

**MEDICARE: An application that assists in finding drug availability per
location: A Case of Kenya**

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Declaration and Approval

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the research proposal contains no material previously published or written by another person except where due reference is made in the research proposal itself.

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Abstract

The Medical field continues to improve with each day, one area is inclusion of e-medical services available over the internet such as pharmacy. Some Hospitals and pharmacies offer this on their website where a user can search for a drug and purchase it then have it delivered to them. Another option is to purchase it then pick it or have it delivered to a nearby pharmacy.

This helps reduce in-person purchase however, not all pharmacies have websites let alone e-pharmacies. One may have to search through a lot of sites before getting contacts to a pharmacy near them and it is not a guarantee that you can get the medicine. The application will be a central place for information such as contacts and location alongside providing information about the drugs available.

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List of abbreviations

KEMSA - Kenya Medical Supplies Agency

PPB – Pharmacy and Poisons Board

UNIDO – United Nations Industrial Development Organization

WHO – World Health Organization

Chapter 1: Introduction

1.1 Background Information

Telemedicine is changing the medicine sector quite a bit with several pros and cons not only in Kenya but all around the world. One of the major benefits is that such online websites sell everything from prescription drugs to health-related products (Jain,V. H et al :2017). Having a wide variety is particularly helpful considering physical stores may be limited by space. The fact remains that drugs purchased at online stores offer high levels of handiness, put forward privacy for the buyer as well as safeguard traditional procedures of prescribing drugs products (Jain,V. H et al:2017).

Although there are multiple advantages, some of the limitations include counterfeit drugs without quality assurance approvals as well such as the rampant increase of stores that sell illegal drugs. Sometimes, one may come across stores that have outdated information and it may be difficult to know whether an online pharmacy is legitimate. There have been multiple instances of people being scammed by these online stores.

After the novel corona virus, online transactions have taken quite a popularity considering the restrictions imposed including social distance. In the case of Kenya, many pharmacies are embracing e-commerce. One may have to search through a lot of sites before getting contacts to a pharmacy near them and it is not a guarantee that you can get the medicine. The application will be a central place for information such as contacts and location alongside providing information about the drugs available.

The proposed solution also aids in helping in proper distribution of medicine by reducing the expiration of drugs. It will provide users with options of drugs in their proximity rather than going to popular pharmacies and hospitals. In conjunction with exciting pharmacy and hospital websites, the proposed system provides their contacts so that the users can reach out for further inquiries. This may also be beneficial because it provides an inventory for pharmacies to tell what drugs are in stock in their area and what drugs are running out of stocks. The system will benefit from previous solutions such as using search engines to find medicine because the system borrows from this concept

1.2 Problem Statement

The Medical field continually improves each year, however, still has challenges such as drug shortages. In Kenya, recently a retroviral drug shortage in the country amid covid caused a stir in the country. Since the pandemic started, treatment for children and lab testing kits have been significantly running low in stock. Consequently, acquiring HIV medications became a problem due to decreased ART supply (Ullah, I. et al:2021). This is just but an example of one drug shortage but from time-to-time certain drugs fall off the market for one reason or another. Due to the shortage, it may be hard to find places where the drug is available.

Assuming you are trying to locate a drug, the option you have are to visit the pharmacies physically, search for online pharmacies or search for contacts for pharmacies online. These options are not very practical because they do not guarantee you getting the drug. The proposed solution is a central website to get information on where certain drugs are available as well as pharmacies around. MediCare provides information not only constrained to drug availability but also the contacts to the pharmacy for any other inquiries.

1.3 Objectives

1.3.1 General Objective

The main goal is to build a website that assist people in getting medicine especially in the case of a drug shortage as well as to ease the search for pharmacies in an unfamiliar area.

1.3.2 Specific Objectives

- I. To investigate how online pharmacies help ease with finding drugs.
- II. Study and analyze the challenges with the current online pharmacies.
- III. Design a website that assists people find drugs they need in stores near them.
- IV. To test and validate the proposed solution.

1.4 Research Questions

- I. How have the current solutions eased the struggle of finding drugs?
- II. What are the challenges with the current solution?
- III. How will the website assist people in finding drugs?
- IV. How will the proposed solution be tested and validated?

