PHARMACY INVENTORY MANAGEMENT SYSTEM

(CASE STUDY: LODBEY PHARMACY)

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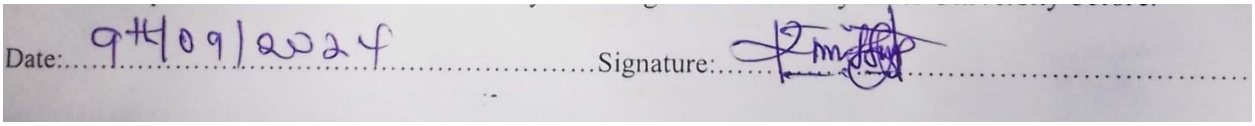
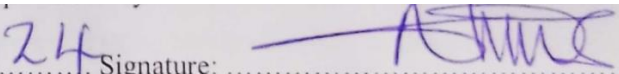
DECLARATION

I IKWAP KOKAS Reg. No. BU/UP/2021/1586 do hereby declare that this Project Report is original and has not been published and/or submitted for any other degree award to any other University before.



APPROVAL

This Project Report was done under my supervision by the said student.

Date: 09.09.2024 Signature: 

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DEDICATION

This project work is dedicated to THE ALMIGHTY GOD the source of all wisdom and guidance, my loving parents Mr. Inyongot Charles Okello and Mrs. Akareut Jeniffer, whose sacrifices made this journey successful, my supportive brother Mr. Osire Samuel and his wife Mrs. Alokit Agnes and Mr. Okurut Joseph for their unwavering sacrifices, encouragement and financial assistance not forgetting our one and only family friend Mr. Amue Simon Peter and his wife Mrs. Agwang Beatrice, my dear supervisor Dr. Angole Richard whose mentorship and guidance have been invaluable and the colleagues who have shared in both the challenges and triumphs of this endeavor. May the almighty God bless you abundantly?

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LIST OF ABBREVIATIONS

HTML	Hypertext mark-up language
MYSQL	my structured query language
SQL	Structured query language
DFD	Data flow diagram
SDLC	System development life cycle
API	Application programming interface
SAD	System analysis and design
MIS	Management information system
RAD	Rapid application Development
CSS	Cascading Style sheets
PHP	Hypertext Pre- processor

ABSTRACT

This project was aimed at designing a pharmacy inventory management system whose major focus is on drug registration, sales order creation, stock balance calculation and report creation.

Methods that were used for collecting data about the system include; interview, observation and focus groups from which information, requirements for the new system were obtained.

The methodologies used includes structured analysis and design (SSADM) which was used to gather sytem requirements as well as RAD which is based on prototyping and was used in analysis and design of the system and deliver working system with all its modules worked upon one after the other.

The technology platform in implementing this system uses visual studio code programming environment with PHP, JavaScript, CSS, Bootstrap, HTML and MYSQL for SQL database using Xamp as local Server.

CHAPTER ONE

INTRODUCTION

1.1 Background

In the contemporary healthcare landscape, efficient inventory management is a critical component for the seamless operation of pharmacies. With the increasing complexity of pharmaceutical products, regulatory requirements, and patient demands, the need for a robust pharmacy inventory management system has become paramount. (Kramer *et all*, 2007)

Pharmacies, whether standalone or part of larger healthcare institutions, grapple with challenges such as stock-outs, overstocking, expiration of medications, and cumbersome manual tracking processes. These challenges not only impede the delivery of timely and accurate healthcare services but also pose financial and regulatory risks.

The advent of technology offers a promising solution to streamline and optimize pharmacy inventory management. An automated system has the potential to enhance accuracy, reduce operational costs, and provide real-time insights into stock levels, allowing pharmacists to focus more on patient care and less on inventory logistics.(Bouanane and Khemissat 2023).

This study aims to design and implement a comprehensive pharmacy inventory management system tailored to address the unique needs and challenges faced by modern pharmacies. By leveraging technology, this system seeks to revolutionize how pharmacies handle their inventory, ensuring the availability of essential medications, minimizing waste, and promoting efficient workflows.

Through a thorough exploration of current inventory management practices, regulatory requirements, and industry standards, this study aspires to contribute to the advancement of pharmacy operations. The resulting system intends to be user-friendly, adaptable, and capable of integrating seamlessly with existing pharmacy information systems, ultimately fostering a more efficient and patient-centric healthcare environment.

1.2 Problem Statement

Lodbey Pharmacy still does not realize the importance of inventory management as they are not equipped with computerized system in running their pharmacy. Currently Lodbey Pharmacy management has kept paper record in filing cabinets. Managing a very large pharmacy with records on papers renders the process tedious, and often inaccurate mostly because the system cannot keep up with pharmacy's dynamic inventory flows. Thus, stock outs, overstocks, and out dated/expired stock and associated costs are a constant problem.

To address the issues stated above, I have to study and implement a Pharmacy inventory management system that enhances efficiency, accuracy, cost saving, data analysis, compliance and patient safety.

1.3 Purpose

The main objective of the study is to develop a pharmacy management system which allows the pharmacist to access the drug records, add new drugs on the cart instantly that will effectively manage the inventory of the pharmacy.

