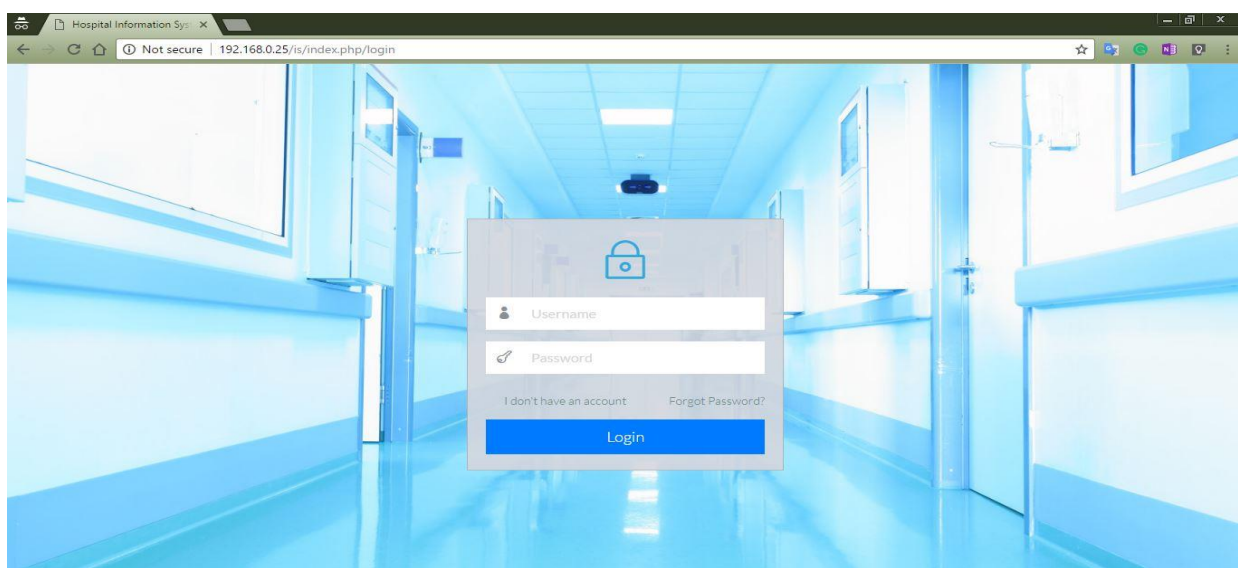


Figure 10: Login screen

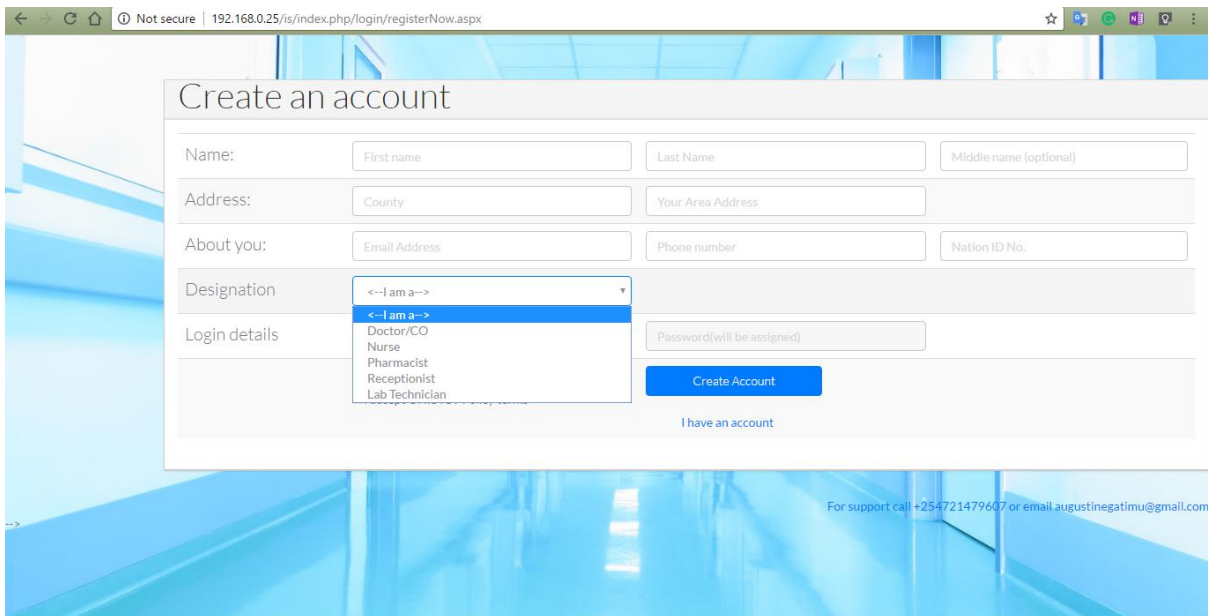


Figure 11: Register screen

7.3.2 Patient registration module

This is where new patients are added in the system and thus the entry point of patients

