UNIVERSITY OF DAR ES SALAAM

COLLEGE OF INFORMATION AND COMMUNICATION TECHNOLOGIES

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CS 499: FINAL YEAR PROJECT 2023/2024

FINAL YEAR PROJECT REPORT

A project Report Fulfillment for the Award of Bachelor of Science in Computer Engineering and Information Technology

Project Title**:**	WELL-CONNECT APPLICATION		
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DECLARATION

I, Bunango Moses J, with registration number 2020-04-00876, declare that this report and the work described in it are my original work, with contributions from others expressly acknowledged or cited. I affirm that the work in this report has been conducted by the Regulations of the University of Dar es Salaam and has not been presented to any other University for examination, either in Tanzania or overseas. All views expressed in this report are my own and do not represent those of the University of Dar es Salaam.

Signature: ……

Date: ……

This report may proceed for submission for assessment for the award of a BSc in Computer Engineering and Information Technology at the University of Dar es Salaam.

Supervisor's Signature: …….

Date: ……

ABSTRACT

This report presents the development of "Well-Connect," an innovative mobile application and pharmacy web portal designed to address the challenges faced by patients with Non-Communicable Diseases (NCDs) in accessing essential medications. The project aims to streamline the process of obtaining NCD medications, improve medication adherence, and provide personalized health insights to users.

The application connects NCD patients with nearby pharmacies, allowing them to easily locate and order their prescribed medications. Key features include secure prescription management, real-time pharmacy stock information, and an AI-powered risk assessment tool for predicting the likelihood of developing NCDs.

The pharmacy web portal complements the mobile app by enabling pharmacies to manage their inventory electronically, process orders efficiently, and communicate directly with patients. This integrated approach enhances the overall healthcare ecosystem by improving accessibility, affordability, and proactive health management for NCD patients.

The project utilizes the Waterfall methodology for development, ensuring a structured approach to requirement gathering, analysis, design, and implementation. Technologies such as Flutter for front-end development, Laravel for back-end implementation, and MySQL for database management are employed to create a robust and user-friendly system.

By addressing the specific needs of NCD patients and leveraging technology to enhance medication access and health monitoring, Well-Connect aims to contribute significantly to improving healthcare outcomes and quality of life for individuals managing chronic conditions.

ACKNOWLEDGEMENT

First and foremost, I would like to express my gratitude to the Almighty for blessing us with the gift of life, allowing us to carry on with our daily routines, and for instilling in me a strong work ethic. This report is the result of the dedicated efforts and encouragement from numerous individuals.

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LIST OF ABBREVIATIONS

AI Artificial Intelligence

BSc Bachelor of Science

CEIT Computer Engineering and Information Technology

CHC Community Health Centers

CoICT Collage of Information Communication Technology

LMIC Lower Middle-Income Countries

NCD Non-Communicable Disease

SDLC Software Development Life Cycle

UML Unified Modelling Language

WHO World Health Organization

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CHAPTER ONE: INTRODUCTION

1.1 General Introduction

The healthcare industry has made significant advancements in computing technology. As a result, applications are now available that make it easier for patients to access specialist medical advice and have medication delivered to their doorstep. Many of these applications have been developed to support patients who are receiving care at home. (scientific reserch, 2019)

The rise of non-communicable diseases (NCDs) such as diabetes, hypertension, and chronic respiratory diseases presents a significant global health challenge. These chronic conditions require ongoing management, often necessitating adherence to medication regimens. This is where mobile health (mHealth) technologies have the potential to revolutionize NCD care by making it more accessible, convenient, and efficient. (scientific reserch, 2019)

This report proposes the development of a mobile app specifically designed for patients with NCD's to better manage their health conditions. Our project aims to guarantee the easy availability of NCD medications, allowing patients to effortlessly obtain them with just a few clicks on the app."

Introducing "Well Connect" - the revolutionary mobile app and pharmacy web portal that simplifies the process to non-communicable disease patients of getting medicine and staying healthy. No need to wait in long queues or rush to different pharmacies to check availability of medication - "Well Connect" has got you covered.

As a patient, you only need to upload your prescription on the app and browse nearby pharmacies to request your refills with just a few taps. You'll be able to see which pharmacies have your medication in stock, so you won't have to worry about guessing. Plus, you'll receive a notification on your phone once your order is ready.

But that's not all "Well Connect" offers. The app also uses AI to assess your risk for common non-communicable diseases like diabetes and high blood pressure. You'll receive personalized tips and recommendations based on your health data to help you stay healthy.

Behind the scenes, the pharmacy web portal helps pharmacies manage their stock electronically, receive prescription requests instantly, and process orders efficiently, Admininistrators can

monitor stock levels across pharmacies, analyze medication usage trends. Plus, pharmacies can communicate with you directly through the app to ensure a smooth experience.

With "Well Connect", patients get a faster and simpler way to stay healthy, while pharmacies gain streamlined operations and satisfied customers. It's the future of healthcare, one tap at a time. Are you ready to embrace it?

1.2 Statement of the Problem

Gaining access to quality healthcare is a constant struggle, Millions of non-communicable disease (NCD) patients worldwide face significant challenges in accessing essential medicines, jeopardizing their health and well-being.

According to WHO Up to 50% of Lower-and Middle-Income Countries (LMIC) patients experience difficulties accessing essential NCD medicines. Medicine shortages affect 1 in 4 health facilities globally, with higher rates in LMICs. High medicine costs further impede access, forcing patients to ration or skip doses, jeopardizing treatment effectiveness. (WHO,Noncommunicable diseases, 2023)

71% of global deaths are attributed to NCDs, predominantly in low- and middle-income countries (LMICs). 17 million people die prematurely from NCDs each year, before reaching the age of 70. NCDs account for approximately 30% of the disease burden in Africa, with cardiovascular diseases, diabetes, and cancers ranking highest. (WHO,Noncommunicable diseases, 2023)

Urgent action is needed to address the challenges of medicine scarcity for NCD patients.

1.3 Objectives

1.3.1 General Objective

Our goal is to develop 'Well Connect,' a healthcare platform designed to connect people suffering from chronic conditions (NCDs) with nearby pharmacies. This app will ensure the availability of prescribed medicines and provide a smooth and secure process for patients to receive them promptly. The platform will manage the supply chain efficiently and leverage smart technology to monitor individuals at risk of developing chronic conditions such as diabetes, blood pressure problems, and obesity. By utilizing AI prediction tools, 'Well Connect' aims to predict and prevent potential health issues before they occur

1.3.2. Specific Objectives

1. Identify and document the needs and expectations of users (user requirements).
2. Design web and mobile applications user interface: develop wireframes and low-fidelity prototypes
3. Develop the mobile app: Focus on features like secure prescription management, pharmacy locator, NCD medication ordering, and NCD AI risk assessment tool.
4. Develop the pharmacy web portal: Focus on functionalities for managing medication stock, receiving prescription requests, processing orders, and ensuring seamless integration with the mobile app

1.4. Significance of the Project

This project will significantly impact the health sector ecosystem through:

1) Enhanced Accessibility to Medications: By offering a secure prescription management system and real-time pharmacy stock information, "Well Connect" empowers users to make informed decisions and eliminates uncertainties regarding medication availability.
2) Prevents future health issues: AI-powered insights and personalized recommendations empower proactive health management, reducing risks for NCDs.
3) Streamlines operations: Reduces paperwork, automates processes, and improves order efficiency, saving time and resources.

4) Improved Medication Adherence: Timely notifications and personalized reminders foster a consistent and disciplined approach to medication intake, preventing interruptions in treatment.

1.5. Project Scope

Well-Connect is an innovative healthcare platform designed to bridge the gap between patients with Non-Communicable Diseases (NCDs) and pharmacies. The project consists of a user-friendly mobile app for patients and a comprehensive web portal for pharmacies, primarily focusing on managing blood pressure, diabetes, and obesity. The mobile app offers features such as secure prescription management, medication ordering, refill reminders, a pharmacy locator, and personalized health insights. It also incorporates AI functionalities to predict and prevent potential health issues related to these chronic conditions.

The pharmacy web portal streamlines pharmacy operations by offering functions such as medication stock management and order processing. Admins can monitor inventory levels across all pharmacies and analyze medication usage trends while ensuring seamless integration with the mobile app. The ultimate goal is to improve medication access, proactive health monitoring, and overall healthcare experiences for both users and pharmacies.

1.6. Organization of the report

The report is organized into chapters focusing on different aspects of the Well-Connect Mobile App.

Chapter One: This chapter introduces the system by providing the general introduction, statement of the problem, project objectives both main objectives and specific objectives, as well as project scope and limitations.

Chapter Two: delves into a comprehensive literature review. This is whereby similar systems that were done before are explained identifying their strength and noting the weaknesses to work on, while

Chapter Three: outlines the methodology used in developing the application, justifications of the used methodology, and the phases to follow

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

Digital applications are becoming more significant in healthcare, particularly in addressing the seamless provision of medications, which is a growing global health concern. This part aims to explore the current healthcare applications that focus on streamlining the medication process and identify their strengths, weaknesses, and opportunities for developing the Well-Connect application.

2.2. Related Works

Several mobile and web applications are currently available for connecting patient and pharmacies, each offering unique features and functionalities. A review of existing applications reveals their strengths and weaknesses, providing valuable insights for the development of the Well-connect application.

2.2.1 Dawa Mkononi

Dawa Mkononi is a product of DMRX Inc., a United States of America-based Company. DMRX Inc. is the holding company of DMRX Company Limited, a company incorporated in Tanzania.
Dawa Mkononi is focused on using innovation to improve the supply chain. Dawa Mkononi's operations mainly target pharmacies, health facilities, and other registered B2B clients. With its data-driven approaches, we have a mission of improving access to medicine distribution and making medicines more available to health facilities. (Dawa mkononi, 2023)

2.2.2 Amazon Pharmacy:

Amazon Pharmacy, launched in 2020, is shaking up the traditional US pharmacy landscape with its convenient online platform and leverage of existing Amazon infrastructure. It offers a wide range of prescription medications delivered directly to your door, often with free Prime membership. Competitive pricing, insurance options, and integration with the Amazon ecosystem attract tech-savvy and cost-conscious consumers. (Amazon, 2020)
While focusing on different markets and target audiences, Amazon Pharmacy represent tech-driven innovation in the pharmacy industry. Amazon offers convenience and affordability, it also

raises potential concerns about data privacy and market competition, highlighting the complexities of technological advancements in healthcare.

2.2.3 m-Pharma

M-Pharma, operating across multiple African nations, strives to improve access to quality healthcare with a focus on pharmaceuticals. They cater to both individuals and healthcare facilities through online and physical pharmacies, offering a wide range of medications at competitive prices.

Leveraging technology, m-Pharma streamlines supply chains ensures medication availability, and tracks patient adherence. Partnerships with stakeholders and data-driven insights further enhance their impact. Overall, m-Pharma plays a key role in transforming the African pharmaceutical landscape by promoting accessibility, affordability, and stronger healthcare systems. (mPharma, 2023)

2.2.4 Afya bora

Afya Bora, focusing on pregnant mothers and women, tackles the challenge of limited healthcare access in Africa. By empowering doctors and hospitals, they aim to bridge the gap between patients and quality care. Their goal? Offer affordable online healthcare with preventive and comprehensive services from qualified professionals. Through virtual consultations, prescription management, and reliable health information, they empower Tanzanians to actively manage their health. This platform holds promise for improving accessibility and affordability, especially for vulnerable populations, ultimately contributing to a stronger healthcare landscape in Tanzania. (Afya bora, 2023)

2.2.5 Nokware

Nokware, launched in 2017, aims to transform healthcare access in Kenya by making quality medication and consultations readily available at fair prices. This e-pharmacy platform offers a diverse range of medications, connects patients with doctors virtually, and delivers medication directly to homes, particularly focusing on underserved communities.

Their impact is significant: Nokware has expanded access to essential medicines, improved affordability through competitive pricing and flexible payment options, empowered patients with information and convenient consultations, and utilized data to optimize healthcare delivery. They contribute to strengthening Kenya's healthcare system through partnerships and data-driven solutions, ultimately working towards a more accessible and affordable healthcare landscape for all. (Nokaware, n.d.)

2.2.5 ePharmacy mobile

ePharmacy Mobile is an Australia-based Company. ePharmacy platforms serve as digital hubs for pharmaceutical services, allowing users to conveniently order prescription medications and healthcare products online. These platforms typically offer features such as prescription uploads, detailed product information, and a broad catalog of health and wellness items. A key advantage is the seamless home delivery of medications, enhancing accessibility for individuals who may find it challenging to visit traditional pharmacies. (ePharmacy,Au, 2023)

2.3. Project Gap

The current landscape of healthcare applications falls short in addressing the unique needs of Non-Communicable Disease (NCD) patients. Although many platforms offer healthcare services, they often do not focus on NCD medications. Existing solutions tend to be more general, providing services beyond the specific needs of NCD patients. In this context, the "Well Connect" project emerges as a specialized and innovative solution, addressing the unmet needs of individuals managing NCDs.

Unlike generic healthcare applications, the primary goal of "Well Connect" is to simplify the ordering and ensure the availability of NCD medications. By identifying the nearest pharmacies with NCD medications in stock, the app ensures accessibility and convenience for patients. Moreover, "Well Connect" stands out by integrating a predictive tool that assesses the risk of developing NCDs. This proactive approach to healthcare is currently lacking in existing applications.

The targeted focus on NCDs makes "Well Connect" a tailored and comprehensive solution to bridge the existing gap in meeting the specific requirements of NCD patients.

2.3.1 Strengths of Existing Applications.

Several strengths characterize existing healthcare applications, contributing to their overall effectiveness:

User-Friendly Interfaces: Many applications prioritize user experience with intuitive interfaces and simple navigation, facilitating easy access to medical services, including medication procurement from nearby pharmacies.

Comprehensive Features: Existing systems often offer features such as secure prescription uploads, multiple payment options, and order tracking, ensuring a holistic user experience.

2.3.1 Weaknesses of Existing Applications

However, certain weaknesses are prevalent in these applications, presenting opportunities for improvement:

Broader Scope, Limited Functionality: Some applications, while catering to a wider customer base, offer basic functionalities such as medication ordering and delivery. They lack specific features crucial for NCD patients, like risk assessment, ensuring medicines are always available and identifying the nearest with the stock.

Deficiency in Preventive Care: Existing healthcare platforms fall short in preventive care. Their primary focus often revolves around fulfilling medication needs, neglecting tools and guidance for preventive healthcare management, a crucial aspect for proactive health maintenance.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

Methodology refers to a set of steps that will be carried out in fulfillment of a certain task at hand. These steps are done in ascending order so as to ensure proper work is done on the required task.

3.2 Methodology Applied

For Well-Connect App, we have chosen the Waterfall Model as our methodology under the Software Development Life Cycle (SDLC). The reason behind choosing the waterfall model is that we need to gather all the requirements and complete everything related to them before moving to the next stage. This applies to every stage, where each stage must be completed before moving to the next one. In the upcoming sections, we will explain the steps involved in the waterfall model that we will be deploying for this project (Waterfall Methodology, n.d.).

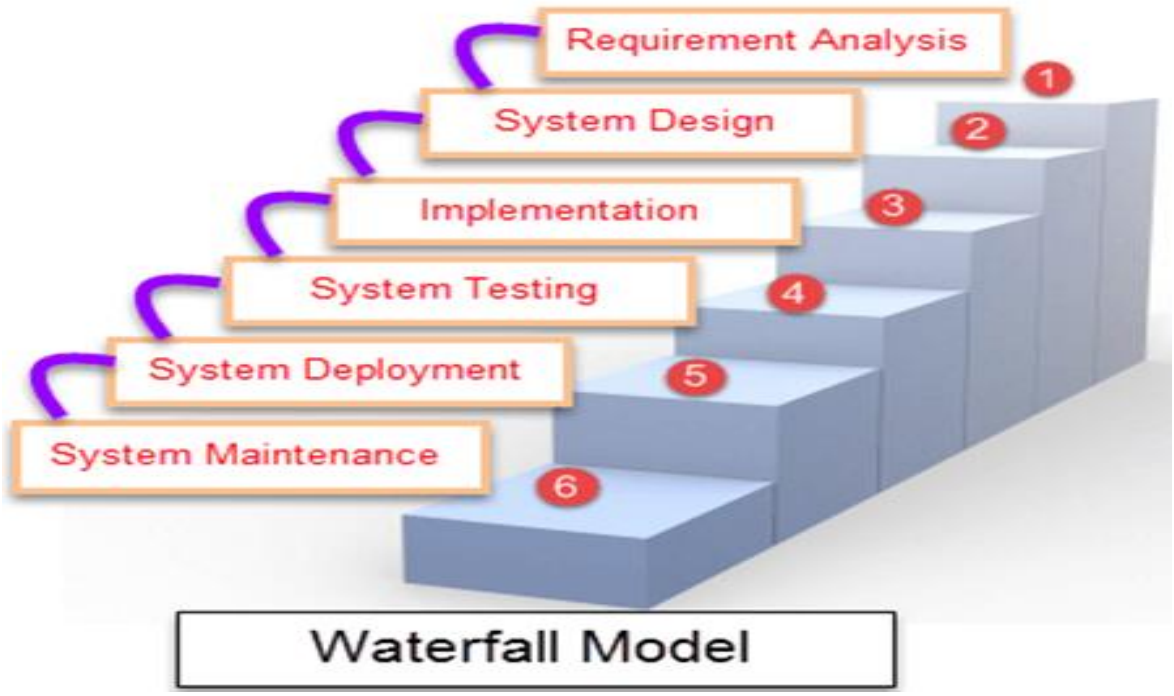


Figure 3.1Waterfall Model of SDLC

3.2.1 Requirement gathering

We conducted interviews with affected parties using prepared questions to identify additional potential problems.

3.2.2 Requirement Analysis

We identified functional and non-functional requirements from the gathered data, detailing system processes and qualities like response time, performance, and security.

3.3 System Design

We crafted a detailed blueprint of the app's structure, appearance, and functionality, creating visual drafts and user-centric UI designs for a positive user experience, supported by comprehensive documentation.

3.4 System Implementation

We used the Flutter framework for front-end development and the Laravel framework for back-end development together with other external API's to implement all relevant functionalities.

3.4.1 Data Analysis

Unified Modelling Language (UML) was used for modeling system design, documenting functional and non-functional requirements, use cases, diagrams, and flow charts.

CHAPTER FOUR SYSTEM: ANALYSIS AND DESIGN

4.1 Data Collection

To gather comprehensive insights into user needs and pharmacy operations, a dual approach was employed, utilizing interviews and online questionnaires through Google Forms.

4.1.1 Interviews

Structured interviews were conducted at Ney Agrovet pharmacy in Bunju-Dar-es-Salaam to gain firsthand information on pharmacy operations, challenges faced, and user expectations. The interviews targeted pharmacy administrators and staff, focusing on the following key areas:

Pharmacy Operations:

How do you currently manage your medicine stock?

What challenges do you face in fulfilling medication orders?

User Interaction:

How do users typically place orders for medications?

What difficulties do users experience in obtaining prescribed medicines?

Stock Management:

How do you monitor and manage your pharmacy's medication stock?

Are there challenges in maintaining an adequate supply of Non-Communicable Disease (NCD) medications?

System Interaction:

How do you envision a digital platform facilitating your pharmacy operations?

What features would be most beneficial for seamless stock management and order processing?