1.4 Objectives

i. To review the literature and determine the requirements for the pharmacy management system.
ii. To design the pharmacy management system for Lodbey pharmacy.
iii. To implement the system for Lodbey pharmacy.
iv. To test and validate the functionality and efficiency of pharmacy management system.

1.5 Significance

Lodbey Pharmacy faces numerous challenges in managing its inventory efficiency, these challenges include manual tracking of stock levels which can lead to errors resulting in overstocking or stock outs, keeping track of expiration dates is difficult which leads to wastage of expired drugs, inefficient inventory management leading to increased operational costs due to excess inventory or emergency restocking.

On the successful development and further implementation of the pharmacy management system, the study shall lead to the following significances;

- The study will equip the researcher with more knowledge and skills about the pharmacy inventory management system which will as well be used as a reference by other researchers who would wish to carryout research on the same field of inventory management systems.
- Minimizes human errors in tracking stock levels, expiration and reorders
- Streamlines the process of tracking and managing inventory reducing time and effort
- Effective inventory management through optimization of medication stock and medical supplies.

1.6 Scope

The study only covers a computerized system for managing the pharmacy's inventory, the area of interest is data capture, processing, storage, retrieval and backup policy.

1.6.1 Area.

It will be conducted at Lodbey pharmacy located in Nagongera Town council.

1.6.2 Time.

As regards to time, it is meant to cover a period of four (4) months.

1.6.3 Content.

- **Product Management:** The system will allow pharmacists to add, update, or remove products from the inventory. This includes details such as drug name, quantity, expiration date, and supplier information.

- **Stock Monitoring and Alerts:** It will monitor stock levels in real-time and provides alerts or notifications when inventory falls below a specified threshold. This helps in preventing stock-outs and ensures timely reordering.

- **Supplier management:** The system will facilitate the addition, modification and deletion of supplier information.
- **Sales Processing:** It will facilitate the creation and processing of sales orders
- **Stock auditing:** The system will be capable of;
    - ✓ **Identifying slow-moving or dead-stock-** items that are not selling or are obsolete
    - ✓ **Detecting stock discrepancies**- reveal any discrepancies between recorded stock levels and actual physical count
    - ✓ **Updating inventory records**- ensures that physical stock matches what is recorded in the system
- **Reporting and Analytics:** It will provide detailed reports on inventory turnover, expired products and sales trends.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction.

This section reviews literature on a system, pharmacy, different types of pharmacy, pharmacy management inventory systems and the records management systems.

As part of the literature review, a case study will be carried out on Pharmacy, the department is in drugs management information system and a detailed investigation into their existing system to accomplish highlighting the problems of the current system.

2.2 A system.

(Alam and El Saddik 2017) defined a system as a collection of subsystems which are linked together to function as a unit with a common purpose or objective for example a computer system can be viewed very simply as comprising of a central processor, various peripherals and software which are linked together with an objective of efficient processing of user programs.

According to (Gruzina and Pererva 2022) a system is an organized, purposeful structure that consists of interrelated and interdependent elements (components, entities, factors, members, parts among others.). These elements continually influence one another (directly or indirectly) to maintain their activity and the existence of the system, in order to achieve the goal of the system.

2.3 Inventory Management

Pharmaceuticals and medications have become the largest investment in any healthcare delivery system. Hospital pharmacy contributes to 23% of the total hospital's expenditures. Medications and drugs consume almost 80% of that total expenditure spent by hospital pharmacy, and the rest 20% is spent on personal or other expenses (Christensen, Gørtz *et all*. 2016). From an economic point of view, an inventory of medical products in pharmacy department reflects a "prepaid" cost to the hospital which is reimbursed through later process of dispensing and billing to patients for charges which basically cover all cost associated with the medication (Federal Accounting Standard Board, 1993). In short, the total cost of hospital pharmacy is all acquisition costs associate with all purchased medications (including those still in inventory), plus costs required to convert medication inventory into patient doses, and any other costs related to ownership of

this type of perishable inventory such as spoilage, expiration, shrinkage, and recalls (Federal Accounting Standard Board, 1993).

According to Rossetti (2008), in pharmacy practice, inventory management take an important role to reducing healthcare total cost without ignoring quality of care by improving and increasing productivity of the healthcare supply chain system.

Gebicki *et all*. (2013) said that there are several constraints regarding inventory management in pharmacy area that can be considerations. Pharmaceutical products and consumable medical equipment require customer service level that is dependent on its criticality, a measure of the consequences of a stock out, and possibly the death of a patient. Medicines are perishable products which mean they have specific length of time in which they can be used. If expiration date is exceeded, products must be wasted causing negative impact to hospital's finance. Referred to Regulation of Health Ministry of Indonesian Republic No. 58/2014, every pharmaceutical product and consumable medical equipment is said to be dead stock or expired when its demand are zero for three months respectively. Ordering products from pharmacy are not always granted by supplier. It is due to limited availability from supplier which means lead time for each product are vary considerably.

According to (Prakash, Prakash *et all*. 2018) "Inventory refers to stocks of anything necessary to do business". The U.S Small Business Administration publication describes what constitutes successful inventory management balancing cost versus benefits of inventory, including: Maintaining a wide assortment without sacrificing service; Keeping stock low without sacrificing performance; Obtaining lower prices by making volume purchases; and maintaining an adequate inventory without an excess of obsolete items.