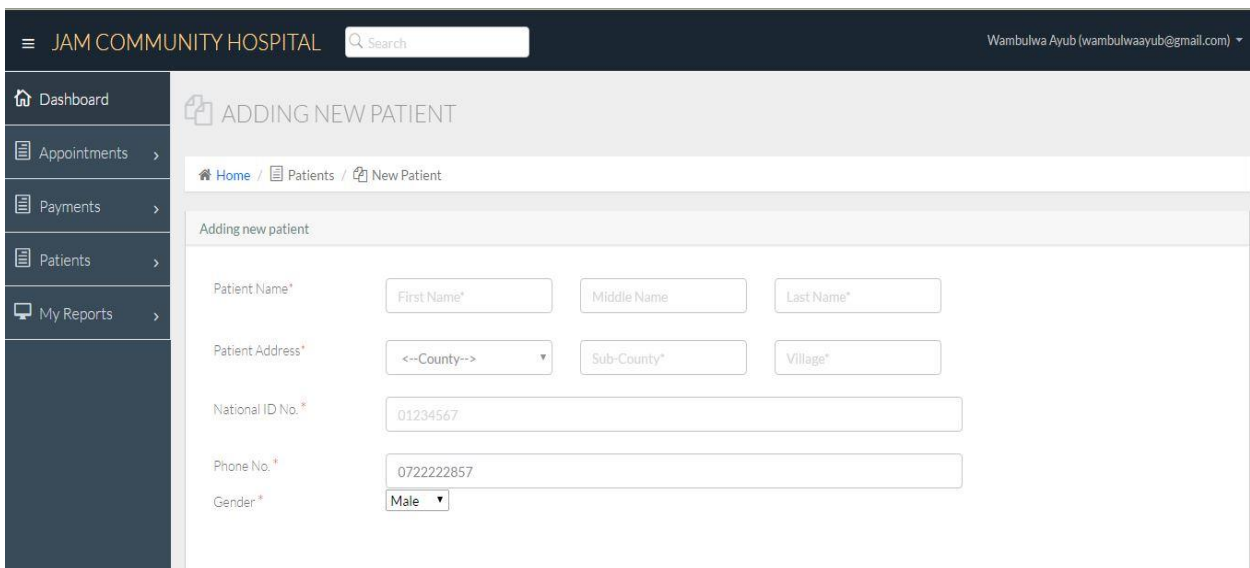


Figure 12: Patient registration page

7.3.3 Appointment module

This allows the facility to schedule their clinics well and have a better report on clinic attendance. It also allows them to only admit a maximum clinic capacity and avoid overloading clinic days.

