# REPUBLIC OF RWANDA UNIVERSITY OF LAY ADVENTIST OF KIGALI (UNILAK)

# FACULTY OF COMPUTING AND INFORMATION SCIENCES DEPARTMENT OF SOFTWARE ENGINEERING

7

RWANDA HEALTH WORKER MANAGEMENT SYSTEM

Case Study: Rwanda community health workers

**ACADEMIC YEAR: 2020-2023** 

Final project submitted to the faculty of Computing and Information Sciences in partial fulfillment of academic requirements for the award of a Bachelor Degree of Science in Software Engineering

\*Submitted by:\*

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## **DECLARATION**

I, Habimana Jambo Florbert hereby declare that the project entitled

"Rwanda Health Worker" submitted in partial fulfillment of the requirements for the award of Bachelor Degree Science in Software Engineering.

I further declare that the work reported in this project has not been submitted, either in part or in full, for the award of any other degree or diploma in this University or any other higher learning institution. All sources of knowledge used have been duly acknowledged. I also declare that the project developed during this Final year project.

	Habimana Jambo Florbert
Date	Signature

## **BONAFIDE CERTIFICATE**

This is to certify that the project entitled "Rwanda Health Worker" submitted by Habimana Jambo Florbert Reg No 16809/2020

University of Lay Adventists of Kigali in partial fulfillment of the requirements for the award of Bachelor's degree in Information technology is a work carried out by her under my guidance.

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Supervisor	<b>Dean of CIS Faculty</b>

Date: ... / .... Date: ... / ....

## **DEDICATION**

To my Father Habimana Peter Emmanuel
To my Mother Kuradusenge Emmerance
To my Brother Habimana Deo Gracious
To my Uncle Munyeshuri Dick Prudence
To my Colleague Nizeyimana Moise

I dedicate this work

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Habimana Jambo Florbert

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## LIST OF ABBREVIATIONS AND ACRONYMS

ABBREVIATIONS DESCRIPTIONS

CSS Cascading Style Sheets

DBMS Database Management system

DFD Data flow Diagram

ERD Entity Relationship Diagram

HTML Hyper Markup Language

HTTP Hypertext Transfer Protocol

ICT Information and Communication Technology

WWW World Wide Web

SDK Software Development Kit

JSON JavaScript object notation

IDE Integrated Development Environment

UML Unified Modeling Language
ORM Object Relational Mapping

RCHW Rwanda Community Health Workers

SSDAM Structured System Analysis and design method

CHWs Rwanda community health workers

**ABSTRACT** 

I have built a mobile system and web app to address the challenges faced by health workers

in delivering services effectively. The existing hard-written system lacks adequate

documentation, making it difficult for health workers to access crucial information.

Furthermore, there is a need for a trusted platform that can provide good documentation to

prevent various disasters, such as malnutrition by building Akarima kigikoni.

To solve these issues, I have developed a mobile application for health workers. This app

allows them to record their daily activities, making it easier to recap the information from

their training. It also includes comprehensive documentation to guide health workers in

different areas, such as malnutrition, contraception, and the treatment of various diseases.

The mobile app also connects to a web system implemented for health centers. This web

system facilitates the generation of reports and provides tools to manage and control the

activities of health workers. The system is designed to ensure better communication and

coordination between health workers and health centers, leading to improved service delivery

and patient care.

In developing this solution, I have utilized the SSDAM methodology, which stands for

System-Scoping, Data Collection, Design, Assembly, and Maintenance. This approach

ensures a systematic and well-structured development process, resulting in a robust and

efficient system.

For the implementation, I have used Python for back-end development, HTML for web-based

user interfaces, and Dart for mobile app development. Additionally, I have chosen

PostgreSQL as the database to store and manage the data efficiently and securely.

With this mobile system and web app, I aim to revolutionize healthcare service delivery,

providing health workers with the tools they need to excel in their roles while ensuring that

patients receive the best possible care. The platform's comprehensive documentation and

reporting capabilities will aid in preventing disasters and promoting better health outcomes

for all.

Keywords:SSDAM ,postgresq

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**CHAPTER ONE: GENERAL INTRODUCTION** 

1.1 INTRODUCTION

The Rwanda Health Worker System is a comprehensive and innovative solution

comprising both a mobile application and a web application. Its primary objective is to

empower Community Health Workers (CHWs) by facilitating efficient management of

health center information related to their daily activities, with a specific focus on

malnutrition, contraception, and parasitic diseases such as malaria. This system aims to aid

CHWs in recording client information, and it also provides reports derived from the

recorded data to their respective health care centers. These reports play a crucial role in

guiding resource allocation and campaign planning, ensuring targeted efforts where they are

most needed based on the collected data.

In our increasingly digital world, the pervasive use of technology offers an optimal means to

enhance service delivery, ensuring timeliness and high service quality for individuals

benefiting from these advancements. In Rwanda, community health workers hold a pivotal

role within the health care framework. They serve as a vital link between service delivery

needs, social and economic development, and the achievement of the Millennium

Development Goals (MDGs). These health workers bolster the health system, effectively

reducing the need for residents to undertake long journeys to access health centers.

In essence, the Rwanda Health Worker System represents a pioneering approach that

harnesses technological tools to empower CHWs, facilitate data-driven decision-making,

and strengthen health service delivery. It aligns with Rwanda's commitment to both

immediate health care needs and broader developmental aspirations.

1.2 BACKGROUND OF THE STUDY

Rwanda community health workers program was established in 1995, aiming at increasing

uptake of essential maternal and child clinical services through education of pregnant

women

and promotion of healthy behaviors and it was linked to the health services. After linking

this

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program to the health service the community health worker now days they provides health services such as testing malaria providing anti-malaria drugs, birth control through giving pills or inject those who don't use pills method and other first health service delivery. According to the reports Demographic and Health Survey (DHS) conducted in 2015 show that simple malaria cases increased from about a million in 2012 to 4.5 million in 2016 rise while severe malaria cases increased from 9,000 to 17,000 during the same period. However, reports indicate that total malaria cases dropped to below four million by end 2018 following the malaria contingency plan that was put in place in 2016.

With the introduction of Home Based Management of Malaria (HBM) for both adults and children through Community Health Workers, malaria patients are being diagnosed and treated early in Rwanda.

At these numbers of malaria cases it shows that there still big numbers and according to the system of gathering information that the RCHW use it is difficult for them to take some measures on how to sensitize people to fight against malaria and other health service they provide to people.

Birth control and fight against paludism through RCHW system involves in some activities of

keeping the information regarding to the treatment of patient by Rwanda community health workers called in Kinyarwanda (Abajyanama bubuzima). By using this system it will be easy

for them to track where to put more effort according to the data obtained.

As we know that the use of information technology in different domain is increasing and taking important role in our country, the improvement of technology is playing sufficient role

through government environment as well as in social-economic and in all other areas of activities. As our country running fast in technology, information technology is truly needed in all sectors of activities. In almost every field in medical or other companies, the importance of computerization has been known especially where good quality of service is the key to success of any area and in development of our county in general. That is why my project is trying to modernize the method of keeping information for patient who has treated by those Rwanda community health workers, as the best way of securing that information and also it will be easy to make some decisions. Statement of the Problem

Rwanda has made significant strides in improving the health of its people by helping them to get quick health service in every region of the country and that service starts at village level. In Rwanda we have 14837 villages and in each village there are people called RCHW who are in charge of providing first line health care service to people at each village.

And by providing that service it needs that RCHW record all information related to patients, and these information are recorded in different books based on which category patient are in and this method of keeping these information tend to be traditional because the risk of losing data is high, time consuming and comes with a higher degree of error, lack of privacy for patients data, also making of reports in this paper based system is a big problem as it takes time by collecting all files and bringing them together so that they can be delivered.

#### 1.3 PROBLEM STATEMENT

Rwanda has achieved remarkable progress in enhancing the well-being of its population through the establishment of easily accessible healthcare services spanning every region of the nation. This commitment to prompt and efficient healthcare commences at the grassroots level, particularly within each of the 14,837 villages that constitute the country.

In Rwanda, the cornerstone of this healthcare initiative is the presence of Community Health Workers (CHWs) embedded within each village. Tasked with delivering essential primary healthcare services, CHWs play a pivotal role in ensuring the health and welfare of village residents.

To fulfill this vital role, CHWs meticulously document pertinent patient information. However, this traditional method of documentation, involving separate books for distinct patient categories, poses significant challenges. These challenges encompass the heightened risk of data loss, prolonged administrative processes, elevated error rates, compromised patient data privacy, and the arduous task of generating reports. Indeed, the existing paper-based system necessitates the laborious assembly of physical files for onward transmission to health care centers.

Furthermore, the dissemination of crucial knowledge, such as techniques for constructing "akarima kigikoni" (a traditional form of elevated crop bed), among the populace and CHWs remains a challenge due to the absence of an effective information recapitulation mechanism.

To address these challenges comprehensively, Rwanda seeks to modernize its healthcare infrastructure, embracing technological solutions that streamline data capture, storage, and retrieval. By transitioning to digital data management, the country aims to mitigate risks associated with data loss and errors while ensuring patient data privacy. This transition will also enable efficient report generation and expedite the transmission of crucial information between CHWs and healthcare centers.

Furthermore, the adoption of digital platforms will provide the means for efficient knowledge dissemination and skills acquisition, empowering both citizens and CHWs with essential information for activities like constructing "akarima kigikoni."

In summation, Rwanda's commitment to universal healthcare and the pivotal role of CHWs necessitates an innovative shift from traditional paper-based data management to digital solutions. This transformation not only enhances patient care but also equips healthcare providers and communities with the tools needed to access, utilize, and share vital healthcare information effectively.

#### 1.4 OBJECTIVES

#### 1.4.1 MAIN OBJECTIVE

The primary objective of the Rwanda Health Worker system is to develop a comprehensive web application and mobile application. These tools aim to empower community health workers by enabling them to efficiently manage and access information related to malnutrition, contraception, and the treatment of parasitic diseases in the context of community-based health service delivery.

The system will not only assist health workers in keeping detailed records but will also provide valuable insights into population dynamics, allowing them to monitor and analyze the growth of their village through recorded data.

Furthermore, the applications will play a crucial role in enhancing the skill set of health workers. They will receive updates on emerging diseases, along with information on effective treatment strategies. This continuous learning platform ensures that health workers stay informed and well-equipped to address new health challenges.

In addition, the system facilitates direct communication between patients and health workers. Patients can easily request assistance or information regarding treatments without the need for constant supervision. This streamlined communication process aims to improve the overall efficiency of health services in the community.

#### 1.4.2 SPECIFIC OBJECTIVES

Below are specific objectives of the new system:

- Provide CHWs with a user-friendly mobile application and web application for data entry and management.
- Generate comprehensive reports from recorded data for analysis and decision-making.
- ❖ Facilitate targeted resource allocation and strategic campaign planning based on data insights.
- ❖ Enhance efficiency and accuracy in service delivery through data-driven decision-making.
- ❖ Contribute to the achievement of Rwanda's healthcare goals and Millennium Development Goals (MDGs).
- \* Reduce the need for residents to travel long distances to access healthcare services.
- \* Reduce the need for residents to travel long distances to access healthcare services.
- Streamline data collection and recording of daily activities, focusing on malnutrition, contraception, and parasitic diseases.
- Empower Community Health Workers (CHWs) to efficiently manage health center information.

