A Web-Based Management Information System for COVID-19 Vaccination

MAKERERE UNIVERSITY

By

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A Project Report Submitted in Partial Fulfillment of the Requirements for the Award of the Degree of Bachelor of Information Systems and Technology of Makerere University

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Supervisor: Dr. Namirembe Esther

Declaration

We hereby declare to the best of our knowledge that this project reports our original work and has not been submitted to any institution for any academic award.

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Approval

The above students corrected the report to the satisfaction of the panel examiners and the supervisor. As their supervisor, I therefore approve this project report for graduation.

Signature: .....

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Lastly, we thank Dr Namirembe Esther who guided us through our final-year project.

Abstract

The study was aimed at developing a web-based management information system for covid-19 vaccination (MISCV) for the Makerere University Hospital staff, to electronically improve data storage, monitoring, and management of covid 19 patients' data during the vaccination process.

The objectives of the study were;

1. To identify the requirements of the web-based MISCV
2. To design the web-based MISCV
3. To implement the web-based MISCV
4. To test and validate the implemented system.

The project management methodology used was the waterfall process model approach: to identify requirements, design, implement, test and validate the developed web-based MISCV.

The researchers used the interview guides to collect data from staff and patients of Makerere University Hospital. The data collection process involved making appointments with the above-mentioned parties so that data could be collected in an organized way.

The researchers recommend that the data upon registration of people's vaccination details should be directly entered into the system to ensure proper storage and avoid mismanagement of the vaccination information.

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List of Abbreviations

MISCV	MISCV
IS	Information Systems
IT	Information Technology
BIST	Bachelor in Information Systems and Technology
C-19	Covid-19 Mobile
EPIVAC	Epidemiology and Vaccinology
EHR	Electronic Health Records
AI	Artificial Intelligent

CHAPTER ONE

INTRODUCTION

1.1 Introduction to the Study

This chapter covers the background to the study area, problem statement, aim, objectives, scope and significance of the study. This section covers the introduction to a web-based management information system for covid-19 vaccination which contains the study to its background, problem statement, aims, objectives, scope and significance of the system.

1.2 Background to the Study

Vaccination is synonymous to immunization. Vaccination can be defined as a preventive measure from a particular disease in question (Anderson et al., 2014). In this study vaccination was perceived as a process to prevent the spread of covid-19. The process also involves management of data or information about a COVID-patient which necessitates use of information systems. No wonder, Osei et al. (2019) indicates that satisfactory vaccination criteria involve a number of initiatives which may include:

i. Ensuring safe vaccination arrival in a particular nation
ii. Setting up stock management systems
iii. Setting up suitable information systems. Since setting up suitable information systems is one of the criteria for satisfactory vaccination, it is important to understand the role of information systems in the vaccination process. Vaccination information systems can also be referred to as immunization information systems. Such systems are used to store immunization details about an individual (European Center for Disease Control (ECDC), 2018). They are confidential in nature, and usually computerized and information can be accessed in timely manner aiding the decision making during the vaccination process.

Computerized information systems are information technology driven systems which may incorporate mobile technology, web technology or any other form of

technology. Mobile technology usually uses mobile devices such as mobile phones (Mayisela, 2013). Web technology relies on the internet and can use web apps provide access to users on a wide range of devices, regardless of operating system, through the browser (MacPherson, 2019). MacPherson, 2019 indicates that this type of technology allows developers to easily make changes to about any information. For instance, patient details. He seems to highlight that web technology can be accessed by any one in any location.

While it has been argued that vaccination is a process in this study, the researchers put their emphasis on the information management side of the vaccination process. In most developing countries, the management of vaccination information is still a challenge. Yet Osei et al (2019) argues that effective information systems are crucial in the vaccination process. They seem to indicate that the information systems in Ghana do not support the immunization process adequately. The situation in Ghana, seems not be different from that in Uganda. For instance, in our baseline study as researchers, we observed how the COVID patients' information was managed at Makerere University Hospital. The university hospital uses a paper system where patients information is stored in files with some inconsistencies. Such a storage system with inconsistences may cause delays in accessing information hence hindering smooth administration to the hospital. As a result, there was need to use our IT expertise to come up with an application to solve the said problem at the university hospital. More elaboration about the problem can be found in the problem statement. Through observation; on our first visit as researchers, we observed that management of covid-19 patients' information was done poorly. This was because, the pandemic had just spread and there was no proper measure or framework to manage such information. Patients' records were stored in files which could easily be destroyed by fire or rain.

1.3 Problem Statement

While effective information systems are crucial in the vaccination process (Osei, 2019), such systems are nonexistent in Makerere University Hospital where vaccination of COVID 19 is taking place. The system in place is paper based with

inconsistencies which is likely to hinder the smooth administration of the university hospital. Such a system can be easily destroyed by fire and water. Additionally, the space the hospital is quite small to accommodate the files of the patients attached to that hospital. Thus, the problem points to improper documentation of information, delays and poor storage of data leading to information mismanagement. Therefore, we suggest that a web-based MISCV should be implemented for proper management of information given advantages of web technology such as easy access and updates to the information as already mentioned in the background.

1.4 Aim of the Study

The study was aimed at developing a web-based management information system for Covid-19 Vaccination (MISCV) for Makerere University Hospital.

1.4.1 Objectives of the Study

1. To identify the requirements of the web-based MISCV
2. To design the web-based MISCV
3. To implement the web-based MISCV
4. To test and validate the implemented system.

1.5 Scope of the Study

The scope of the study covered three main areas:

1.5.1 Conceptual Scope

Conceptually, the researchers identified the requirements they used to design, implement, test and validate a web- based MISCV.

1.5.2 Geographical Scope

The study was conducted at Makerere University hospital in the Wandegeya, Kampala district.

1.5.3 Sample Scope

The sample scope was covered staff and patients from Makerere university hospital.

1.6 Significance of the Study

The benefited the categories of people;

1.6.1 Researchers in IS Field

Researchers in the field of information systems or information technology. They would use the report for future reference and further research.

1.6.2 The workers in the Health Sector

This research contributed to enhance efficiency in management of health information. Vaccination data can be managed through use of web-based systems.

1.6.3 Policy makers

The government would use the study for policy making towards information management in pandemics.

1.7 Conclusion

In conclusion, this chapter introduced the subject matter of the study by clearly outlining its key areas. This chapter aimed at highlighting the back ground of the study, problem statement, aim and objectives, scope and significance of the study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter we review literature about information systems pointing to how requirements are elicited, how the systems are designed, implemented and testing in a systematic way. We also reviewed literature about the nature and applications of information systems for vaccination highlighting strengths and opportunities where possible.

2.2 Elicitation of Information Systems Requirements

Since web-based systems are computerized information systems, the development of such systems is perceived differently by different scholars. Scholars of project management usually begin with a feasibility study before engaging in any project. In this case the development of a computerized information system would be regarded as a project. In traditional systems analysis and design the technical aspect of requirements elicitation is a very vital stage in the development of a computerized system (Preece et al., 1994). Elicitation of requirements at times referred to as requirements identification (Somerville, 2011). It is the process of gathering data to identify the requirements that would be used in the development of the system (Preece et al., 1994). In this project we shall consider it as the process of gathering data from Makerere University Hospital patients and staff to develop a web-based management information system for vaccination.

The process of requirements elicitation/ identification can be accomplished using a questionnaire or interview guide. A questionnaire is a data collection tool that is usually used to collect data from a large population and mainly used in quantitative studies (Oppenheim, 1992). An interview guide is mainly used in qualitative studies where the number of respondents may not be high. An interview is retrospective and respondent is given chance to provide information without intimidating them hence making it a genuine option. Observation approach is where a researcher uses his/ her eyes to see what is taking place in view of the study they are carrying out. Since the

development of the web-based management information system is qualitative in nature and given the fact that researchers carried out the study genuinely, an interview guide was adopted. Additionally, the researchers also used observation technique mainly during the baselining and data collection process. Using this method, they were able to identify the paper-based system in place at Makerere University Hospital.

2.2 Design Methods or Models that can be used in the Development of Information Systems

There are different design methods or models that can be used the development of an information system. The researchers have begun with the soft systems method. This type of design method is from a systems perspective. The system is considered in its totality. Focus is not on a problem par se but the situation from which the problem stems (Preece et al., 1994).

Another design method can be the cooperative design method. In this method users participate in analysing and planning socio-technical requirements. It can also be a socio-technical cooperative design geared towards the human machine system (Preece, 1994). Preece et al. (1994) indicates that there is also a Multiview design method caters for the social-technical and soft systems views. In this design method, the purpose, stake holders and the perspective of system owners are explicit. Information is modelled and structured. Using a functional model, tasks or roles are set and then technical requirements are used to design the computer system.