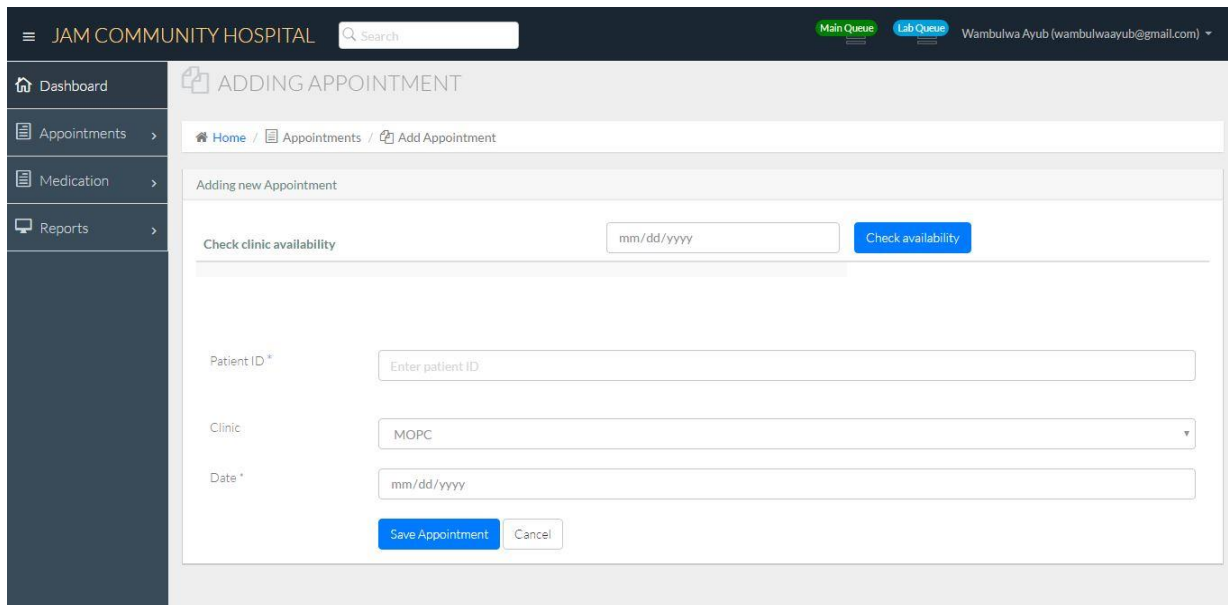


Figure 13: Appointment module

7.3.4 Billing module

This is where all medical bills and services are charged and cash payments collected.

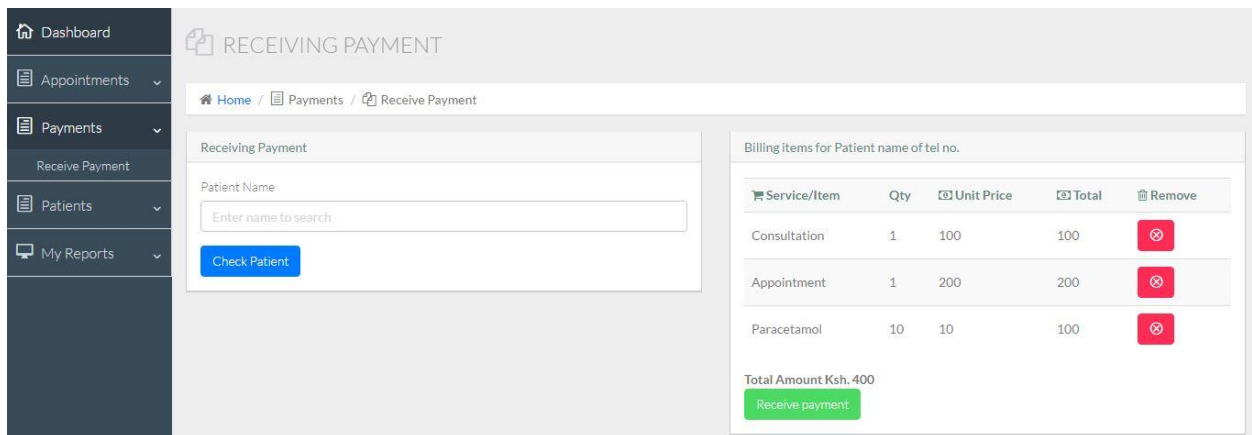


Figure 14: Billing module

7.3.5 Triage module

This is where all patient vitals such as weight, height, blood pressure are entered before seeing the doctor/clinician.

Kindly Fill all the fields below

Patient ID *	<input type="text" value="Enter patient ID"/>
Weight (in KG)	<input type="text" value="Weight e.g. 15"/>
Height (in CM)	<input type="text" value="Height e.g. 150"/>
Blood Pressure (in mm Hg)	<input type="text" value="Blood Pressure e.g. 120/80"/>
Temperature (in °C)	<input type="text" value="Temperature e.g. 37.5"/>
Age bracket	<input type="text" value="<--Select-->"/>

Figure 15: Triage module

7.3.6 Clinician module

This is where all case history, chief medical complaints, prescriptions and lab requests are made. It is core to hospital's performance.

Figure 16: Clinician module

7.3.7 Prescription module

This allows clinician to issue drug prescription to patients and pharmacy dispense the drugs.

Home / Medication / Add Prescription

Adding Prescription

Patient ID

Drug	No of days	Usage Per day	Notes
Paracetamol 500mg	7	2x2	Avoid alcohol

Add prescription

Figure 17: Prescription module

7.3.8 Lab request module

This allows doctor/clinician to make a lab test request for the patient and the laboratory technician responding back with test results.