Thomas C. Harrington (1990) "Implementing an Effective Inventory Management System" emphasizes the element of control important in effective inventory management.

"A professional discipline that is primarily concerned with the management of document-based information systems. The application of systematic and scientific controls to recorded information required in the operation of an organization's business"

From the quotes above, we conclude that the control element inventory management is an important aspect in developing the system associated with inventory management. Effective inventory control and systematically in an organization can facilitate the management of the

organization in manage inventory, make decisions, plan and control the flow or stock articles and reports.

2.4 Inventory control.

An inventory control system is a system that encompasses all aspects of managing a company's inventories; purchasing, shipping, receiving, tracking, warehousing and storage, turnover, and reordering. In different firms the activities associated with each of these areas may not be strictly contained within separate subsystems, but these functions must be performed in sequence in order to have a well-run inventory control system. Computerized inventory control systems make it possible to integrate the various functional subsystems that are a part of the inventory management into a single cohesive system.

In today's business environment, even small and mid-sized businesses have come to rely on computerized inventory management systems. Certainly, there are plenty of small retail outlets, manufacturers, and other businesses that continue to rely on manual means of inventory tracking. Indeed, for some small businesses, like convenience stores, shoe stores, or nurseries, purchase of an electronic inventory tracking system might constitute a wasteful use of financial resources.

But for other firms operating in industries that feature high volume turnover of raw materials and or finished products, computerized tracking systems have emerged as a key component of business strategies aimed at increasing productivity and maintaining competitiveness. Moreover, the recent development of powerful computer programs capable of addressing a wide variety of record keeping needs-including inventory management-in one integrated system have also contributed to the growing popularity of electronic inventory control options is important in any commercial environment, but even more so when it comes to maintaining inventory in a pharmaceutical setting because public health is involved. Anyone with pharmacy technician training can appreciate the importance of having enough medical stock in both retail and hospital pharmacies at all times in order to be able to successfully fill the prescriptions that customers may need immediately. Successfully dispensing prescriptions may seem like a simple task, but if you’ve ever observed the operation of a hospital or community pharmacy, you’ll understand the need for an efficient inventory control structure

2.5 Inventory control methods.

Various methods are available when controlling inventory in a pharmacy. Here is a list of the methods and short descriptions differentiating each one:

- The open-to-buy budget method provides an allotted amount of funds, within a specific timeframe, for purchasing pharmaceutical inventory
- The short-list method identifies all of the products that are low in stock and need to be replenished, and provides this information to the individual in charge of placing inventory orders
- The minimum and maximum method is used to find out how much to order of each item as well as when is best to order, while providing a limited dollar allowance
- The stock card method is used to trace when items are brought into storage and taken out

Each of these methods are useful in controlling inventory on their own, however when implementing an efficient inventory management system, it is preferable to use a combination of all available methods to establish a customized system that best meets the needs of a specific pharmaceutical environment.

2.6 Types of inventory management systems.

There are two main types of inventory systems, the perpetual inventory system and the periodic inventory system. Both are valid inventory systems that you could consider using. The main difference between the two systems is how often inventory data is updated.

2.6.1 The periodic inventory method.

Is one in which inventory data is updated after a specific interval of time, usually once a year? This is where the term periodic comes from. Data is entered into the inventory systems after a specific period of time, unlike with perpetual inventory, where the data is updated constantly as sales occur.

In the periodic inventory system, information is not kept consistently up to date. Inventory information is noted, but total store of the inventory is only taken once a year.

This inventory management system appeals to many people because you don’t have to spend as much money up front to set up the technology and inventory software needed to keep track of data in a perpetual inventory system. Excel may well suffice for this type of inventory control.

And when you are starting a business, upfront cost minimization is critical. However, if you plan to grow quickly and think you might want a better handle on your inventory, then the periodic system may not be right for you. While it's important to be aware of the numerous costs associated with launching software and systems, the cost of running out of inventory or having to stock more than you really need may actually be higher than the cost of the software.

One of the major drawbacks of selecting this inventory system is that for the entire year in between when your inventory is totaled, you don't have immediate access to inventory information. Thus, it's essential to consider the size and scope of your business when choosing to use this system. If you severely overstock or under stock your business, the problem may not become apparent for a while. Some people find that the savings from this type of system make up for the risks associated with it. The other consideration is the cost of switching – sometimes it's better to bite the bullet and put the right management tools in place at the start, rather than disrupting the business later to implement a software change.

In conclusion, there are two main types of inventory control systems, periodic and perpetual. Both are valid choices for your inventory management system. Keep in mind your long-term goals before you select a short-term approach. There are a lot of options for growing into inventory management solutions over time and the upfront cost of a perpetual system may not be that high after all.

2.7 Pharmacy.

A pharmacy is defined as the science and technique of preparing and dispensing drugs. It is a health profession that links health sciences with chemical sciences and aims to ensure the safe and effective use of pharmaceutical drugs. The scope of pharmacy practice includes more traditional roles such as compounding and dispensing medications, and it also includes more modern services related to health care, including clinical services, reviewing medications for safety and efficacy, and providing drug information. Pharmacists, therefore, are the experts on drug therapy and are the primary health professionals who optimize use of medication for the benefit of the patients.