The approach was borrowed in the development of the interfaces and database as a storage unit of the web-based MISCV. This design mechanism can also use entity and data flow modelling technicalities. User perspectives are highly considered and incorporated in the developed system (Preece et al., 19914). This approach does not only ensure proper design of the system but also ensures that ensures that change management is effective in case the designed system is put to use. Given the advantages of this approach, the researchers adopted the same design method whereby the baseline study was taken in understanding the environment in which the system operated. Given such a background it was inevitable to point out main users of the information system to be designed. The users were required to exchange ideas on

what system they would require to aid the vaccination process. We also borrowed a social and technical systems approach whereby we collected data from the users and technically analysed and designed them. From the design method discussed we used the entity relationships and data flow techniques as shown in chapter 4.

Design models can also be subdivided into different stages for instance the interface design, middleware and database design (Sommerville, 2011). These designs models are very essential components systems development. Other design models include application of use cases which are usually used in unified modelling language and applied in the object-oriented environment (Larman, 2001). They usually capture essentials of a domain to have a clear understanding.

2.3 Implementation of Information Systems

Implementation is the process of building the web according to its design. A web implementor creates hypertext markup language (HTML), Common Gateway Interface (CGI) programs, and/or Java scripts and/or applets (Nielsen, 2013). The implementation process is synonymous to software development because it involves using a specific syntax for encoding web structures or a programming language in a formal language in computer files. Although there are automated tools to help with the construction of HTML documents, a thorough grounding in HTML enriches the web implementor's expertise. During the development of the web-based management information systems for COVID- 19-vaccination, we used different programing tools/ languages. These constituted python, JavaScript, HTML, CSS, jQuery Django frame work and SQL which helped in the design and functionality of the system.

The programming process involves these key practices:

- At the outset, create an extendible directory and file structure to manage the web's files and/or software components (CGI or Java programs).
- Use HTML tools were helpful.
- Check the web's implementation in various browsers.
- Use templates or web generating schemes for supporting a consistent look and feel.

During the programming process of the web-based MISCV we considered the requirements we had elicited following the technical design as shown in chapter 4.

Implementation can be carried out instantly by replacing the old system with the newly functioning system (Eason, 1988). However, this approach requires careful planning and ensuring that the users of the new information system are well trained. Another way to implement an information system can be through a parallel approach where the old and new system operate concurrently until the old is phased out (Eason, 1988). There is always an insurance policy against failure of the system. The problem to such an approach is that the users may fail to appreciate the new system. Implementation can further be introduced in phases where an information system can be introduced in a particular organization in phases over a period of time (Eason, 1988). Trials and dissemination can also be used as implementation strategy whereby trials are carried out per department and then the information system goes live. This can be an easy of identifying problems (Eason, 1988). The incremental implementation strategy geared to assist end users and used for unplanned evolution (Eason, 1988). Since we are implementing the web-based MISCV system for academic purposes at this particular point suggesting an implementation strategy may not be inevitable. However, the incremental strategy would be best to support the end user of any system.

2.3 Testing and Validation of Information Systems

Testing and validation are key in information systems development. Failure to carry out the said activities may lead to system failure. Testing is the identification of defects in a software (Sommerville, 2011). According to Sommerville (2011) testing can be carried component by component per piece of program. It can also be carried out after the whole system is completed hence systems testing. Lastly testing can be carried out on presenting the system to the customer thus termed as acceptance testing. In this project we applied component testing whereby we were able to identify defects in the web-based application we came up with. This enabled us to work bit by bit hence making it easy for us to identify defects in our application. Besides that, we also

carried out systems testing this was done in the process of integrating the software application such as the interface, database among others.

Validation is defined as the process of ensuring that the software meets what the customer requires (Sommerville, 2011). To validate our application, we presented our simulated application to the users and they appreciated the development.

Another approach to testing emphasizes, black white and grey box testing. There are several techniques for information systems testing such as black box texting among others. Testing is usually carried out using system data and validation carried out to see whether system does what it is intended to do. Are the user requirements met?

2.4 Nature and Applications of Information Systems for Vaccination

Information systems for vaccination are at times called information systems for immunization. Such systems use information technology to manage information. For instance, a COVID- 19 mobile application was developed by a team of Makerere University researchers (Wamai, 2021). The application was developed to collect and keep patients' information secure. The application was used for COVID-19, timely reporting and decision making to improve the efficiency of COVID-19 response and capture community feedback. In terms of reservation, the application system enables one to book for a COVID-19 test from the nearest authorized laboratories. This is done by filling a lab booking form which locates the test center near you. Additionally, it also enables different user's right from Community, VHTs District Task Force DTF and National Task Force NFT by filling the contact tracing form. This application does not cater for the vaccination. The envisaged web-based MISCV is therefore recommended as a model that can be used for the vaccination process.

Li and Ray (2010) developed a mobile application for managing influenza information. They collected the requirements using the experimental approach. Besides mobile technology web-technology can also be applied in the management of information with in the health sector. Atkinson et al. (2020) indicates that digital immunization systems can solve challenges in data capturing. Nehra (2019) web-based systems can use surgical assistance with augmented reality. Remote

consultation of doctors can take place through use of web-based technology. Real time access to data can be achieved. Given the numerous advantages of web-technology we have chosen to apply in our solution for vaccination. The solution developed can easily organize information where the documentation and normalization of data is simplified and solves the problem of it being time consuming.

Mikelsone et al (2021) states that web-based information systems can be easily updated, require less money to maintain and have high chances of being used. In a developing country like Uganda where the division of immunization and vaccination find it difficult to monitor its activities such as monitoring vaccines and patients' data. Implementation of web-based technology would be vital given their advantages. Muscoplat and Rajamani (2017) developed a comprehensive immunization computerized information system for reporting, client follow up, vaccine management, keeping immunization history, clinical decision support, forecasting and recommendations, data processing and exchange. The system shares data with different hospitals and clinics for decision support.

While information systems used for vaccination may be mobile or even web-based, we have chosen to use the web-based approach given the advantages of the web-based system such as easy access and updating as mentioned above.

2.5 Conclusion

Literature review was carried out systematically in relation to the objectives. It was decided that requirements would be collected using an interview guide. Several design issues have been presented with respect to the methods or models. In this particular study a Multiview design perspective has been opted for. The implementation process has not only presented the environments but also the strategies. Testing and validation have been briefly discussed and later on a general picture on the nature and application of information systems for vaccination. The next section leads us to the methodology or approach which was used to achieve the objectives

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter elaborates on the modified waterfall methodology used to achieve the research objectives as stated in chapter one. It can generally be referred to as a blue print for achieving the objectives.

3.1 Modified Waterfall Methodology

This methodology was adopted using the qualitative paradigm. The methodology was chosen because we wanted to complete a task before we proceeded to another (borrowed from Sommerville, 2011). Observation was used earlier on as a baseline strategy where we identified the paper-based information system used for COVID vaccination process at Makerere University. From the qualitative paradigm we identified the area of study as Makerere University Hospital where we mapped the population of study. The population of study were staff and patients of Makerere University hospital. Purposive sampling in particular was used to collect data from the staff of the university hospital (i.e. hospital administrators and medical personnel). The patients interviewed were students, administrative staff from Makerere University who were interacted with. Purposive sampling was chosen because the researcher had in mind the respondents who could provide the information.

After identifying the area, population of study and choosing a sampling approach, the researchers developed the interview guide. The interview guide was mainly developed based on the strength, weakness, opportunity and threats (SWOT) analysis. The SWOT technique is a strategic planning technique used to improve companies but has larges been used in the development of information systems of late ((Benzaghta, 2021). Questions 6 to 10 are part of the SWOT analysis. For instance, question 6 is about strength of the existing COVID vaccination system that was in place. For the interview guide please see appendix A.

The development of the interview guide was followed collection, analysis and transformation into systems specifications which were technically the basis of the relational design model used in chapter four. At this point the researchers were able to

achieve the second objective of the study. Later, the researchers were able to choose create the web according to its design in the chosen programming environment to produce the software application that is to say the web-based MISCV. The final nail to our project was component testing where by the interface was tested and integrative testing where the whole application was tested. Getting back to our users they were able to appreciate our application hence ensuring validation.

3.2 Ethical issues

Besides incorporation of the qualitative paradigm in the modified waterfall model, we also considered ethical issues while carrying out this project. Ethics are very important in software development (Sommerville, 2011). We acted professionally, we requested for a letter from our college that we presented to Makerere University hospital. This letter acted as a proof of verification that we were students of Makerere University. Thus, during our interaction with the interviewees, they were not scared and provided the information without being scared.

3.3 Conclusion

This chapter gave a blue print of the approach used in achieving the objectives. The most thrilling part of the methodology was the ability of the researchers to make the systems approach more pronounced in a social environment. This was achieved by fore fronting the modified waterfall model visa vie the qualitative paradigm. The chapter has generally elaborated the waterfall model and pointing to how the objectives were achieved.