JAM COMMUNITY HOSPITAL Search Queue Wambulwa Ayub (wambulwaayub@gmail.com)

Dashboard

Tests

Test items

Reports

ADDING TEST RESULTS

Home / Tests / Add Test Results

Patient ID Load Lab Request

Test	Result
Blood Sample for Malaria Parasite (MPS)	

Figure 18: Lab request page

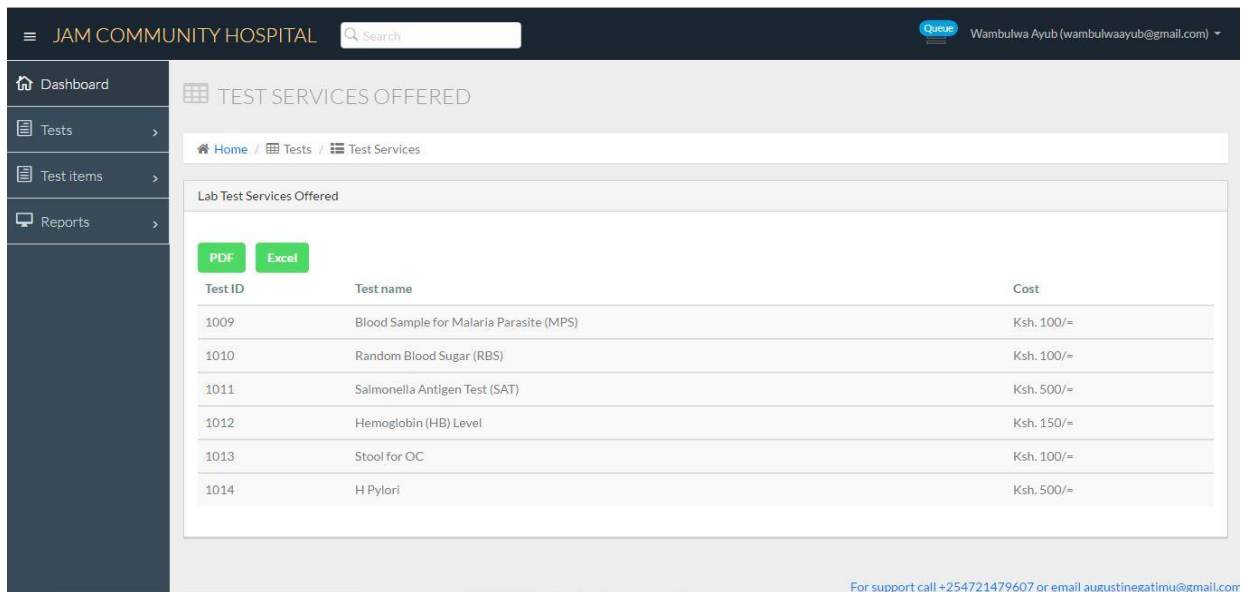


Figure 19: Tests offered

7.3.9 Reports Module

This generates all operational and patient reports for the facility. It is highly flexible in dates and can be done on any date range.

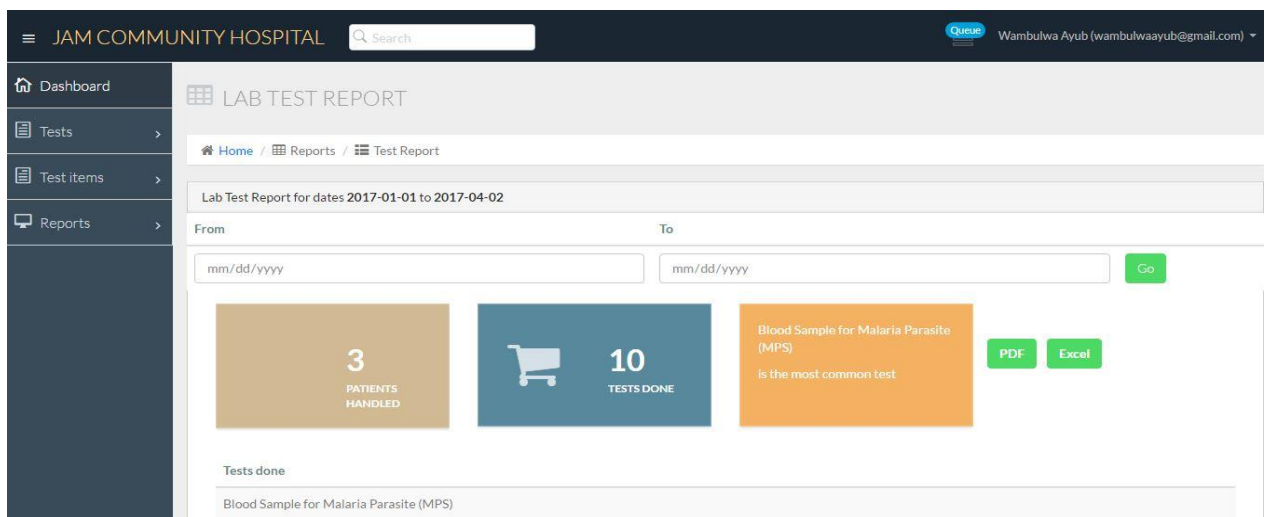


Figure 20: Reports per date

Also, patient case history can be retrieved under reports module.