2.8 Types of Pharmacy

2.8.1 Hospital Pharmacy.

Pharmacies within hospitals differ considerably from community pharmacies. Some pharmacists in hospital pharmacies may have more complex clinical medication management issues whereas pharmacists in community pharmacies often have more complex business and customer relations issues.

Because of the complexity of medications including specific indications, effectiveness of treatment regimens, safety of medications (i.e., drug interactions) and patient compliance issues (in the hospital and at home) many pharmacists practicing in hospitals gain more education and training after pharmacy school through a pharmacy practice residency and sometimes followed by another residency in a specific area. Those pharmacists are often referred to as clinical pharmacists and they often specialize in various disciplines of pharmacy. For example, there are pharmacists who specialize in hematology/oncology, HIV/AIDS, infectious disease, critical care, emergency medicine, toxicology, nuclear pharmacy, pain management, psychiatry, anti-coagulation clinics, herbal medicine, neurology/epilepsy management, pediatrics, neonatal pharmacists and more.

Hospital pharmacies can often be found within the premises of the hospital. Hospital pharmacies usually stock a larger range of medications, including more specialized medications, than would be feasible in the community setting. Most hospital medications are unit-dose, or a single dose of medicine. Hospital pharmacists and trained pharmacy technicians' compound sterile products for patients including total parental nutrition (TPN), and other medications given intravenously. This is a complex process that requires adequate training of personnel, quality assurance of products, and adequate facilities. Several hospital pharmacies have decided to outsource high risk preparations and some other compounding functions to companies who specialize in compounding. The high cost of medications and drug-related technology, combined with the potential impact of medications and pharmacy services on patient-care outcomes and patient safety, make it imperative that hospital pharmacies perform at the highest level possible.

2.8.2 Clinical pharmacy.

Pharmacists provide a direct patient care service that optimizes the use of medication and promotes health, wellness, and disease prevention. Clinical pharmacists care for patients in all health care settings, but the clinical pharmacy movement initially began inside hospitals and clinics. Clinical pharmacists often collaborate with physicians and other healthcare professionals to improve pharmaceutical care. Clinical pharmacists are now an integral part of the interdisciplinary approach to patient care. They often participate in patient care rounds drug product selection.

The clinical pharmacist's role involves creating a comprehensive drug therapy plan for patient-specific problems, identifying goals of therapy, and reviewing all prescribed medications prior to dispensing and administration to the patient. The review process often involves an evaluation of the appropriateness of the drug therapy (e.g., drug choice, dose, route, frequency, and duration of therapy) and its efficacy. The pharmacist must also monitor for potential drug interactions, adverse drug reactions, and assess patient drug allergies while designing and initiating a drug therapy plan.

2.8.3 Ambulatory care Pharmacy.

Since the emergence of modern clinical pharmacy, ambulatory care pharmacy practice has emerged as a unique pharmacy practice setting. In 2011 the board of Pharmaceutical Specialties approved ambulatory care pharmacy practice as a separate board certification. The official designation for pharmacists who pass the ambulatory care pharmacy specialty certification exam will be Board Certified Ambulatory Care Pharmacist and these pharmacists will carry the initials BCACP.

According to (Niznik, He *et all*. 2018), Pharmacists in this setting often do not dispense drugs, but rather see patients in office visits to manage chronic disease states. In the federal health care system (including the VA, the Indian Health Service, and NIH) ambulatory care pharmacists are given full independent prescribing authority. In some states such North Carolina and New Mexico these pharmacist clinicians are given collaborative prescriptive and diagnostic authority.

2.8.4 Compounding Pharmacy.

Compounding is the practice of preparing drugs in new forms(Siamidi, Pippa *et all*. 2017). For example, if a drug manufacturer only provides a drug as a tablet, a compounding pharmacist might make a medicated lollipop that contains the drug. Patients who have difficulty swallowing the tablet may prefer to suck the medicated lollipop instead.

Another form of compounding is by mixing different strengths (g, mg, mcg) of capsules or tablets to yield the desired amount of medication indicated by the physician, physician assistant, Nurse Practitioner, or clinical pharmacist practitioner. This form of compounding is found at community or hospital pharmacies or in-home administration therapy.

Compounding pharmacies specialize in compounding, although many also dispense the same non-compounded drugs that patients can obtain from community pharmacies.

2.8.5 Consultant Pharmacy.

Consultant pharmacy practice focuses more on medication regimen review (i.e. "cognitive services") than on actual dispensing of drugs. Consultant pharmacists most typically work in nursing homes, but are increasingly branching into other institutions and non-institutional settings. Traditionally consultant pharmacists were usually independent business owners, though in the United States many now work for several large pharmacy management companies (primarily Omnicare, Kindred Healthcare and PharMerica). This trend may be gradually reversing as consultant pharmacists begin to work directly with patients, primarily because many elderly people are now taking numerous medications but continue to live outside of institutional settings. Some community pharmacies employ consultant pharmacists and provide consulting services.