1.5 Justification

MediCare provides numerous advantages over the current options such as searching the internet for contacts or online drugs. A lot of time is spent searching through sometimes unrelated data as well. With physical visits to the pharmacies not only is time spent but also money on transport. This is further challenged with drug shortages. The stock out periods of essential medicines ranged from between 14 days and 46 days per year in both faith-based health facilities and public health facilities respectively (Barasa, N. et al:2018). The MediCare also ensures that drugs are used before expiry by directing people to pharmacies where drugs are available.

1.6 Scope and Limitation

The project, MediCare, is to provide users with the information as to where certain drugs that they wish to get are available as well as guide them in finding pharmacies near them, also only work with certified medical suppliers. The project will not actively sell any drugs or deliver them to the users. The limitations are for instance that a user have access to the internet and the user must have a smart phone.

Chapter 2: Literature Review

2.1 Introduction

This chapter talks about the solution proposed and the domain in which it operates. This includes the technologies and tools available, mode of operation and other related methodologies.

2.1 Current Methodologies of Locating Pharmaceutical Products in Kenya

2.1.1 Directory Lists.

According to (*Web Directory - New World Encyclopedia*, 2017), a web directory is an organization of websites according to their purpose into categories and subcategories and it is created and reviewed by humans. Directory lists in Kenya are available for access to the public through medical bodies such as PSK, WHO, web directories and news outlets. Directory lists contain basic company information and includes contact information.

2.1.2 In-Person Visits to Pharmacies

This is physically moving to pharmacy premises to obtain products available. Pharmacies in Kenya mainly establish under 3 categories: hospital, clinical and outpatient. The first 2 are attached to a hospital and clinic respectively wherein they operate.

2.1.3 Referencing And Recommendations.

People looking for pharmaceutical products are directed by professional medical personnel who are occasionally in charge of dispensing and prescribing to clients. This is the main mode of operation in hospital / clinical setting.

2.1.4 Government Agencies

These roll out programs to distribute pharmaceutical products to the public in a cheap and accessible way. Some schemes such as family planning, HIV/ AIDS health drives, immunization etc. have been rolled out at a massive scale countrywide.

2.2 Challenges Of Locating Pharmaceutical Products in Kenya

According to the WHO, A counterfeit medicine is one which is deliberately and fraudulently mislabeled with respect to identity and/or source. Counterfeiting can apply to both branded and generic products and counterfeit products may include products with the correct ingredients or with the wrong ingredients, without active ingredients, with insufficient active ingredients or with fake packaging.

In March 2011, the Kenya Association of Pharmaceutical Industry (KAPI) estimated that counterfeit medicines accounted for approximately Kenya Shilling 9 billion (USD 100 million) in sales annually. This figure corresponds to between 20 percent-25 percent of the total legal commercial pharmaceutical market [3]. Counterfeit medicines pose a public health risk because their content can be dangerous, or they can lack active ingredients. Their use can result in treatment failure (and contribute to increased resistance in, for instance, antimalarials that contain insufficient active ingredients) or even death. Unlike substandard medicines where there are problems with the manufacturing process by a known manufacturer, counterfeit medicines are made by people with the intent to mislead (Elaine, 2012).

(UNIDO, 2010), Regulators lack experience in pharmaceutical production, Administrative hurdles and bureaucracy and lack of awareness of the need for rapid market development. According to (Abuga et al., 2019), informal pharmacies in Kenya contribute to 66% of the national count of pharmacies. Out of 343 items on the Kenya Essential Drug List (EDL), KEMSA procures only about 117 selected items, based on available funds. Some medicines on the EDL which are not procured include medicines for what are commonly known as neglected diseases; for example, paracetamol syrup (antipyretic for children), diethylcarbamazine (falaricide), azithromycin (antibiotic), ivermectin (for onchocerciasis), cyclophosphamide (cancer drug), and pentamidine (leishmaniasis). These are often left out during selection of medicines considered to be of vital importance because of budgetary constraints.

Price regulation also presents a challenge for the public looking for pharmaceutical products. The WHO/HAI pricing survey (2004) showed that the public procurement prices of generics (MPR 0.65) were below the International Reference Prices (IRPs) in Kenya, while prices paid by consumers were greater than the IRPs. In the government facilities, patients paid 1.99 times the IRPs for generics and 3.6 times the IRPs for originator medicines. In the private sector, consumers paid 3.33 and 18.1 times higher prices for generics and originator drugs, respectively (Selvaraj, 2019).