Date	Metrics & Notes	Lab and Prescription																
2017-02-12	<p>Metrics for Joshua Kilonzo (1001):</p> <table border="1"> <thead> <tr> <th>Weight</th> <th>Height</th> <th>Temp</th> <th>B.P</th> <th>BMI</th> </tr> </thead> <tbody> <tr> <td>53</td> <td>152</td> <td>37</td> <td>121/72</td> <td>22.9398</td> </tr> </tbody> </table> <p>Notes: Temperatures high Started vomiting two days ago. Now having a lot of fever and pain joints</p> <p>Plan 1. BS for MPS</p>	Weight	Height	Temp	B.P	BMI	53	152	37	121/72	22.9398	<p>Lab Tests for Joshua (1001)</p> <p>Blood Sample for Malaria Parasite (MPS)</p> <p>MPS Parasites seen</p> <p>Prescription for Joshua Kilonzo (1001)</p> <table border="1"> <thead> <tr> <th>Drug</th> <th>Usage</th> <th>Notes</th> </tr> </thead> <tbody> <tr> <td>Paracetamol 500mg</td> <td>2x3 for 7 Days</td> <td>Take with heavy meals Take more water</td> </tr> </tbody> </table>	Drug	Usage	Notes	Paracetamol 500mg	2x3 for 7 Days	Take with heavy meals Take more water
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Drug	Usage	Notes																
Paracetamol 500mg	2x3 for 7 Days	Take with heavy meals Take more water																

Figure 21: Patient medication history

7.4.1 Administrator's module

This allows for system and hospital administration only e.g. activating, suspending of accounts.

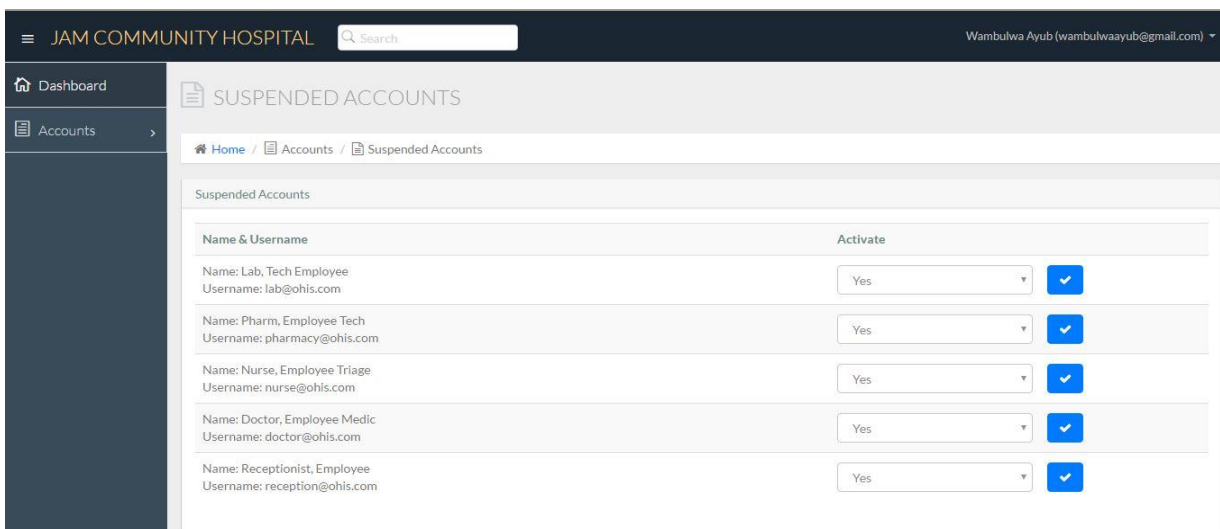


Figure 22: Administrator module

8 PROJECT IMPLEMENTATION METHODS AND MANAGEMENT PLAN

8.1 Key institutional issues that were addressed

In any given scenario of implementing a new way of doing things in an institution, there are always issues that arise. How these issues are addressed determines the success of the acceptance and testing stage of the system. At Justice and Mercy Community Project Oyugis, some of the issues dealt with include:

- **Maintenance Costs:** This entails the post-implementation costs that will be incurred in the project lifelong duration, example; basic system and network troubleshooting, user support (e.g. training new employees who will be hired after implementation and training), other utility subscription software required for the performance (e.g. antivirus programs are annual subscriptions), etc.
- **Computer Literacy:** This issue ought to be addressed first before any implementation, since most of the workers may be interacting with such a system for the first time. Therefore, basic computer training classes were held first before system implementation.