CHAPTER FOUR

DATA PRESENTION, TECHNICAL ANALYSIS AND DESIGN AND WEB-BASED MANAGEMENT INFORMATION SYSTEM FOR COVID 19 VACCINATION

4.1 Introduction

This chapter comprises of data presentation, technical analysis and design of the web-based MISCV. This entire chapter summarized the data collected through the interview guide which was technically analyzed through identifying requirements and later presented as specifications. Thereafter, the collected data was transformed into the technical design whereby data was modelled using the relational model.

4.2 Data Presentation

Presentation of data has been done in relation to the questions in the interview guide. In the first question we sought to know whether the respondents were aware of COVID 19. Most of the respondents we interacted with were aware of COVID 19. This was a point of information in helping us understand that respondents engaged in the vaccination process. The second question posed to the respondents sought for information about the departments of the organization to understand the information flow cycle. It was clarified from the data that Makerere University hospital has 8 departments. The most fundamental one was the Medical Records Department and it is considered as COVID-19 vaccination information management center.

According to Makerere University Hospital, the medical records department's primary role is to ensure secure, efficient and effective creation, storage, maintenance and dissemination of Makerere University Health Services' medical records. As a requirement, every patient that visits Makerere University Health Services has to be registered with the records department and a patient number which is unique for each patient is assigned to the patient before accessing a particular clinic/medical service. The details of COVID-19 patients are registered in a book. This implies that the system in place is manual. It was also observed that the process of getting a COVID 19 vaccine are:

i. Registration. This is where a patient is given a registration sheet where he is supposed to provide unique id for registration and other details, and his/her information is recorded in the book.
ii. The patient receives a Covid-19 jab.
iii. Then the patient's details are put in the system.
iv. The patient receives a vaccination card after receiving both of the jabs.

One of the strengths of the system in place is that it can allow monitoring of the immunization performance. The weaknesses in the system are: Time consuming especially in uploading patient details which are collected manually.

It is very slow in terms of uploading data: Since the system gets data from different health centers country wide, this causes a lag in imputing patients' data into the systems database. It doesn't allow real time input of patient's vaccination data: Since the system is accessed by the admins only, staff are not able to input and update patients details directly into the system.

From our interview guide we showed the need of the web-based system and engaged users to choose feature they would prefer to be incorporated if such a system was to be deployed in their organization. The following features were chosen:

Request for vaccination information easily. This saves time because a patient or staff will need few seconds and receives the response.

Application making notifications using messages. SMS uses the regular mobile network and is not dependent on the internet or any other technical issues thus making anyone in modern society reachable. Because a user usually has his or her mobile device turned on at any given time an SMS can urgently update a patient about any information about the vaccination.

4.3. SYSTEM ANALYSIS

The main objective of system analysis is to define the requirements of web-based management information system for covid_19 vaccination. Analysis was carried out to analyze the findings that were collected about the current system to understand the

specific functional and non-functional requirements as well as user defined requirements for a web-based management information system for covid_19 vaccination.

4.3.1. Data Analysis

The collectedrawdatawascollectedandorganizedsothatthevariableinformationcouldbe extracted from it. The process of organizing and thinking about the data was a key to understanding what data did or did not contain.

4.3.2. Requirements Determination and Analysis

4.3.2.1 Requirements gathering

Duringrequirementgatheringdatacollectiontechniquesandtoolsdiscussedinchapterthree came up with user requirements. In this process, there was interaction with various individuals which includecovid-19 staff and patients.

4.3.3. User requirements

These are the requirements that govern the project deliverable as expresses by the prospective users of the system. The researchers categorized the requirements basing on the different users of the system and these included; covid-19 staff and patients.

4.3.3.1. To Staff

- The system should be able to allow staff register covid-19 patients.
- The system should be able to allow staff update, delete and retrieve patients' information urgently.
- The system should be able to allow staff to show a report about the vaccinated patients in a given period of time.

4.3.3.2. To Patients

The system should request for vaccination information easily.

The system should send notifications using messages.

4.3.4. Requirement Analysis

Requirement analysis was done in order to categorize the user requirements into functional and non-functional requirements. At this stage, the researchers used "Measurable goals as a tool for analysis. With measurable goals, best practices take the composed list of requirements merely as clues and repeatedly ask "Why" until the actual system purposes are discovered.

Individuals and developers can then devise tests to measure what level of each goal has been achieved thus far and from this, the actual functional and non-functional requirements are derived as below;

4.3.4.1. Functional Requirements

These are servicing the system by providing, how it should react to particular inputs, or how it should behave in particular situations. They include the following;

- System should store information about covid-19 patients and staff.
- System should authenticate and allow access to only authorized users.
- The system should show the number of vaccinated users in a bar graph
- The system should interact with the database.
- The system should give feedback to both covid-19 patients and staff.
- The system should be able to generate reports when needed.

4.3.4.2. Non-Functional Requirements

These are constraints that must be adhered to during the system development for example operational costs, performance, reliability and others. These include;

- The system should be faster in information processing.
- The system should be reliable and accurate that is to say it should be able to provide data whenever it is needed.
- The system should convey results in a consistent manner. This means that whether a lot of information has to be processed, the results produced should have the same feel and thus easy to understand.
- The system should promote data integrity, which means that unauthorized users should not alter data.

4.3.5 System Requirements

These are the services that the system should provide and the constraints under which it should operate. These requirements are categorized in form of hardware and software requirements.

4.3.5.1 Hardware Requirements

These were the minimum hardware requirements that were used to develop the MISCV.

Table 4. 1: Hardware Requirements

Hardware	**Description**
Processor	1.68GHZ processor speed and above
Memory	1GB RAM and above
Disk Space	1GB and above

4.3.5.2 Software Requirements

These were the minimum software requirements that were used to develop the MISCV.

Table 4. 2: Software Requirements

Software	**Description**
Windows (7, 8, 8.1, 10 and 11)	Up to date windows version
Apache2 webserver	Apache2 with all services running
MySQL database	MySQL database software
Python (Django Framework)	Support Python v8.0 and above
jQuery	Support JavaScript Libraries

4.4 System Design

The third objective aimed at designing how the Web-based application will be represented on the website.

Since the system is interoperable, this includes object oriented and relational models. In this case we shall use, a use case diagram, sequence diagram, Enhanced Entity relation diagram.

In the system design three phases were followed which included the conceptual, logical and the physical design.

4.4.1 Conceptual design

A conceptual model is a representation of a system. It shows how people, places and things interact in the system design.

The following figure show how the different users are interacting with the system

Figure 4. 1 CONTEXT DIAGRAM (DFD LEVEL 0)

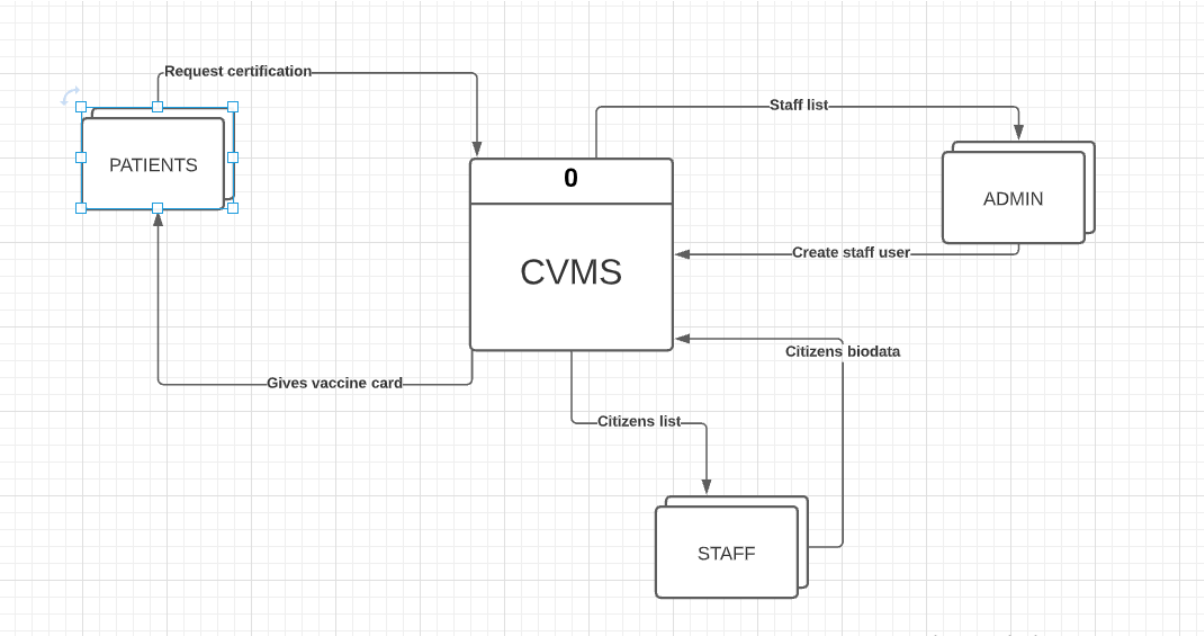


Figure 4. 2DFD LEVEL 1

Shows the data flow diagram on how data has been worked by different entities in MISCV