From an article from WHO and Ministry of Medical Services, concerning the pharmaceutical profile in Kenya, it states that “In Kenya, there are no legal or regulatory provisions affecting the pricing of medicines. The government runs an active national medicines price monitoring system for retail patient prices in the public, faith-based and private facilities. There are no regulations mandating that retail medicine price information should be publicly accessible” (cinnellae, 2011).

(UNIDO, 2010) further adds that “Stock-outs of essential medicines persist despite an improved distribution system introduced by KEMSA. They arise mainly from the long lead times involved in international tendering and lack of adequate funding. Local manufacturers could play a larger role in mitigating the impact of stock-outs by at least catering to acute shortages or emergency needs.”.

2.3 Related Works

2.3.1 E-pharmacies

An e-pharmacy/ internet pharmacy – a pharmaceutical business that combines e-commerce with pharmaceutical over-the-counter services such as consulting to achieve their business objectives. Drugs are displayed on the site and during order purchase, a prescription (mandatory) is made by professional medical personnel. Examples of this in Kenya include: Pharmashop Co, GoodLife Pharmacy etc. Pharmart Galleria is shown in Figure 2.1 below.

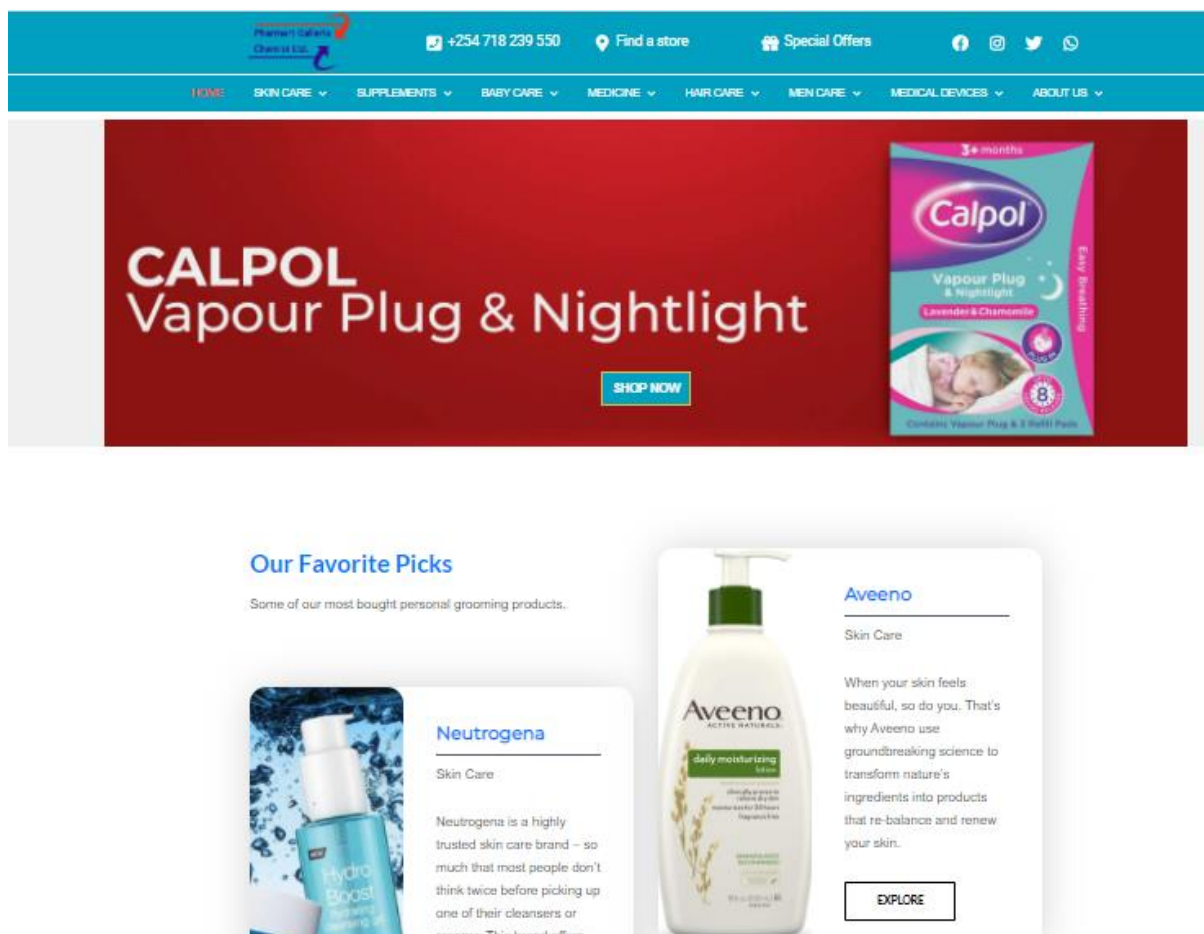


Figure 2.1 E-pharmacy in Kenya

“One e-health industry with potential for major disruption is the e-pharmacy. Since the first e-pharmacy business was formally registered in Kenya in 2013, the sector has seen at least eight