4.1.2 Online Questionnaire

To ensure a broader perspective, an online questionnaire was distributed to potential users through Google Forms. The questionnaire included inquiries related to NCD awareness, user preferences, expectations, Sample questions included: (well connect,survey, 2024)

Through online Google forms, we have gathered valuable data regarding the expectations of customers for the seamless medication of individuals with Non-Communicable Diseases (NCDs) using our well-connected application.

1. Medication Availability:

The primary concern expressed by our users is the availability of prescribed medications. It is essential that the app enables users to easily check the current stock status of their medications at nearby pharmacies.

2. Predictive Health Tool:

Users have shown significant interest in a tool that goes beyond medication management. The integration of a predictive health tool, which utilizes health metrics, resonates strongly with our users.

3. Easy Prescription Upload:

The simplicity of the prescription upload process is a key requirement for our users. The process must be intuitive, ensuring a seamless and efficient transaction when placing medication orders.

4. Nearby Pharmacy Locator:

Convenience plays a central role in the user experience. Therefore, the app should include a feature allowing users to easily locate nearby pharmacies. This will facilitate optimal decision-making in terms of accessing medication.

5. Privacy and Data Security:

The utmost security and confidentiality of health-related data is a non-negotiable expectation of our users. They require reassurance that their information will be handled with the highest standards of privacy and data security.

6. Efficient Medication Refill Process:

Efficiency in the medication refill process is of paramount importance to our users. The app should simplify the refill process, enabling users to reorder their medications with ease and without unnecessary complications.

The aforementioned customer requirements were also derived from the responses provided by customers in the form of some of these pie charts and other data.

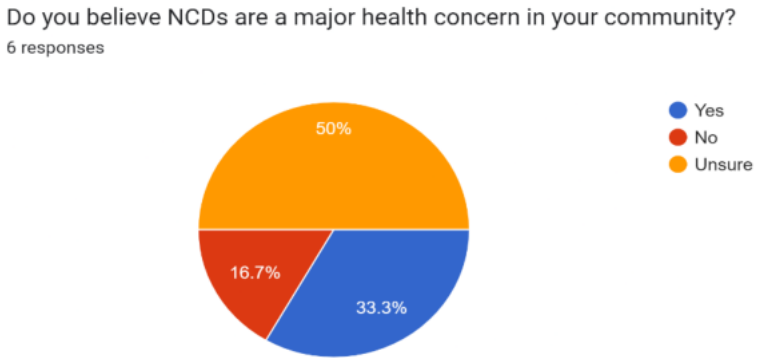


Figure 4.2: perception of Community on Non-Communicable Diseases (NCDs)

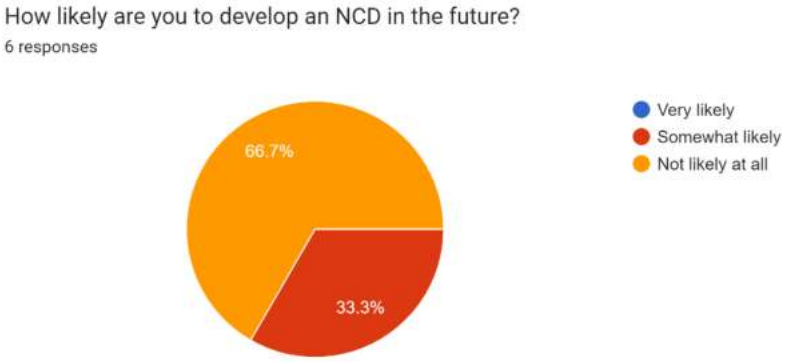


Figure 4.3: Responses from people NCD risk prediction

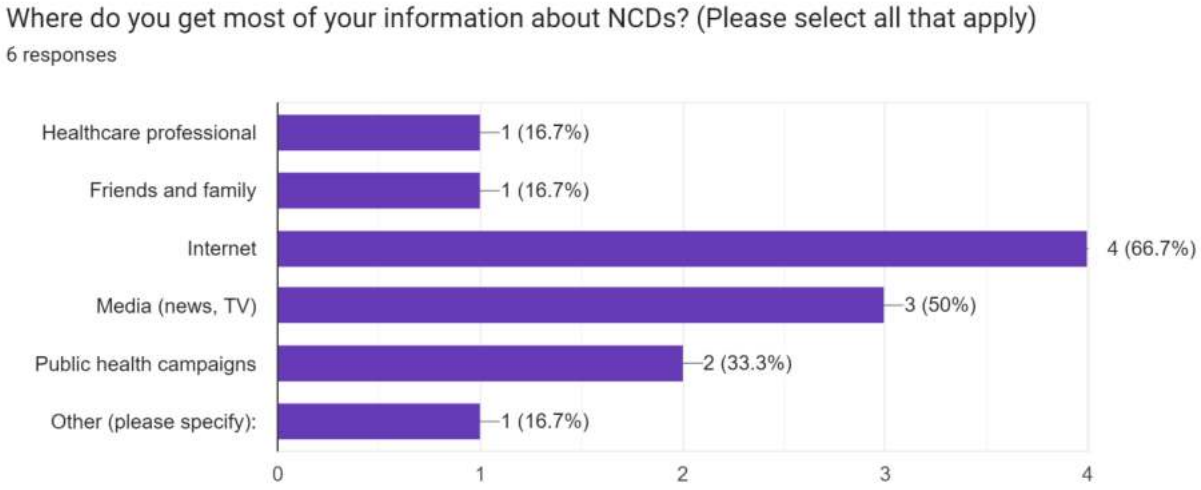


Figure 4.4: Responses on source of information

4.2 Requirement analysis

A requirement is a statement specifying the actions or attributes essential for a system to accomplish its intended purpose. Requirement Analysis entails identifying and describing what the system must achieve in terms of its goals (Functional Requirements) and the attributes it must possess (Non-Functional Requirements) (techtarget, 2021). This section details the identified and gathered requirements, categorized into Functional and Non-Functional Requirements.

4.2.1 Functional Requirement

These requirements represent the observable tasks or processes essential for the Application's development to attain its primary objective. They encompass all tasks to be automated by the Mobile Application. The following are the functional requirements of well-connect application;

Table 1: Functional requirement

Ref No.		Functional description	Category
F1		User Authentication and Authorization.	
	F1.1	The system should have a secure authentication mechanism to allow users to log in.	Evident
	F1.2	Different roles (User, Pharmacy Admin, System Admin) should have distinct authorization levels.	Evident

F2		Medicines(drugs) search	
	F2.1	Users should be able to search for desired NCD medicine or drugs through the system.	Evident
	F2.2	The search results should display the availability of the drug and nearby pharmacies with stocked medications.	Evident
F3		Order placement	
	F3.1	Users should be able to select a pharmacy from the search results and place an order.	Evident
	F3.2	Order placement should require the user to upload a valid prescription	Evident
F4		Prescription processing	
	F4.1	The system should facilitate the transfer of uploaded prescriptions to the respective pharmacy admin dashboard.	Evident
	F4.2	Pharmacy admins should be able to view and process the prescriptions.	Evident
F5		Stock Management	
	F5.1	Pharmacy admins should have a dashboard to manage their stock of NCD medicines in their pharmacy.	Evident
	F5.2	The system should allow updating and visualizing the remaining stock.	Evident
F6		System Admin Actions	
	F6.1	The System Admin should have access to view the stocks of all pharmacies.	Evident

	F6.2	The System Admin should be able to notify pharmacies to refill their stocks when necessary.	Evident
F7		Non-Communicable disease (NCD) Prediction	
	F7.1	The system should provide users with a feature to predict the occurrence of Non-Communicable Diseases (NCD).	Hidden
	F7.2	The NCD prediction feature should be accessible within the user interface.	Hidden

4.2.2 Non-Functional Requirements

These requirements encompass qualities or standards that the Mobile Application under development must possess or adhere to, although they are not tasks to be automated by the application. The subsequent list outlines the non-functional requirements integral to the development of the system.

Table 2: Non-Functional requirements

Attribute	Constraint
Security	The application must ensure data security, specifically for user information like medical records. It should implement robust authentication and authorization mechanisms to restrict access, enhancing privacy and protection.
Performance	The application must ensure quick responsiveness to user requests, striving for minimal latency in data processing and interactions between the mobile app and the pharmacy web portal.
Usability	The app should prioritize a user-friendly design for both the mobile

	app and the pharmacy web portal to enhance accessibility for individuals with chronic conditions and pharmacies.
Accessibility	The application should ensure accessibility for both users with non-communicable diseases (NCD) and those without, facilitating preventive measures for all individuals.
Compliance	The app must ensure compliance with healthcare regulations and data protection laws to safeguard user privacy and meet industry standards.

4.3 Use Case Analysis

Background

Use case analysis is a method for gathering and communicating software requirements from the user's perspective. It describes how users interact with a system to accomplish specific tasks, focusing on externally visible behaviors. Use cases typically consist of diagrams and documents that outline system responses to user actions, the value provided to users, and the roles users play. This approach helps ensure that the system design aligns with user needs and expectations, making it a valuable tool in software development and requirements gathering processes

4.3.1 Patient/User:

The main user of the "Well Connect" system is the individual who engages with the mobile app to simplify the process of acquiring prescribed medications. Through this app, users can effortlessly place orders for medications by uploading their prescriptions. They can also track their dosage history for better management and make use of the predictor tool to assess the risk of developing Non-Communicable Diseases (NCDs). This proactive health monitoring helps users take preventive measures, making the app not only a convenient tool for medication procurement but also a holistic health advisor.

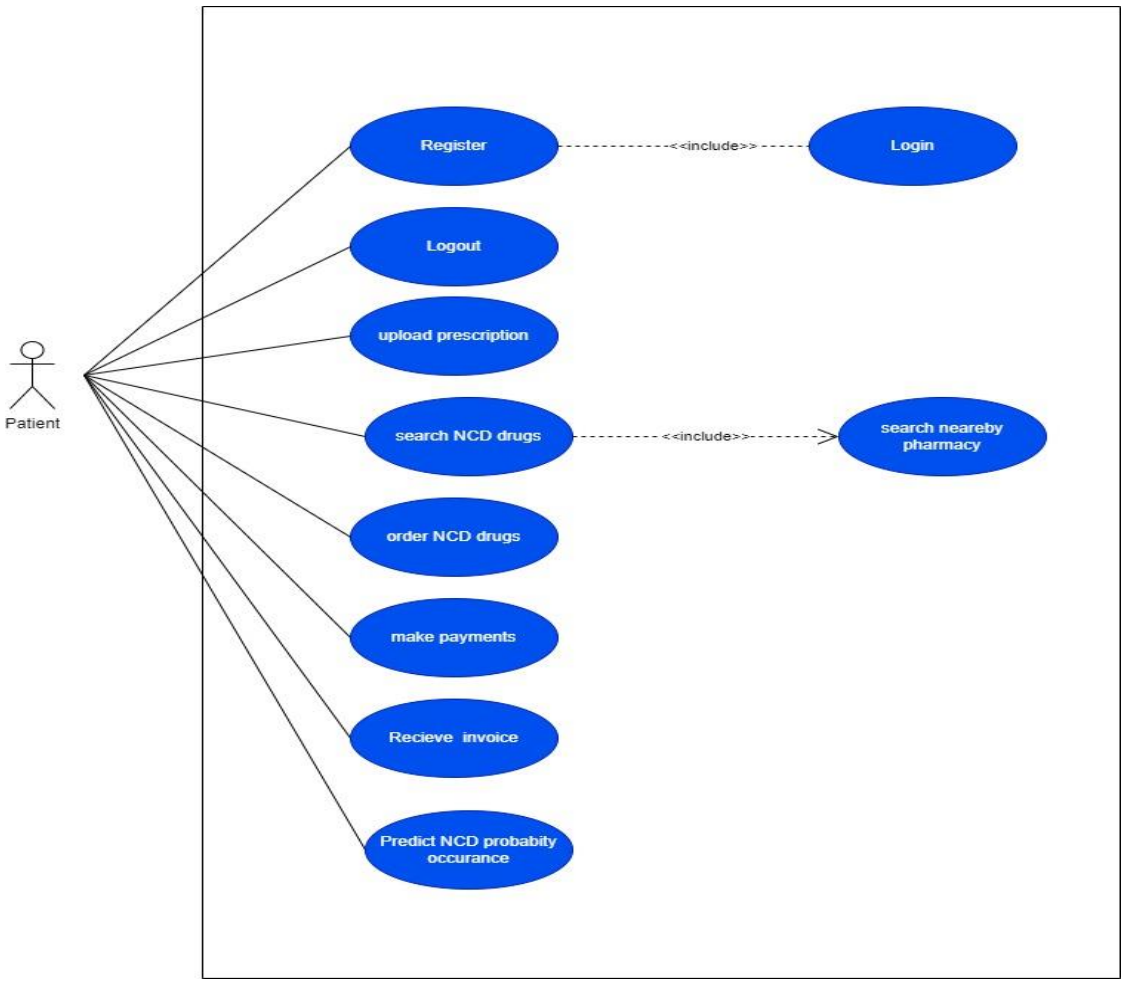


Figure 4.5: Use Case Diagram for Patient

4.3.2 Pharmacy Admin:

The Pharmacy Admin is a critical player in the healthcare system, and they operate through the pharmacy web portal. It is their responsibility to manage the medication stock and ensure its accuracy and availability. The admin also plays a vital role in processing orders initiated by users through the mobile app. The seamless coordination between the mobile app and web portal ensures that the pharmacy admin efficiently handles medication requests, contributing to a smooth and responsive healthcare experience.

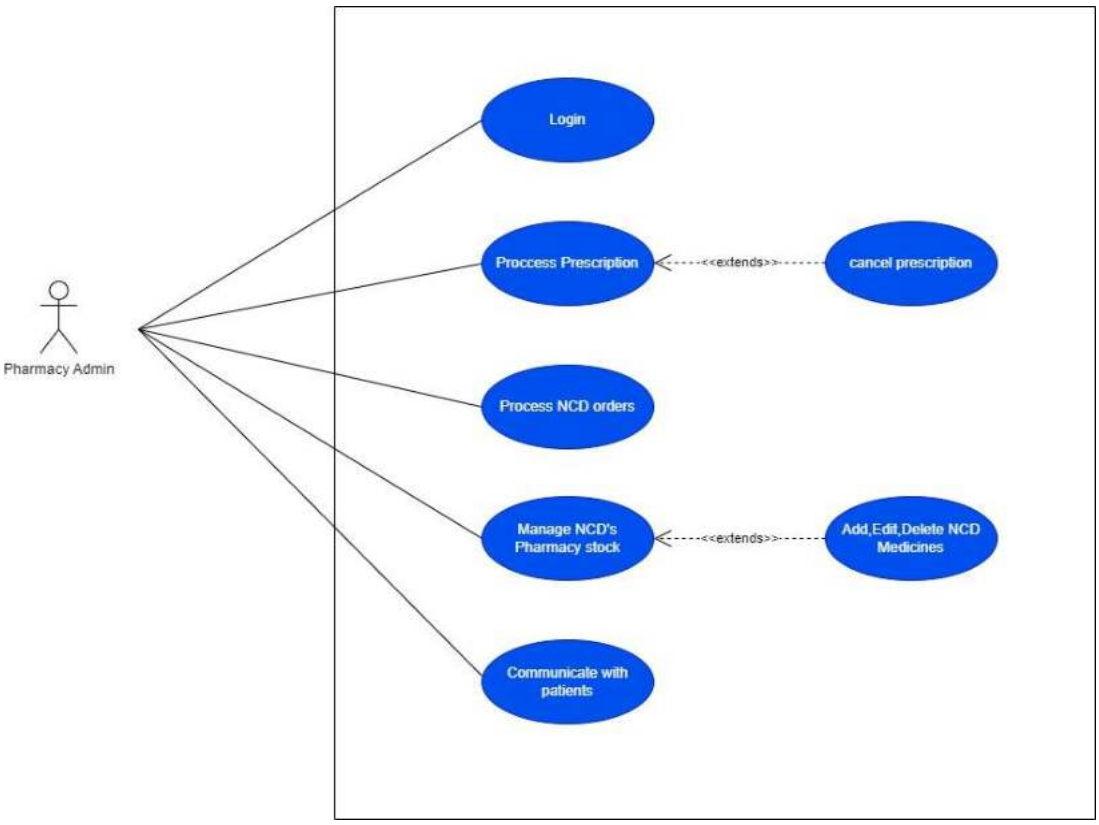


Figure 4.6: Use Case Diagram for Pharmacy Admin

4.3.3 System Administrator:

The System Admin plays a crucial role in overseeing the entire "Well Connect" system. Their main focus is on ensuring the availability of NCD medications by monitoring stock levels across all connected pharmacies. If low stock levels are detected, the admin has the authority to notify pharmacy admins immediately, allowing them to refill their stock. This proactive approach to stock management helps to maintain a consistent supply of medications, ensuring that users have timely access to the prescribed drugs they need to manage their health conditions.

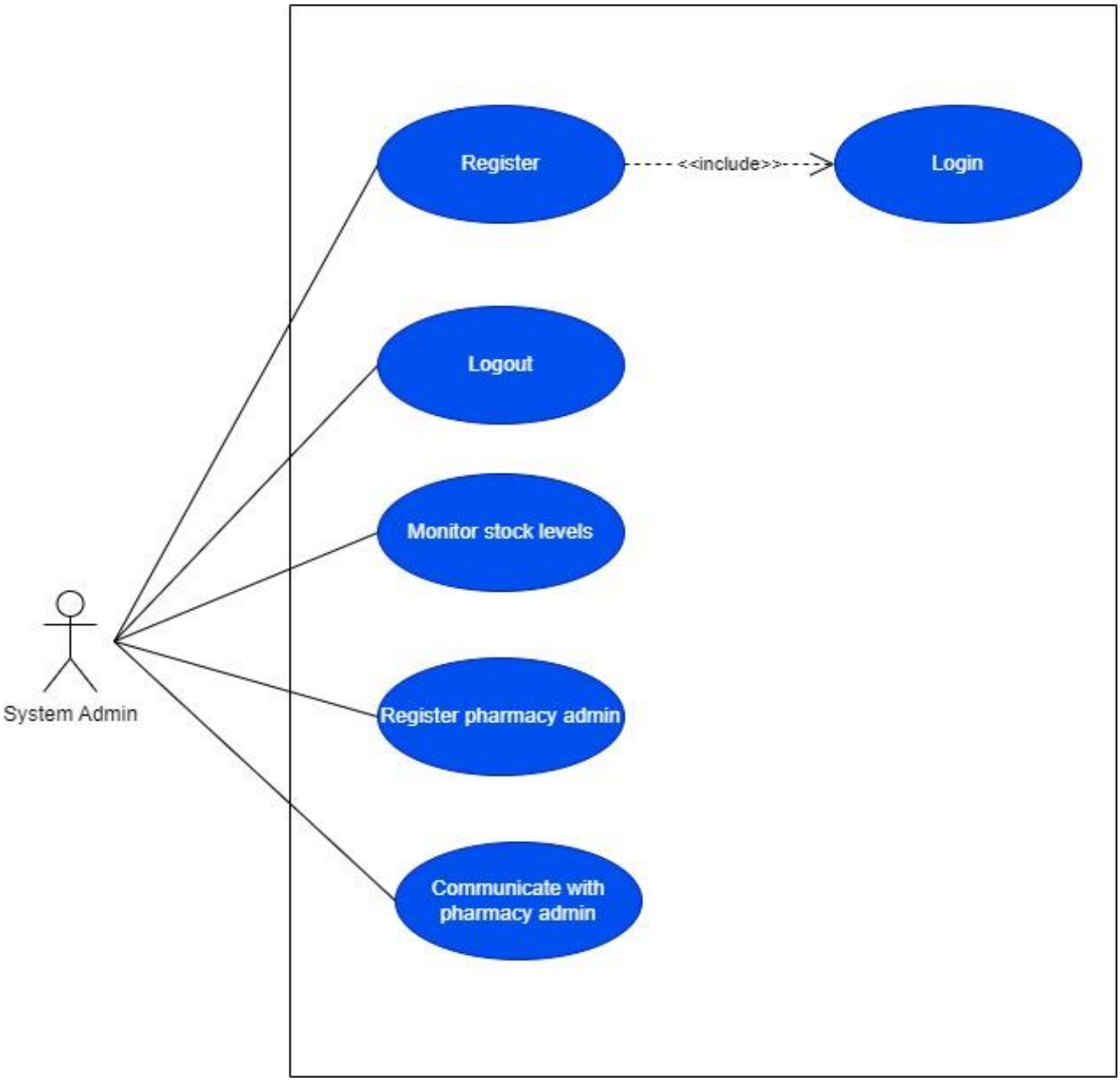


Figure 4.7: Use Case Diagram for System Admin

4.3.4 Combinational Use Case:

This use case combines all actors in the System, showing how each actor interacts with the system by performing their respective actions.