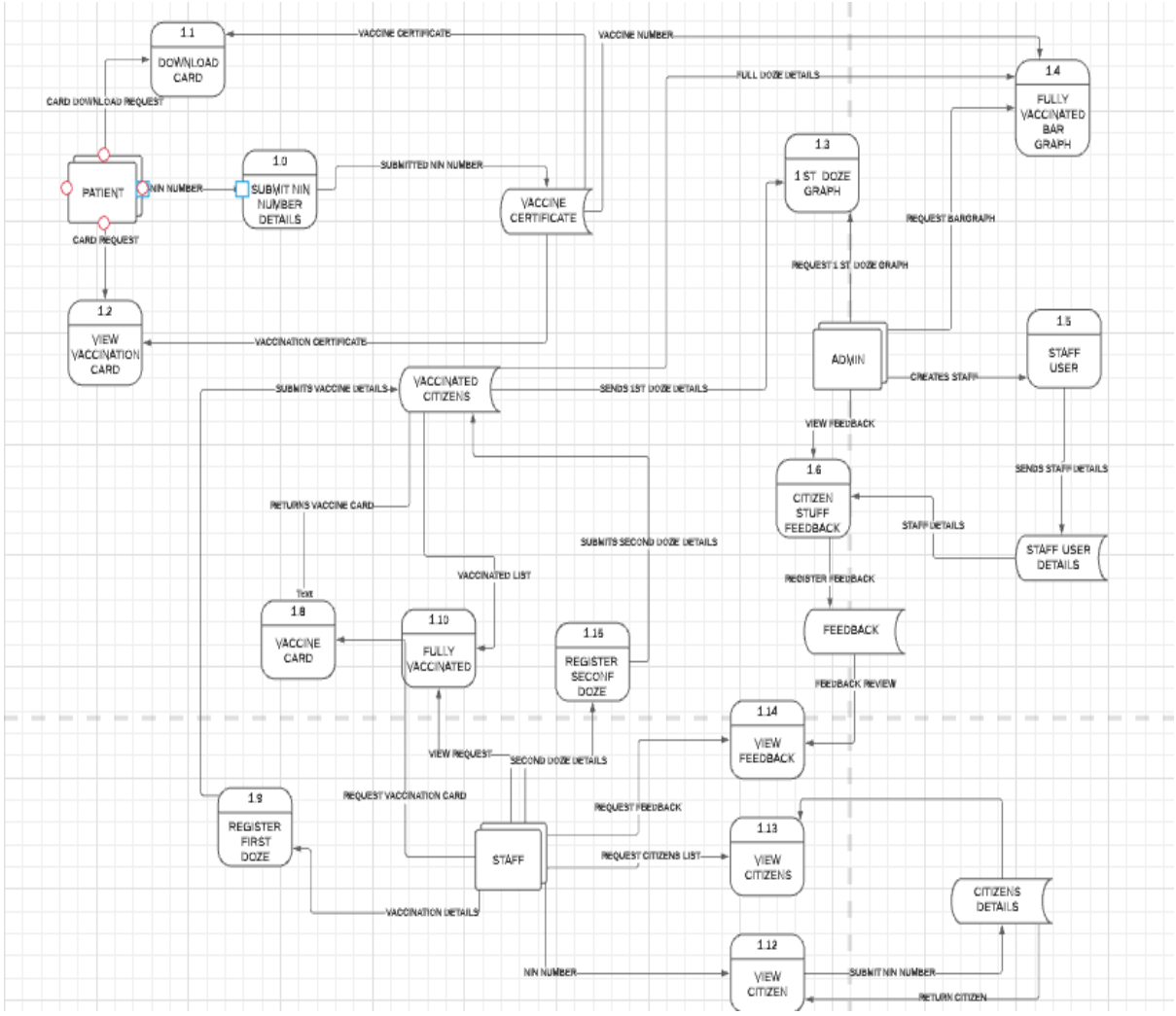


Table 4.1 Data Dictionary

The table below explains the flow of information from the above figure and also explains the flow of contextual data.

Entity	Description
Staff	A staff is one who works as the system administrator and manages the system. He feeds and runs the system by adding information such as register covid-19 patients, checking in and out. He is also responsible for updating the system and also verifying the identity of the registered patients.
Administrator	An administrator is the overall supervisor. He is responsible for adding in new staff members and also manages the database for the system.
Patients	A patient is one who is registered as a user of the system whom the staff considers as a legitimate user of the system.
MISCV	MISCV is the system design for covid-19 staff and patients to help them during the process of covid-19 vaccination data management
MISCV Database	The MISCV database is a storage platform where all information that is entered into the system is stored. The database helps the covid-19 staff to retrieve the previously stored

	information to carry out vaccination.

4.4.2 Logical Design

The logical design was used to derive the data requirements for the system. In the logical design, all data entities and their attributes are represented. It also shows how the child entities directly interact and interface with each other in the system while demonstrating integrity constraints as well as data types for the identified entities.

4.4.3 Physical Design

The physical design is divided into two categories. These are; the database design and interface design. These designs are fully described as used in the system.

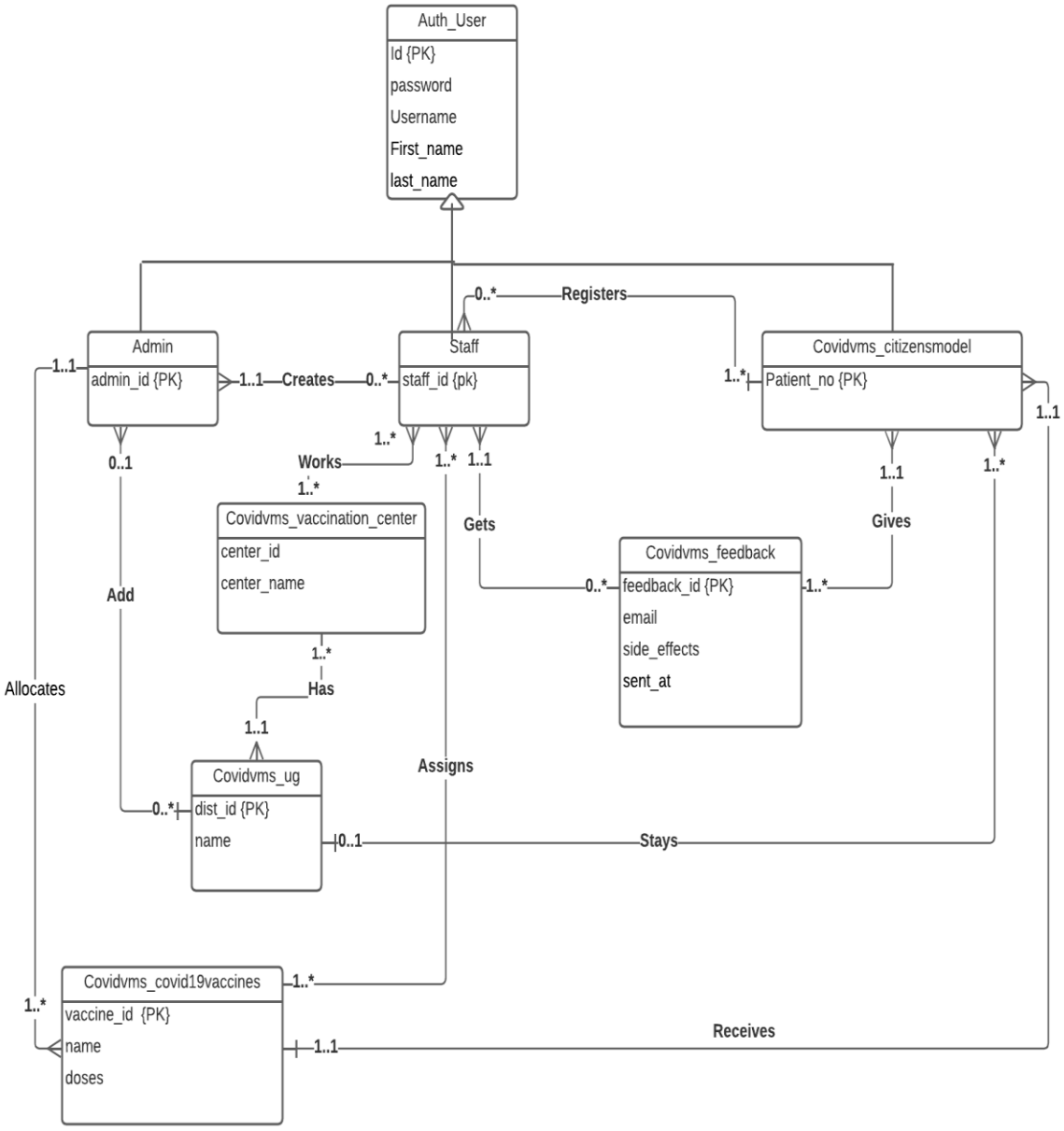
4.4.4 Database Design

In the physical database design, the Entity Relationship Diagram is decomposed into relation tables as shown below.