other firms emerge, each having its own unique model. The growth is relatively slow, with clients expressing preference for physical pharmacies. However, those in market expect e-pharmacy to grow in time.”, (Rosalind, 2018). The article further suggests that e-pharmacies are heavily urban components especially in Nairobi and still a new concept subject to possible regulation in the future.

2.3.2 Pharmacy Groups

Pharmacy associations are pools of individually run pharmacies that collaborate to gain a competitive advantage in the industry.

(Rosalind, 2018) states that “The Kenya Pharmaceutical Association’s Pharmnet is a network of individually-owned pharmacies that are operated by pharmaceutical technologists. The Kenya Pharmaceutical Association is the professional body representing pharmaceutical technologists, who operate nearly four-fifths of all licensed retail pharmacies in Kenya. Unlike the commercial chains, Pharmnet targets lower income groups, with deliberate effort to consolidate certain aspects of the smaller business establishments (for instance, pooled purchasing and quality assurance mechanisms).”

On the other hand, consolidation carries certain regulatory and market failure risks. In poorly controlled markets, consolidation could result in monopolies, which are inherently inefficient. Monopolists have incentive to restrict supply and raise prices, which then creates problems of poor access and inequity. While consolidation is relatively minimal in Kenya, experiences higher up the distribution chain suggest the possibility of dominant players emerging. A 2015 DFID-supported study, for instance, found that three distributors controlled between 44% and 66% of market share across four Kenyan counties (mixed rural and urban).

2.3.3 Search Engines

A search engine is a web service to look for webpages and/ or websites on the world wide web. It is the first stop for people looking for a piece of information on the internet and is influential in locating pharmaceutical products. A medicine search on Microsoft is shown in Figure 2.2 below.

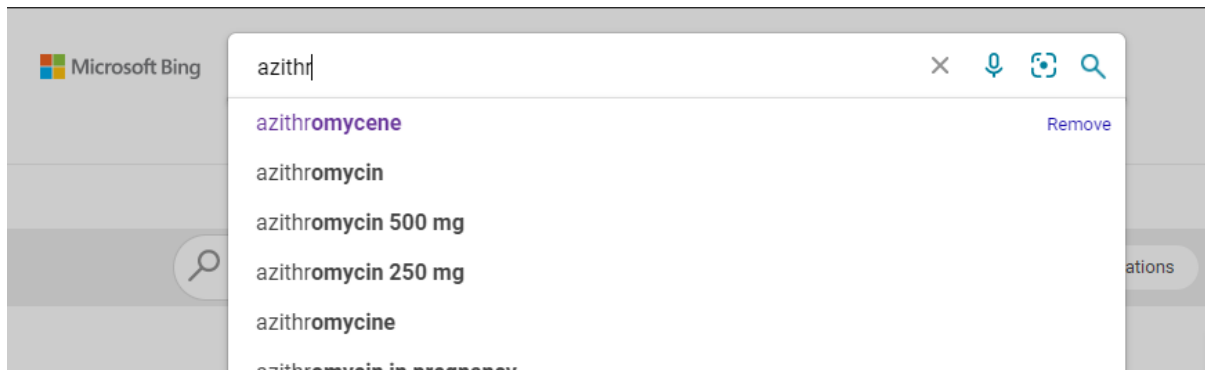


Figure 2.2 Product Search

2.4 Limitations in Related Works

Information gaps exist among the solutions described above and we go further to support it with formal review. According to an article on NCBI, (Strzelecki, 2020), “As the answer to research question 1, the author found that anyone can create health and medical content and publish it online. It does not need to be checked and corrected by a medical professional.”

(Rosalind, 2018) says that “The size, number or volumes of sales in the retail pharmaceutical industry is largely undocumented.” PPB does not register chains as chains, each outlet is registered as a standalone, there is no documentation of the number of chains in Kenya, and the number of outlets in each chain.”