## 1.5 SIGNIFICANCE OF THE STUDY

The study on the Rwanda Health Worker System is significant for multiple reasons. This innovative solution, encompassing mobile and web applications, empowers Community

Health Workers (CHWs) to efficiently manage health center information, focusing on malnutrition, contraception, and parasitic diseases. By streamlining data recording and reporting, the system facilitates informed decision-making, targeted resource allocation, and timely health campaigns. This approach aligns with Rwanda's commitment to healthcare and broader developmental goals, while also reducing healthcare barriers and embracing technological advancement. Ultimately, the study underscores Rwanda's leadership in utilizing technology to enhance healthcare delivery and improve societal well-being.

# 1.6 MOTIVATIONS AND INTEREST OF THE PROJECT 1.6.1 PERSONNEL INTEREST

The Rwanda Health Worker System, consisting of mobile and web applications, is of significant interest to a diverse group of stakeholders. It empowers Community Health Workers (CHWs) by simplifying data management related to malnutrition, contraception, and parasitic diseases. The system generates reports aiding resource allocation and campaign planning, benefiting health care centers, authorities, and patients. Its digital approach enhances access to healthcare, aligns with Rwanda's development goals, and appeals to technological innovators. Ultimately, the system's impact ranges from improved health outcomes to informed policymaking and showcases Rwanda's commitment to progressive healthcare solutions.

#### 1.6.2 PUBLIC INTEREST

The Rwanda Health Worker System holds significant public interest by improving healthcare access and outcomes for the entire population. Through empowered Community Health Workers (CHWs) and digital tools, it ensures timely and accurate healthcare services, especially for underserved communities. The system's focus on malnutrition, contraception, and parasitic diseases enhances disease prevention and management. By optimizing resource allocation and promoting community empowerment, it aligns with Rwanda's developmental goals, enhances data security, and showcases technological advancement. Ultimately, the system's public significance lies in its potential to positively impact health equity, well-being, and national healthcare leadership.

#### 1.6.3 ACADEMIC INTEREST

The Rwanda Health Worker System is academically intriguing due to its innovative use of technology in healthcare delivery. It offers research opportunities in healthcare innovation, informatics, data analytics, public health, management, community empowerment, ethics, development studies, and global health. Its multidisciplinary nature makes it a valuable platform for exploring topics ranging from technological advancements to healthcare outcomes and societal impact. The system's potential contributions to various fields make it a compelling subject for academic inquiry and research.

## 1.7 SCOPE OF THE PROJECT

The scope of the Rwanda Health Worker System project is extensive and encompasses the development of a comprehensive technological solution to empower Community Health Workers (CHWs). This includes creating mobile and web applications for efficient data collection, management, and reporting. The project aims to enhance healthcare services by focusing on malnutrition, contraception, and parasitic diseases. It involves generating insightful reports for resource allocation and targeted campaigns. The system's integration with the health care framework aligns with national goals and contributes to the Millennium Development Goals. The project's impact extends to underserved areas, promoting digital health adoption, capacity building, and long-term sustainability. Ultimately, the scope reflects a holistic approach to improving healthcare access and outcomes, aligning with Rwanda's developmental aspirations.

## 1.8 EXPECTED RESULTS

Rwanda Health Worker will largely benefit from the use of this system, record is specifically looking for the following results:

- To keep all records of patients, children has malnutrition and families contraception
- To know the statistics of paludism diseases.

Health worker is specifically for the following results:

- To access the information about what he/she recorded in the system.
- To record information regarding paludism diseases, show children has malnutrition and family took contraception

- Help them to get number of family and malnutrition are in their village Staff is specifically for the following results:
- To review the records in general patients, malnutrition and family contraception.
- To manage accounts for health workers and other users' permissions.
- To access all information recorded by a health worker, make a final decision for analysis of it.

#### 1.9 ORGANIZATION OF THE WORK

The project is organized into six chapters.

The first chapter is the general introduction. It includes introduction, background of the project, where the general idea concerning the project is explained, and the problem statement, objectives of the project, scope, Assumptions of the study and expected results, motivation and interest of the project, techniques and methodology that will be used in the project, organization of the work.

**The second chapter** focuses on the literature review. In which I will write about what I have read but related to my work. It helps to know what has been done by other researchers in order to know where to emphasize or improve.

The third chapter deals with the analysis of existing systems. It consists of working principles and problems within the system and the proposed solution to the new system.

The fourth chapter concerns the analysis and the design of the proposed system. It is made up of analyzing and designing the new system.

**The fifth chapter** is about the implementation of the new system. It is about implementation, experimentation, optimization, evaluation, technology tools used and justification of using them rather than any others. Important interfaces are also shown in images. At the end of this chapter, I will discuss testing.

The sixth chapter is the last chapter in this project that deals with the conclusion of the project and states some recommendations for future work, and enhancement.

## **CHAPTER TWO: LITERATURE REVIEW**

## 2.1 INTRODUCTION

The purpose of this chapter is to give a brief description about the terms that are used during the development. It provides definitions and characteristics of technologies used in this project. The overview on the concepts serves as the root that leads to the development of Rwanda Health workers.

#### 2.2 KEY CONCEPTS

#### **2.2.1 INTERNET**

Internet, a system architecture that has revolutionized communications and methods of commerce by allowing various computer networks around the world to interconnect. Sometimes referred to as a "network of networks," the Internet emerged in the United States in the 1970s but did not become visible to the general public until the early 1990s. According to recent data from the International Telecommunication Union (ITU), as of 2021, around 4.9 billion people around the world have access to the internet. It's difficult to estimate exactly how many people will have access to the internet in 2023, but given the continuous growth in internet adoption, it's expected that the number will continue to increase. Since the advancement of ICT in Rwanda, Rwanda's government has strongly highlighted the importance of ICT among people and organizations in Rwanda. The Internet starts to bloom and become a popular and competitive advantage to many organizations. In this world of technology, the Internet is a popular medium to access and share information. It is the easiest and fastest way to broadcast and retrieve information. The Internet also provides unlimited access to anyone, any place and at any time.

## 2.2.2 COMPUTER

A computer is a programmable machine. The two principal characteristics of a computer are: It responds to a specific set of <u>instructions</u> in a well-defined manner and it can <u>execute</u> a prerecorded list of instructions (a <u>program</u>).

This is a device that will help to access the internet and use it to connect to the web application of this Rwanda Health Worker.

## 2.2.3 MOBILE PHONE (SMART PHONE)

A smartphone is a mobile phone that allows you to perform various tasks beyond making phone calls, including installing and running software applications similar to a computer. Smartphones use touch screens to enable users to interact with them, and there are thousands of apps available for personal, gaming, and business purposes. The image depicts the Apple iPhone, which is currently one of the most popular smartphones on the market.

#### 2.3 SPECIFIC TERMINOLOGIES

#### **2.3.1 ONLINE**

The term "online" typically describes a system or device that is connected to a larger network, such as the internet. When a device or system is online, it means that it is able to communicate with other devices or systems on the network and access online resources. Accessing a remote system via a terminal is one way to use a device or system that is online. This can include using a remote desktop application to access a computer or server that is located elsewhere on the network. The state of a computer when it is turned on and connected to the internet via an ISP is typically referred to as "online" or "connected." This means that the computer is able to communicate with other devices on the internet and acess online resources. It's worth noting that being online or connected to the internet does not necessarily mean that a device or system is secure. It's important to take steps to protect devices and systems from online threats, such as by using antivirus software, keeping software and security patches up to date, and practicing safe browsing and online behavior. (https://www.britannica.com/technology/Internet)

#### 2.3.2 Health worker

Health workers should have access to patients' medical records, including information about their history, current medical conditions, and medications. Additionally, health workers should also have access to information about patients' nutritional status, including any signs of malnutrition or dietary deficiencies. This information can help health workers provide appropriate care and make recommendations for dietary changes or supplements. In addition, health workers should also have access to information about family planning and

contraception. This can include information about different types of contraception, their effectiveness, and any potential risks or side effects. This information can help health workers educate patients about their options and make informed decisions about their reproductive health.(<a href="https://www.britannica.com/technology/computer">https://www.britannica.com/technology/computer</a>)

## **2.3.3 STAFF**

In your system, the staff user holds a pivotal role, encompassing activities of viewing, editing, and making final decisions. They access the system to analyze relevant data, assess information, and gain insights critical to decision-making. Through the user interface, they interact with various features, reviewing documents, reports, or data sets to evaluate different options.

When editing, the staff user can modify and update content, settings, or parameters within the system to align with evolving requirements. This empowerment allows them to tailor the system's functionalities to specific needs and objectives.

The staff user's most crucial role lies in making final decisions. Based on the information gleaned and any modifications applied, they weigh pros and cons before arriving at a conclusive choice. Their decisions might impact processes, resources, strategies, or outcomes, influencing the direction of the organization.

User-friendly interface design and intuitive navigation facilitate the staff user's seamless engagement with the system. Accurate, up-to-date information and real-time collaboration capabilities enhance their ability to make well-informed decisions promptly. The synergy between user interactions, data utilization, and decisive actions forms a dynamic loop, contributing to the efficiency and effectiveness of your system's overall functioning. (https://www.britannica.com/technology/mobile-phone)

## 2.3.4 Contraception

Contraception refers to any method or technique used to prevent pregnancy. It is also sometimes referred to as birth control. Contraceptive methods can include barrier methods, hormonal methods, intrauterine devices (IUDs), and sterilization procedures. Contraception works by either preventing sperm from fertilizing an egg, or by preventing an egg from

being released from the ovaries. Different types of contraception have varying levels of effectiveness, and some methods may have potential risks or side effects that should be considered before use. (https://www.britannica.com/technology/online-site)

#### 2.3.5 Malnutrition

Malnutrition refers to a condition that occurs when the body does not receive the necessary nutrients to maintain proper health and function. Malnutrition can occur due to insufficient intake of nutrients, poor absorption of nutrients, or increased nutrient requirements. There are different types of malnutrition, including under nutrition, over nutrition, and micronutrient deficiencies. Undernutrition occurs when the body does not receive enough calories, protein, or other essential nutrients. This can lead to stunted growth, weakened immune function, and an increased risk of infections and diseases.

#### **2.3.6 SYSTEM**

System software is a type of computer program that is designed to run a computer's hardware and application programs. If we think of the computer system as a layered model, the system software is the interface between the hardware and user applications. The operating system is the best-known example of system software. The OS manages all the other programs in a computer. (Software, n.d.)

#### 2.3.7 HEALTH CARE CENTER

At our distinguished healthcare center, we have established a comprehensive and dynamic approach to health workforce management. Through our state-of-the-art portal, we exercise meticulous control over the activities of our dedicated health workers, ensuring a harmonious blend of efficiency and excellence. This innovative platform allows us to seamlessly align the actions of our health workforce with their registrations on the portal, enabling us to track and monitor their schedules, patient interactions, and crucial tasks.

Our vigilant oversight extends to the meticulous creation of detailed reports that encapsulate the entirety of their activities in accordance with the information they have registered within the portal. These reports serve as a comprehensive reflection of their dedication and contributions, encompassing critical aspects such as patient care, appointments, treatments

administered, and educational endeavors undertaken. This diligent documentation not only ensures transparency but also empowers us to make informed decisions, optimize resource allocation, and elevate the standard of care we provide.