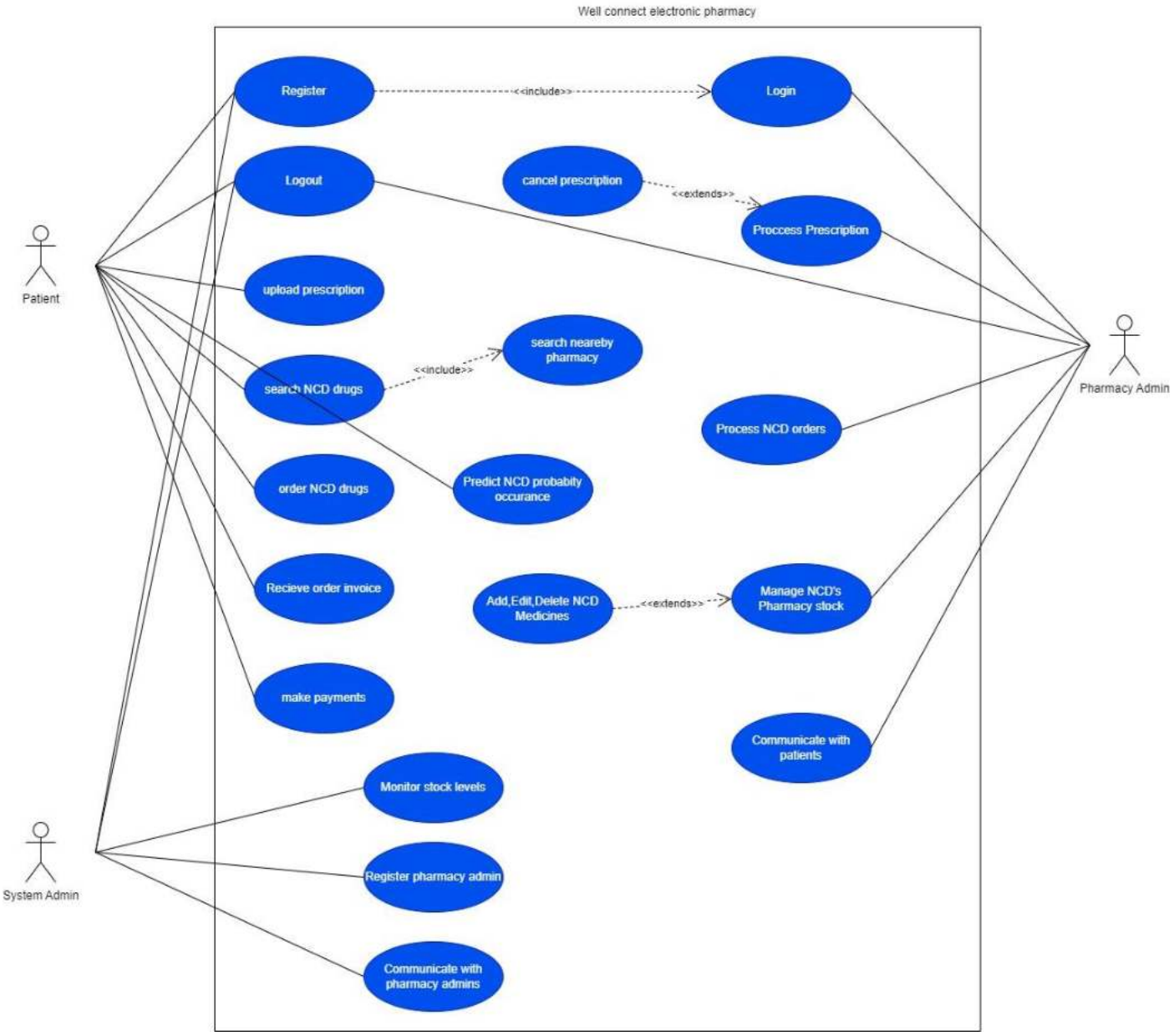


Figure 4.8: The Combination Use Case

4.3.5 Use Case Description:

This section gives more description about the above-described use cases

Use Case: Register

Use Case Name	Register
Actors	Patient/User
Priority	High
Description	Allows users to create a new account in the system.
Precondition	i. The App has active internet connection ii. The Guest user does not have an existing account
Normal Course	i. The App displays a registration form with relevant fields. ii. The user fills in all relevant fields. iii. The App performs validation on the fields. iv. The User submits the registration form. v. The System processes the registration form. vi. The App displays feedback.
Postcondition	i. User receives confirmation of successful registration. ii. The user has access to all features provided by the App
Exception	1) The user enters invalid data in the registration form i. The App displays an error message 2) The user enters credentials of an account that exists i. The App display an error message with directions to log in

Use Case: Search for NCD Medicines

Use Case Name	Search for NCD Medicines
Actors	Patient/User
Priority	High
Description	Allows users to search for available NCD medicines, those at nearby pharmacies preferred.
Precondition	i. User must be logged in. ii. The App has to have active internet connection

Use Case Name	Search for NCD Medicines
Normal Course	i. The App displays different categories of NCD's (i.e. Blood pressure, diabetes and so on), where user can select one category and find the medication he/she wants. Above the categories there will be a search option where ii. User enters search criteria (e.g. medication name). iii. System retrieves matching medicines from database. iv. System displays search results to the user.
Postcondition	User views available NCD medicines.
Exception	No matching medicines found: System prompts user to refine search criteria.

Use Case: Upload Prescription

Use Case Name	Upload Prescription
Actors	Patient/User
Priority	High
Description	Allows users to upload their prescription for medication orders.
Precondition	i. User must be logged in. ii. The App has to have active internet connection
Normal Course	i. User selects prescription file and adds it to the system. ii. Prescription is sent to selected pharmacy with the desired medication.
Post condition	Prescription is successfully uploaded.
Exception	Invalid prescription: System prompts for valid prescription.

Use Case: Order NCD Medication

Use Case Name	Order NCD Medication
Actors	Patient/User
Priority	High
Description	Allows users to place orders for medications based on their prescriptions.
Precondition	User must have uploaded valid prescription.
Normal Course	i. User selects desired medications. ii. User confirms order details. iii. procced payment processes to confirm order placement.
Postcondition	Order is successfully placed.
Exception	Insufficient funds: System prompts for alternative payment method.

Use Case: View Order Status

Use Case Name	View Order Status
Actors	User
Priority	Medium
Description	Allows users to view the status of their medication orders.
Precondition	User must be logged in.
Normal Course	i. User navigates to order history. ii. System retrieves order status. iii. System displays order status to the user.
Postcondition	User views order status.
Exception	No orders found: System notifies user to place an order.

Use Case: Predict NCD Probability of occurrence

Use Case Name	Predict NCD Probability of occurrence
Actors	User
Priority	Medium
Description	Allows users to predict the like hood of them developing NCD (particularly Blood pressure and diabetes) and then provide them with recommendations based on their health data.
Precondition	i. User must be logged in. ii. User has to fill metrics like age, blood pressure(mmHg), Blood sugar levels, body measurements(weight/Height), life style factors, family history on diabetes, his/her current condition
Normal Course	i. User accesses prediction section. ii. User fills a form, filling his health information concerning (blood pressure and diabetes analysis) iii. System analyzes data and does a prediction according to filled data whether the user is at risk of developing Blood pressure or diabetes or not iv. System displays results to the user and the recommendations.
Postcondition	User views health insights.
Exception	No health data available: System prompts user to input data.

Use Case: Receive and Process Prescriptions

Use Case Name	Receive and Process prescriptions
Actors	Pharmacy Admin
Priority	High
Description	Allows pharmacy admins to receive and process prescriptions sent by patients

Use Case Name	Receive and Process prescriptions
Precondition	Pharmacy admin must be logged in.
Normal Course	i. Pharmacy admin accesses order management section. ii. System retrieves pending orders with prescription attached with that order. iii. Pharmacy admin verifies if the prescription is valid.
Postcondition	Prescription is valid, invoice is sent to the user to complete payments
Exception	Prescription is invalid: Pharmacy admin notifies user for clarification.

Use Case: Receive and Process Orders

Use Case Name	Receive and Process Orders
Actors	Pharmacy Admin
Priority	High
Description	Allows pharmacy admins to receive and process medication orders placed by users.
Precondition	Pharmacy admin must be logged in.
Normal Course	iv. Pharmacy admin accesses order management section. v. System retrieves pending orders. vi. Pharmacy admin verifies order details. vii. Pharmacy admin prepares medications for dispensing. viii. Pharmacy admin updates order status in the system.
Postcondition	Order is successfully processed and ready for pickup/delivery.
Exception	Order verification failure, Pharmacy admin notifies user for clarification.

Use Case: Manage Inventory

Use Case Name	Manage Inventory
Actors	Pharmacy Admin
Priority	High
Description	Allows pharmacy admins to manage medication stocks and inventory levels.
Precondition	Pharmacy admin must be logged in.
Normal Course	i. Pharmacy admin accesses inventory management section. ii. System displays current stock levels. iii. Pharmacy admin updates stock quantities based on deliveries and dispensing. iv. Pharmacy admin sets stock refill thresholds.
Postcondition	Inventory is accurately managed and monitored.
Exception	Stock update failure: System notifies pharmacy admin what went wrong.

Use Case: Manage Pharmacy Accounts

Use Case Name	Manage Pharmacy Accounts
Actors	System Admin
Priority	High
Description	Allows system admins to create, modify, and manage pharmacy accounts within the system.
Precondition	System admin must be logged in.
Normal Course	i. System admin accesses pharmacy account management section. ii. System displays list of existing pharmacy accounts. iii. System admin creates new pharmacy account or modifies existing accounts. System admin verifies account details and activates account.

Use Case Name	Manage Pharmacy Accounts
Postcondition	Pharmacy account is successfully created or modified.
Exception	Duplicate account creation: System prompts for unique details.

Use Case: Monitor Stock level

Use Case Name	Monitor Stock level
Actors	System Admin
Priority	Medium
Description	Allows system administrator to monitor NCD medicines stock level to ensure availability of NCD medicines in pharmacies around people.
Precondition	System admin must be logged in.
Normal Course	i. System admin accesses system monitoring dashboard. ii. System admin enters the Stock level section and accesses pharmacy stocks
Postcondition	Stock level is monitored and maintained.
Exception	Unusual activity detected: System admin investigates and resolves issues.

4.4 Sequence Diagram

A sequence diagram, sometimes referred to as an event diagram or an event scenario, shows the order in which objects interact. (Lucidchart, 2023) This way, simple runtime scenarios can be represented as illustrated in the figures below.