4.4.4.1 Entity Relation Diagram

An Entity Relationship Model is a detailed logical representation of data in an organization. It is expressed in terms of the relationships among entities and the attributes of entities and their relationships. Figure 4 show the entity relationships in our system.

Figure 4.3 Entity relationship diagram adds allocates



4.5 Conclusion

Chapter four, was about the design of the system. Results exhibited how data moves and changes through an information system in a graphical top-down fashion ultimately giving a graphical representation of the system components, processes and interfaces between them.

Entity Relationship Diagrams were used whose results depicted how well the relationship is between the different entities and their attributes in the back end of the system.

It was established that coming up with good designs of the system, you need to be well conversant with case tools for example PyCharm and Atom as they help in the design of the required system.

CHAPTER 5

5.1 System Implementation

Since an inter-operable model is used, Wamp Server and MySQL were used as web server technologies and implementation of the database respectively. This produced an enhanced database with fast and easy insertion, maintenance and retrieval of required information.

The interface was designed using object-oriented python framework (Django) to develop the front end of the system.

WampServer encompasses a MySQL component that enabled the creation of the system database and tables that provided the platform from which the system information is stored.

In order for Python interface to interact with MySQL we showed the scenario by using a state chart diagram. It describes the flow of control from one state to another state.

Now that the information is kept in a database it can be called upon at any time and at any point. The problems associated with the manual storage system like the rain or destruction cannot be experienced in that the records can be backed up. The patients who are vaccinated, their information can be sent to different data centers.

5.2 System Test and Validation

5.2.1 System Testing Results

System testing was performed on the entire system in context of the functional requirements and system requirements and the following tests were carried out.

5.2.2 Unit testing

Functional components of the system were identified during the development process. Based on the functional requirements of the system, test cases were designed that were used with predetermined fixtures used as a dummy database against which tests of the functional units were carried. The tests helped identify parts of the system that were not functioning as intended.

5.2.3 Integration Testing

In this kind of testing, two or more components were coherent. For example, we ensured that the database captures the specific fields according to their respective attributes. This also ensured that the storage and retrieval functions of the database connection with the interface worked perfectly

The tables with information concerning different aspects of the software were rightly placed and are easily accessible by the system administrator.

We did different sub systems and integrated them, we did integrated system, then we did a system sub system where we had to integrate python interface with MySQL.

5.2.4 Compatibility Testing

The system was tried out on different web browsers for example chrome, opera mini, fire fox, safari and internet explorer to test the compatibility of the web system and the problems encountered in internet explorer were fixed.

5.2.5 System Testing

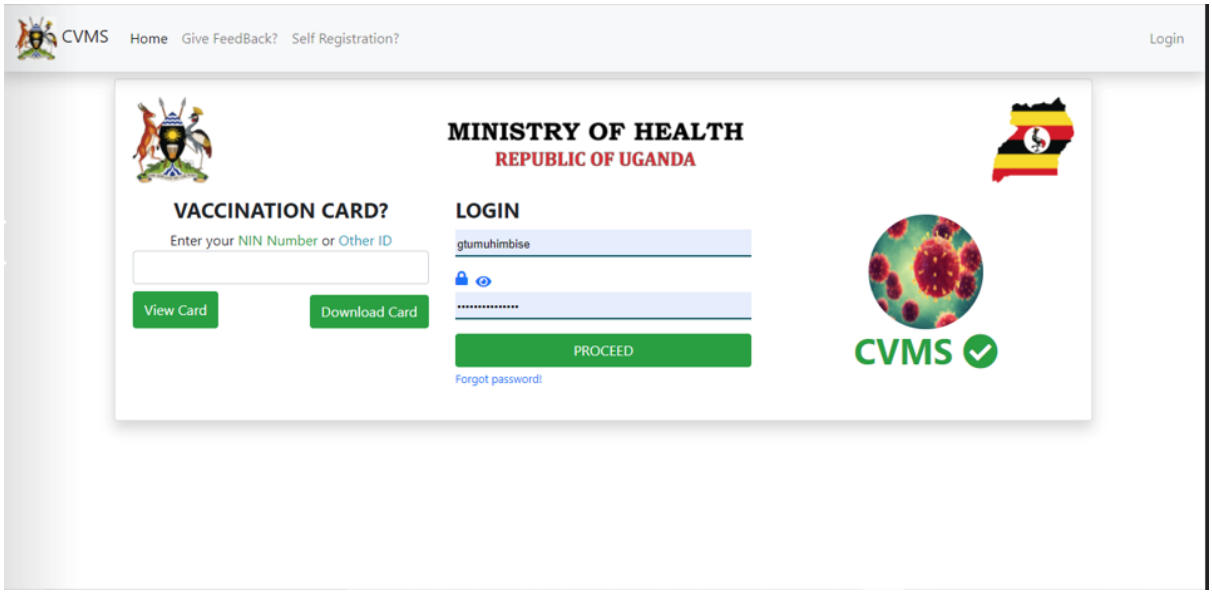
System testing was done using real data. Complete components of the system were tested against the requirements specifications.

Using raw data, finished components of the intended users to identify weaknesses and strengths of the system and give advice where necessary.

5.3 THE USER INTERFACE DESIGN OF MISCV

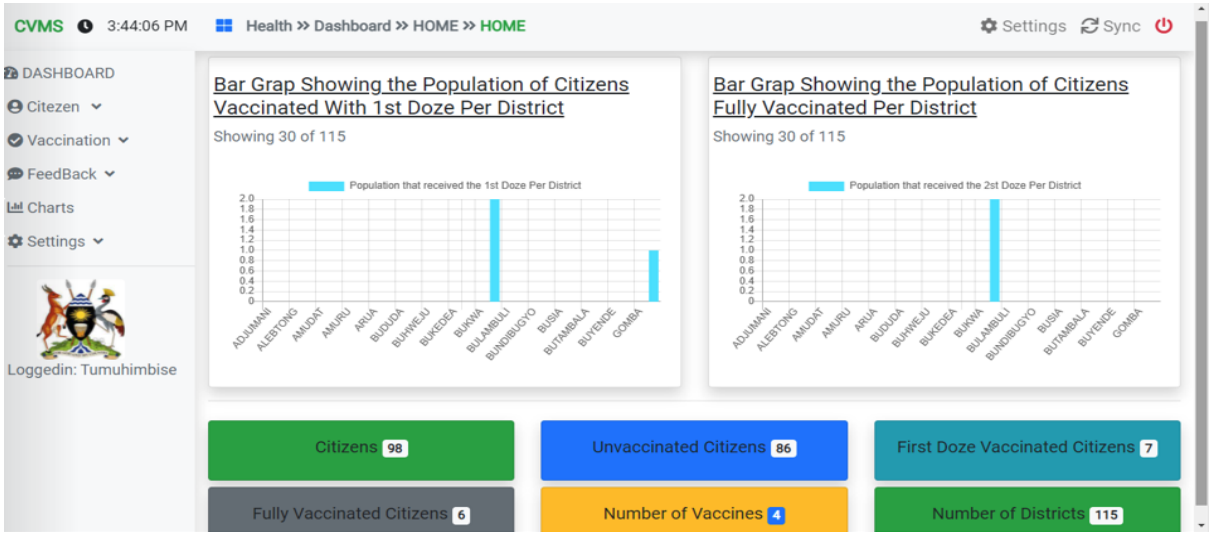
The following figures show the full interface of the MISCV and its interactions.

Figure 5.1 Login Page



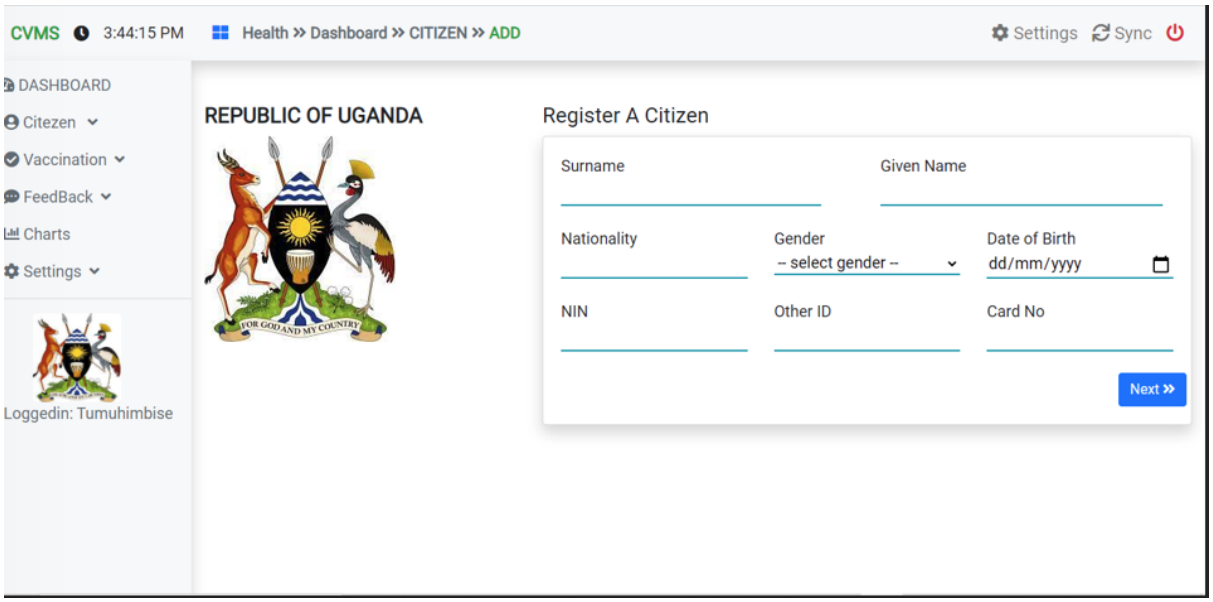
This is where staff log in and fully vaccinated citizens download their vaccination card from.