8.2 Project Activities

8.2.1 Management

Plan Project

Develop Project Plan

Track Project

Prepare status reports

Collect and analyze project metrics

Perform Quality Assessment Activities

Prepare Quality Assessment Plan

8.2.2 Conduct Reviews

Design

Preliminary Design preparation

Development of Enterprise Architecture

Preparing of Data Flow Diagrams

Preparing of Logical Data Model

Preparing of Detailed Design

Document Designing

Review Design

8.2.3 Development

Develop Software

Develop User Interface

Develop Backend transition

8.2.4 Procurements

Procure server

Procure Computers

Procure User Interface Building Tool

Procure Operating System

8.2.5 Conversion of manual data

Develop Conversion Plan from traditional to new system

8.2.6 Develop User Manual

8.2.7 Developing of a testing plan

Plan Acceptance Test

Conduct Acceptance Test

8.2.8 Installation

Develop Installation Plan

Install server-side scripts

8.2.9 Site Preparation

Maintenance

Hardware Maintenance

Software Maintenance

8.2.9 Post implementation

Conduct performance reviews

8.3 Implementers, Partners, and Beneficiaries

The developers who worked very closely with the target end users implemented the system. This close working relationship reduced any resistance and made users actively involved in the development process. A change management head coordinated the entire process.

The core beneficiaries of the system are the active users (health practitioners), their clients (patients) and government agencies (the consistent data captured is useful in decision-making by the government).

8.4 Communication Strategies

Communication between the developers and the users was real time or through the electronic media, any issue raised were addressed promptly

8.5 Documentation Process

As outlined in the activities section, documentation started taking place at the design phase. Moreover, thereafter, it was an ongoing activity as the development activities took place. It is important to capture every necessary detail that requires documentation every time there is progress. The final documentation was done after successful acceptance testing of the system was done.

8.6 Risks and Assumptions

Behind every Information System, there lies risks to bear. In the sense of a health information system, there are several risks experienced as below:

- Data privacy and confidentiality. When handling health-related data, it is important to maintain confidentiality, there might be some infringement. If a user prints data and misplaces the printout, or prints unnecessary data, this might expose it to unauthorized viewers.
- Security. This is an evolving threat in the information systems sector. It entails hacking, spoofing, unauthorized access, etc. For example, if a user forgets to logout, unauthorized persons many have access to patient's data.
- Burglary. Since the system runs on computers and computer related hardware, this might expose computers to theft.

8.7 Sustainability Plan

Three health workers from Justice and Mercy Project underwent midterm training. The training equipped them with the necessary knowledge and skills that will be key to the sustainability of the system in the facility. Before implementation, training was be conducted to ensure that all the users are conversant with the system functionalities.

Table 1: Project's Monitoring & Evaluation Plan

Objective	Activity	Project Measure	Tools/ Resources Required	Measured by:	Measure taken every:	Date completed
To determine the area of need.	Conduct need assessment	List challenges	Stationary ,laptop	PLP management developer	Daily	28/09/2015

Develop proposal	a Consulting Literature review	Challenges discussed with management addressed in the proposal	Stationary ,laptop	Developer Supervisor Adviser UNITID	Daily	29/02/2016
Presentation of the proposal	Presenting	Complete proposal <ul style="list-style-type: none"> • Introduction • Problem statement • Project Objectives • Justification • Implementation plan • Project M&E plan • Time frame • Budget 	Stationary ,laptop	Fellow Supervisor Adviser UNITID	5 days	8-12 February
Project review	Discussion supervisor and adviser	Listing any concerns	Stationary ,laptop	Best practice	Within one week	February 2016
Project implementation	<ul style="list-style-type: none"> • Purchasing of required resources • Training of staff members • Testing of the programme 	Running the program Users knowledge of the program	<ul style="list-style-type: none"> • Hardware • Software • Users • Conducive environment 	Fellow Supervisor Adviser UNITID Users PLP management	Daily	From April 2016
Support	Solving problems in implementation	Running program Users knowledge of the program	Hardware Software Users Conducive environment	Fellow Supervisor Adviser UNITID Users PLP management	Daily	Continuous

Project reporting	Presentations	Developer Sponsor Mentor UNITID	Laptop Projector	Fellow Supervisor Adviser UNITID PLP management CDC	April 2017	April 2017

9. PROJECT MONITORING AND EVALUATION

9.1 Logical Framework in Monitoring and Evaluation

An efficient Monitoring and Evaluation system has a clear rational trail of results, which covers the important levels including inputs, outputs, outcomes and impact. Figure 9.1 exhibits these interconnections in JAM's Electronic Health Record Project.

Inputs: refers to resources put into the project to achieve delivery of services;

Processes: are activities carried out for the achievement of project's goals

Outputs: are tangible products that are necessary to achieve the objectives.