Through our commitment to harnessing cutting-edge technology and seamless integration, we orchestrate a symphony of health workforce management that resonates with precision and purpose. The reports generated from our portal-driven activities not only showcase the remarkable efforts of our health workers but also stand as a testament to our unwavering dedication to the highest standards of healthcare delivery.(Rwanda health n.d)

#### 2.5 COMPARATIVE STUDY

Under this section, we describe the relevant project consulted by other researchers in the same field. Here we focus on showing the similarities as well as the differences among both projects compared.

In designing and implementing our project, we used to consult the project done by IRINIMBABAZI Jean Marie Vianney entitled "ONLINE MEDICAL CONSULTATION". This was realized in 2022 under the supervision of Mrs. NIYOGAKIZA Denyse. (Jean, 2022)

The project involves developing a web and mobile application to facilitate online patient consultations at La Croix du Sud Hospital. Key objectives include reducing queue times, creating a comprehensive consultation database, ensuring data security, introducing online consultation methods, providing first aid information to patients, and integrating online payment options for appointment bookings.

#### 2.6 SIMILARITIES

The similarities of previous research and the new research is, all of those researches are focused on how it can manage the information about Rwanda health workers and make it secure and easier available for everyone who provides service.

Our project and compared project have some similarities like both projects are education based, and are web applications and mobile applications that use internet connection to provide services and also are about Rwanda Community Health Worker activities.

#### 2.7 DIFFERENCES

In the previous system, a paper-based approach was employed, where each Rural Community Health Worker (RCHW) maintained physical books to record patient information. However, operating within this framework proved to be quite cumbersome due to its reliance on manual operations. Many tasks required significant human effort, which impeded efficient functioning.

Under the existing system, patient details were painstakingly handwritten onto paper and stored in files. This approach posed challenges, particularly when attempting to retrieve historical patient data. The system also encountered difficulties in communication and reporting due to its non-digital nature. Furthermore, data security was a concern, with no established method for safeguarding patient information. The absence of backups or digital copies left records vulnerable, as natural events could lead to irretrievable data loss.

Given the rapid technological advancements, there is a concerted effort to transition swiftly from this traditional, paper-based method to a digital system. The current paper-based approach, focused on recording the activities of Community Health Workers, such as treating malaria and aiding pregnant women, presents a high risk of data loss.

To address these challenges, our country is actively embracing technology to expedite this shift from conventional to digital systems. This transformation aims to enhance the management of patient information, ensure data security, and streamline communication. Through this digital transition, we intend to optimize the operations of Community Health Workers and improve overall healthcare outcomes.

There are some issues caused by this manual system below:

- Manual Labor Intensity: The paper-based system required significant manual effort for recording, storing, and managing patient information, leading to inefficiency and increased workload.
- **Limited Automation:** Lack of automation in operations resulted in slower processes and reduced overall efficiency.
- **Inefficient Data Retrieval:** Retrieving old patient information from paper records was time-consuming and challenging, affecting timely access to critical data.
- Communication and Reporting Challenges: Non-digital communication and reporting methods hindered effective sharing of information among healthcare providers.
- **Data Security Risks:** Patient data stored on paper records lacked proper security measures, making it susceptible to unauthorized access or loss.
- Lack of Backup: Absence of digital backups meant that data was at risk of being permanently lost in case of damage to or destruction of paper records.
- **Resource Intensive:** Maintaining physical records consumed valuable resources, including storage space, materials, and personnel time.
- Limited Accessibility: The non-digital nature of the system restricted access to patient information, especially for remote or off-site use.
- **Risk of Data Inaccuracy:** Manual data entry introduced the possibility of errors, potentially leading to inaccurate patient records.
- Dependency on Physical Presence: Healthcare providers needed physical access to paper records, which could hinder timely decision-making or patient care in certain situations.
- **Difficulty in Data Analysis:** Analyzing trends or patterns in patient data was challenging without the convenience of digital tools.
- Vulnerability to Natural Disasters: Paper records were at risk of being lost or damaged during natural incidents or disasters, compromising patient information.
- **Reduced Collaboration:** Lack of a centralized digital system made it harder for multiple healthcare providers to collaborate and share information seamlessly.
- Limited Scalability: The manual system could struggle to manage the growing volume of patient data and healthcare activities effectively.

• **Environmental Impact:** The extensive use of paper contributed to deforestation and environmental concerns, aligning poorly with sustainability goals.

#### 2.8 PERSONAL CONTRIBUTIONS

The proposed solution performs all the works that have been performed by the existing one, and above all there is a lot of enhancements and security of data compared to the existing one. A lot of things in the proposed system is automated which reduce the work, space and money. The proposed system will work by using computers and to simplify the tasks data will be stored in databases.

The system will be easy to use and is compatible with many devices, it will be a web application which will be running on a web browser, no matter what type of device you are using, and you will be able to access the system.

It will be a web application which will run on a PC or any device that can be connected to internet, it only requires a browser and it doesn't matter the type of operating system you are using. I decide to implement the computerized system where every community health will be

able to have access to the system for better way of recording all information regarding to their

work and the community health worker might be able to generate report regarding to the service they provide

Other solution for the new system:

- The data will be stored in the database, which will make it safe.
- Information will be sent and received easily.
- The report will be generated automatically by click on generate report
- Collecting user's files in the system will not take long. As it is used to take while
- Collecting by reading each individual report written by hand.
- Secured data.
- No need to buy papers and books for writing or recording different information.

#### **CHAPTER THREE: EXISTING SYSTEM ANALYSIS**

#### 3.1 INTRODUCTION

"Tomorrow belongs to those who prepare for it today." Understanding the existing system is crucial for conceiving the new system. Therefore, we will conduct a thorough analysis of the current system to identify its description, functions, inconveniences, and operational processes. System analysis involves delving into both existing and proposed systems to determine desirability and potential improvements. This process entails investigating the system, identifying shortcomings, and using this insight to recommend enhancements.

This chapter allows for a comprehensive examination of the manual Rwanda Health Worker system. Through this analysis, we aim to gain a clear understanding of its workings, functions, drawbacks, and operational inefficiencies. Understanding the existing system will enable us to compare it with the proposed new system. Ultimately, this analysis will help us pinpoint existing problems and propose solutions to address them effectively.

#### 3.2 HISTORICAL BACKGROUND

Rwanda community health workers program was established in 1995, aiming at increasing uptake of essential maternal and child clinical services through education of pregnant women

and promotion of healthy behaviors and it was linked to the health services. After linking this

program to the health service the community health worker now days they provides health services such as testing malaria providing anti-malaria drugs, birth control through giving pills or inject those who don't use pills method and other first health service delivery.

According to the reports Demographic and Health Survey (DHS) conducted in 2015 show that simple malaria cases increased from about a million in 2012 to 4.5 million in 2016 rise while severe malaria cases increased from 9,000 to 17,000 during the same period.

However, reports indicate that total malaria cases dropped to below four million by end 2018 following the malaria contingency plan that was put in place in 2016.

With the introduction of Home Based Management of Malaria (HBM) for both adults and children through Community Health Workers, malaria patients are being diagnosed and

treated early in Rwanda.

At these numbers of malaria cases it shows that there still big numbers and according to the system of gathering information that the RHW use it is difficult for them to take some measures on how to sensitize people to fight against malaria and other health service they provide to people.

Birth control and fight against paludism through rchw system involves in some activities of keeping the information regarding to the treatment of patient by Rwanda community health workers called in Kinyarwanda (Abajyanama bubuzima). By using this system it will be easy

for them to track where to put more effort according to the data obtained.

As we know that the use of information technology in different domain is increasing and taking important role in our country, the improvement of technology is playing sufficient role

through government environment as well as in social-economic and in all other areas of activities.

As our country running fast in technology, information technology is truly needed in all sectors of activities.

In almost every field in medical or other companies, the importance of computerization has been known especially where good quality of service is the key to success of any area and in development of our county in general.

That is why my project is trying to modernize the method of keeping information for patient who has treated by those Rwanda community health workers, as the best way of securing those information and also it will be easy in making some decisions and remind health worker information about there training also up-skill to the user through the documentation

## 3.3 GEOGRAPHICAL LOCATION

#### 3.3.1 Rwanda Health Community workers

In each village, a well-structured healthcare network is established, comprising three Community Health Workers (CHWs). This dedicated team includes an Animatrice de Santé Maternelle (ASM), responsible for maternal health, and a Binôme, consisting of a male and a female CHW. These CHWs are strategically located within the heart of the village, ensuring accessibility and close proximity to the community they serve. With an average

village size of 50 to 150 households, this arrangement enables the CHWs to provide comprehensive and personalized healthcare support to every resident.

## 3.4 RCHW MISSION, VISION AND VALUES

#### 3.4.1 MISSION STATEMENT

To engender conditions for achieving good health for the entire population to enable them to contribute to sustainable development in Rwanda.

### 3.4.2 VISION STATEMENT

To ensure the provision of holistic community health care services for all, for the betterment of the entire population.

#### 3.4.3 UNIVERSITY VALUES

The healthcare system is underpinned by three dedicated Community Health Workers (CHWs) assigned to each village, where the population typically consists of 100 to 150 households. These CHWs function within distinct roles, each contributing to the well-being of the community.

The Animatrice de Santé Maternelle (ASM) stands as a pillar of maternal health, identifying expectant mothers and offering consistent support throughout pregnancy and postpartum periods. Ensuring safe deliveries by connecting women with skilled healthcare professionals is at the core of the ASM's responsibilities.

The Binôme, a dynamic male-female CHW duo, takes on multiple crucial tasks. These encompass the integral iCCM framework, involving the assessment, classification, and treatment or referral of prevalent childhood ailments like diarrhea, pneumonia, malaria, and malnutrition. Moreover, they play a vital role in the community-based distribution of contraceptives, administer Directly Observed Therapy (DOT) for Tuberculosis, and contribute to the prevention of Non-Communicable Diseases (NCDs). Their duties extend to proactive behavior change activities and preventive healthcare measures.

Through this collaborative effort, the CHWs uphold values of holistic care, proactive health interventions, and community empowerment, ensuring that vital healthcare services reach every corner of the village and contribute to the overall well-being of its residents.

#### 3.5 DESCRIPTION OF THE EXISTING SYSTEM

In the current system was paper based system where every RCHW had books where they record patient's information. So working with the current system was a little bit tiresome as it

is full of non-automatic operations and that requires a lot of human efforts to perform most of

the tasks in a way which is needed.

The current system works by manually writing down on a paper some of the details related to

patient and keep the records in a file, hence keeping papers appears to be a hard job once it comes to the retrieving of some old patient's information. Hard communication and reporting

the system was a big challenge faced in the current system. There is no secured way to keep data

related to patients, no backups, no soft copies which means when there is some natural incident which can cause the books to be ruined there will be no other way to retrieve back what was there in the store of those books.

#### 3.6 PROBLEMS ANALYSIS

After analyzing the existing system, I have identified the following problems which are caused by manual system:

- Workload Distribution: While the roles of ASM and Binômes are distinct, the
  distribution of responsibilities among the CHWs might be uneven. Ensuring a fair
  and balanced workload allocation could be a challenge.
- **Skill and Training:** To effectively handle maternal health and childhood illnesses, CHWs require specialized training. Ensuring that all CHWs are adequately trained and competent in their respective roles could be a logistical challenge.