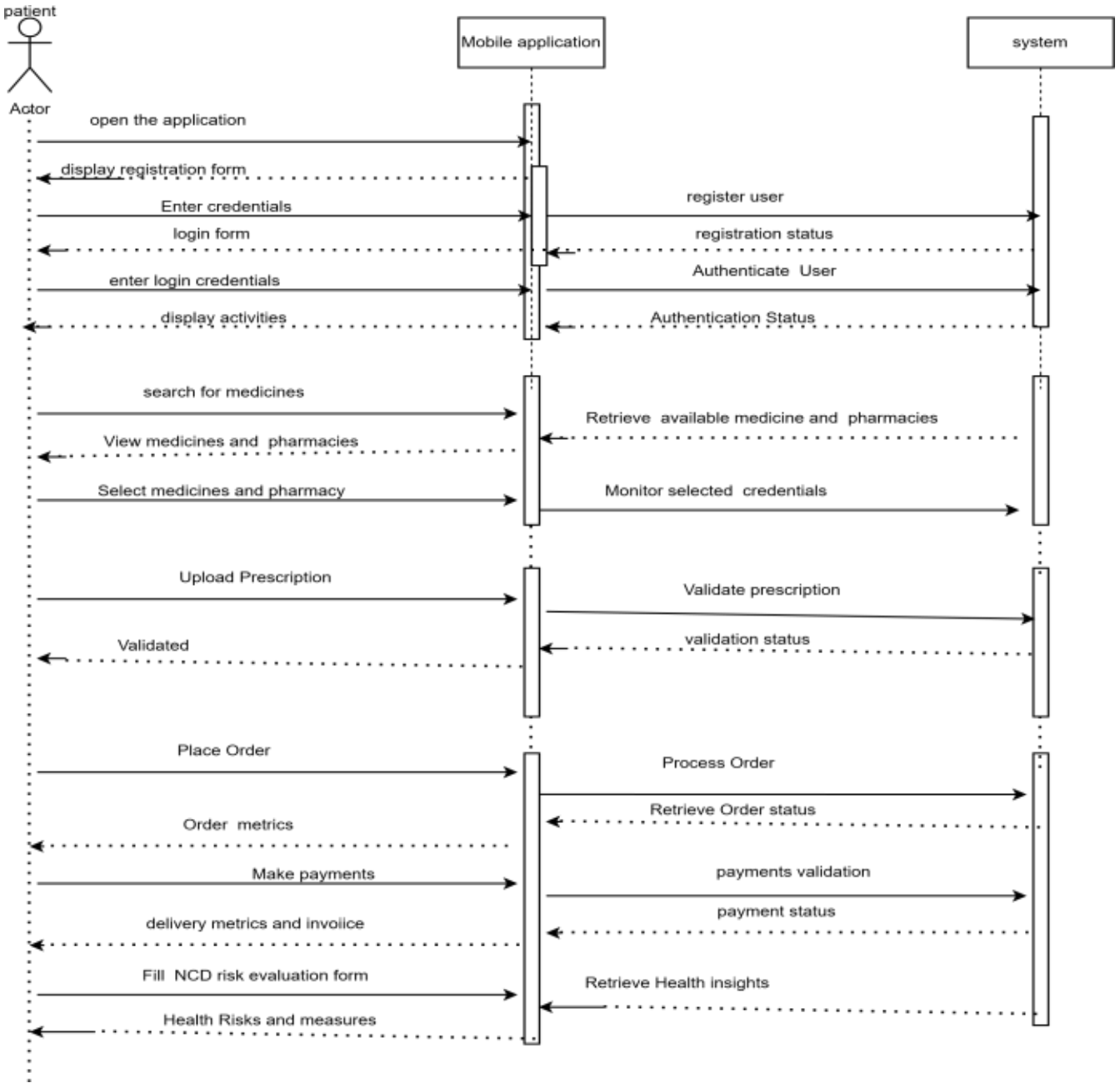


Figure 4.9: Patient's sequence diagram

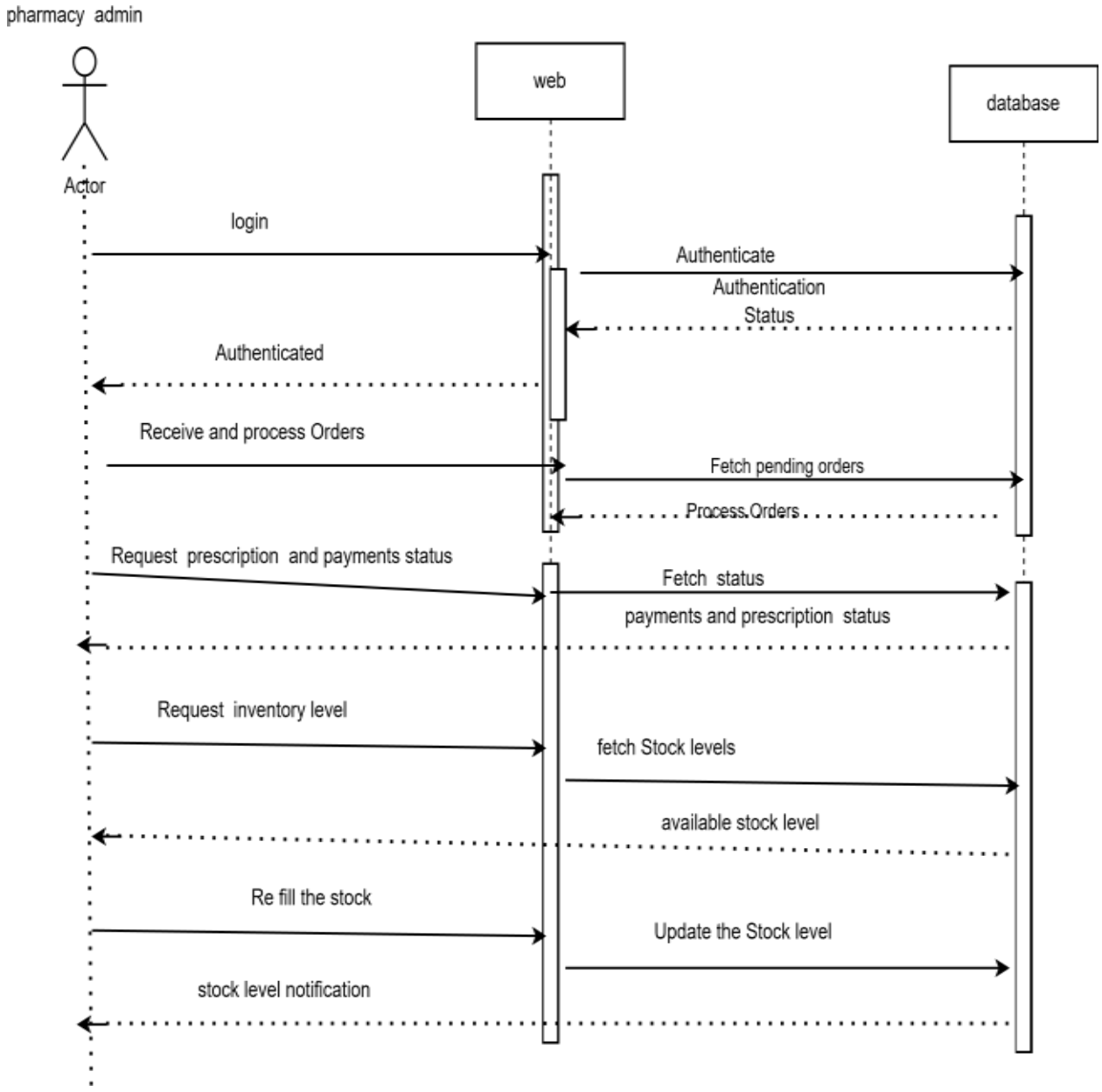


Figure 4.10: Pharmacy admin sequence diagram

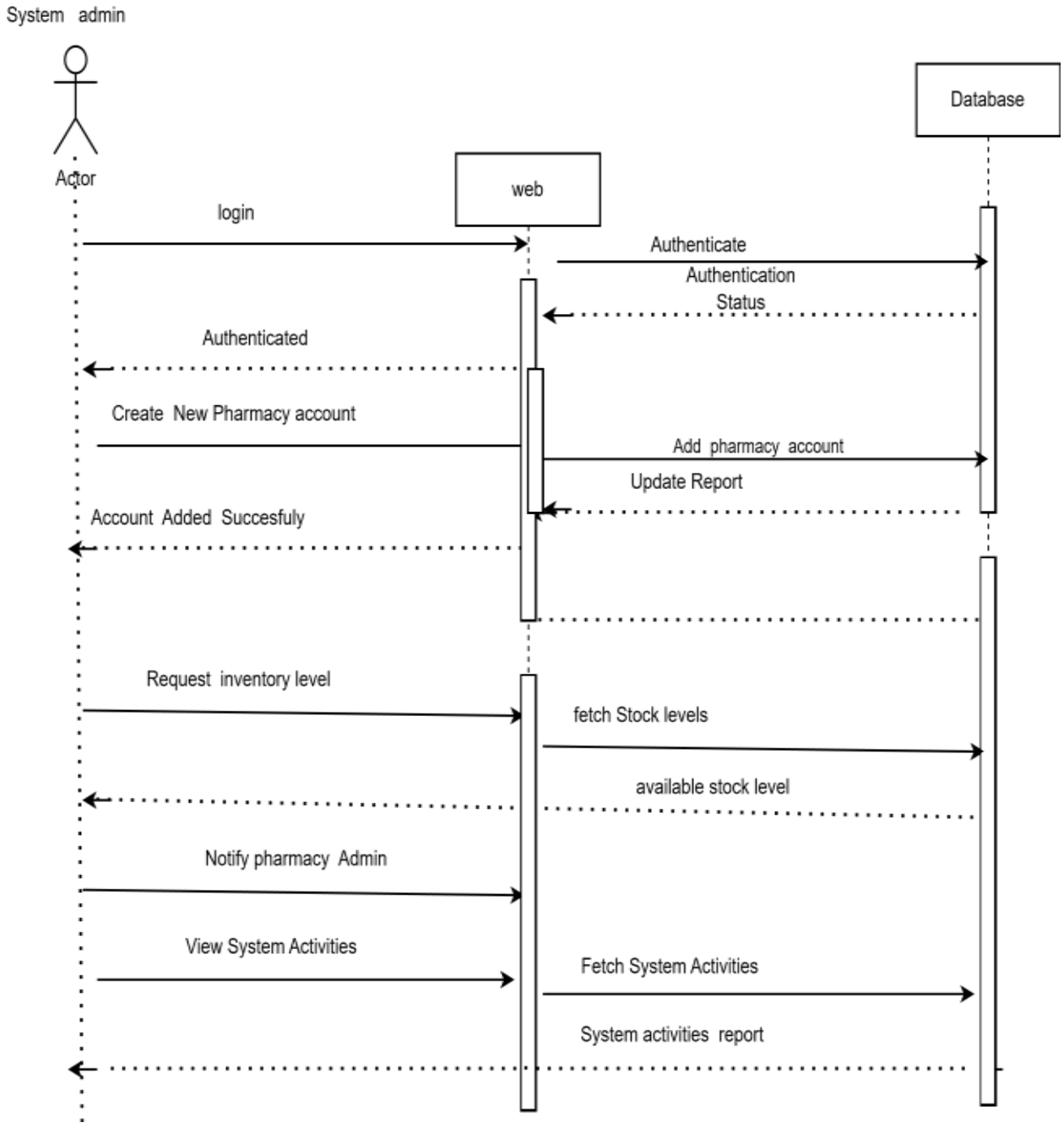


Figure 4.11: System admin sequence diagram

4.5 Entity relationship diagram

An entity-relationship diagram (ERD) is a graphical representation of a database is to be made. It shows all the tables needed to create the database and all table attributes. A database is simply a storage area for the system data. (Lucidchart, 2023) It is composed of entity types and specifies relationships that can exist between entities (database tables). The E-R Diagram will be used as a guide during the implementation of the database of the system.

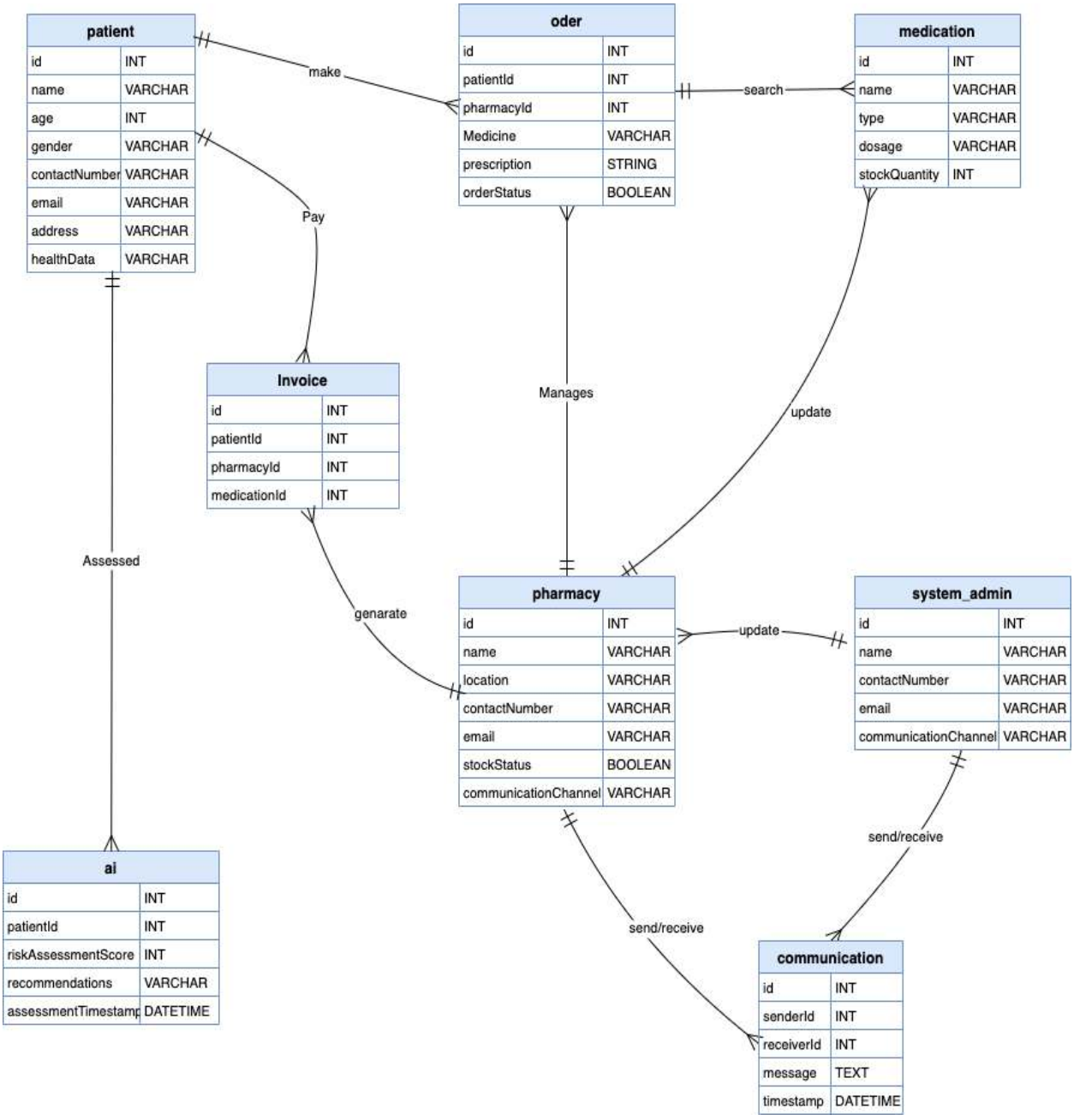


Figure 4.12: ER diagram for the Well connect NCD medication system.

4.6. Simple Architecture Prototype

For this project, we will use a simple architecture.

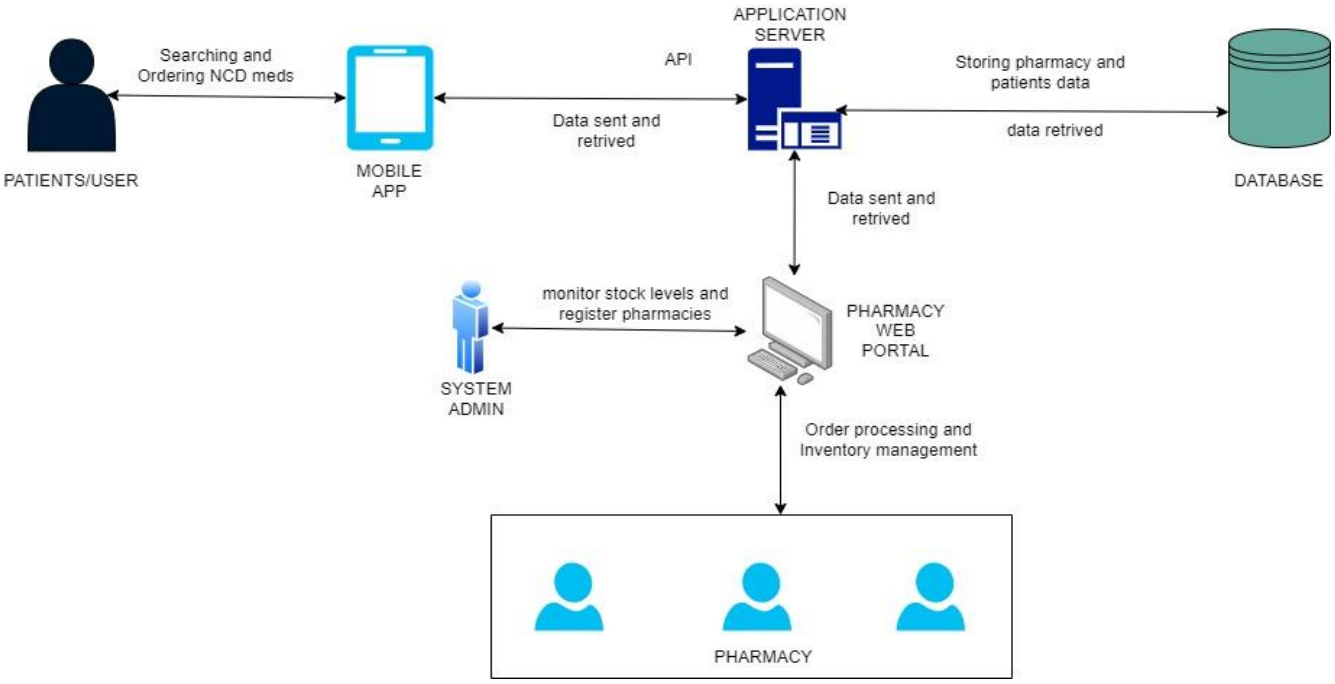


Figure 4.13: Simple Architecture Prototype

The simple architecture involves the existing mobile application communicating with the pharmacy web portal through the user of REST API.

CHAPTER FIVE: SYSTEM IMPLEMENTATION

5.1 Introduction

This chapter details the implementation of the "WELL-CONNECT" system, focusing on the development of a mobile application for NCD patients and a web-based portal for pharmacy administrators. The following sections will outline the technologies used, the design of the user interfaces, and the integration of various system components.

5.2 NCD Mobile Application Implementation

The mobile app enables users/patients to view pharmacies with NCD medication stock and their locations and to place orders when necessary. Additionally, the app helps users to perform NCD risk assessments to understand the state of their health.

5.2.1 Technology used in mobile app development

The mobile app was developed using the Dart programming language and the Flutter framework. These technologies were chosen for their robustness and cross-platform capabilities, ensuring that the app works seamlessly on both Android and iOS devices. The backend of the mobile application was developed using the Laravel framework, which provides a solid foundation for building secure and scalable web applications.

To enhance the functionality of the app, various APIs were integrated:

- Flutter wave API: This API was used to facilitate secure payment processing within the app. Patients can make payments for their medications directly through the app.
- Open AI API: This API was utilized to provide AI-based health assessments and recommendations. Users can perform NCD risk assessments and receive personalized health tips.
- Open Street Maps API: This API was integrated to provide location and map services, allowing users to locate nearby pharmacies with the required medications.

5.2.2 Mobile Application Interfaces

The mobile application features several user-friendly interfaces, which refer to all the screens that the user (NCD patients) will interact with when using this application. It is designed to ensure that all activities that the user wants to achieve in the application are met

5.2.2.1 Landing Page, User Registration and Login

This interface allows new users to register and existing users to log in securely. Social login options via Google or Apple are also available for convenience.

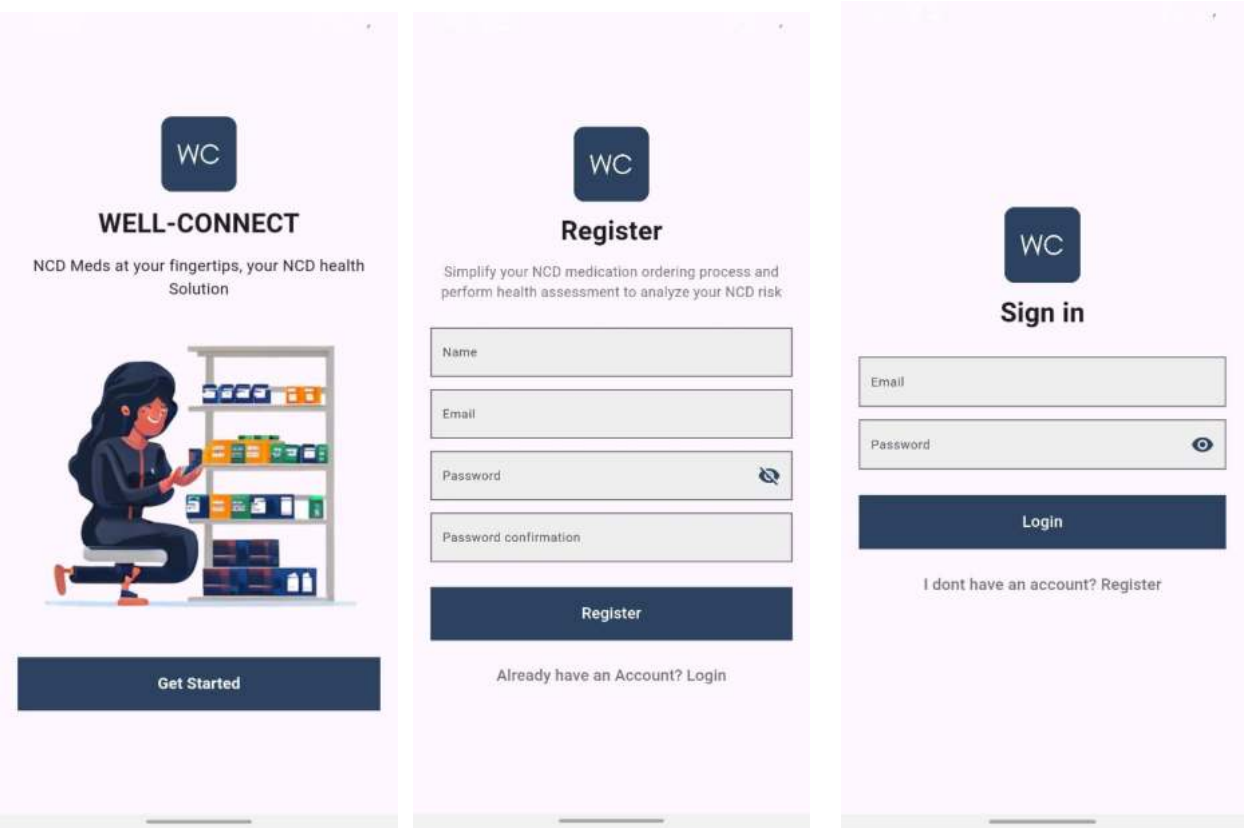


Figure 5.14: Landing, Login, Register Pages

5.2.2.2 Home Page

The home page serves as the main entry point for users. It includes a search bar for finding NCD pharmacies and sections for viewing pharmacies and performing health assessments.

- Search NCD Pharmacy: Users can search for pharmacies by entering keywords in the search bar.

- View Pharmacies: Users can view nearby pharmacies that stock NCD medications. Each pharmacy entry provides options to view the distance and location on the map.
- Health Assessment: Users can take an NCD risk test to assess their health status. This section leverages the OpenAI API to provide personalized health recommendations. (health, 2024)

Search Page: The search page allows users to filter and find specific NCD medications. Users can search by entering the name of the medication and filtering by categories such as Blood Pressure, Diabetes, Cancer, and Obesity.

- Search NCD Medicine: Users can enter the name of the medicine they are looking for.
- Filter by Categories: Users can filter their search results by selecting categories relevant to their condition, making it easier to find the required medication.