2.8.6 Veterinary Pharmacy.

Veterinary pharmacies, sometimes called animal pharmacies, may fall in the category of hospital pharmacy, retail pharmacy or mail-order pharmacy. Veterinary pharmacies stock different varieties and different strengths of medications to fulfill the pharmaceutical needs of animals. Because the needs of animals, as well as the regulations on veterinary medicine, are often very

different from those related to people, veterinary pharmacy is often kept separate from regular pharmacies (Papich 2015).

2.9 Pharmacy Management System.

According to (Rathnayake 2021), Pharmacy Management System is a system that consists of data entry, retrieval and stock monitoring facility, tracking drug dispensing pattern, generation of reports and statistics and others. Pharmacy Management System focuses on pharmacy store operation and how it manages the inventory flow with suppliers (external) and departments' dispensary (internal). The system covers typical operations like receiving medication from suppliers, processing departments' medication requests, distributing medication to departments, returning expired medication to suppliers.

2.10 Records Management System.

According to (Penn and Pennix 2017), Records management system, also known as Records information management (RIM), is the professional practice or discipline of controlling and governing what are considered to be the most important records of an organization throughout the records life-cycle, which includes from the time such records are conceived through to their eventual disposal. This work includes identifying, classifying, prioritizing, storing, securing, archiving, preserving, retrieving, tracking and destroying of records.

2.10.1 A record.

(Toyo 2017) A record is something that represents proof of existence and that can be used to recreate or prove state of existence, regardless of medium or characteristics. A record is either created or received by an organization in pursuance of or compliance with legal obligations, or in the transaction of business. Records can be either tangible objects, such as paper documents like birth certificates, driver's licenses, and physical medical x-rays, or digital information, such as electronic office documents, data in application databases, web site content, and electronic mail (email).

2.10.2 Records Life Cycle.

The records life cycle (or records lifecycle) consists of discrete phases covering the life span of a record from its creation to its final disposition (Miller, Miller *et all*. 2018). In the creation phase,

records growth is expounded by modern electronic systems. Records will continue to be created and captured by the organization at an explosive rate as it conducts the business of the organization. Correspondence regarding a product failure is written for internal leadership, financial statements and reports are generated for public and regulatory scrutiny, the old corporate logo is retired, and a new one including color scheme and approved corporate font takes its place in the organization's history.

Examples of records phases include those for creation of a record, modification of a record, movement of a record through its different states while in existence, and destruction of a record.

Throughout the records life cycle, issues such as security, privacy, disaster recovery, emerging technologies, and mergers are addressed by the records information management professional responsible for organizational records information management programs. Records information management professionals are instrumental in controlling and safeguarding the information assets of the entity. They understand how to manage the creation, access, distribution, storage, and disposition of records and information in an efficient and cost effective

2.10.3 Records Classification.

Records managers use classification or categorization of record types as a means of working with records. Such classifications assist in functions such as creation, organization, storage, retrieval, movement, and destruction of records. At the highest level of classification are physical versus electronic records.

Classification of records is achieved through the design, maintenance, and application of taxonomies, which allow records managers to perform functions such as the categorization, tagging, segmenting, or grouping of records according to various traits.

Physical records are those records, such as papers, that can be touched and which take up physical space.

Disadvantages of physical records.

- Inconsistency in data entry, room for errors.
- Reduction in sharing information.
- Time consuming and costly to produce reports.
- Lack of security.

- Duplication of data entry.
- Customer queries are difficult to respond to as information is stored in different places and may even require that you find the right person before being able to respond.
- It takes more effort and physical space to keep track of paper documents

Electronic records, also often referred to as digital records, are those records that are generated with and used by information technology devices.

Advantages of electronic records.

- Electronic files may go missing but can easily be recovered, nor do they easily fall into the wrong hands., the difficult task of securing confidential information is simplified with a digital document management system, electronic documents are easily encrypted with access controls using passwords and an authentication system
- The switch to electronic documents can be tremendously cost-saving for most companies. With digital systems, there is a cost for the scanning and filing technologies, but once digitized, the cost for data storage is low.
- Easy access from the moment the document is scanned, it becomes accessible from any computer by an authorized employee. Electronic documents can be retrieved immediately, shared and routed to any employee who needs it.
- Allows you to back up records and keep them in a safe place in case of fire or theft.
- Easy to generate orders, invoices, debtor reports, financial statements, employee pay records, inventory reports.
- Helps you record business transactions, including income and expenses, payments to workers, and stock and asset details.

CHAPTER THREE

METHODOLOGY

3.1 Introduction.

This chapter presents all the methods, procedures, assumptions and tools used to carry out the study on pharmacy inventory management system. It contains sections; 3.2 area of study, 3.3 population and sampling, 3.4 sampling method, 3.5 data collection method, 3.6 data analysis and representation, 3.7 system design methods, 3.8 system implementation tools, 3.9 testing and evaluation.

3.2 Area of study.

The study was conducted at Lodbey pharmacy for a period of four (4) months

3.3 Population and sampling.

The population sample comprised of one (01) Physician, one (01) Pharmacist and three (03) Nurses

3.4 Sampling methods.

The sampling and the method used are shown in the table 3.1 below

Sample	Quantity	Reason
Physicians	01	Purposeful sampling because he was the only one to provide information
Pharmacists	01	Purposeful sampling because he was the only one to provide information
Nurses	3	Simple random sampling because the number is smaller

Table 3.1: Sampling Methods

3.5 Data collection methods.

This is a qualitative research from which data was collected qualitatively

Qualitative data was collected using the using the tools below;

3.5.1 Interviews.

I conducted a face-to-face interview with 1 Physician, 3 nurses, 1 pharmacist and this will help me to fully understand their experiences while at the pharmacy and learn what exactly takes place there.