Failure to forecast ongoing conditions is common among these works. E-pharmacies cannot broadcast market conditions as they belong to a small set of big pharmacy chains in Kenya. Since the first e-pharmacy business was formally registered in Kenya in 2013, the sector has seen at least eight other firms emerge, each having its own unique model (Rosalind, 2018)

2.2 Conceptual Framework

The MediCare solution described above (see section 1.3) has its operation deployed in 5 steps illustrated below in Figure 2.3. Pharmacy records belong to the pharmacy information system of the pharmacy. The internet facilitates communication between the entities labelled on the diagram. The MediCare system transforms data and fulfills user requests which it sends out. MediCare UI residing on the user’s device then packages user requests and returns system reviews in terms of views to the user.

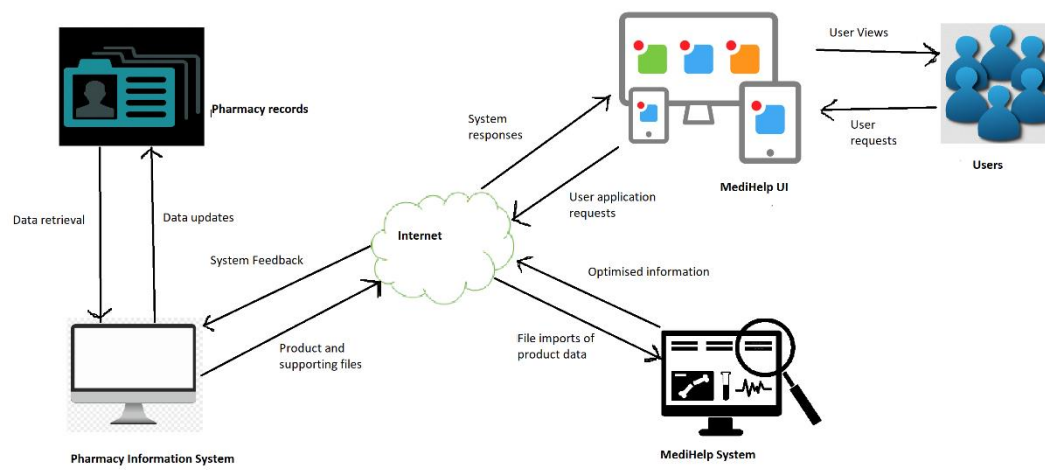


Figure 2.3 Conceptual Framework

Chapter 3: Methodology

3.1 Introduction

Following up on the former chapter, here we discuss the solution's overall plan, components involved, implementation of the plan and deployment of the software system.

This project will be developed using Structured System Analysis Design (SSAD).

3.2 Justification

This approach models a system using its data and the processes that act on it. As linear data manipulation is the core focus of our approach, it strongly justifies this approach.

3.3 Applied Development Approach to Be Used

Rapid Prototyping is a development approach among iterative methods that focuses on producing a product, getting feedback from end users, and using that to modify design until the product fully achieves its functions at the end of the process.

It is ideal for pushing a product to market early and for handling the requirements for MediCare which end users may not be sure about. It is also a low-risk project and requires constant interaction with end users.