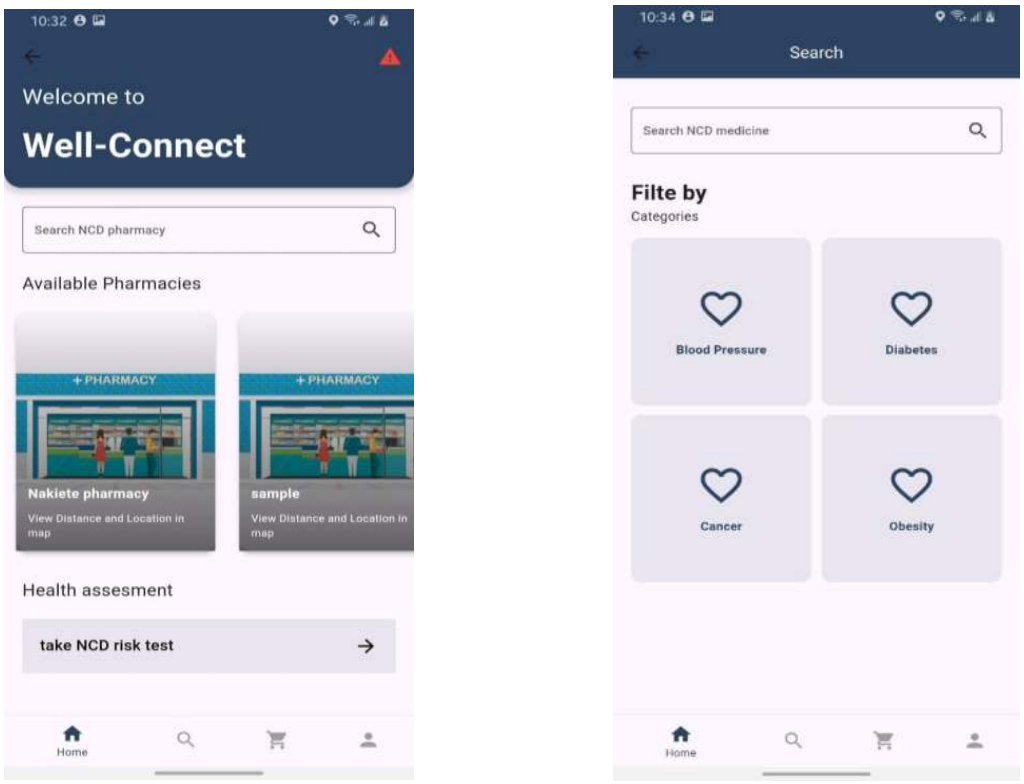


Figure 5.15: Home Page & Search Page

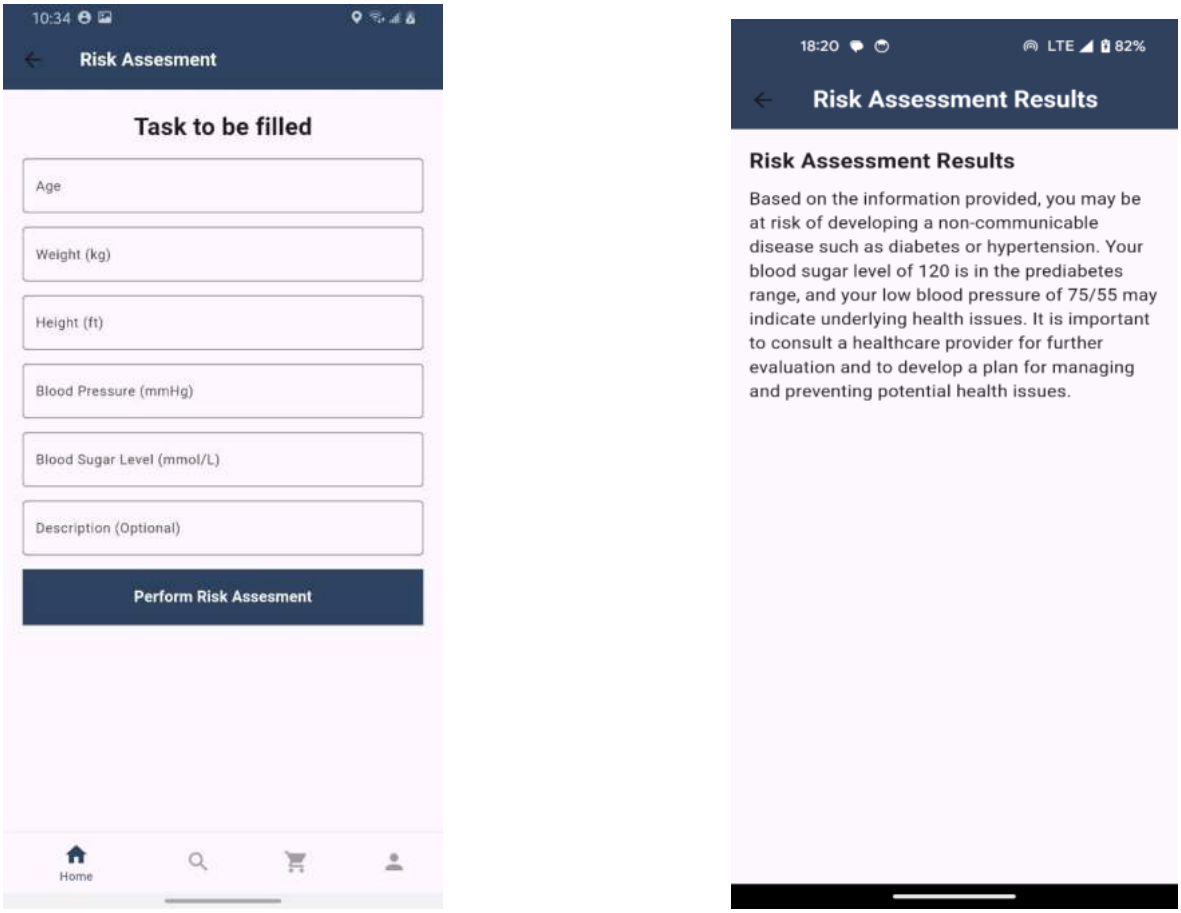


Figure 5.16: Risk Assessment Form & Response

5.2.2.3 Pharmacy Page

When the user selects a pharmacy from the list, they are directed to the pharmacy page. This page provides comprehensive details about the selected pharmacy, including its location and available NCD medications. The key features of the pharmacy page are:

1. Map Section:
    - View in Map: The user can click to view the pharmacy's location on the map. This feature utilizes the OpenStreetMaps API to display the exact location of the pharmacy.
    - Distance Calculation: The map also shows the distance between the user's current location and the pharmacy, helping the user to plan their visit.
2. Available NCD Medicines:

- Medicine List: Below the map section, a list of available NCD medications at the pharmacy is displayed.
- Add to Cart: Users can add medicines to their cart directly from this list by selecting the desired medication. This feature facilitates easy and quick ordering of necessary medications

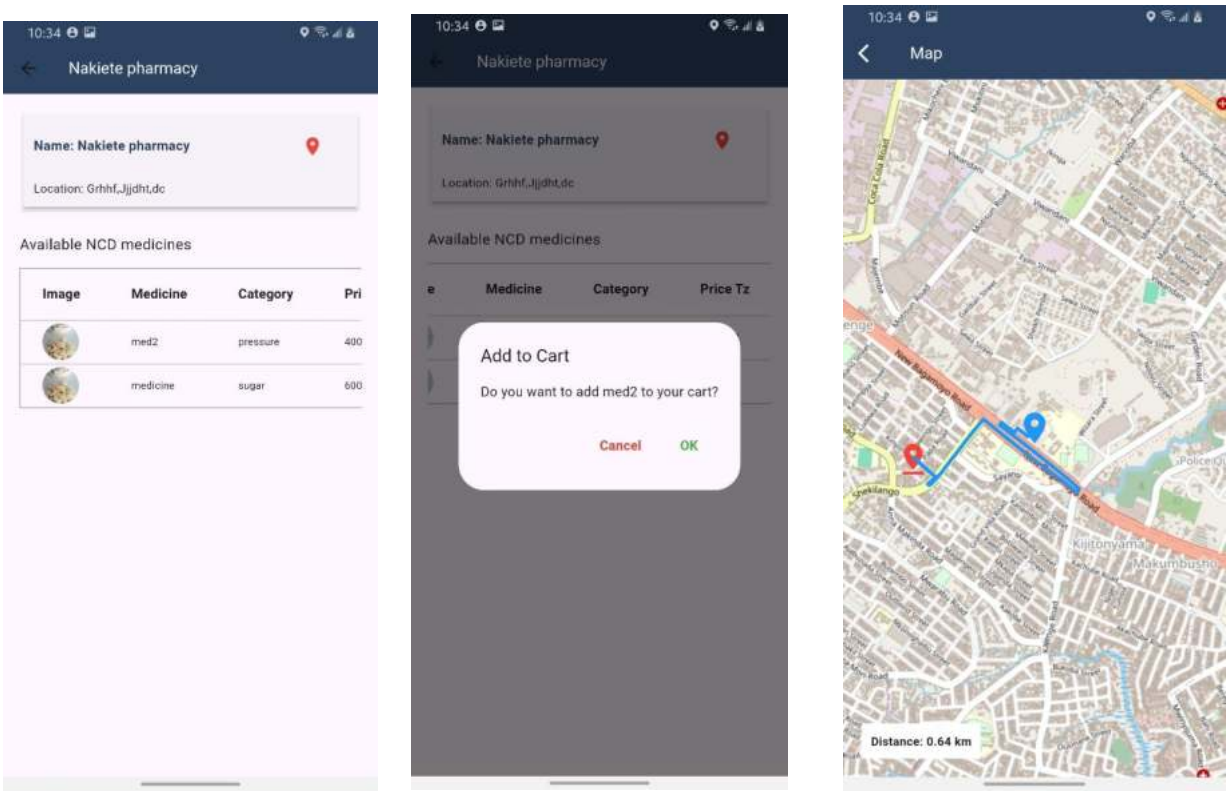


Figure 5.17: Pharmacy stock & Location

5.2.2.4 Cart Page

When the user navigates to the cart page, they can review the medications they have selected and proceed with the necessary steps to finalize their order. The cart page is designed to ensure a smooth and efficient ordering process, with the following key features:

- View and Review Cart:

  The user sees the list of medications they have added to their cart, with detailed information about each item.

  They can adjust quantities or remove items if needed.

- Upload Prescription:

  The user uploads their prescription by clicking the upload button and selecting the appropriate file from their device. This section includes an upload button that allows users to select and upload an image or PDF of their prescription from their device

- Select Payment Method:

  The user chooses either the online payment option or the cash-on-delivery option. This option utilizes the Flutter wave API payment gateway to facilitate secure and convenient online transactions.

  Alternatively, users can opt to pay cash upon delivery. This option allows users to receive their medications and pay the delivery person directly.

- Place Order:

  After reviewing all details and ensuring the prescription is uploaded, the user clicks the "Place Order" button.

  The app processes the order, sends a confirmation notification, and updates the order status.

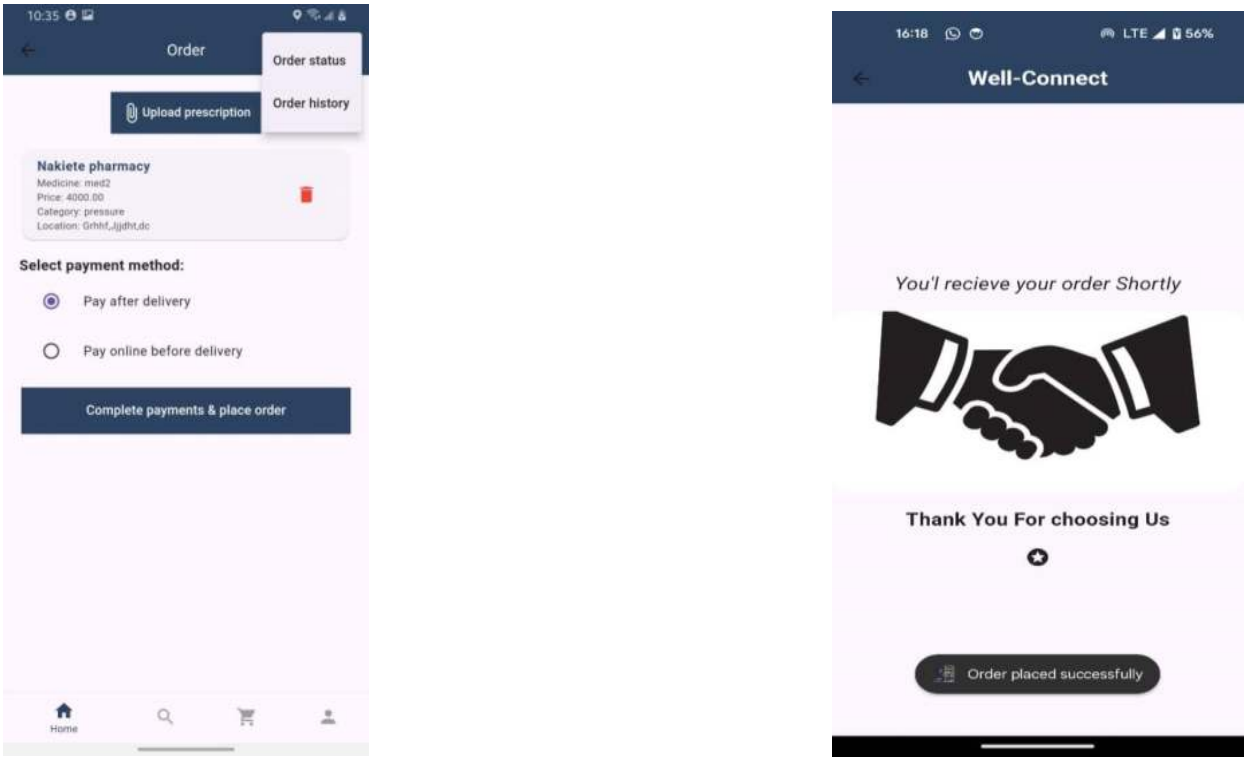
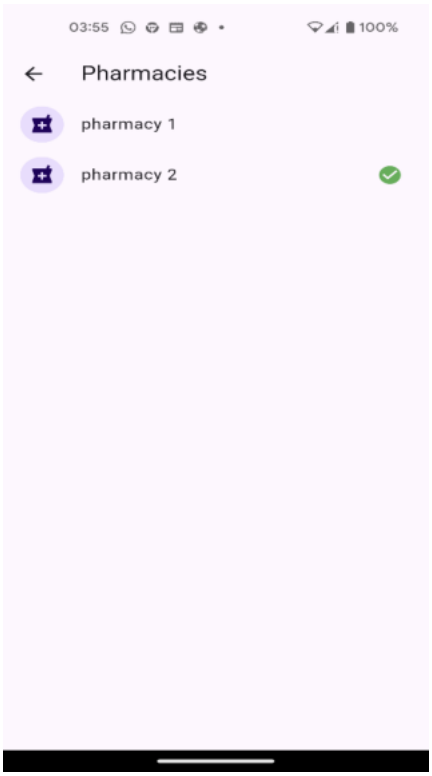


Figure 5.18: Cart and Ordering Pages

5.2.2.5 Order Tracking

The order tracking feature in the Well-Connect mobile application allows users to monitor the progress of their orders in real-time. This feature provides transparency and ensures that users are well-informed about the status of their medication orders from the moment they place them until they are delivered.

Also Pharmacists can provide remarks and additional information about each medication, such as dosage instructions and usage guidelines.



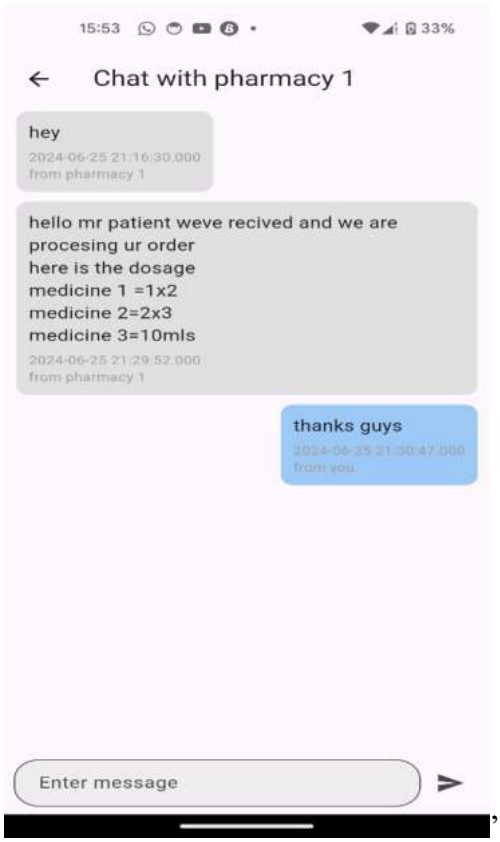


Figure 5.19: Order tracking and chatting Page

5.2.2.6 Profile Page

The profile page is an essential part of the Well-Connect mobile application, providing users with the ability to manage their personal information and account settings. The profile page includes the following key features:

- View Profile Details:

Profile Picture: An image of the user (optional), Full Name: The user's full name, Email Address: The user's email address, Phone Number: The user's contact number, Address: The user's residential address, Date of Birth: The user's date of birth (optional).

- Update Profile Details, Delete Account, Log Out

Users can click on the "Edit" button to update their profile details. This action opens an editable form where users can modify their information.

"Delete Account" button is available for users who wish to permanently delete their account.

Clicking the "Log Out" button ends the user's session and redirects them to the login screen.

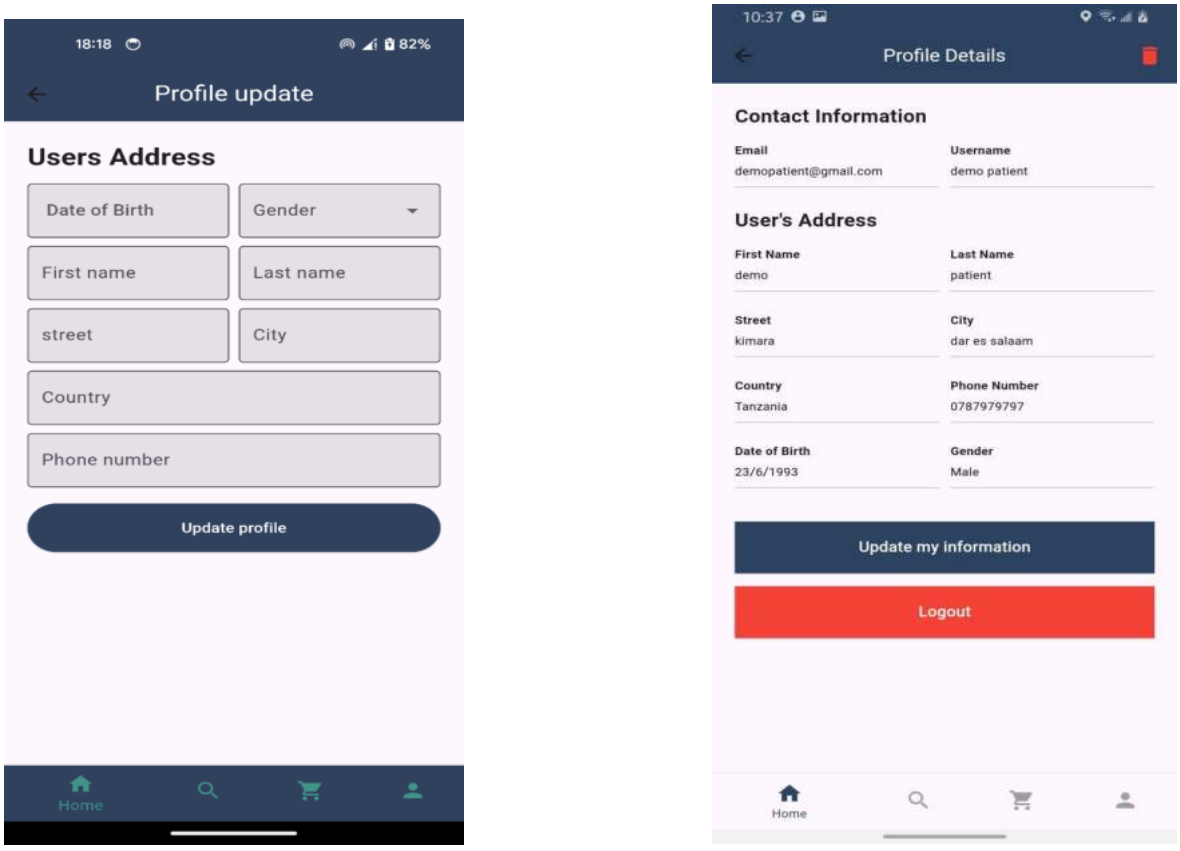


Figure 5.20: Profile Pages

5.3 Pharmacy Web Application

This section delves into the comprehensive implementation of the "Well Connect" application, detailing the pivotal technologies and methodologies employed to bring this system to life. This section covers the development stack, collaboration tools, and testing environments used during the development process. Furthermore, we explore the various features and functionalities of the web portal, including user interfaces for unregistered pharmacies, system administrators, and registered pharmacies. This introduction provides a foundation for understanding the technical and operational aspects that support the Well Connect system, ensuring efficient management and seamless user experience.