Figure 5.2 Home Page



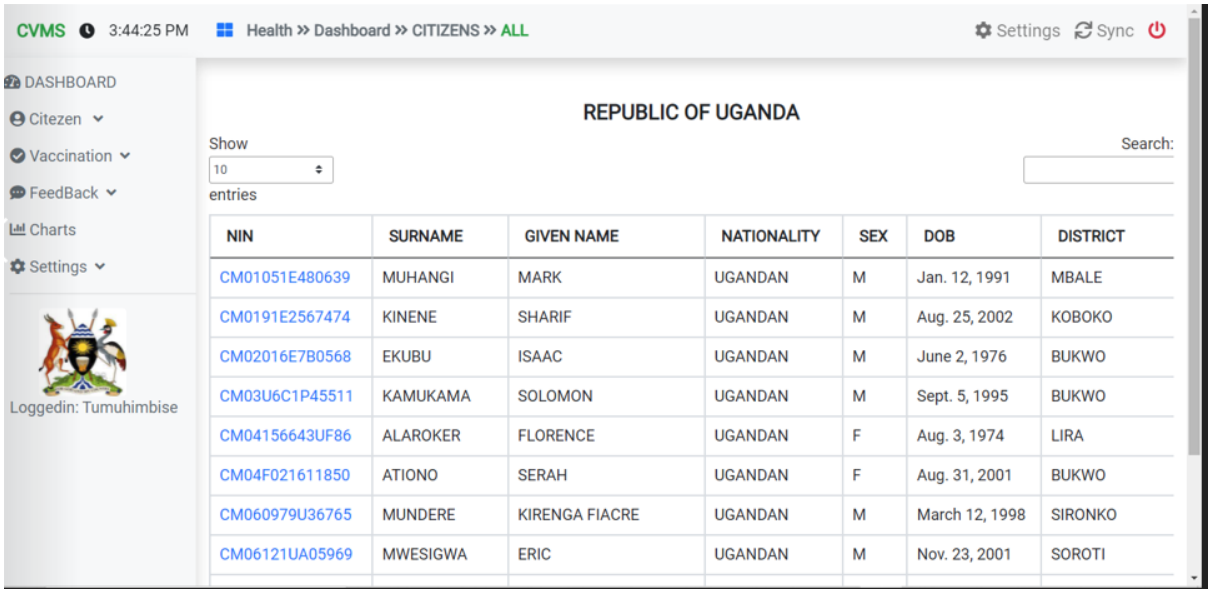
This is the homepage interface that the staff is logged into which shows the graphs for vaccinated citizens.

Figure 5.3 Register A Citizen



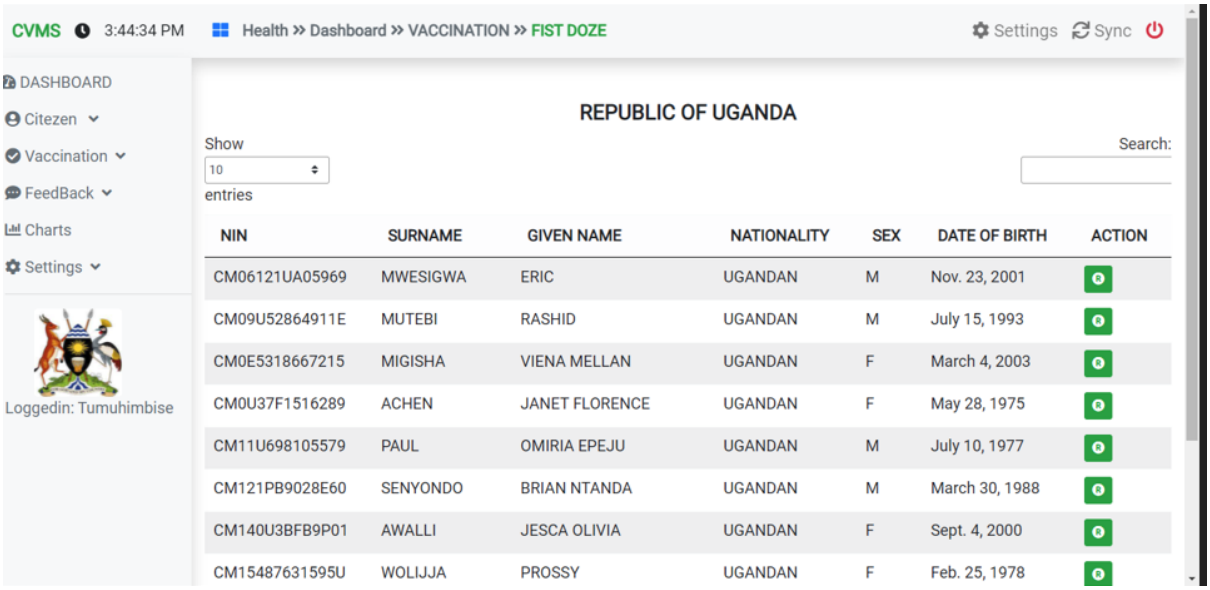
This is where new users are registered from with their names and the National Identification Number.

Figure 5.4 List of registered Citizen



The list shows the number of registered citizens ready to get the doze.

Figure 5.5 Registered patients

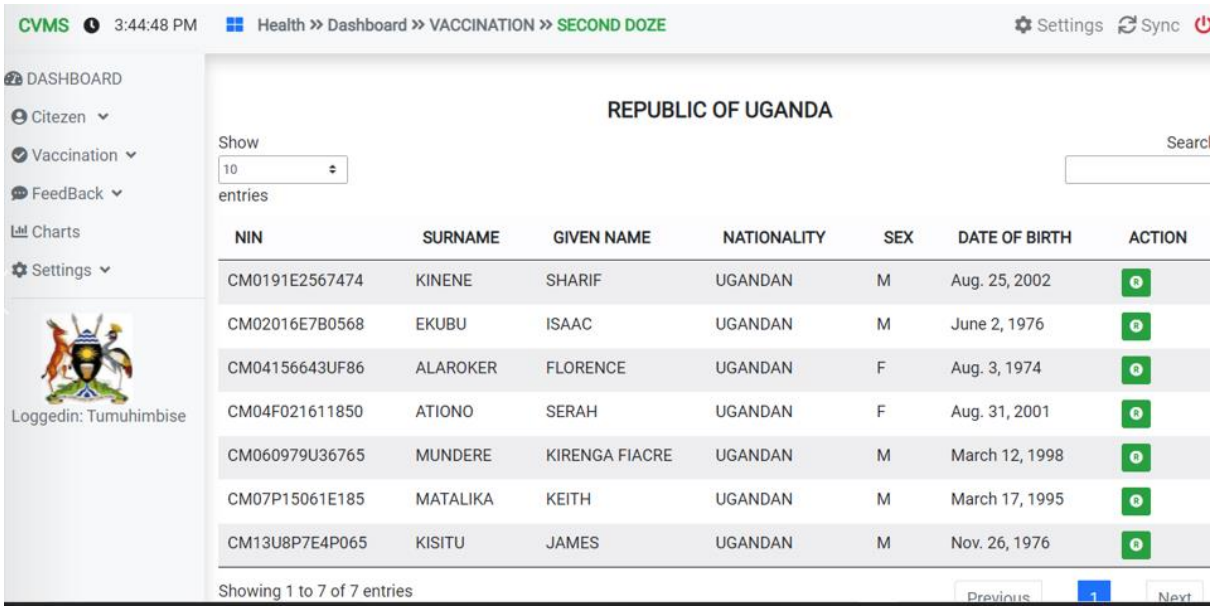


The patient details are stored in the database and is ready to be given the vaccine.