Some interviews will be conducted online through phone calls to the physician and the pharmacist to gather information about the organization structure of the pharmacy.

3.5.2 Observation.

I used this technique to gather accurate information about how the system actually operates, in practice. This involved watching and recording the behaviors and characteristics of operations and processes in the pharmacy. In this case I saw how the drugs were arranged in the shelves and also how the documents are kept.

3.5.3 Focus group.

According to (Gawlik 2018), a focus group is one type of group interviews where the interviewed individuals have been put together in groups by the researchers. Furthermore, Focus Groups are not be conducted as several one-to-one interviews simultaneously, instead focus groups is about creating a situation of open discussion concerning this area under investigation where all participants feel comforted in expressing their opinions and responding to the other opinions around them. Before execution of focus group discussion, open ended questions are set by the researcher to provide him with the opportunity of creating a discussion environment among the members of a focus group (O. Nyumba, Wilson *et all*. 2018), discussed that one of the biggest challenges of focus groups is that it requires resources to gather the participants. Also, the participants may not give the right information as required by the researcher under the area of investigation.

3.6 Development of the system.

The development approach employed for this project was the structured analysis and design method (SSADM). The project development process was broken into stages, models, steps and

tasks. The first model developed in SSADM was the data model which is part of requirements gathering and consists of well-defined stages, steps and products.

The specific methodology employed was the Rapid Application Development (RAD) which is based on prototyping and iterative development with no specific planning involved. It focused on gathering user requirements through meetings or focus groups, early testing of the prototypes by the user using iterative concept, reuse of the existing prototypes, continuous integration and rapid delivery. The functional modules were developed in parallel as prototype and integrated to make the complete product for faster product delivery.

3.7 System Testing and Validation.

Both unit testing and integration testing were performed on the pharmacy inventory management system to clarify the specifications of the system to reveal possible faults and establish confidence in the system.

Unit testing focused on one function at a time in that whether the researcher designed a function, it would be tested instantly before proceeding to design another.

After all modules had been assembled to form a full system, integration testing was performed. The goal of integration was to ensure that all the system components worked together and could be combined to make fully functioning system.

User testing was performed at the end, this involved the potential users of the system to test the system if it met their requirements.

Software validation was done to determine whether the software product satisfies or fits its intended use.

CHAPTER FOUR

FIELD STUDY AND SYSTEM DESIGN

4.1 Introduction.

This chapter presents the results from the field and system design. The chapter has the following sections 4.2 Background information of the current system, 4.3 Strength of the current system, 4.4 Weakness of the current system, 4.5 System requirt5ements and 4.6 System design

4.2 Background information of the current system.

Lodbey Pharmacy was founded by Mr. Grace Mukisa on August, 2022 in Nagongera Town council and it is sitting in the premises of 20 By 5 meters by size along Nagongera- Tororo Road. They majorly deal in the selling of pharmaceutical products to the population within and outside of the Town Council and their mission is provision of medical services through customer relations and service.

4.2.1Current system in use.

Inventory management is a critical aspect of any pharmacy's operations. In the case of Lodbey Pharmacy, a small local establishment, this process is carried out manually. This report presents a case study of Lodbey Pharmacy's manual inventory management practices

At Lodbey Pharmacy, inventory management begins with the visual inspection of the inventory. The pharmacist or a designated staff member visually surveys the stock of medicines and other items. They then compare the in-hand stock against a product list and quantity recorded in a physical ledger. When new drugs or batches of drugs arrive, manual entries are made into the pharmacy's register. These entries include details like the name of the medicine, quantity, date of arrival, and expiry date.