- Coordination: Coordinating between ASM and Binômes, as well as aligning their efforts with other healthcare professionals, might require strong communication channels and standardized protocols.
- Access to Skilled Health Workers: Ensuring that ASM successfully connects pregnant women to skilled health workers for deliveries requires efficient transportation and collaboration with healthcare facilities.
- Quality of Care: Maintaining the quality of care delivered by CHWs, especially in complex cases like maternal health and childhood illnesses, is vital to avoid misdiagnosis or inadequate treatment.
- **Community Engagement:** Building trust and engagement within the community is crucial for CHWs to gain acceptance and effectively deliver healthcare services.
- **Supervision and Monitoring:** Regular supervision and monitoring of CHWs' activities are essential to ensure accurate record-keeping, adherence to protocols, and consistent service quality.
- Resource Availability: Adequate resources, both in terms of medical supplies and supportive infrastructure, need to be in place for CHWs to perform their duties effectively.
- Long-Term Sustainability: To maintain the program's effectiveness and impact, ensuring long-term funding, community participation, and government support is essential.
- **Data Management:** Efficient management of patient data, especially in the case of chronic illnesses and maternal health records, requires a reliable and secure digital system.
- Cultural Sensitivity: CHWs need to be culturally sensitive to address diverse community needs and traditions, particularly when providing reproductive health and family planning services.
- Effective Referral System: A robust referral system must be in place to ensure that patients requiring higher levels of care are effectively referred to appropriate healthcare facilities.
- Challenges in Remote Areas: In remote villages, logistical challenges related to transportation and access to resources might impact the CHWs' ability to deliver timely care.
- Addressing NCDs: While CHWs play a role in preventing NCDs, a comprehensive strategy may be needed to effectively address this growing health concern.

Changing Healthcare Landscape: As the healthcare landscape evolves, adapting
the roles and responsibilities of CHWs to match emerging healthcare needs could
pose challenges.

#### 3.7 PROPOSED SOLUTIONS

The proposed solution performs all the works that have been performed by the existing one, and above all there is a lot of enhancements and security of data compared to the existing one. A lot of things in the proposed system is automated which reduce the work, space and money. The proposed system will work by using computers and to simplify the tasks data will be stored in databases.

The system will be easy to use and is compatible with many devices, it will be a web application which will be running on a web browser, no matter what type of device you are using, and you will be able to access the system.

It will be a web application which will run on a PC or any device that can be connected to internet, it only requires a browser and it doesn't matter the type of operating system you are using. I decide to implement the computerized system where every community health will be able to have access to the system for better way of recording all information regarding to their work and the community health worker might be able to generate report regarding to the service they provide.

Other solution for the new system:

The data will be stored in the database, which will make it safe.

Information will be sent and received easily.

The report will be generated automatically by click on generate report

Collecting user's files in the system will not take long. As it is used to take while collecting by reading each individual report written by hand.

Secured data. No need to buy papers and books for writing or recording different information.

#### CHAPTER FOUR: ANALYSIS & DESIGN OF NEW SYSTEM

#### 4.1 INTRODUCTION

Analysis is defined as a study of something in detail, in order to get a deep understanding of it. System analysis helps to know better how the existing system works and what it does. Design is the first step in the development phase for any techniques and principles for the purpose of defining a system in sufficient detail to permit its physical realization. The design activities are important in this part, because they affect the success of the software implementation.

This chapter describes various diagrams as well as models used to develop my system. Those

diagrams are a functional diagram, data flow diagrams, entity relationship diagram, data dictionary, logical data model, and physical data model.

## 4.2 Design of the New System

System design is needed for the purpose of defining a system in sufficient detail to permit its physical realization and accurately translate the customer's requirements into a finished system.

### **4.2.1 Functional Requirement**

Rwanda Health worker system will support three actors

- ❖ Healthcare workers will be able to log in to the system, record and access information about patients with paradisum diseases, contraceptives, and malnutrition within villages, as well as gather detailed family data. Additionally, they will have the opportunity to enhance their skills and knowledge in the latest paradisum-related developments.
- ❖ Health centers will have the capability to log into their system and efficiently register new health workers, as well as effectively manage their workforce through the system. Furthermore, they will have the option to generate various reports specific to particular days.
- The System Admin should have the capability to log in, manage user accounts, access recorded data such as information on paradisum diseases, granted

contraceptives, and cases of malnutrition. They should also be able to register different addresses and families within the system and ultimately make final decisions regarding system operations.

## 4.2.2 Non-Functional Requirements

## -Hardware Requirements:

- Computer
- Mobile phone

## -Software Requirements:

- ♦ Operating System: Ubuntu TLS 20.4 and Android 10
- ❖ Technologies: HTML,CSS, JavaScript, Css, Python,Dart, and SQL
- Frameworks:Django,Flutter,Tailwind Css,GetUIkit
- ❖ Database Server: Postgres
- Web Server: Nginx ,Ngrok Server.

## -Security:

The system should be secured against unauthorized access, ensuring that each account only has access to functions and data for which they have been granted permission.

## -Reliability:

The system should be able to operate 24/7 without any interruption

#### -Performance:

The system must have a high speed of manipulation data and reply to the user request

#### -Maintainability:

The system must be maintainable/rectifiable once it crushed

## 4.3. Structured System Analysis and Design Methodology (SSADM)

Structure System Analysis and Design Methodology is a system approach to the analysis and

design of information systems. System design methods is a discipline within the software development industry which seeks to provide a framework for activity and the capture, storage, transformation, dissemination of information so as to enable the economic development of computer systems that are fit for purpose.

SSADM was developed with the following objectives:

Develop an overall better quality system, improve the way in which projects are controlled and managed, make it possible for projects to be supported by computer based tools and improve communication between participants in a project so an effective framework is in place.

By using SSADM, I design the diagrams that help to achieve a good implementation of my system. The diagrams are as follows:

- ✔ Functional Diagram
- ✓ Data Flow Diagram (DFD)
- ✓ Entity –Relationship Diagram (ERD)

## 4.4 Functional Diagram

A functional diagram is a visual representation showing how different parts of a system or software interact to perform specific functions. It can be created using various types of diagrams like flowcharts, data flow diagrams, and UML diagrams. You can learn more about them in resources related to systems engineering, software design, and control systems. (Wikipedia,2022)

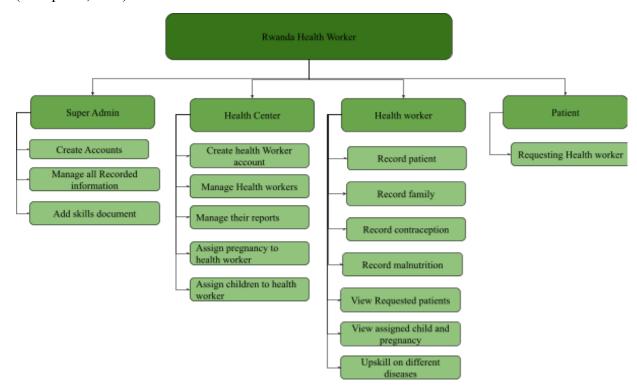


Figure 2: 4.1 Functional Diagrams

A function diagram is a diagram that indicates the functions of the principal parts of a total system and also shows the important relationships and interactions between among these parts

we have 3 functions followings:

- Registration: This function deals with administration in registering a health worker and health center in this system and.
- Operations management: is the function that deals with general services of the
  - system, and shows what the system should do
- \* Reports: this is function helps in generating different reports

## 4.5 Data Flow Diagram (DFD)

A data flow diagram shows the way information flows through a process. It includes data inputs, outputs, data stores, and the various sub processes the data moves through. Data flow diagrams are built using symbols and notation to describe various entities and their relationships.

DFDs consist of four major components:

- 1. **External entity**: people or organizations that send data into the system or receive data from the system.
- 2. **Process**: models what happens to the data i.e. transforms incoming data into outgoing data.
- 3. **Data store**: represents permanent data that is used by the system.
- 4. **Data flow**: models the actual flow of the data between the other elements.

### 4.5.1. Data Flow Diagram notations

#### 1. PROCESSES

Process is the transformation that inputs one type of data and outputs a different type. It is a conversion of data from one form to another. A process cannot output data without getting some in, data cannot be created in a process.

1	2
3	

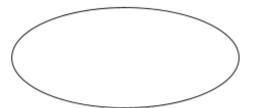
In this figure each number represents the specific function, and is mentioned below:

- 1. Represent just a number of processes.
- 2. Represent an actor that can perform that process.
- 3. Represent the name of the process.

#### 2. EXTERNAL ENTITY

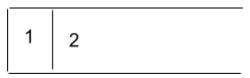
The external entity represents the actors outside the system that interact with the system.





### 3. DATA STORE

Data stores are repositories for data that are temporarily or permanently recorded within the system. It is an "inventory" of data. These are common links between data and process models. Only processes may connect with data stores. Data stores are represented by a Narrow opened rectangle as follows.



In this figure each number represent the specific function, and is mentioned below:

- 1. Represent just a number of data
- 2. Represent a table name where data is stored.

#### 3. DATA FLOW

Data flow represents the input (or output) of data to (or from) a process ("data in motion").

### 4.5.2 Context Diagram (Level 0)

System context diagrams show a system, as a whole and its inputs and outputs from/to external factors. System Context Diagrams represent all external entities that may interact with a system (Sweet, 2011)

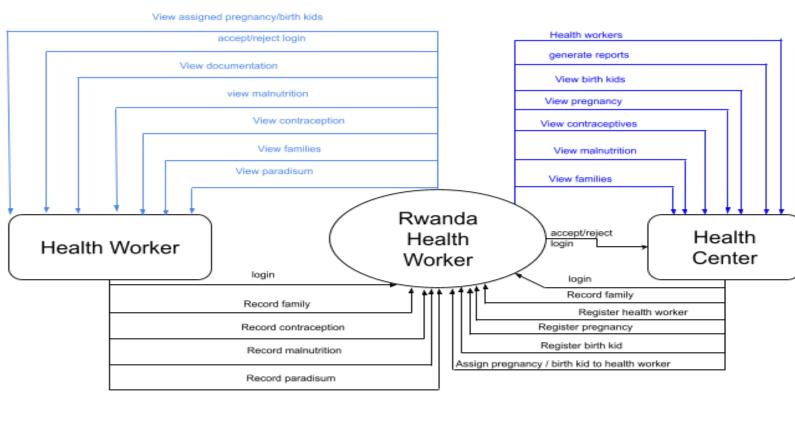


Figure 3: 4.2 Context Diagram

### 4.5.3 Data Flow Diagram level 1

A level 1 DFD, notates each of the main sub-processes that together form the complete system. We can think of a level 1 DFD as an "exploded view" of the context diagram. In a level 1 DFD, the system will be broken into main, larger processes which will handle the

data. Low arrows will track the data, connecting and reconnecting with these processes.

Additional levels will decompose these main processes into smaller and smaller ones.

Eventually, the DFD has broken each process into a "primitive process" where the process is defined in simplest terms.