Outcomes: are actual or intended changes due to the intervention

Impact: is the overall and long-term effect of an intervention, for instance, quantifiable health changes associated with outcomes, and particularly reduced mortality and morbidity.

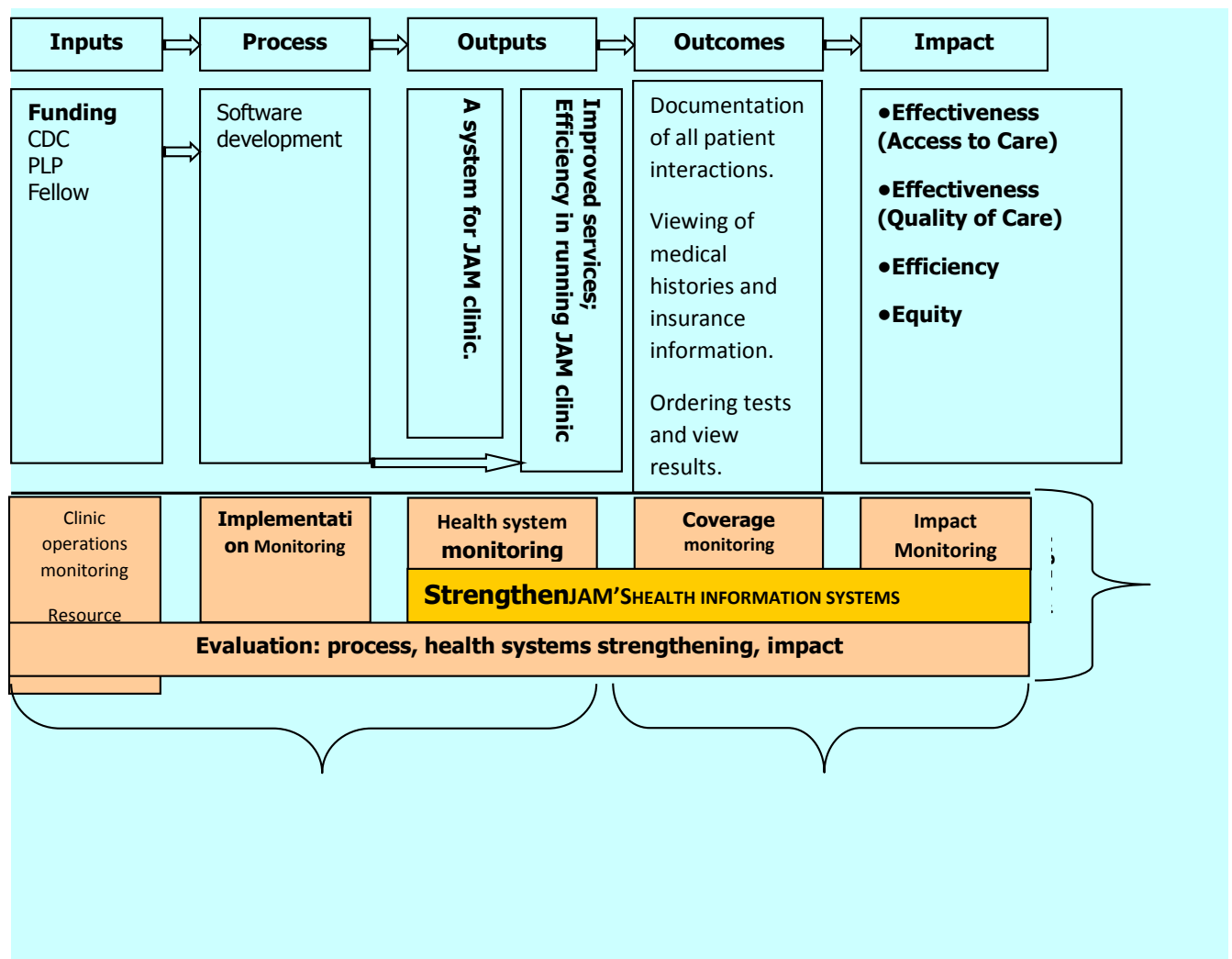


Figure 23: Framework for measuring results

Progress against indicators were monitored regularly by the system developer and implementation committee. While the progress of the project against set timelines were assessed every week, overall effectiveness of the project was tracked monthly. This was determined using identified indicators;

- Number of enrolled clients
- Number of defaulters identified and traced
- Reports produced.
- Time taken to attend to a client.
- Reports from client satisfaction survey

All measurements recorded in the course of this project were preserved electronically at the PLP.