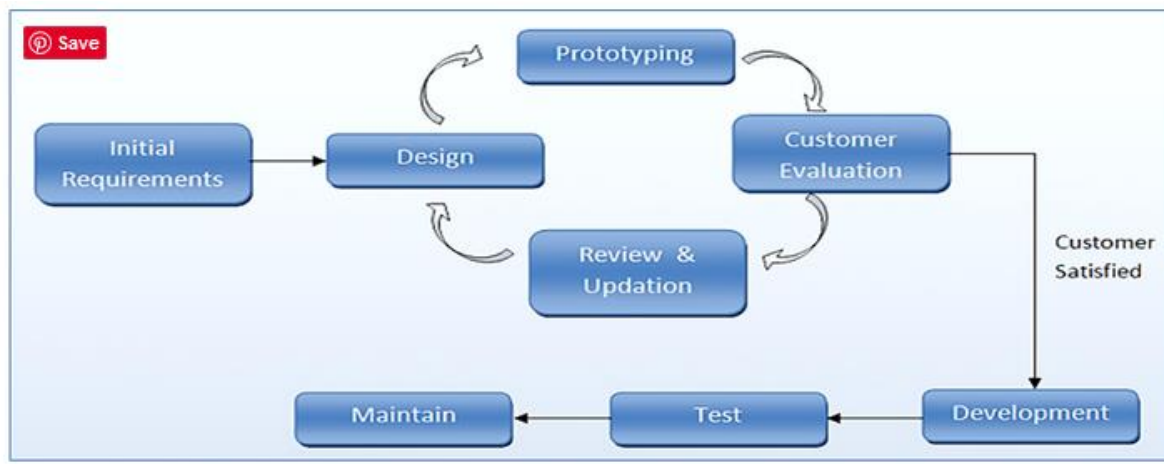


Figure 3.1 Rapid Prototyping Method

3.3.1 Initial requirements

This is the first phase where user requirements are collected for planning the system. Under this stage we will plan for the duration of our project, its structure, activities to be done and management. Specific outcomes include system proposal, user requirements and systems specification.

3.3.2 Conceptual design

in this phase, requirements drawn are transformed into a template to follow for building the system. The specific outcomes of this phase are the specifications of how pharmacy data will be manipulated, how users interact with the system and the architectural style. Outputs from this phase allows for setting up a prototype.

3.3.3 Prototyping

Prototyping involves building a tangible version of the project from the information collected about the system. Under this phase we will create features for user input from end users and pharmacies, processing data collected, storage update and output of information. Specific outcomes include user interface, databases, maps, and coding.

3.3.4 customer evaluation

User feedback is important for gauging how well a system has performed and if the system is satisfactory or changes need to be made before going out to market. This stage is important to us because it enables us to find areas for improvement, absorb new requirements and do quality benchmarking.

3.3.5 review

This involves making changes in the software development to cater for recent changes. User stories on what is required from our system will be categorized, discussed according to priority and changes decided on put back into the design.

3.3.6 Release

In this stage user satisfaction is substantial and the system can therefore undergo final implementation and put on market. We will test our application, deploy it on live servers and continue to do maintenance.

3.4 System Analysis

3.4.1 Use Case Diagram

A use case diagram shows the possible actors (users) in a system and actions that they can do in the system. This will illustrate process flow and responses between MediCare, a pharmacy and a user.

3.4.2 System Sequence Diagram

This shows the timeline in which processes occur for a use case in the system. This will give an order of interactions between users and the system.

3.4.3 Sequence Diagram

It shows the order of interactions for a particular subsystem use case in the system and will be used to properly design processes for big systems flows.

3.4.4 Entity Relation Diagram

An ERD diagrammatically represents all entities of the system and how they relate with each other by associations. This will be used in creating the database off MediCare.

3.4.5 Context Diagram

This diagram shows the overall interaction between a system and external entities. This will be used in explaining user requirements to pharmacies and users to improve understanding of the system.

3.4.6 Data Flow Diagram

A DFD shows how processes occur in a system and data manipulation. Level zero DFD will be used in coding, validating user requirements and testing. A Level 1 breaks down a complex process to understand its inner working. This diagram will be used to improve system documentation and code modularisation.

3.5 System Design

This section describes how MediCare will be structured, implemented, and deployed in detail. It also describes the milestones to be achieved.

3.5.1 Data Design

The logical schema of the system is described in this sub-section. below are the components and relationship of our database system.

Entities

Users. These are people using the system with the aim of finding pharmaceutical products.

Pharmacies. These are professional bodies licenced to provide pharmaceutical products and services.

Maps. these are geographical locations of pharmacies.

Relationships

The relationships of these three entities are well described in the Entity Relationship Diagram.

3.5.2 Mockups

Here, wire frames are used to describe the user interfaces of MediCare. wire frames are diagrams that are meant to illustrate how an interface should look like.

3.5.3 Architecture

And architecture is a framework that lays out the sub-systems that make up a system and how control and communication is achieved. MediCare will use a three-layer architecture system that is described in the architecture diagram document.

3.6 System deliverables

3.6.1 System Proposal

This describes the business case, its feasibility analysis and the proposed solution. It also describes the objective of this solution and an overview of its specifications.

3.6.2 Database Design

Implementation of the logical schema relationships and creation of the database based on the physical schema.

3.6.3 User Interface Design

Built code that defines the user interfaces of the system.

3.6.4 Algorithms

Pseudo code that will guide the coding of processes defined therein.

3.6.5 Mapping

Data visualisation in the form of maps tagged with supporting features.

3.6.6 Integrating

Linking together all modules of the system to create a functioning prototype.

3.5.1 Testing

Validation and verification of the system.