## 4.5.3.1 DFD Level

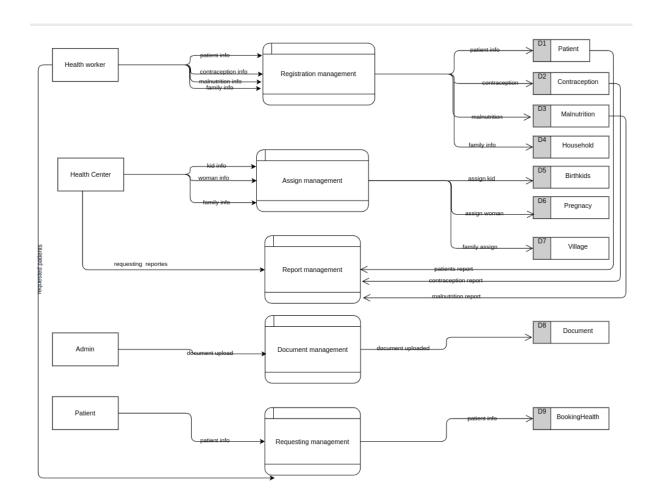


Figure 4: 4.3 DFD Levels 1

## 4.6 Entity Relationship Diagram

Entity Relationship Diagram, also known as ERD, is a type of structural diagram for use in database design. An ERD contains different symbols and connectors that visualize two important information: The major entities within the system scope, and the inter-relationships

among these entities. Entity relationship diagrams provide a visual starting point for database

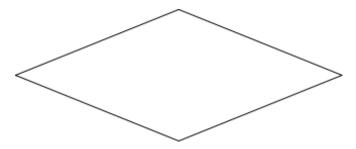
design that can also be used to help determine information system requirements throughout an organization.

### **Entity**

An entity is a piece of data-an object or concept about its store. An entity is a person, object, place or event for which data is collected. The entity is represented by a rectangle and labeled with a singular noun.

### Relationship

A relationship is how the data is shared between entities; relationships may be represented by a diamond shape, or more simply, by the line connecting the entities. In In either case, verbs are used to label the relationship.



There are three types of relationship between entities:

One-to-one (1, 1): one instance of an entity (A) is associated with one other instance of another entity (B).

One-to-many (1, N): one instance of an entity (A) is associated with zero, one or many instances of another entity (B), but for one instance of entity B there is only one instance of entity A.

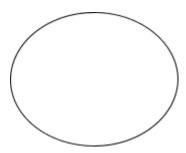
**Many-to-many** (N, N): one instance of an entity (A) is associated with one, zero or many instances of another (B), and one instance of entity B is associated with one, zero or many instances of entity A.

### **Cardinality**

In data modeling, the cardinality of one data table with respect to another data table is a critical aspect of database design. Relationships between data tables define cardinality when explaining how each table links to another. The cardinality defines the relationship between the entities in terms of numbers.

A data attribute is a characteristic common to all or most instances of a particular entity. Synonyms include property, data element, and field.

An attribute may be represented by an oval shape.



The following diagram shows an entity relationship diagram of Rwanda Health worker

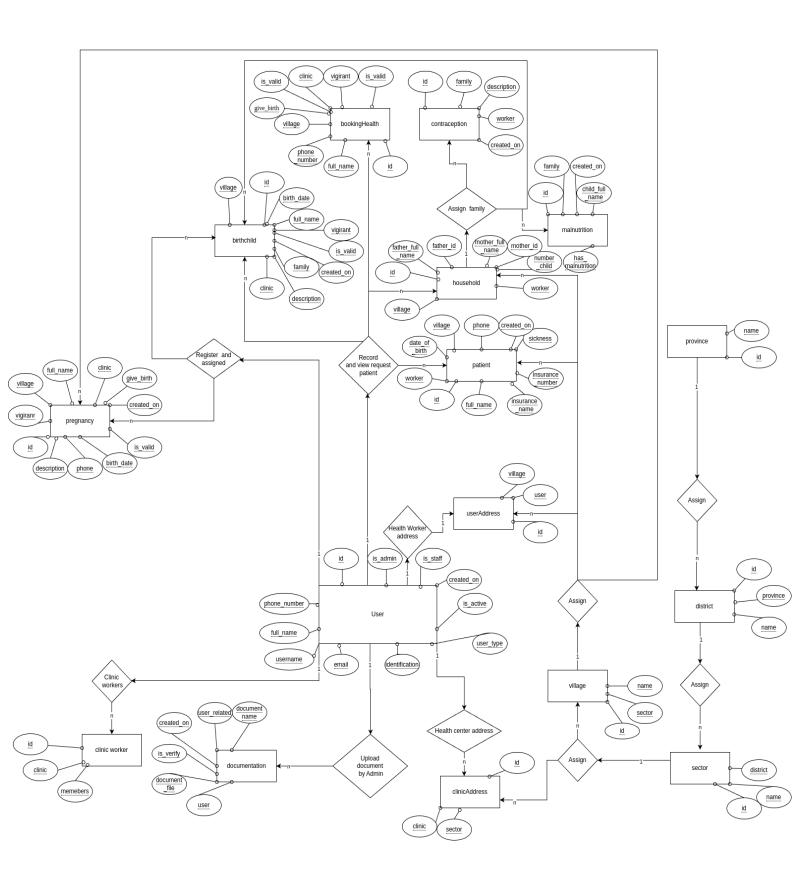


Figure 5: 4.4 Entity Relationship Diagram

### 4.7 Logical Data Model

User(id,email,full\_name,username,phone\_number,identification\_number\_card,user\_type,is\_active,is\_staff,is\_admin,created\_at)

Province(id, name)

District(id,name,#province)

Sector(id,name,#district)

Village(id,name,#sector)

UserAddress(id,#user,village)

Patient(id,full\_name,insurance\_name,insurance\_number,sickness,phone,#village,date\_birth, #worker,created on)

Contraception(id,#family,description,#worker,created on)

Malnutrition(id,#family,child\_full\_name,has\_malnutrition,#worker,created\_on)

HouseHold(id,

father\_full\_name,father\_id\_no,mother\_full\_name,mother\_id\_no,number\_children,phone\_nu mber,#worker,#village,created\_on)

BirthChild(id,full\_name,#family,description,#clinic,#village,birth\_date,#vigilant,is\_valid,cre ated\_on)

Documentation(id,document\_name,user\_related,is\_verify,document\_file,#user,created\_on)

Pregnancy(id,full\_name,description,phone,birth\_date,#village,give\_birth,#clinic,#vigilant,is
valid,created\_on)

BookingHealth(id,full\_name,phone\_number,#village,description,is\_valid,#worker,created\_o n)

## 4.8 Data dictionary

A Data Dictionary is a collection of names, definitions, and attributes about data elements that are being used in a database or information system. It describes the purposes of data elements within the context of a project. Data dictionaries are used to provide detailed information about the contents of a database, such as the names of measured variables, their data types or formats, and text descriptions. A data dictionary provides a brief guide to understanding and using the data.

Table 4.8.1 : Data dictionary : User

Table Name	Attributes	Туре	Constraints	Comments
user	id	string	Primary key	user identification
	email	varchar	null	User Email
	full name	varchar	Not null	Course name
	username	varchar	unique	Username
	phone_number	varchar	Not null	User phone number
	identification_n umber_card	varchar	Not null	User Identification number
	user_type	varchar	Not null	User type
	is active	boolean	Not null	User is active
	is_staff	boolean	Not null	User is staff
	is admin	boolean	Not null	User is admin
	created_on	date	Not null	Date registered

Table 4.8.2 : Data dictionary : Province

Table Name	Attributes	Types	Constraints	Description
Province	id	string	Primary key	Province identification
	name	varchar	Not null	Name of province

Table 4.8.3 : Data dictionary : District

<b>Table Name</b>	Attributes	Types	Constraints	Description
District	Id	string	Primary Key	District Identification
	name	varchar	Not null	district name
	province	string	Foreign key	Province identification

Table 4.8.4 : Data dictionary : Sector

<b>Table Name</b>	Attributes	Constraints	Types	Description
Sector	Id	string	Primary key	Sector
				identification
	name	varchar	Not null	Sector name
	district	string	Foreign key	District
				identification

Table 4.8.5 : Data dictionary : Village

<b>Table Name</b>	Attributes	Constraints	Types	Description
Village	id	string	Primary key	Village identification
	name	varchar	Not null	Village name
	district	string	Foreign key	District belong

Table 4.8.6 : Data dictionary : UserAdrress

<b>Table Name</b>	Attributes	Constraints	Types	Description
UserAdrress	id	string	Primary Key	User address identification
	user	string	Foreign key	User location
	village	string	Foreign key	village located

Table 4.8.7 : Data dictionary : Malnutrition

<b>Table Name</b>	Attributes	Constraints	Types	Description
Malnutrition	id	string	Primary Key	Malnutrition identification
	family	string	Foreign key	Household identification
	child_full_name	varchar	Not null	Child full name
	has_malnutrition	boolean	Not null	Child has malnutrition

worker	string	Foreign key	health worker recorded
created_on	date	Not null	Date of create

Table 4.8.8 : Data dictionary : Patient

<b>Table Name</b>	Attributes	Constraints	Types	Description
Patient	Id	string	Primary key	Patient identification
	full_name	varchar	Not null	Patient name
	insurance_name	varchar	Not null	Patient insurance
	insurance_number	varchar	Not null	Patient insurance number
	sickness	varchar	Not null	Patient sickness
	phone	varchar	Not null	Patient contact
	village	string	Foreign key	location of patient
	date_of_birth	date	Not null	Patient date of birth
	worker	string	Foreign key	Worker recorded
	created_on	date	Not Null	Date of create

Table 4.8.9 : Data dictionary : Household

Table Name	Attributes	Types	Constraints	Description
Household	id	string	Primary key	family
				identification
	father_full_nam	varchar	Not null	family father
	e			name
	father_id_no	varchar	Not null	family father
				identification
	mother_full_na	varchar	Not null	family mother
	me			name

mother_id_no	varchar	Not null	family mother
			identification
number_child	int	Not null	Number of
			children in
			family
phone_number	varchar	Not null	Phone of family
worker	string	Foreign key	Health worker recorded
village	string	Foreign key	Village family belong
created_on	date	Not null	Date of record

Table 4.8.11 : Data dictionary : Contraception

<b>Table Name</b>	Attributes	Constraints	Туре	Description
Contraception	id	string	Primary key	Contraception identification
	family	string	Foreign key	Household identification
	description	text	null	Contraception description
	worker	string	Foreign key	Health worker identification
	created_on	date	Not null	Date of record

Table 4.8.12 : Data dictionary : BirthChild

Table Name	Attributes	Type	Constraints	Description
BirthChild	id	string	Primary key	Child
				identification
	full_name	varchar	Not Null	name of child

	family	string	Foreign key	Family child he/she belong
	description	text	null	description of child
	clinic	string	Foreign key	where child got birth
	village	string	Foreign key	where child live
	birth_date	date	not null	date of child born
	vigilant	string	Foreign key	health worker assigned
	is_valid	bool	Not null	is still valid
	created_on	date	Not null	Date of record

Table 4.8.14 : Data dictionary : Pregnancy

Table Name	Attributes	Type	Constraints	Description
Pregnancy	id	string	Primary key	Pregnancy
				identification
	full_name	varchar	Not Null	name of woman
	phone	varchar	Not Null	contact of pregnant
	description	text	null	description of
				woman
	clinic	string	Foreign key	where child got
				birth
	village	string	Foreign key	where child live
	birth_date	date	Not null	date of birth
	vigilant	string	Foreign key	health worker
				assigned
	date_give_birth	date	Not null	date she gave
				birth

give_birth	bool	Not null	to help user
			know if give
			birth
is_valid	bool	Not null	is still pregnant
created_on	date	Not null	Dateof record

Table 4.8.15 : Data dictionary : Documentation

<b>Table Name</b>	Attributes	Constraints	Type	Description
Documentation	id	string	Primary key	file identification
	document_name	varchar	Not null	file name
	user_related	varchar	not null	user has access
	document_file	varchar	Not null	this is location of file
	user_uploaded	String	Not null	user uploaded
	is_verify	bool	Not null	document accept
	created_on	date	Not null	Date of record

Table 4.8.16 : Data dictionary : BookingHealthcare

<b>Table Name</b>	Attributes	Constraints	Type	Description
BookingHealt	id	string	Primary key	booking identification
hcare	full_name	varchar	Not null	patience name
	phone_number	varchar	not null	patient contact
	village	varchar	Not null	this is location of patient
	description	text	Not null	describe how he/she feel

worker	string	null	health worker
			accepted
is_valid	bool	Not null	booking is valid
created_on	date	Not null	Date of record

## 4.9. Physical Data Model

A physical data model represents the actual structure of a database tables and columns, or the messages sent between computer processes. Physical data modeling is conceptually similar to design class modeling, the goal being to design the internal schema of a database, depicting the data tables, the data columns of those tables, and the relationships between the tables.