9.2 How the achievements of project were evaluated and communicated

Measurements and other information relating to the project were pooled as described in the plan and combined for compilation of progress and annual reports. Results were shared with the PLP management and the other participants in the project, alongside facilitating the identification and implementation of improvements on the project. Project participants have the chance to reflect on and recognize achievements realized.

Baseline measure changes were also included in the schedule and submitted alongside progress and monthly reports. Before this was done, we took supplementary measurements for comparison with the baseline measures taken before the start of the project. These were recorded and changes discussed and their impact on the goal of improving care to clients.

We held a mini-workshop of crucial participants and to evaluate how the project worked for them, presented the information collected and asked for their feedback. We also asked users of the system about their thoughts on improvements using a brief survey form.

Project participants will also hold a meeting to mark the end of the project, and promoted the works to users and the local community. Participants also made a presentation on project outcomes to JAM administration.

10. SECURITY AND ETHICAL ISSUES.

Ethical challenges were addressed by restricting access to only authorized persons through the use of passwords, use of antivirus and frequent review of the system to identify emerging weakness with the system.

The project was submitted to University of Nairobi Ethical Review Board to ensure that it meets the entire set standards that govern interactions with human subjects.

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11. APPENDICES

11.1 APPENDIX I: BUDGET

NO	ITEM	DETAILS	QNT	UNIT	COST	SHOP
1	Computers	<u>Desktops</u> 3.0 GHZ Speed I3 4.0 GB DDR 500 GB HDD	2	40,000.00	80,000.00	The Computing Solutions Ltd.
		Server	1	50,000.00	50,000.00	
2	UPS	PowerBack	4	4,500.00	18,000.00	
3	LAN Infrastructure	D-Link Router	1	15,000.00	15,000.00	
		CAT 6 Cables	50 m	80.00	4,000.00	
		Conduits, Clips	20	100.00	2,000.00	
4	Operating Systems	Windows 10 Pro	1	27,000.00	27,000.00	
5	Office Application	Microsoft office 2016 Enterprise Edition	1	19,305.00	19,305.00	
6	4GL Object Oriented Development Software	Java SE 8.0	1	FREE	FREE	
		Java FX Scene Builder	1	9,000.00	9,000.00	
7	Local Database	MySQL	1	32,000.00	32,000.00	
8	Antivirus	McAfee Antivirus 2016	4	2,800.00	11,200.00	
9	Relevant Publication	Standards and Guidelines for Electronic Medical Record Systems in Kenya – MOH	1	1,500.00	1,500.00	

ITEM	DETAILS <i>Justice and Mercy Community Project Oyugis</i>	QNT		UNIT	C
		DAYS	TEAM		
	<u>Planning and Identification of Problems</u>				
	Site Visits to other major Public and Private Hospitals in South Nyanza (Cost of Transport plus allowances)				
	<i>Day 1; Homa-Bay County Hospital</i>	1	4	3,500.00	14
	<i>Day 2; Rongo Sub-County Hospital</i>	1	4	3,500.00	14
	<i>Day 3; Tabaka Mission Hospital</i>	1	4	3,500.00	14
Programme Development Cycle, Team and Processes	<u>Analysis</u>				
	<i>Day 4; Data, Constraints and Solution to problems</i>	1	4	3,000.00	12
	<u>Design</u>				
	<i>Day 5; Charting: Top-Down to be adopted</i>				
<i>TEAM = 4 Fluent Java Developers</i>	<i>Day 6; Algorithm</i>	1	4	3,000.00	12
	<i>Day 7; Pseudo code</i>	1	4	3,000.00	12
	<i>Day 8; Database and the Tables</i>	1	4	3,000.00	12
	<i>Day 9, & 10; Forms and Graphical User Interfaces, Objects</i>	1	4	3,000.00	12
	<i>Day 11, 12 & 13; Code: (Events, Classes, Procedures, Methods, Decisions</i>	2	4	3,000.00	24
	<i>Day 14; Reporting (Standard MOH Forms compatibility format)</i>	3	4	3,000.00	36
	<i>Day 15; Feedback and Error control</i>	1	4	3,000.00	12
	<i>Day 16; Test and Debugging</i>	1	4	3,000.00	12
	Induction	1	4	5,000.00	20
Implementation	Refreshments				8
	Projector (Rent)				5

TOTAL

500,005.00

11.2 APPEDIX II:WORK PLAN

Task to be completed							
	January 2016	February 2016	March 2016	April 2016	May to August 2016	August to December 2016	January to July 2017
Develop a proposal	✓	✓					
Presentation of the proposal			✓	✓			
Project implementation					✓		
Report Writing						✓	
Report submission and presentation to university examination board							✓

Table 2: Work plan