Figure 5.6 Give doze to patient

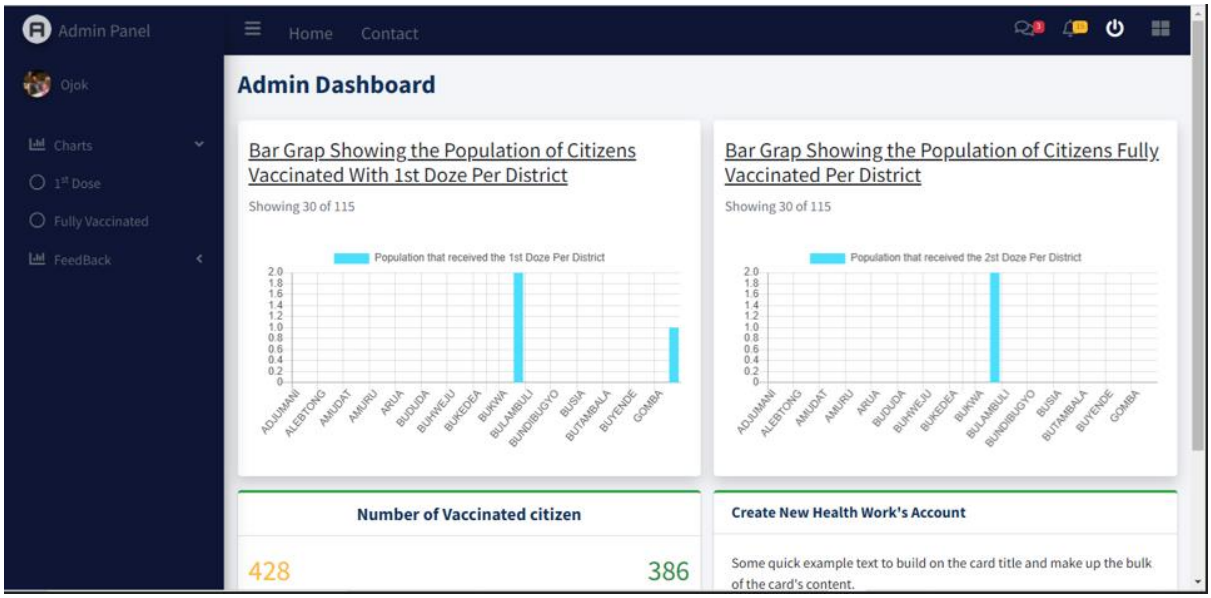
This is when the patient is ready to receive the second doze.

Figure 5.7 Give second doze to patient



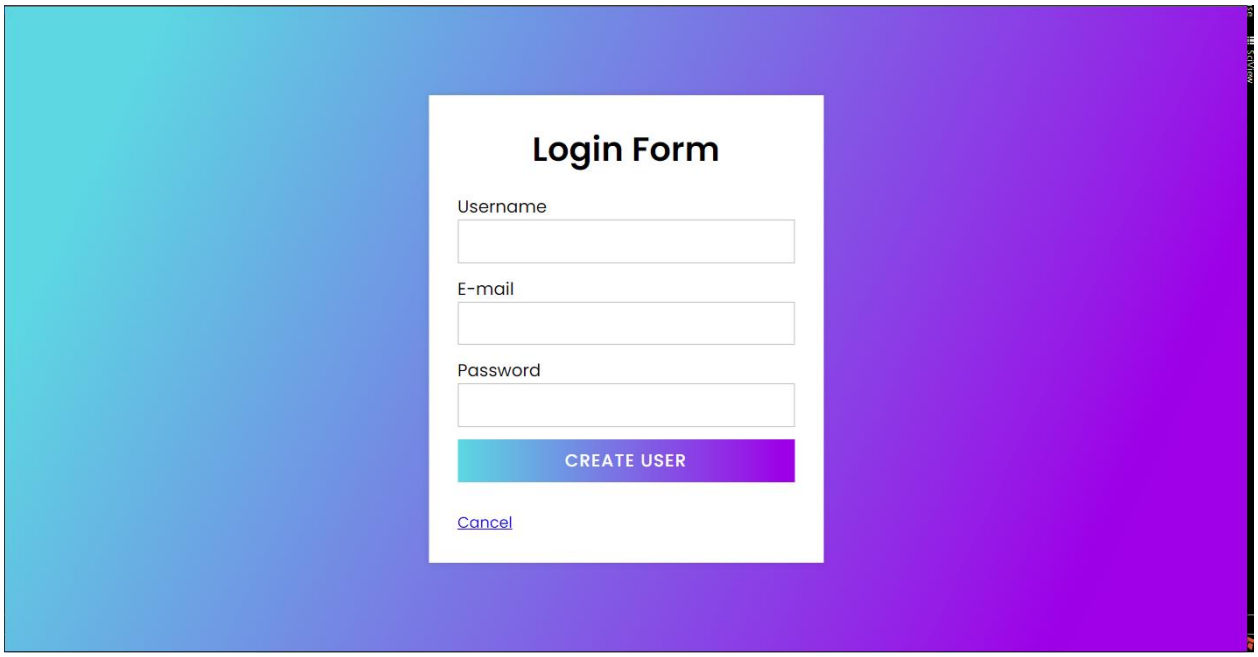
This is the final step of being given a doze to a patient.

Figure 5.8 Admin panel



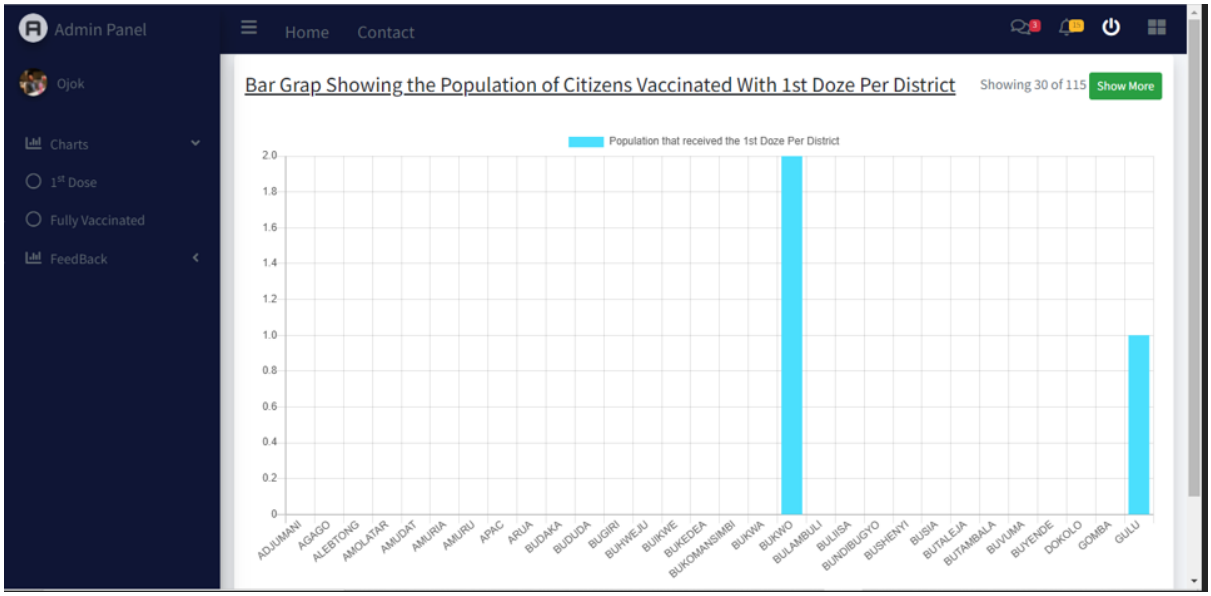
This is the admin panel, all those who have admin privilege are directed to this dashboard once they login.