5.3.1 Technology used in web app development

❖ Development Stack:

- Programming Language: PHP
- Framework: Laravel

❖ Collaboration Tools:

- Version Control: Git and GitHub: These tools facilitate teamwork by allowing developers to track changes, collaborate on code, and revert to previous versions if necessary.
- Development Environment: Visual Studio Code: This code editor provides functionalities essential for building the application.

Local Testing: XAMPP: This software creates a local web server environment, enabling developers to test the application on their computers before deploying it to a live server.

5.3.2 Web Application Interfaces

❖ Landing Page

- Form for Unregistered Pharmacies to request for registration in the well connect system

❖ Login Page

- For Sign in System Admin and Registered pharmacies

❖ Admin Dashboard

- Overview of all registered Pharmacies
- List of requested and registered pharmacies

- Ability to register new pharmacies
- Stock level Monitoring for all registered pharmacies

❖ Pharmacy Order management dashboard

This dashboard provides a central hub for managing NCD patient orders.

- View All Orders: See a comprehensive list of all orders received from NCD patients.
- Confirm Prescriptions: Review and confirm the validity of each prescription.
- Patient Location & Navigation: Access patient location information and explore routes for delivery.
- Order Details: View a detailed list of all medications ordered, along with their respective quantities and total cost.
- Order Completion: Mark orders as complete once processing is finished.
- Patient Communication: Send notes to patients directly through the dashboard, providing updates or any additional information.

❖ Pharmacy Stock dashboard

- Stock Management (View and manage medication stocks)
- Stock Level Notifications**:** It automatically alerts users when inventory reaches predefined thresholds, ensuring timely restocking and avoiding stockouts.
- In-Chat System Admin Reminders**:** System administrators can directly communicate with users through a chat interface to provide reminders, updates, or important information related to inventory.

Below are the screenshots of the Well connect web application system user interface

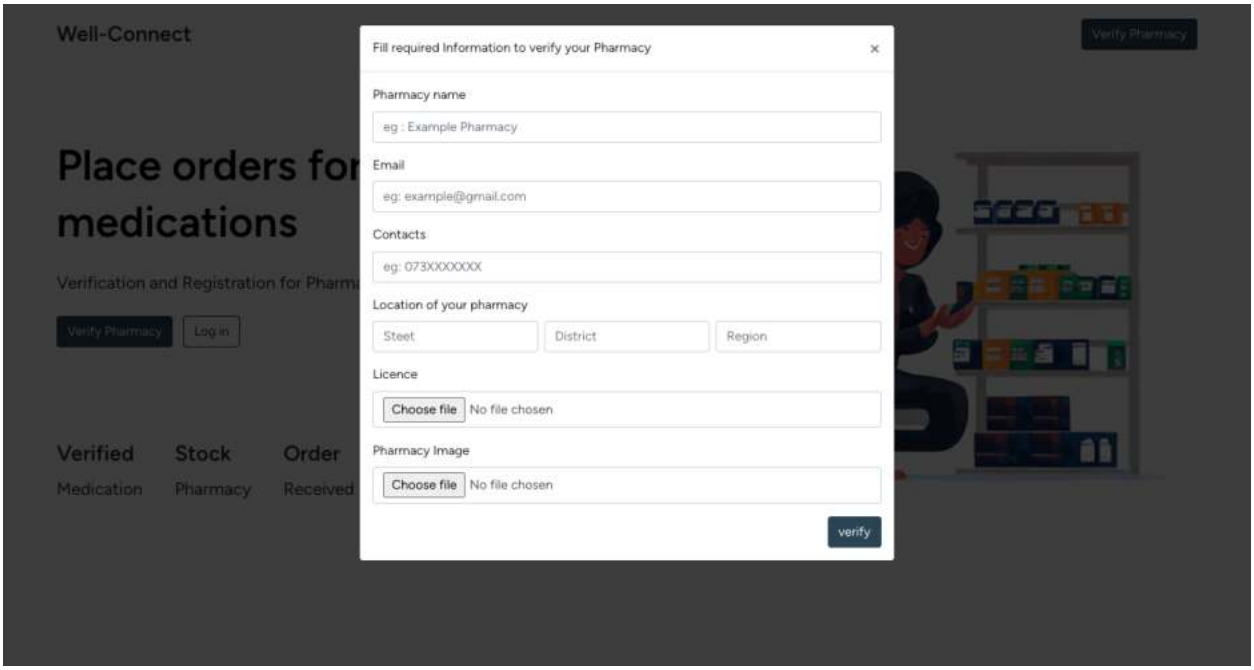


Figure 5.21 Landing page with registration request form to the system for pharmacies

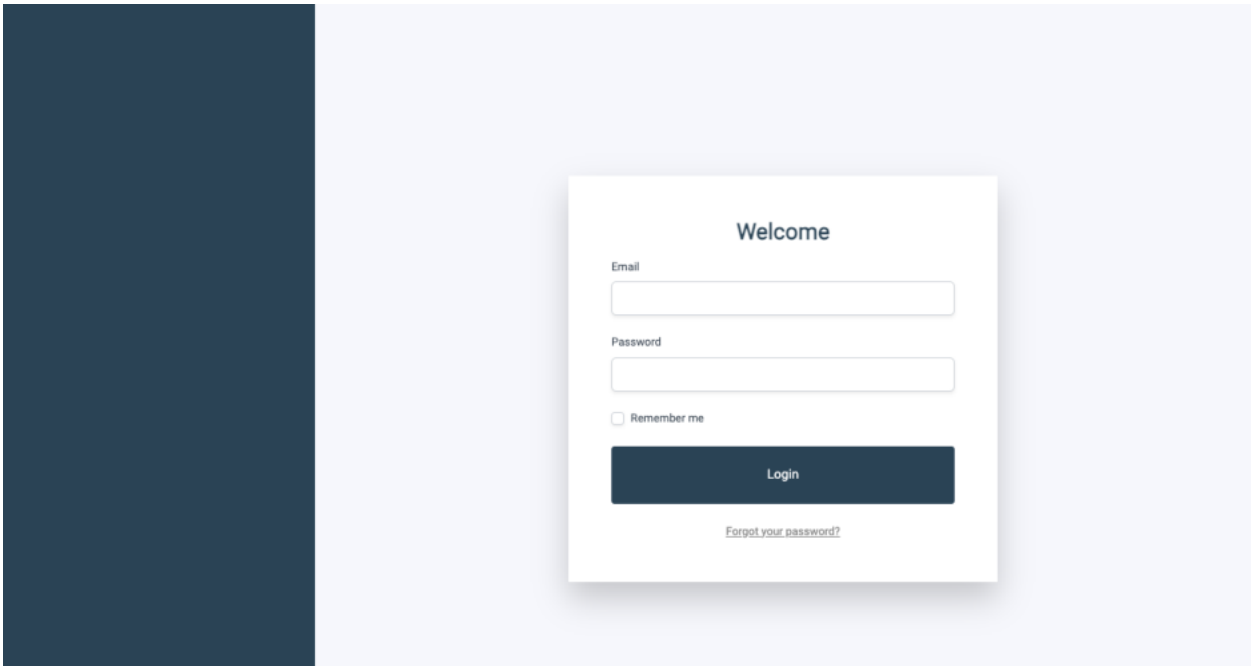


Figure 5.22 Login page for both system admin and registered pharmacies

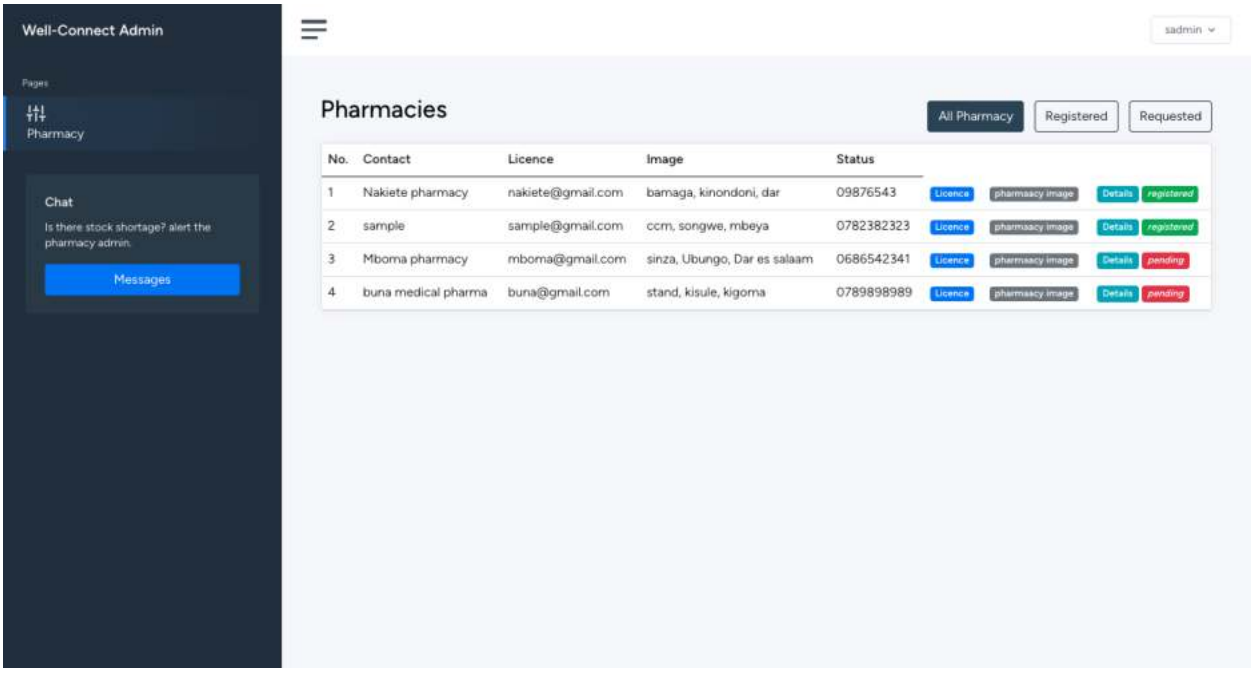


Figure 5.23 System admin dashboard that consist of all super user activities

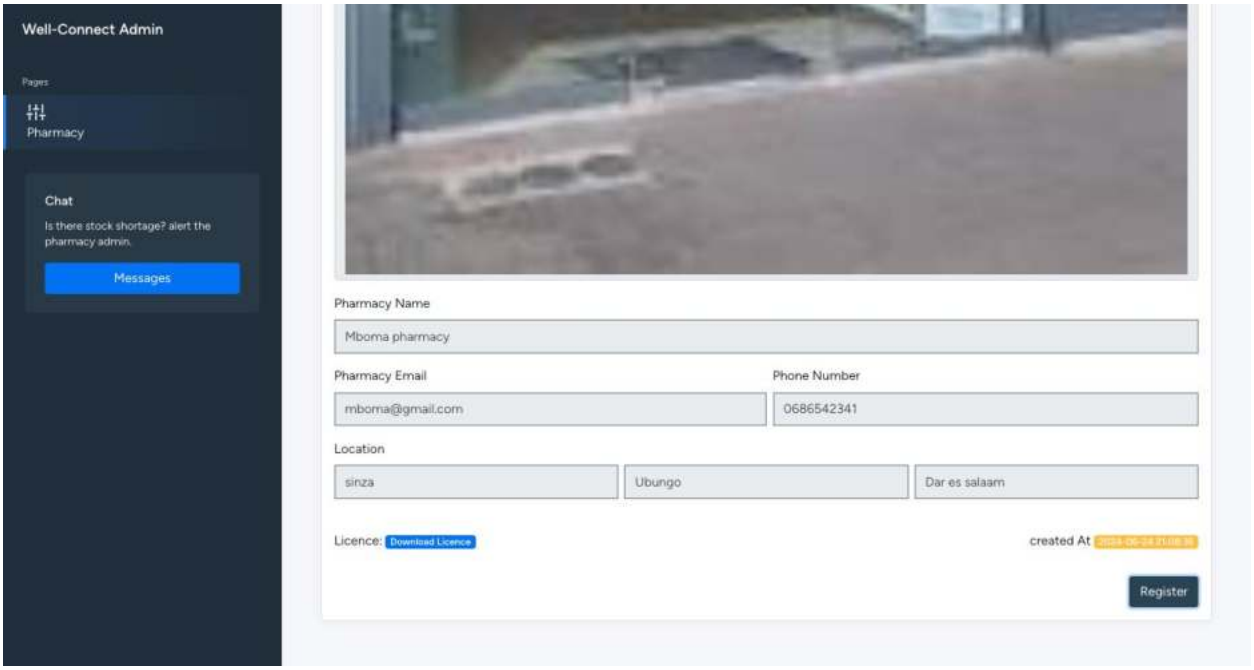


Figure 5.24 Inspection page of requested pharmacy before registration

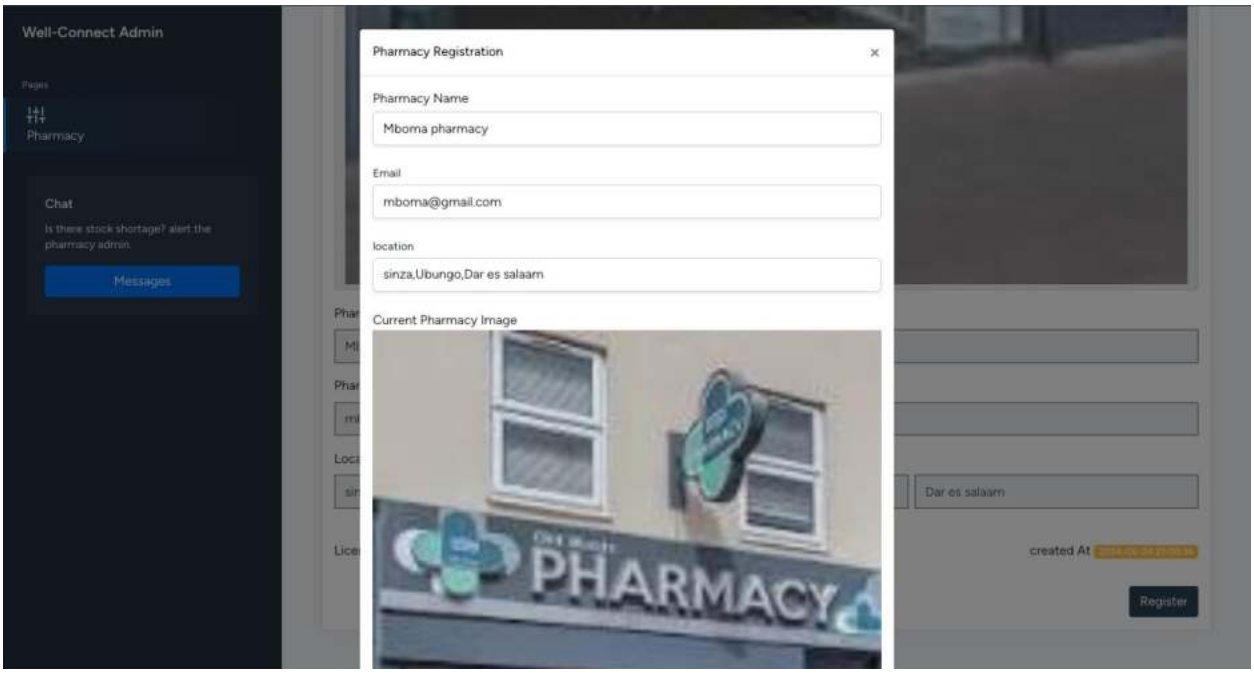


Figure 5.25 Form to register pharmacy

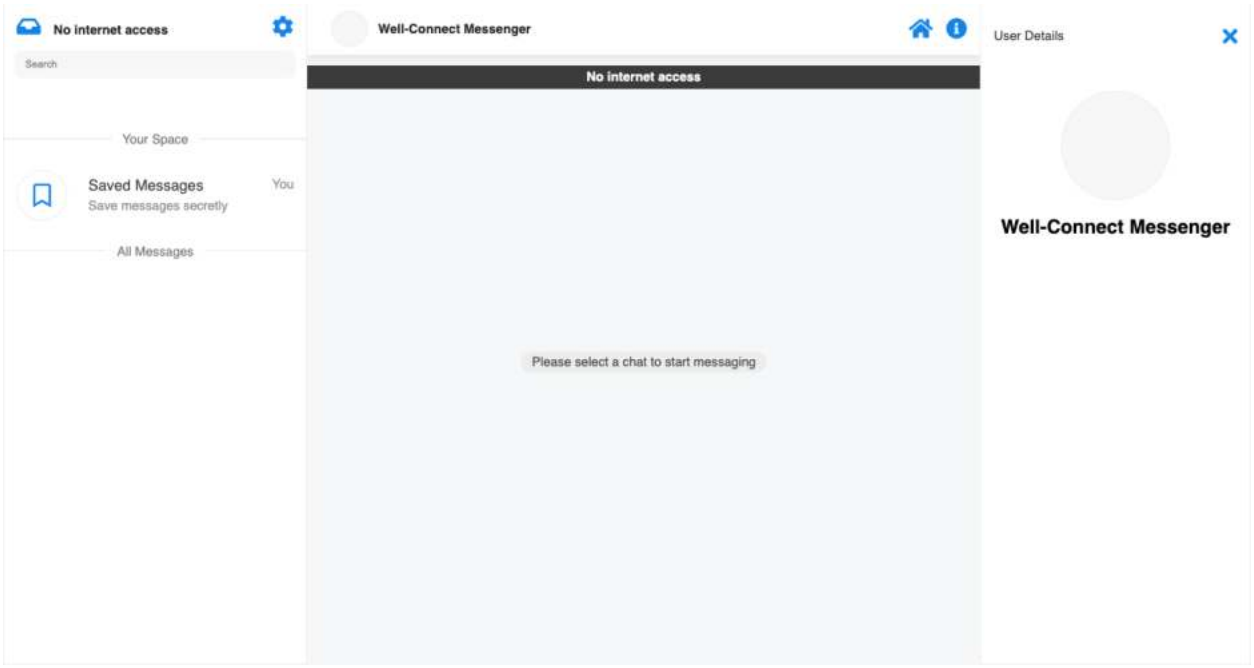


Figure 5.26 Message page for chatting that used by system admin and registered pharmacy