3.6.7 Deploying

Fully hosted application running on live servers accessible to users.

3.6.8 Support and Maintenance

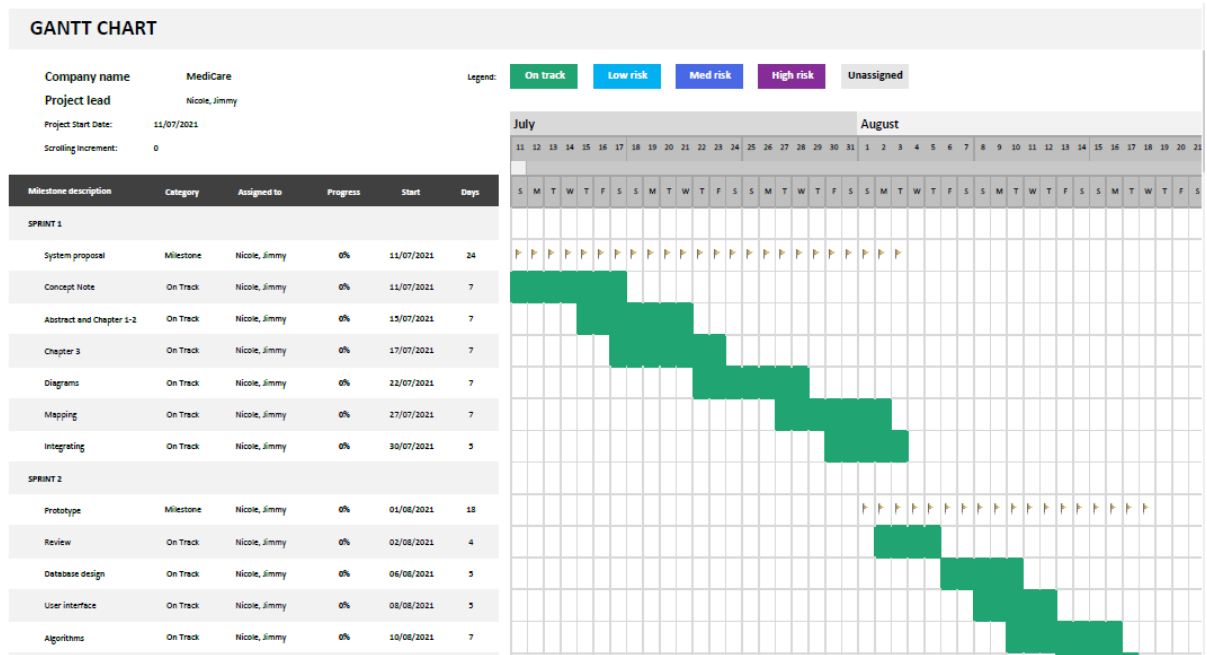
Handling operational issues that arise as users interact with the system.

References

- The Role of Mobile Technology in Kenya Healthcare* | i3 Consult | Integrated Intelligence for Healthcare Industries. (n.d.). Retrieved July 6, 2021, from <https://www.i3consult.com/the-role-of-mobile-technology-in-kenya-healthcare/>
- Web directory—New World Encyclopedia*. (n.d.). Retrieved July 6, 2021, from https://www.newworldencyclopedia.org/entry/Web_directory
- Abuga, K., Ongarora, D., Karumbi, J., Olulo, M., Minnaard, W., & Kibwage, I. (2019). Sub-Standard Pharmaceutical Services in Private Healthcare Facilities Serving Low-Income Settlements in Nairobi County, Kenya. *Pharmacy*, 7(4), 167. <https://doi.org/10.3390/pharmacy7040167>
- UNIDO. (2010). *Pharmaceutical Sector Profile: Kenya*. 104.
- Sakthivel Selvaraj, “Ensuring Access to Medicines in East Africa: Lessons from India”, *ORF Occasional Paper No. 201*, July 2019, Observer Research Foundation.
- Elaine, T. (2012). *Counterfeit medicines in Kenya*. Pfizer Global Health Fellows Program. https://cdn.pfizer.com/pfizercom/responsibility/global_health/elaine_tai.pdf
- cinnellae. (2011). Kenya Pharmaceutical Country Profile. *Ministry of Medical Services – Kenya*, 63. https://www.who.int/medicines/areas/coordination/kenya_pharmaceuticalprofile_december2010.pdf

Appendix

Gantt Chart



Appendix 1 Gantt Chart