A physical data model presents the database-specific context missing in conceptual and logical data models. It represents the tables, columns, data types, views, constraints, indices and procedures within the database and/or the information communicated during computer processes. Physical data models should be built in relation to a specific database management system (DBMS) as well as the specific requirements of the processes that operate based on the data (erwin, 2022). The following figures represent Physical data model of "online medical consultation system"

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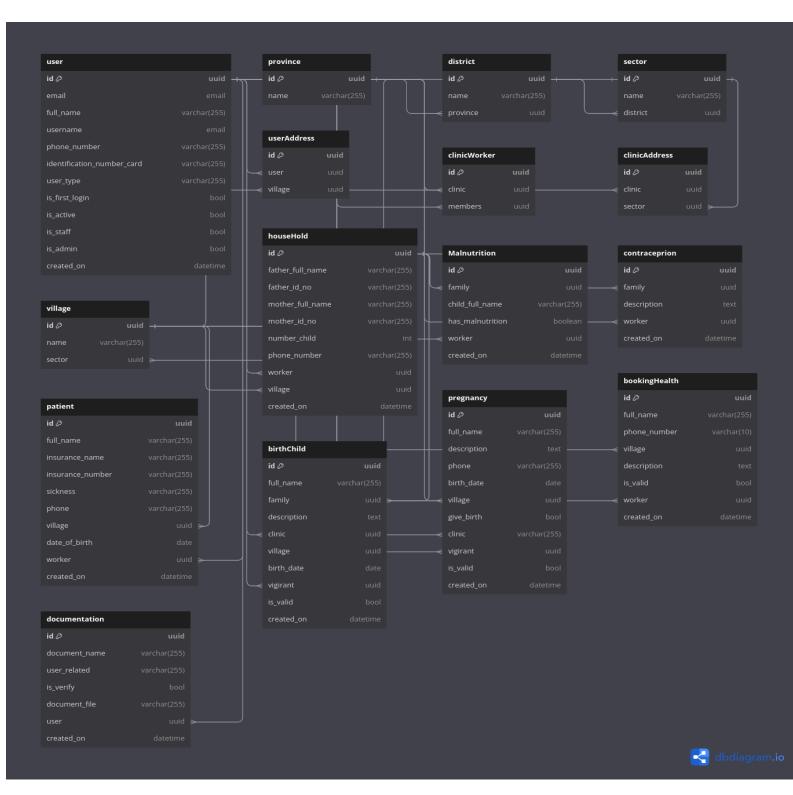


Figure 6: Physical data model

#### **CHAPTER 5: IMPLEMENTATION OF THE SYSTEM**

#### 5.1 Introduction

This chapter describes the development of the "**Rwanda Health Worker**". It includes a brief overview of the technologies used to make the application, operation, tests that have been applied. Last but not least, software and hardware compatibility requirements.

### 5.2 Technologies used

To develop this application, we have used different technologies namely:

## 5.2.1 Django

Django is a high-level, open-source web framework for Python, designed to simplify and speed up web development. It follows the Model-View-Template (MVT) architectural pattern, provides tools for common tasks like database operations, URL routing, and includes features for security, authentication, and an admin interface. Django promotes clean, modular code and is widely used for building scalable and maintainable web applications.

#### 5.2.2 Flutter

Flutter is an open-source UI software development toolkit created by Google for building natively compiled applications for mobile, web, and desktop from a single codebase. It allows developers to use a single language, Dart, to create visually appealing and high-performance applications for iOS, Android, and the web. Flutter is known for its expressive and flexible widget-based architecture, hot reload feature for rapid development, and the ability to create beautiful, consistent user interfaces across different platforms.

#### 5.2.3 Android studio

Android Studio is the official integrated development environment (IDE) for Android app development. It provides a comprehensive set of tools and features to streamline the entire development process, including code editing, debugging, testing, and performance analysis. Android Studio is based on IntelliJ IDEA and offers robust support for building, deploying, and optimizing Android applications. It is widely used by developers to create native Android apps using languages like Java and Kotlin. The IDE also supports the development of Android Wear, Android TV, and Android Auto applications.

## 5.3 Software testing

Software tests play an important role in software engineering. They help to verify the effectiveness of the software to see if it actually does what it was supposed to solve. Listed are key aspects to take into consideration in software testing

- i. Does the application meet the requirements that guided its design and development?
- ii. Does the application work as expected?
- iii. Can the application be implemented with the same characteristics and satisfy the needs of the country?

The following are some types of software testing:

### 5.3.1. The Unit Test:

Unit testing Unit testing is a process to ensure the proper functioning of particular software or a portion of a program. It is a method by which individual units of source code, sets of one or more computer program modules together with associated control data, usage procedures, and operating procedures, are tested to determine if they are fit for use.

### 5.3.2 The Integration test

Is the phase in software testing in which individual software modules are combined and tested as a group? This test is useful to check the assembly of the different parts of the software. It is also a progression of tests, in which the software and hardware components

are collected and tested until the entire system is tested. The application modules have been successively tested until completion to ensure that the whole, constituted by the assembled software components, answers to the required functional and technical specifications.

### **5.3.3** The Validation tests

The last test phase has the role of validating the software in its external environment. The product has been put in the final situation in order to verify if it perfectly answers the needs expressed in the first phase. The validation test is important, since it is necessary to verify if the setting up of the application corresponds to the expressed needs. The application has been tested in its entirety, and it is in this way that we noticed that the progress of operations done corresponds to the functional specifications.

### **5.4 Software Results Presentation**

## 5.4.1 Web portal

## 5.4.1.1 Home Page

The homepage is the initial page users see on our web portal, providing guidance based on their input. If the user is eligible, they can log in to the healthcare center system. For urgent situations, users can request an emergency check-up from Umujyanama.

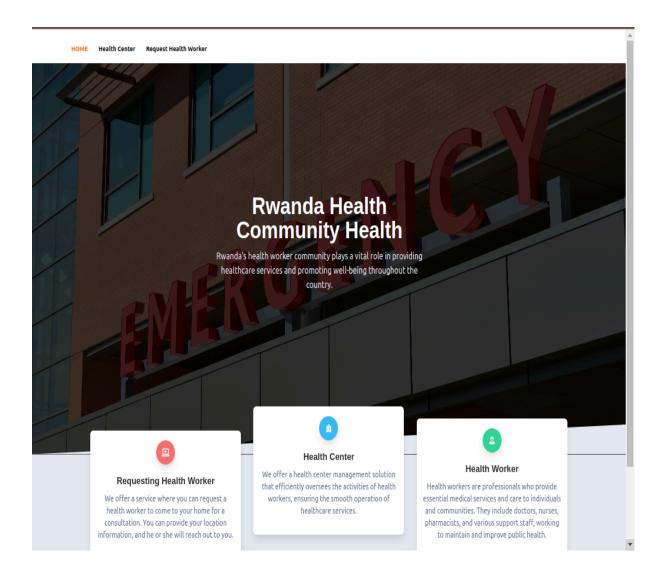


Figure 7: Home Page

## **5.4.1.2 Requesting Health Worker**

The page where patients can request an urgent check-up is designed for them to communicate their current health condition. Here, patients can describe how they are feeling, and this information will be visible to healthcare workers in their accounts. This ensures that a dedicated health worker can promptly attend to and provide personalized care based on the patient's reported symptoms.

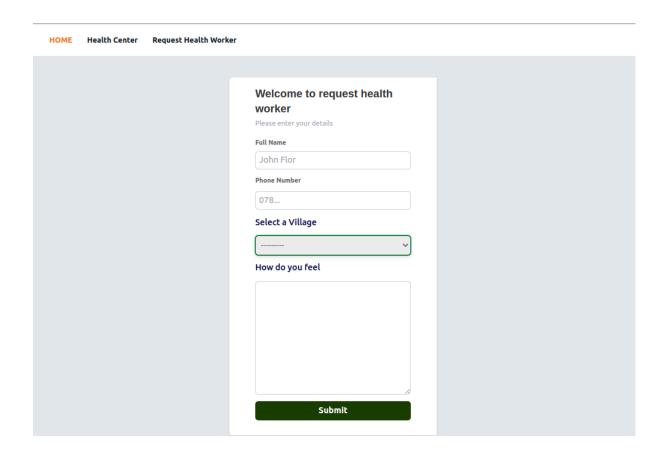


Figure 8: Request Health Worker

## **5.4.2 Administration Portal**

# 5.4.2.1 Admin Login Page

The admin user possesses superuser privileges, allowing them to manage other users within the system. However, to access these capabilities, the admin must log in by providing their credentials through a dedicated login page.

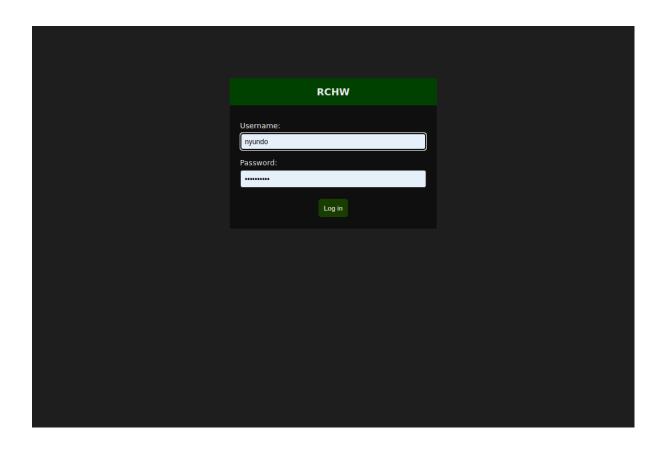


Figure 9: Admin Login

## 5.4.2.2 Add new Health care Center

The administrator is the sole user endowed with the ability to create a healthcare center account. This involves furnishing details about the healthcare center, and upon successful creation, the account credentials are relayed through the provided email address.