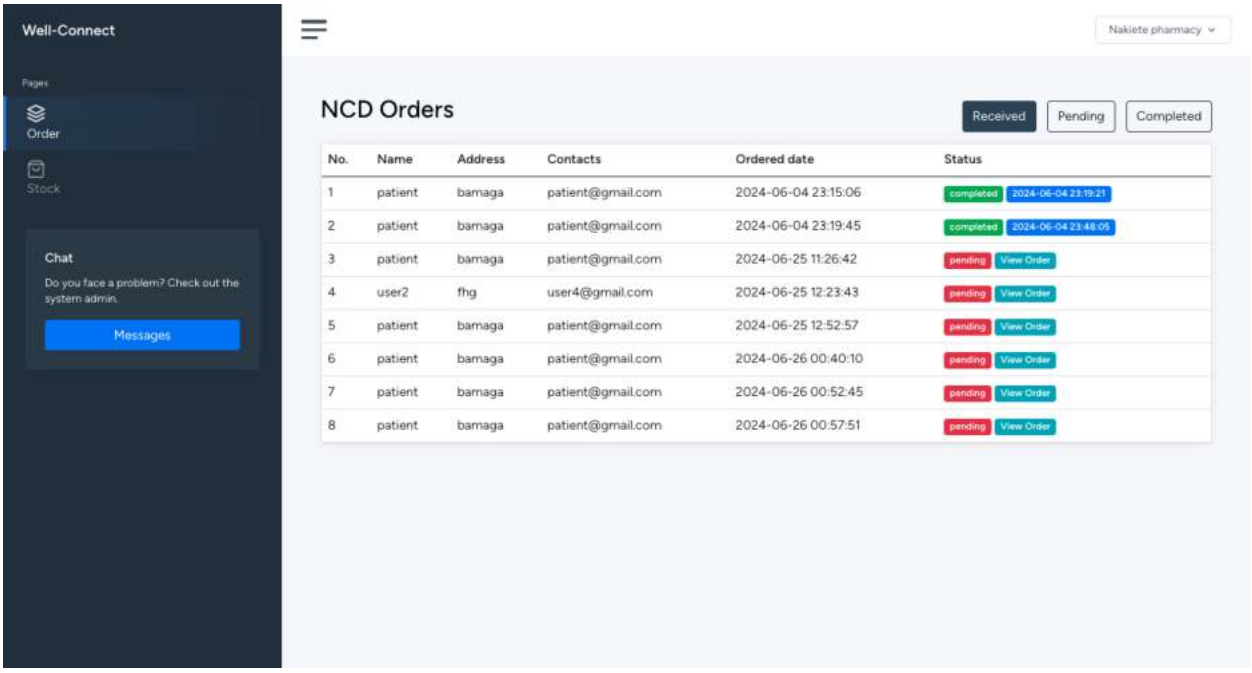


Figure 5.27 Pharmacy received orders page shows all orders and time ordered

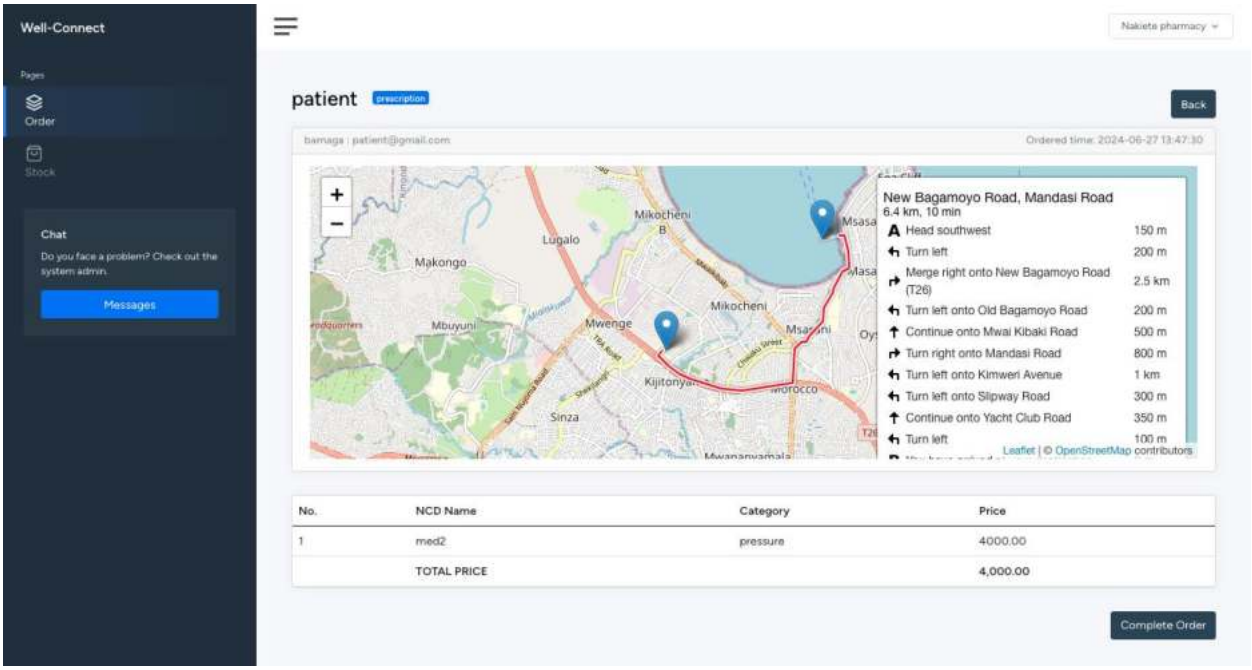


Figure 5.28 Individual order details and prescription inspection page with patient location

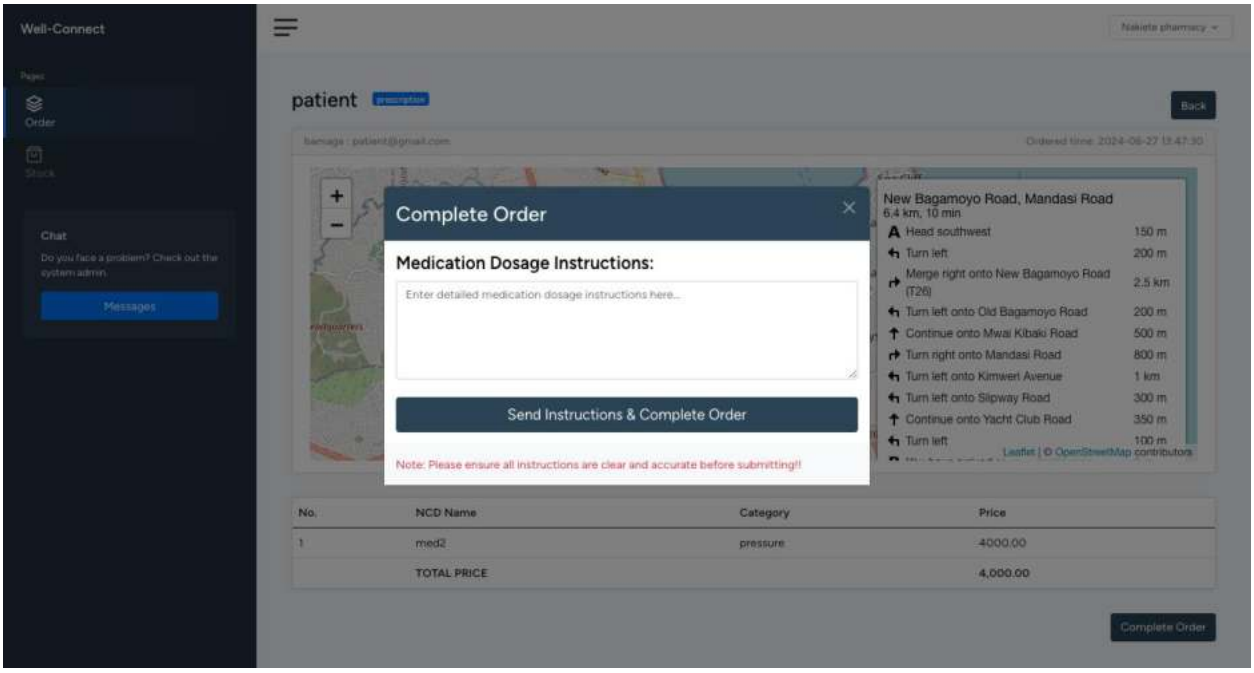


Figure 5.29 Form to send instruction to the patient on medicine use

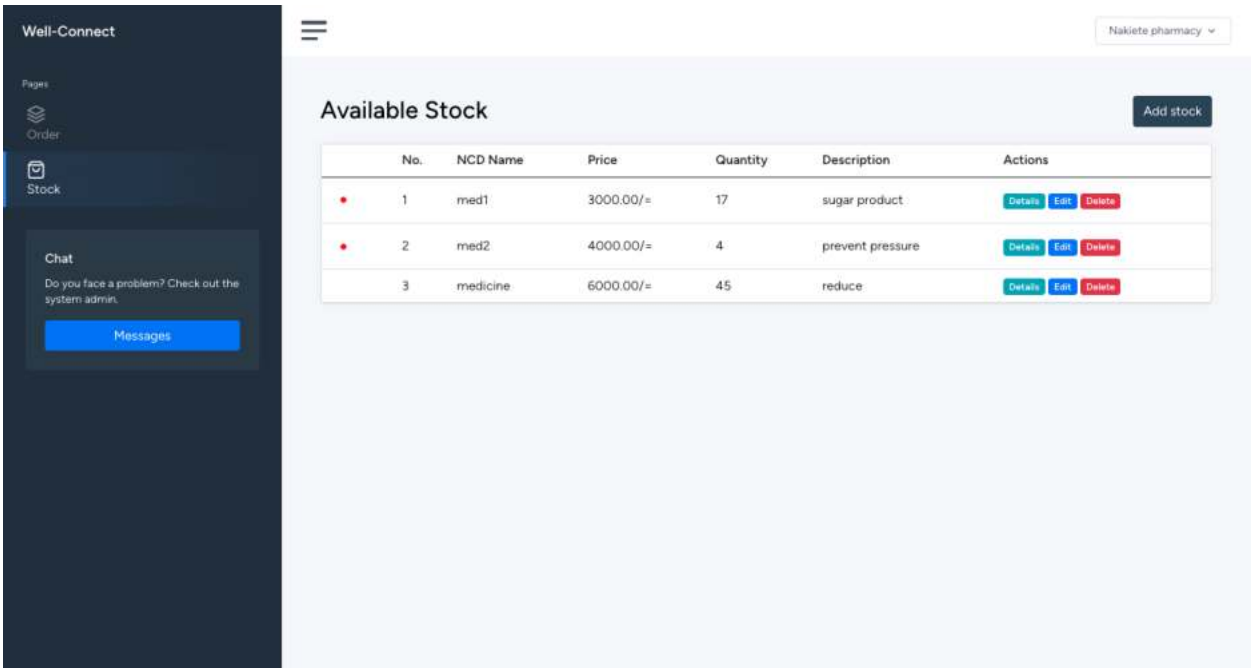


Figure 5.30 Stock management page for pharmacy

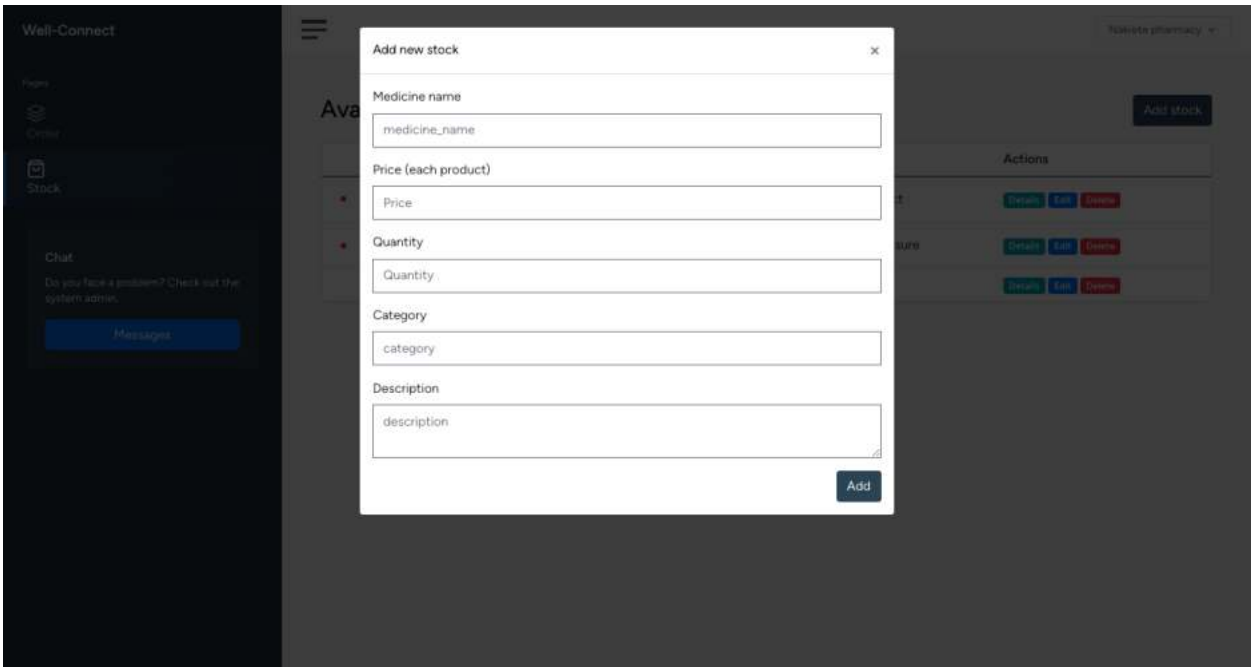


Figure 5.31 Form to add stock to the pharmacy stock

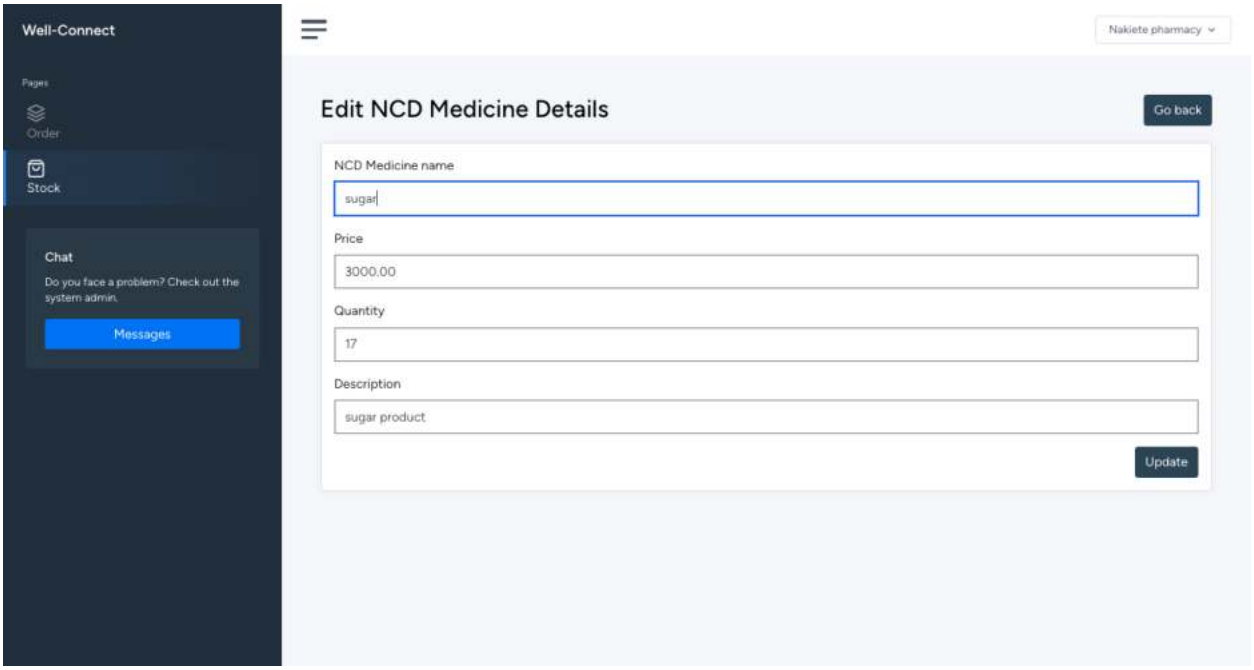


Figure 5.32 Stock update page

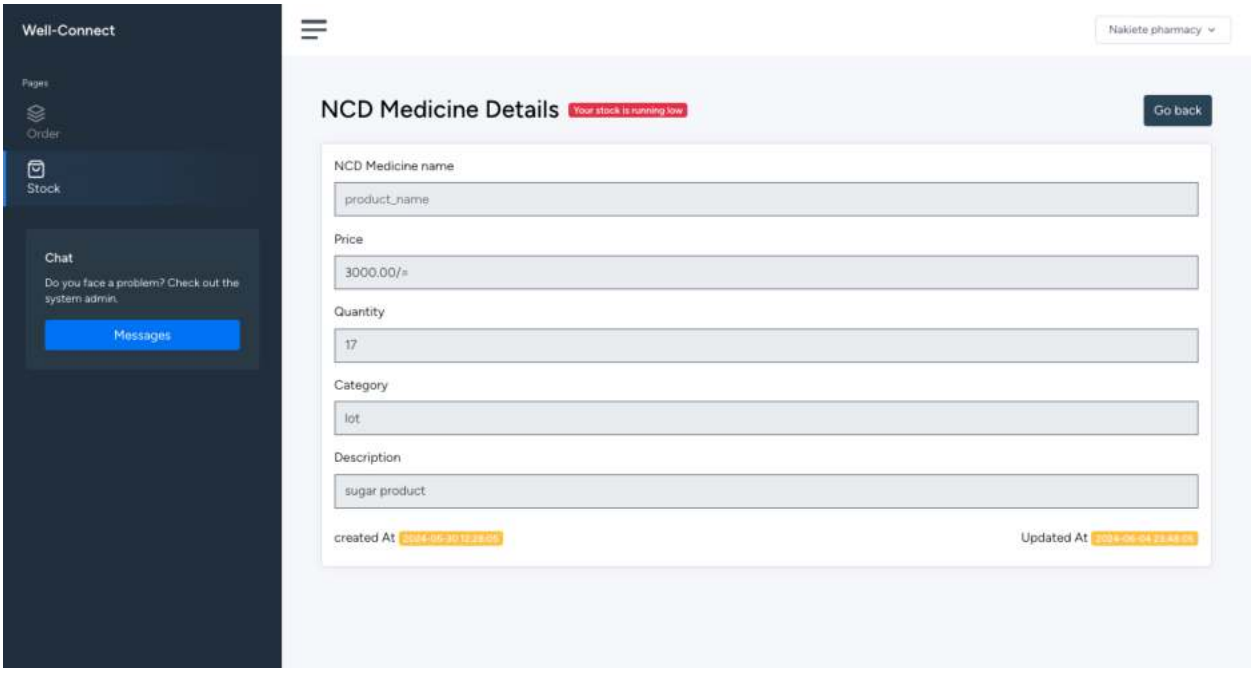


Figure 5.33 Stock details status

5.4 Database Implementation

The system uses MySQL database to organize data. It consists of tables including center users, unverified pharmacies, risk assessments, profiles, pharmacy orders, and pharmacies, ordered medicine, medicine, messages, ch favorites, cart and the cart history.