4.2.2 Organization structure.

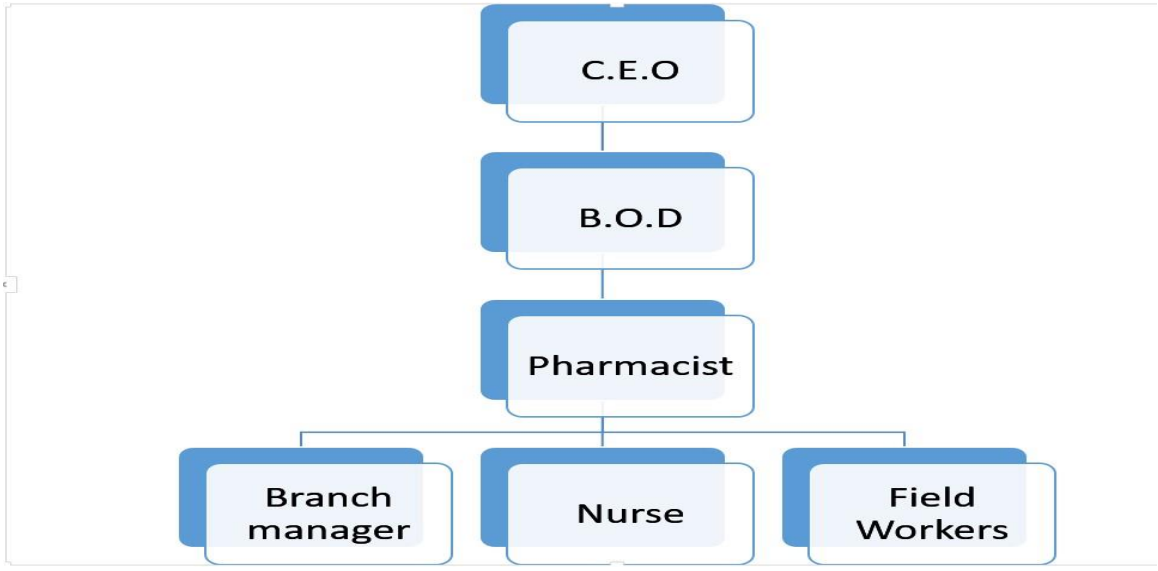

Figure 4.1: Organization Structure

At the top is the chief executive officer who is responsible for the overall management and decision making of the pharmacy

Below the CEO is the BOD (Board of Directors) which provide oversight of and guidance to the CEO and the pharmacy as a whole.

Next is the pharmacist who oversees the pharmaceutical operations, ensuring the quality and legality of medications and their dispensation.

Finally, the pharmacy has branch manager, nurses, and field workers. The branch manager oversees the day to day operations of specific branches of facilities, while nurses and field workers carryout various tasks related to patient care, medication distribution and field work.

4.3 Strength of the current system.

- It does not require specific skills and knowledge in the field of ICT to handle patient problems and records.
- The system is cheap as it doesn't incur costs such as electricity and extra man power to man the new system such as data analysts and others.

4.4 Weakness of the current system.

- Difficulty in easily retrieving a record of interest at a later time.
- Large physical storage area (rooms) are required for storing book records.
- Book-based records tend to fade with time hence information lose.
- High risk of losing information in case of a disaster such as fire outbreak, flooding earthquakes among others.
- The director cannot access the system from a distance without physically coming to the facility.

4.5 System requirements.

The Pharmacy Inventory Management System (PIMS) is a critical tool for any pharmacy, designed to ensure the efficient management of medicines and related products. It plays a pivotal role in maintaining optimal inventory levels, preventing stock-outs or overstocking, and ultimately, ensuring customer satisfaction.

The system requirements for a PIMS are the conditions or capabilities needed by this system to perform its functions effectively. These requirements are typically categorized into two main types: functional requirements, which define what the system should do, and non-functional requirements, which specify how the system should perform these tasks.

This report will outline the key system requirements for a PIMS, taking into account the unique needs and challenges faced by pharmacies. Our aim is to provide a comprehensive guide that can serve as a foundation for the development or enhancement of a PIMS.

4.5.1 Functional requirements.

These are the tasks that the system is intended to perform and without such the system is actually meaningless. The functional requirements of the system are as follows.

- Inventory tracking. The system allows tracking of pharmaceutical inventory including drugs, supplies, and equipment with features of adding, updating and deleting items
- Order management. It has the ability to generate purchases order.

- Stock level monitoring. The system is capable of monitoring stock levels enabling timely re-ordering to prevent stock-outs.
- Reporting and analysis. The system generates reports on inventory levels, usage and expiration dates.
- Security. The system ensures data security and integrity through access controls and encryption.

4.5.2 Nonfunctional requirements.

The non-functional requirements are not directly concerned with the specific functions rendered by the system, but increases on the accuracy, reliability, performance of the system and they include the following;

- Usability. The system has an intuitive user interface supporting easy navigation and efficient workflow for pharmacy staff to minimize errors and training time.
- Scalability. The system can be scaled to accommodate the growth of inventory size and transaction volume ensuring optimal performance.
- Reliability. The system is reliable with minimal downtime and robust backup and recovery mechanism to prevent data loss or system failures.

4.6 System design.

According to (Wasson 2015), System design is the process of defining the architecture, interfaces, and modules for the system to realize functionality of the requirements. This was through the use of system design tools such as system architecture, context diagram, DFD, User Case modeling diagram ERD and to help to know how different processes interact with each other and their relationships.

4.6.1 System architecture.

A system architecture is the conceptual model that defines the structure, behavior, and more views of a system.