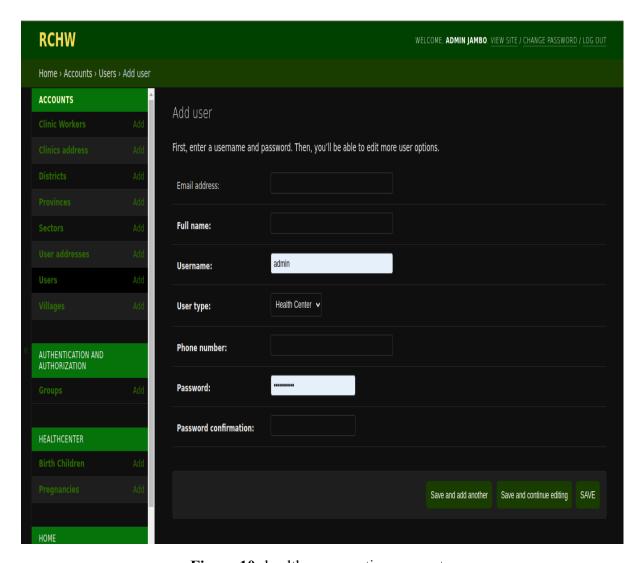


Figure 10: health care creation account

### 5.4.2.3 Manage Users

From this page, the superuser can efficiently manage all users within the system. This includes making final decisions, having the ability to modify any user's information, and, if necessary, removing users from the system. The superuser acts as the ultimate authority, ensuring control and oversight over user-related activities.

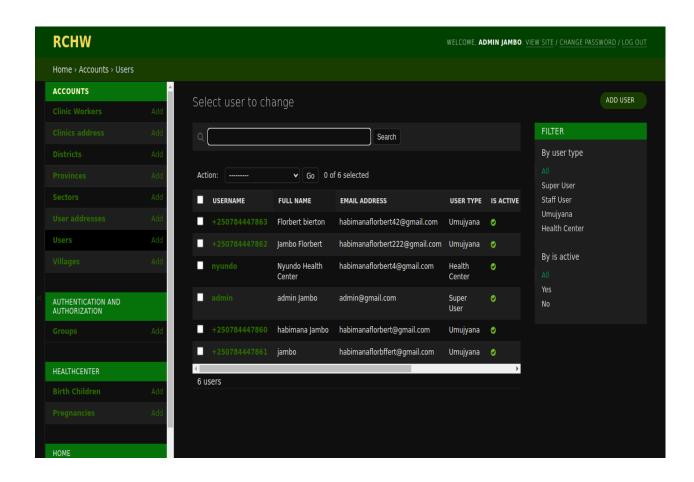


Figure 11: User Manage

## 5.4.2.4 Add document to upskill

This page serves as the platform where the super admin can upload documents intended for specific types of users. These documents are carefully curated to aid in the upskilling of health workers, providing valuable insights and knowledge on various diseases and healthcare practices.

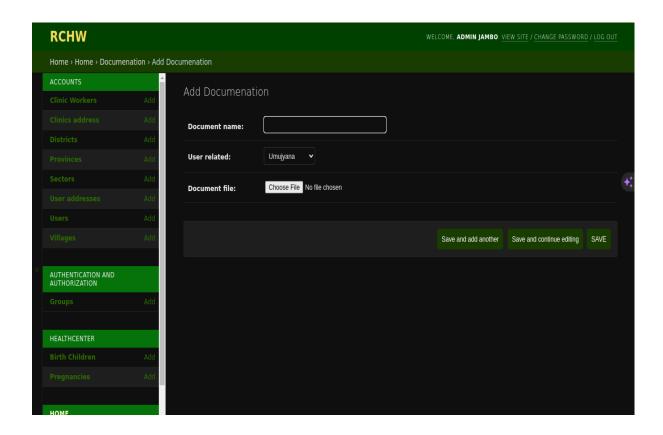


Figure 12:Add document to upskill

### **5.4.3** Healthcare center Portal

### 5.4.3.1 healthcare center login

This is the designated login page where healthcare centers can access the system by entering their provided credentials. Additionally, healthcare centers have the capability to manage and control health workers within the system.

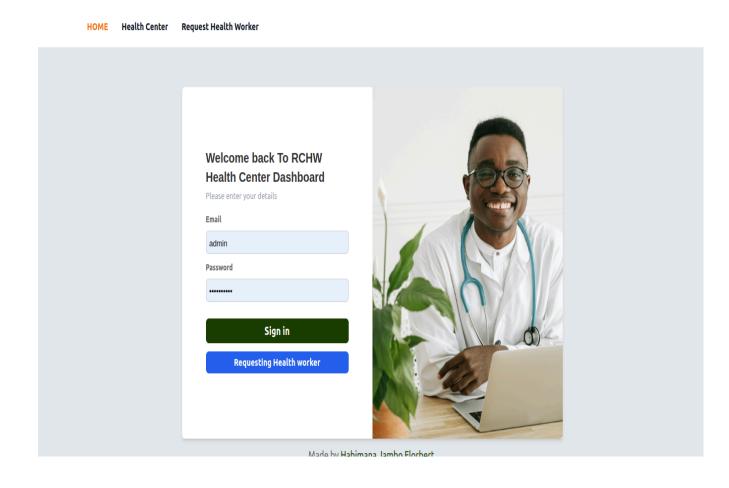


Figure 13: healthcare center login

### 5.4.3.2 Healthcare center dashboard

The dashboard serves as the central hub where the health center can oversee and manage monthly activities related to Health workers, including the tracking and handling of illnesses.

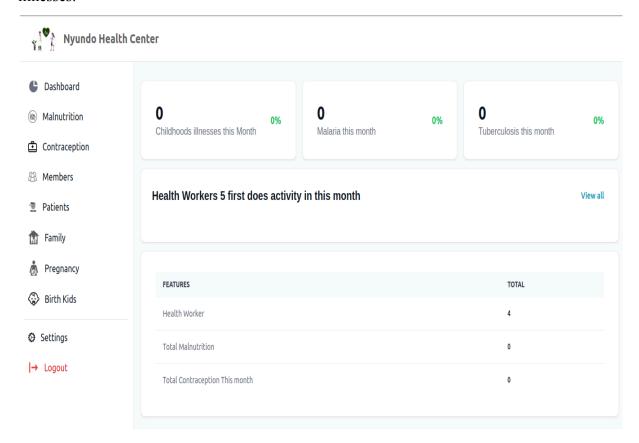


Figure 14: healthcare center dashboard

### 5.4.3.3 Create new Healthworker

The health care center possesses the capability to create and manage new health workers through its portal. Upon creation, health workers are notified via their provided email addresses, receiving their login credentials. This streamlined process ensures efficient onboarding and management of health workers within the system.

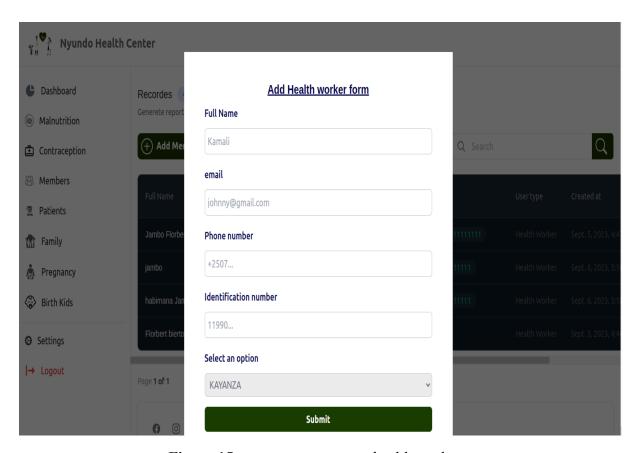


Figure 15: create new account health worker

### 5.4.3.4 Managing health worker accounts

This page serves as the platform where health care centers can effectively manage their health workers, including the option to deactivate them based on the center's discretion or in accordance with their suggested criteria.

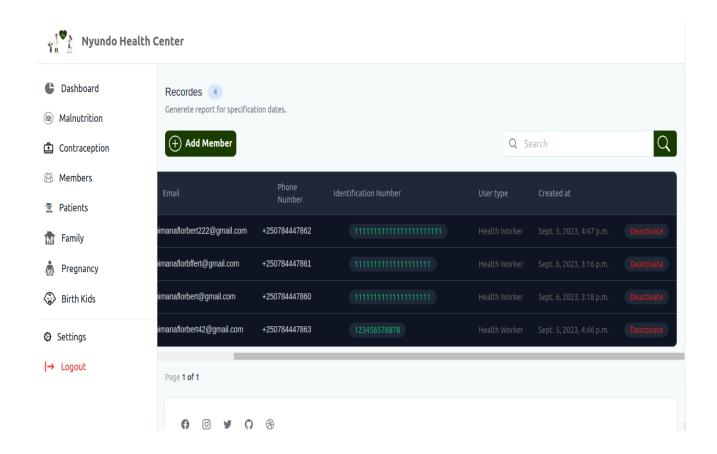


Figure 16: Manage Health worker

# 5.4.3.5 Add new family

This is the dedicated page for adding new families to the system. These families can then be assigned to a child in case they are identified as having malnutrition or for other relevant activities.

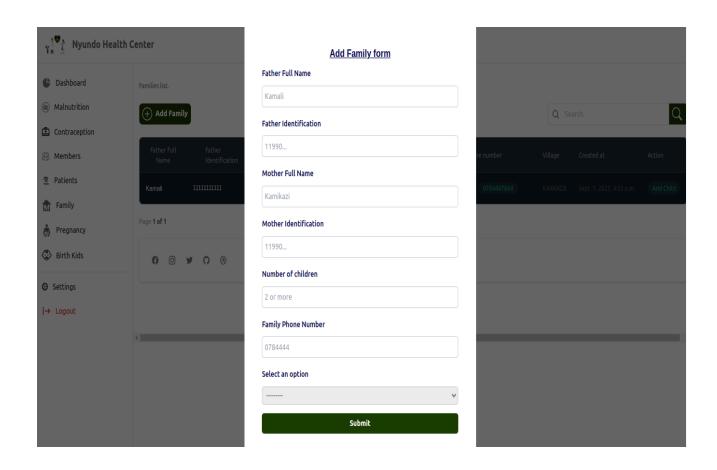


Figure 17: Add new family

# 5.4.3.6 Assign family to Child

This form is used by the health center to assign a child to their respective family within the system.

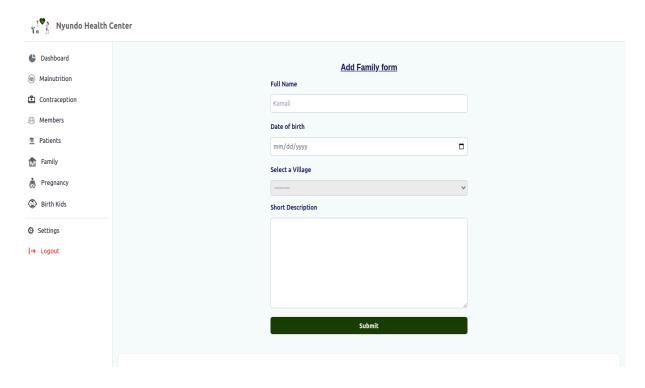


Figure 18: Assign family to Child

# 5.4.3.7 Add pregnant Woman

This form is specifically designed for the health center to add new pregnant women to the system.