Figure 5.9 Create staff user



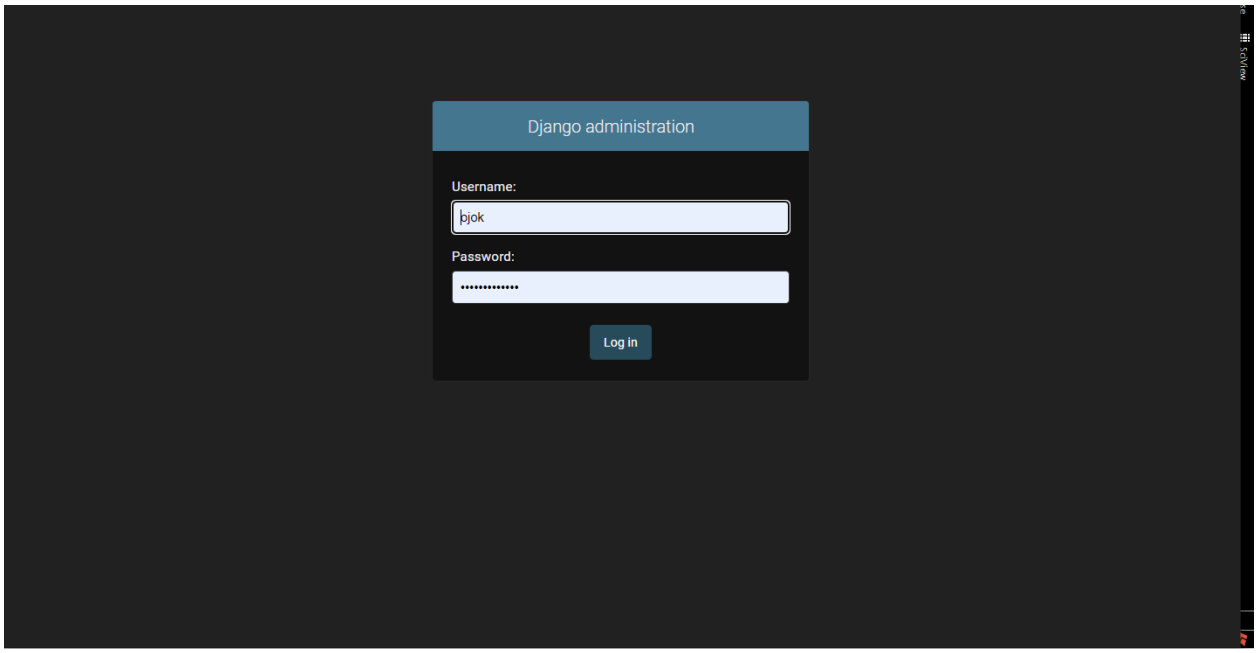
At the admin panel, the admin can create a new staff user in the system.

Figure 5.10 Partial vaccination in districts



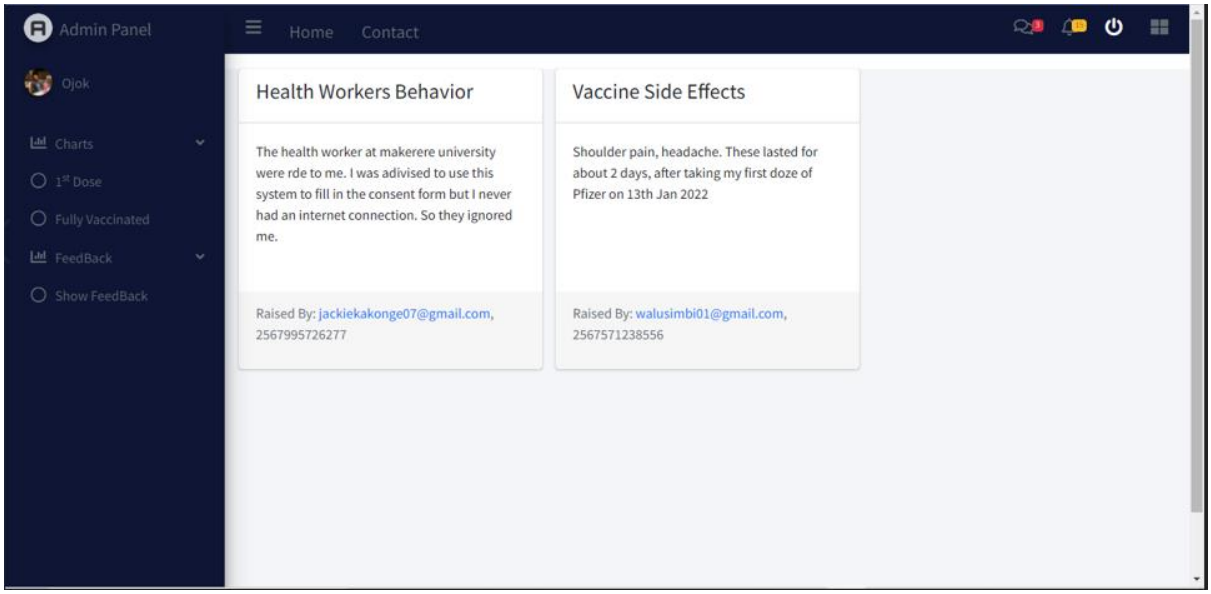
This shows the partial number of patients that have been vaccinated.

Figure 5.11 Super Admin login panel



At this level the super admin allows to create admin users that in turn create staff users.

Figure 5.12 Admin feedback



5.4 Systems Validation

A prospective validation was conducted on MISCV system. The ability to store information about covid-19 patients and staff, authenticate and allow only authorized

users, shows the number of vaccinated users in a bar graph, query data in the database, has interfaces for entering and viewing data and give feedback to both covid-19 patients and staff.

The installation qualifications confirmed that all installed hardware and software for MISCV system met specifications. The installation qualifications indicate that the MISCV system was properly installed and no variances required.

5.5 Conclusion

Chapter six tested, implemented and validated the system. The system was analyzed and the output implemented in this chapter.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Introduction

This is the final chapter of the research. It covers the summary, conclusion based on the findings presented in the data presentation and discusses the recommendations

6.1 Summary

In summary we identified the requirements through requirements elicitation using an interview guide. We then designed the MISCV system using the relational model, and also implemented MISCV under an appropriate programming environment then later tested and validated the system.

6.3 Conclusion

In conclusion, MISCV has been developed to handle information management problems at Makerere University hospital. The said model can be adopted or further developed for information management.

6.4 Recommendations

It has been recommended that where information is not well managed using the manual means, a web-based system can be appropriate. Based on the findings, the researchers suggest that the following should be put in place to implement a MISCV.

Training of covid-19 staff.

The staff should endeavor to be trained on how to manage the new MISCV, and how to operate the new covid-19 system and they should be impacted with skills for effective operation of MISCV.

More equipment for new covid-19 system activities to be offered.

The hospital should purchase equipment that is of software and hardware such as drivers, servers, scanners among others. This will enrich the activities hence lead to effective operation of MISCV.

Setting up rules and regulations.

The hospital should set up rules and regulations regarding the usage of recording data and access to the system using the MISCV. Measures should be set.

Improve security of patient data in the system

The hospital should grant authorized access to information. This will eliminate people with other intentions like theft and fraud that could endanger the records like patients' records.

Further research can be carried in the development of the MISCV as a mobile platform. The MISCV was an information management platform it could further be used as a case for embedding security features.

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Appendix A

The following is the attached interview guide that was used to answer chapter 4

INTERVIEW GUIDE FOR NURSES, DOCTORS AND TOP LEVEL MANAGERS/ DIRECTORS

RE: AN INTERVIEW GUIDE FOR DESIGNING A WEB-BASED MANAGEMENT INFORMATION SYSTEM FOR COVID-19 VACCINATION

We are students of Bachelors of Information Systems and Technology, Makerere University carrying out a study on management information system for covid-19. We aim at developing a web-based management information system for covid-1. We intend to develop web-based application because of its cross-platform compatibility.

COVID-19 has impacted society in one way or another. COVID-19 as of today demands vaccination. Vaccination is a process that involves information management. In order to manage the information properly during the vaccination process there is need to come up with modern applications to enhance the vaccination process.

This interview guide targets nurses, doctors and top-level managers/directors at University Hospital. It is presumed that nurses, doctors, and managers are involved in the vaccination process of COVID 19. It is against such a background that you have been selected to participate in this study. Please provide the most appropriate answer of your choice. Your opinions will not be disclosed to ensure confidentiality. Filling this questionnaire can take a maximum of 10 minutes. After feeling in the questionnaire please contact Ojok David Odonga at COCIS. Thanking you in advance for your cooperation.

Yours faithfully,

Please put your signature

Joan Kabahuma

Ojok David Odonga

Godwin Tumuhimbise

Denis Mujuni

Benon Lusawo

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1. Have you heard of COVID-19?

Yes ☐ No ☐

2. Have you been vaccinated against corona virus?

Yes ☐ No ☐

3. How many departments does your organization have, please state them?

4. How many COVID 19 vaccination information management canters do you have?

5. COVID 19 vaccination is a process that incorporates information management, please elaborate on the vaccination process in relation to information management?

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6. What are the strengths of the COVID 19 vaccination information management system in your organization?.....

7. What weaknesses have been identified with the COVID 19 vaccination information management system in your organization?.....

8. Which of the following COVID 19 vaccination information management technique is implemented in your organization?.....

i. Use of web-based applications
ii. Use of mobile applications
iii. Manual system

9. Since our aim is to come up with a web-based application, your views as a user in the actual development of this application are important. Which of the following features do you prefer to be incorporated in the web-based application we intend to design?

i. Beautiful user interface
ii. Read only content with simple navigation and links
iii. Download information from the appropriate server
iv. Customized content to specific needs in view of the vaccination process
v. Interaction with other users via chat room
vi. Input data easily
vii. Request for vaccination information easily
viii. Application making notifications using messages
ix. Allow users to query database
x. Real time access to the data

10. Please provide any other information that you may find useful in the development of a web-based application?