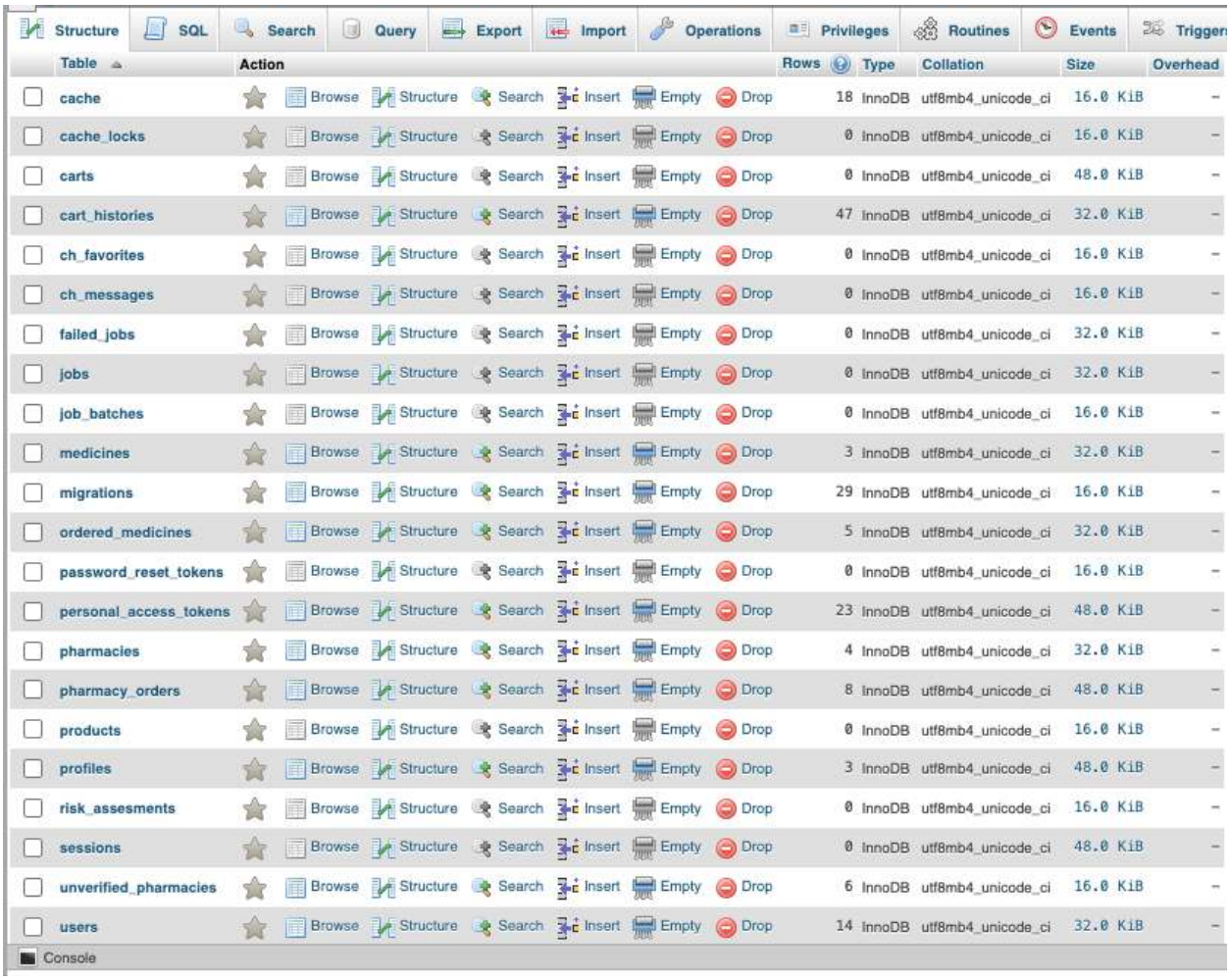


Figure 5.34. Structure of well connect database

CHAPTER 6: CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

In conclusion, the Well Connect app offers a transformative solution to the healthcare challenges faced by non-communicable disease (NCD) patients in Tanzania. By integrating an intuitive mobile app for patients, a robust web portal for pharmacy administrators, and a comprehensive database, the system simplifies the process of accessing essential medications and managing health. This user-centric approach ensures that patients can easily search for medications, upload prescriptions, and receive personalized health insights, thereby improving treatment adherence and overall health outcomes. Pharmacy administrators benefit from streamlined inventory management and order processing, enhancing operational efficiency and customer satisfaction.

The implementation of the Well Connect app in Tanzania addresses critical issues such as medication shortages, high costs, and long wait times, which are common in lower- and middle-income countries. By providing an efficient and accessible solution, the app significantly improves healthcare accessibility and delivery for NCD patients. With the potential for future enhancements and expansions, the successful deployment in Tanzania sets a strong precedent for adoption in similar contexts, showcasing its potential to revolutionize healthcare delivery in developing countries. Stakeholders are encouraged to support its continued implementation to ensure broader access to essential medications and improved healthcare outcomes.

6.2 RECOMMENDATIONS

To further enhance the effectiveness and reach of the Well Connect app, it is recommended to focus on user education and infrastructure support. Providing comprehensive training for patients and pharmacy staff will ensure smooth adoption and utilization of the app's features. Additionally, partnering with telecom providers to improve internet access and offer affordable smartphones can help bridge the digital divide, making the app more accessible to all users.

Expanding the network of participating pharmacies and integrating telehealth services will enhance the app's value. This will provide comprehensive healthcare services and ensure reliable medication availability. Our future plans involve developing wearables and devices to measure blood pressure and blood sugar levels, which will be integrated into our telemedicine services with doctors. This advancement will offer seamless, real-time health monitoring for patients and enable more effective remote consultations with healthcare professionals.

Continuous system improvements based on user feedback and technological advancements are essential for maintaining the app's relevance and efficiency. Establishing a robust monitoring and evaluation system will help track performance, user satisfaction, and health outcomes, guiding future enhancements. Collaborating with government agencies and health organizations to advocate for supportive policies and seeking funding opportunities will further bolster the app's development and deployment. As the app proves successful in Tanzania, planning for expansion to other regions facing similar challenges will enable broader access to improved healthcare management for NCD patients

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APPENDIX A: PROJECT SCHEDULE

S/N	Task	Weeks													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Project definition, scope and limitations														
2	requirement gathering from the client														
3	Literature review														
4	Data collection														
5	Mid-semester project report preparation and submission														
6	Mid-semester project presentation														
7	System analysis and design														
8	Final semester I project report preparation														
9	Final semester I project documents submission														
10	Final semester I project presentation														
11	Project Implementation and Testing (Semester II)														
12	Final Project Report (Semester II) and Submission														
13	Final Project Presentation (Semester II)														

APPENDIX B: PROJECT BUDGET

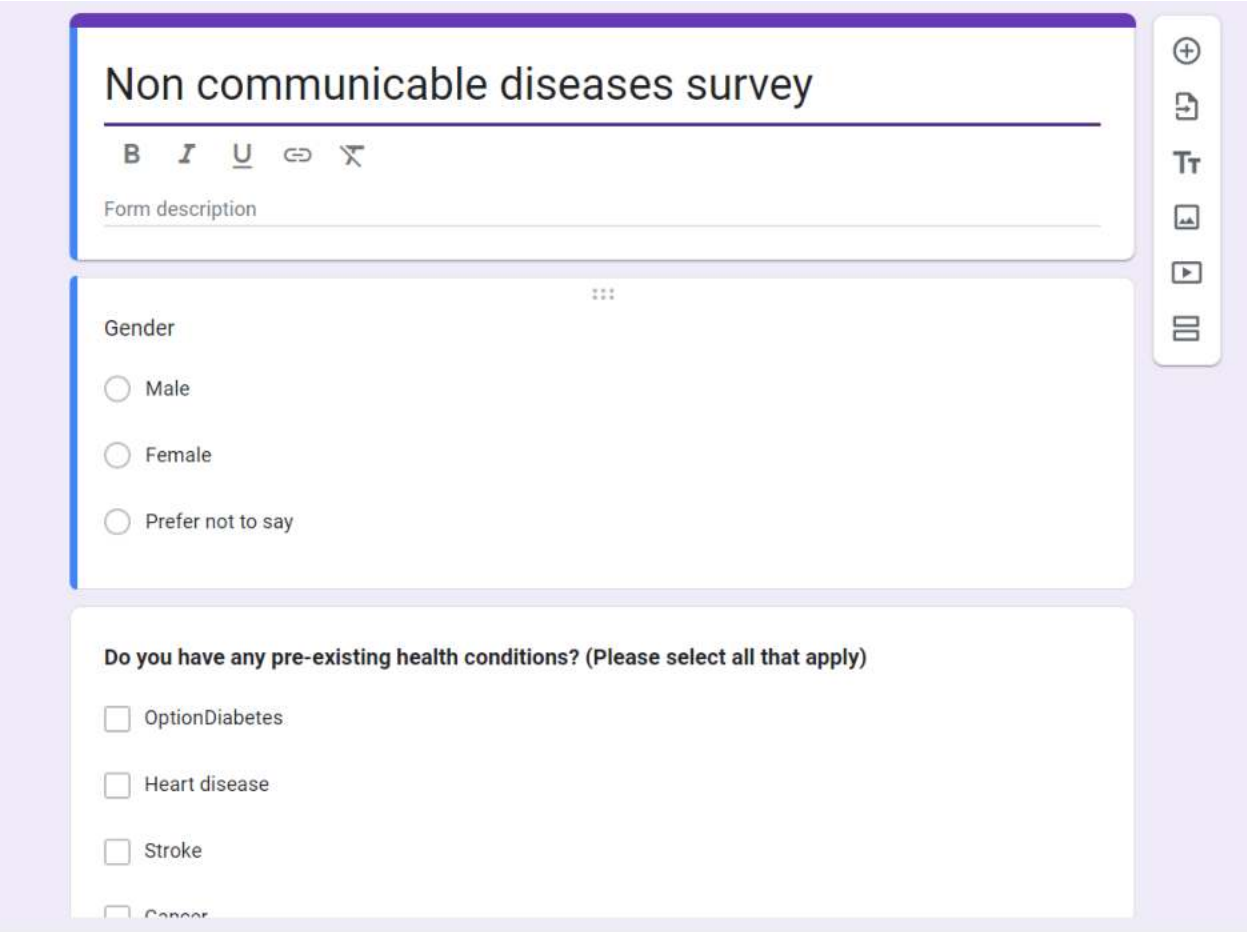
Bbudget Category	**Estimated Amount**
Hosting Services	200,000/=
API Expenses	100,000/=
Internet services	280,000/=
Printing & Documentation	70,000/=
Marketing and promotion	50,000/=
Transport	100,000/=
Total Estimated Amount	800,000/=

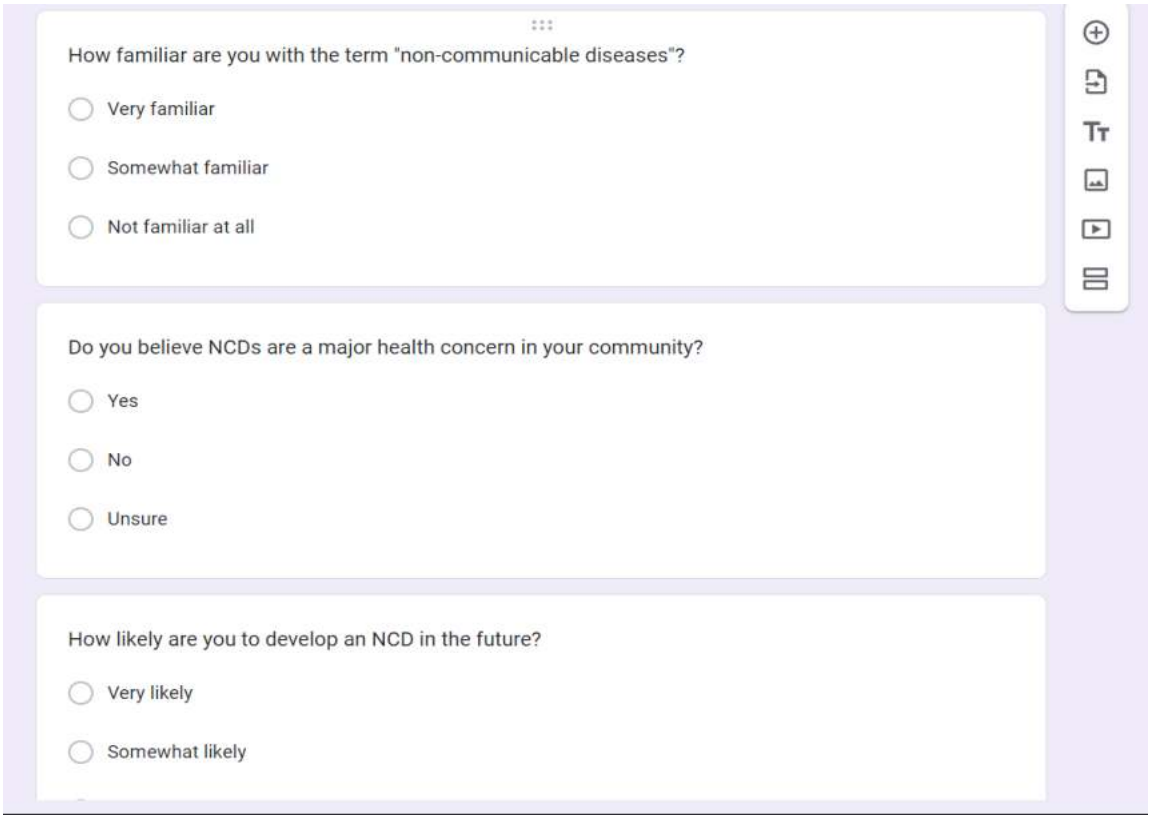
Figure 5.35: Project budget

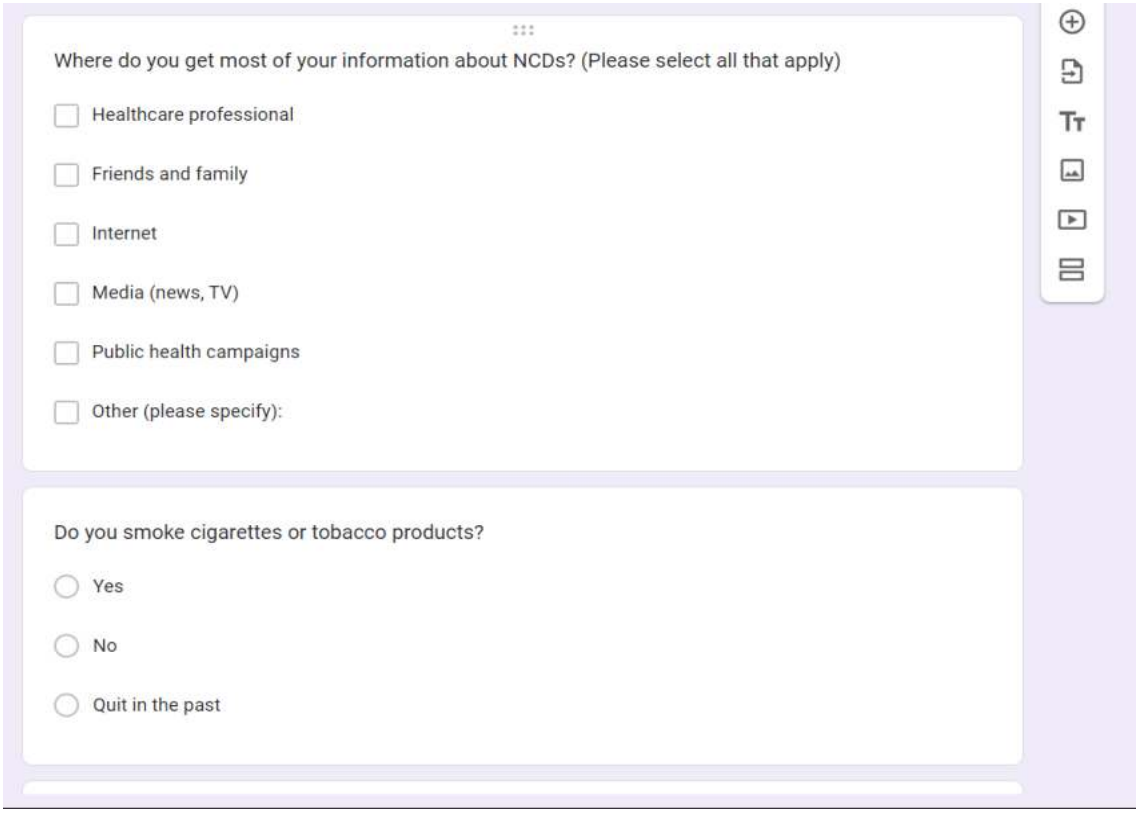
APPENDIX C: QUESTIONNAIRE USED

Questionnaire used is obtained from the link below and is shown as seen in pictures below

https://docs.google.com/forms/d/1ErDCsik2HvpMd6JY9I4mmsSa7IR-ypCPFPrksckUK88/edit?pli=1




How familiar are you with the term "non-communicable diseases"?
Very familiar
Somewhat familiar
Not familiar at all
Do you believe NCDs are a major health concern in your community?
Yes
No
Unsure
How likely are you to develop an NCD in the future?
Very likely
Somewhat likely


Where do you get most of your information about NCDs? (Please select all that apply)
Healthcare professional
Friends and family
Internet
Media (news, TV)
Public health campaigns
Other (please specify):
Do you smoke cigarettes or tobacco products?
Yes
No
Quit in the past

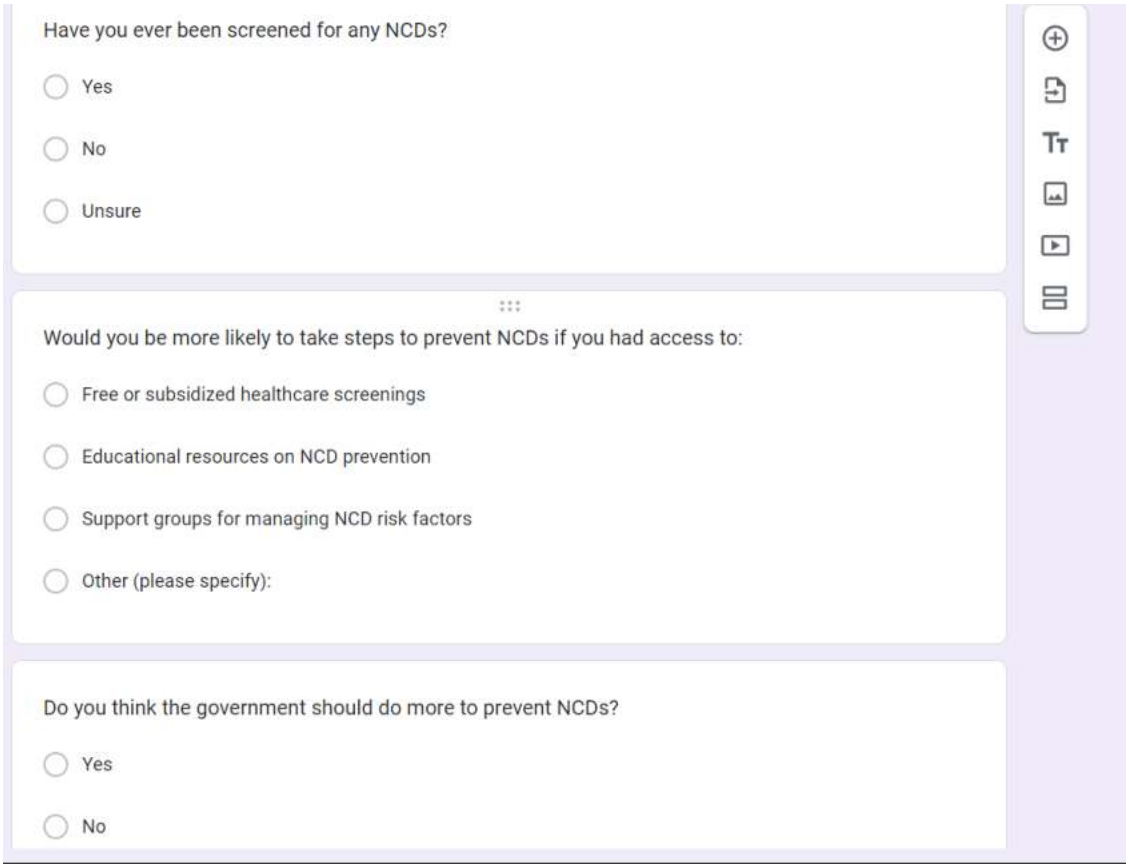


Figure 5.36: Questionnaire questions