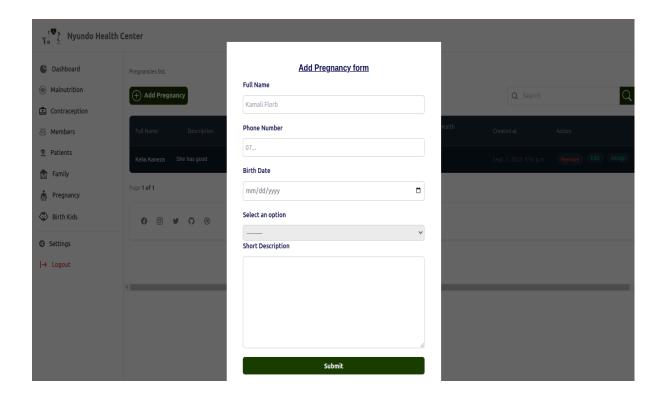


Figure 19: Add pregnant Woman

# 5.4.3.8 Assign woman to Health worker

This platform is where the health care center assigns women to health workers for daily follow-up.

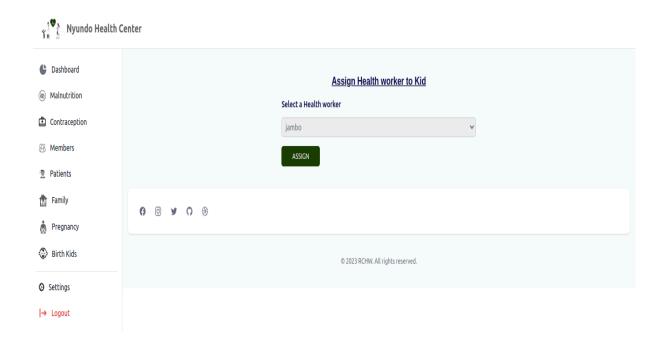


Figure 20: Assign woman to Health worker

## 5.4.3.9 Assign woman to Health worker

This is the designated space where health workers are assigned to children, enabling them to conduct regular follow-ups on the children's well-being.

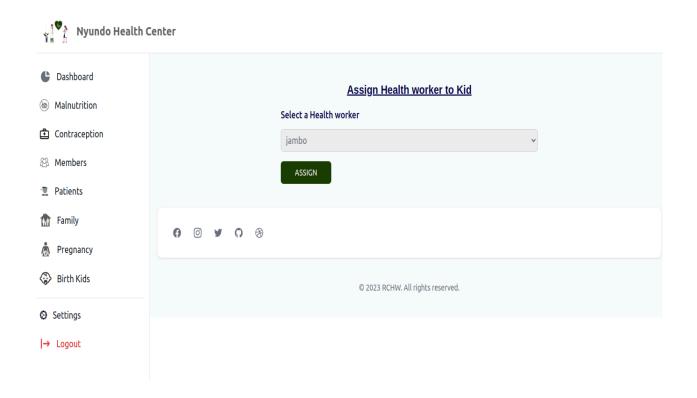


Figure 21: Assign woman to Health worker

## 5.4.3.10 Report of Birth children from specific date

This section facilitates the generation of reports in PDF format, aiding health center managers in creating comprehensive reports using the system. The generated reports can be conveniently shared via email or downloaded for further analysis.

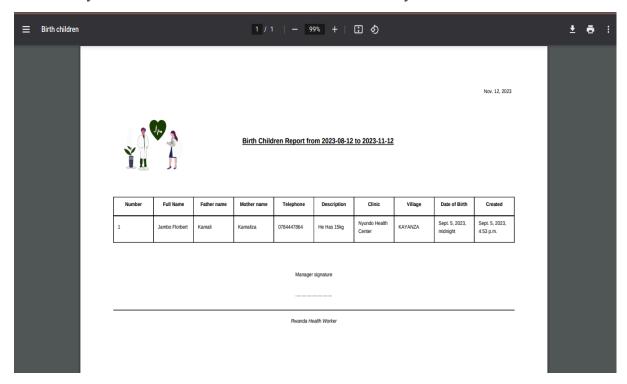


Figure 22: Report of Birth children from specific date

# **5.4.4** Healthcare Worker Portal

# 5.4.4.1 Health Worker login

This is the dedicated login portal for health workers, allowing them to access their personal information by providing the credentials issued by their respective health centers.

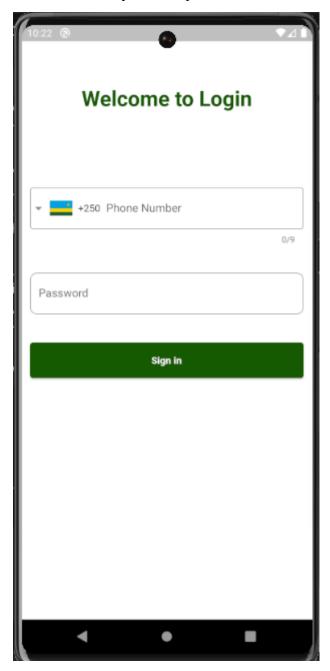


Figure 23: Health worker login

#### 5.4.4.2 Health Worker dashboard

This is the platform where health workers can comprehensively track their activities. It provides insights into recorded families, malnutrition cases in their assigned village, as well as patients entered into the system, including information related to contraception.



Figure 24: Health Worker dashboard

## 5.4.4.3 Health worker add patient

This is the designated space where health workers can add new patients by providing their information. The entered data is reported promptly to their health center, allowing for swift decision-making based on the provided information.

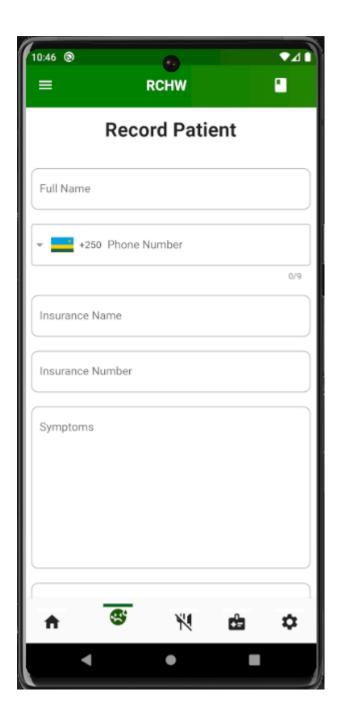


Figure 25: Health worker add patient

### 5.4.4.4 Health worker add malnutrition

This page serves as the platform where health workers can add children identified with malnutrition. By providing information about the child's family, the health worker can initiate follow-up activities to address the child's nutritional needs.



Figure 26: Health worker add malnutrition

# 5.4.4.5 Health worker add contraception

This is the designated page where health workers can record information about contraception provided by individuals who choose to use it.



Figure 27: Health worker add contraception

### 5.4.4.6 Health worker edit his account

This is the section where health workers can update their account information and change their password. The process involves providing the last valid password for security verification.

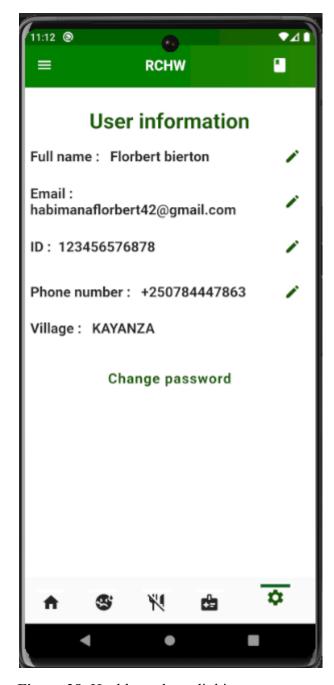


Figure 28: Health worker edit his account

## 5.4.4.7 Health worker review requested patient

This page is where health workers can review and accept patient visit requests from individuals in their assigned village. Accepting these requests ensures that health workers can proactively attend to patients within their village, preventing the need for patients to seek out health workers themselves.



Figure 29: Health worker review requested patient

## 5.4.4.8 Health worker to add new family

This is the dedicated page where health workers can register new families in the system. If a family does not already exist, the health worker can add them to the system for convenient access and management.



Figure 30: Health worker to add new family

## 5.4.4.9 Health worker pdf for upskill on new diseases

The PDF document repository is a valuable resource for health workers to enhance their skills. It contains information on treating new diseases and serves as a reference for previously taught conditions, facilitating continuous learning and professional development.



Figure 31: Health worker pdf for upskill on new diseases

## 5.4.4.10 Assigned pregnant woman

This is the dedicated page where health workers can view the list of pregnant women assigned to them. It enables health workers to efficiently follow up on these women, providing comprehensive care and support throughout their pregnancy journey.



Figure 32: Assigned pregnant woman

## 5.4.4.11 Assigned birth kid

This is the designated page where health workers can locate and access information about the children assigned to them. It facilitates efficient follow-up, allowing health workers to monitor and address the well-being of these children with care and attention.

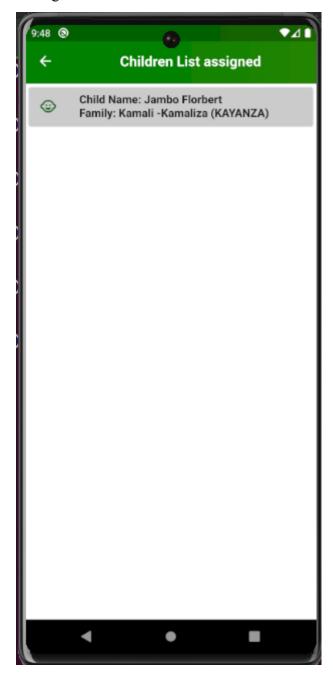


Figure 33: Assigned birth kid

### **CHAPTER 6: CONCLUSION AND RECOMMENDATIONS**

#### 6.1 Conclusion

Rwanda Health Worker is a comprehensive system designed to empower health workers and healthcare centers by providing seamless access to medical services. This innovative system allows patients to conveniently request services through the mobile app or web portal, enabling health workers to locate and assist them efficiently. The goal is to enhance accessibility and improve healthcare delivery in Rwanda.

For health workers, the mobile app serves as a valuable tool for continuous learning. It facilitates upskilling by providing resources on both new and recent diseases, ensuring that health workers stay informed and adept in their roles. The mobile app also enables health workers to update their daily activities, ensuring real-time communication with healthcare centers. This feature not only enhances data accuracy but also streamlines the reporting process.

On the healthcare center side, the system provides a centralized platform for efficient management of health workers. Daily reports generated from the system allow healthcare centers to make informed decisions. The secure storage of information on the server mitigates the risk of data loss and enhances overall data security.

The system addresses challenges identified in previous chapters, offering solutions such as the mobile app for health worker upskilling and a centralized server for secure data management. Additionally, the mobile app simplifies patient consultations by allowing them to request health workers for in-person visits directly from their mobile devices. The app also facilitates health workers in monitoring pregnancies and tracking the development of children in their respective villages.

In summary, the Rwanda Health Worker system, accessible through both web and mobile platforms, is poised to revolutionize healthcare management and patient care in Rwanda.

#### **6.2 Recommendations**

It is recommended that the developed web-based application and mobile app be further optimized and adapted for use in Rwandan hospitals. The application holds the potential to offer Rwandan citizens time and cost savings while providing quick access to specialized medical assistance.

For future researchers interested in this topic, it is suggested to conduct advanced research to incorporate missed features such as:

- Implementing APIs to connect the Rwanda Health Worker with Medical Insurance Databases to verify the patient's insurance status and insurance identification.
- Developing an API to connect the Rwanda Health worker System with Rwanda Immigration/Emigration Databases to validate the existence and validity of the patient's passport within Rwanda.
- Integrating an API to connect to the National ID Agency (NIDA) to verify the authenticity and validity of the patient's ID.

These additional features would enhance the system's functionality and contribute to a more comprehensive and secure online Rwanda Health Worker experience for patients in Rwanda.

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