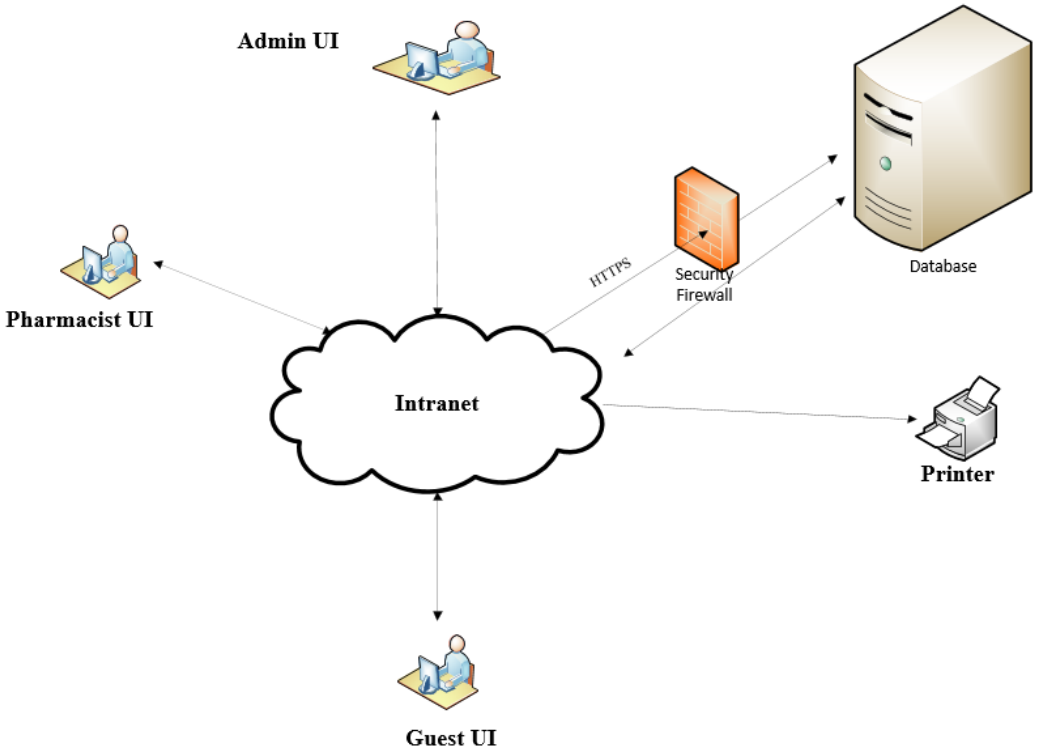

Figure 4.2 system architecture

4.6.2 Context diagram.

This is a type of DFD that provides the visual representation of the system and its interaction with external entities. It is a high-level view of the system, showing the overall flow of data between the system and external entities.

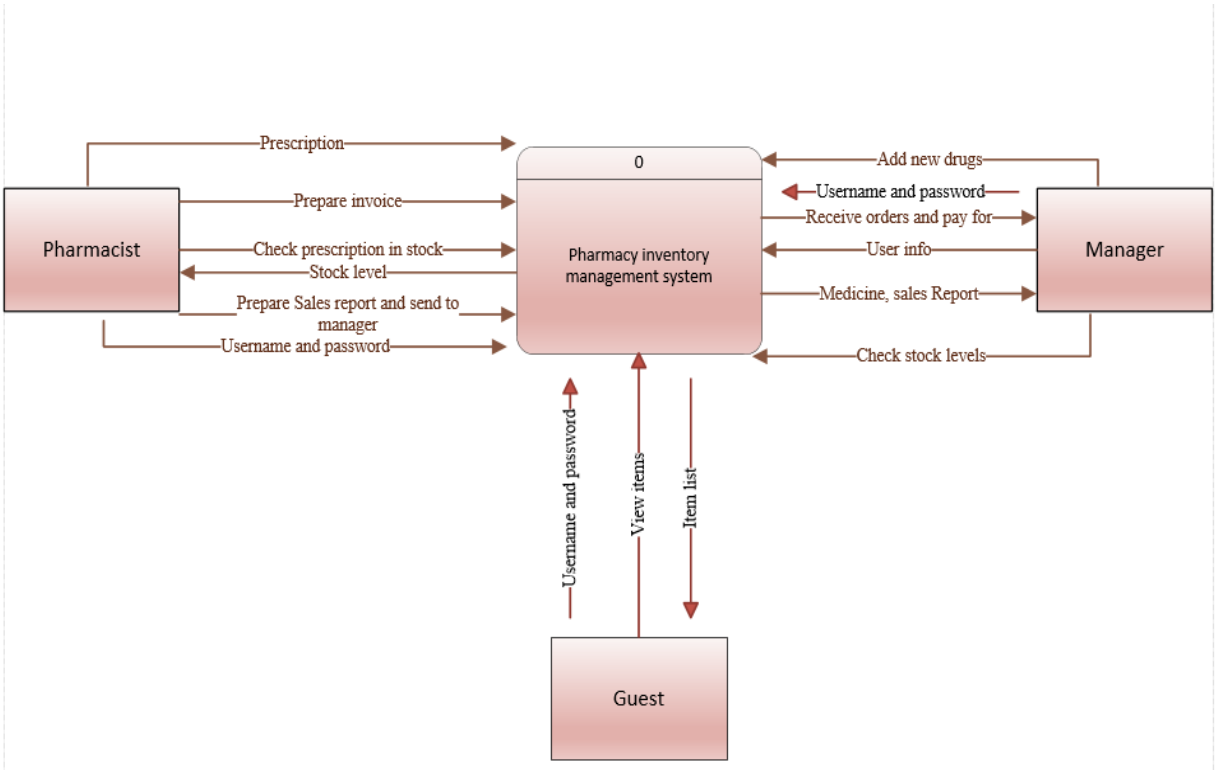

Figure 4.3 Context diagram

4.6.3 Data flow diagram (DFD).

This is the denoted view of the context diagram. Its function is to deepen the concept derived from the context diagram specifically showing broader details of pharmacy inventory management system DFD level 0. This is to clarify the paths of data and its transformation from input to output.

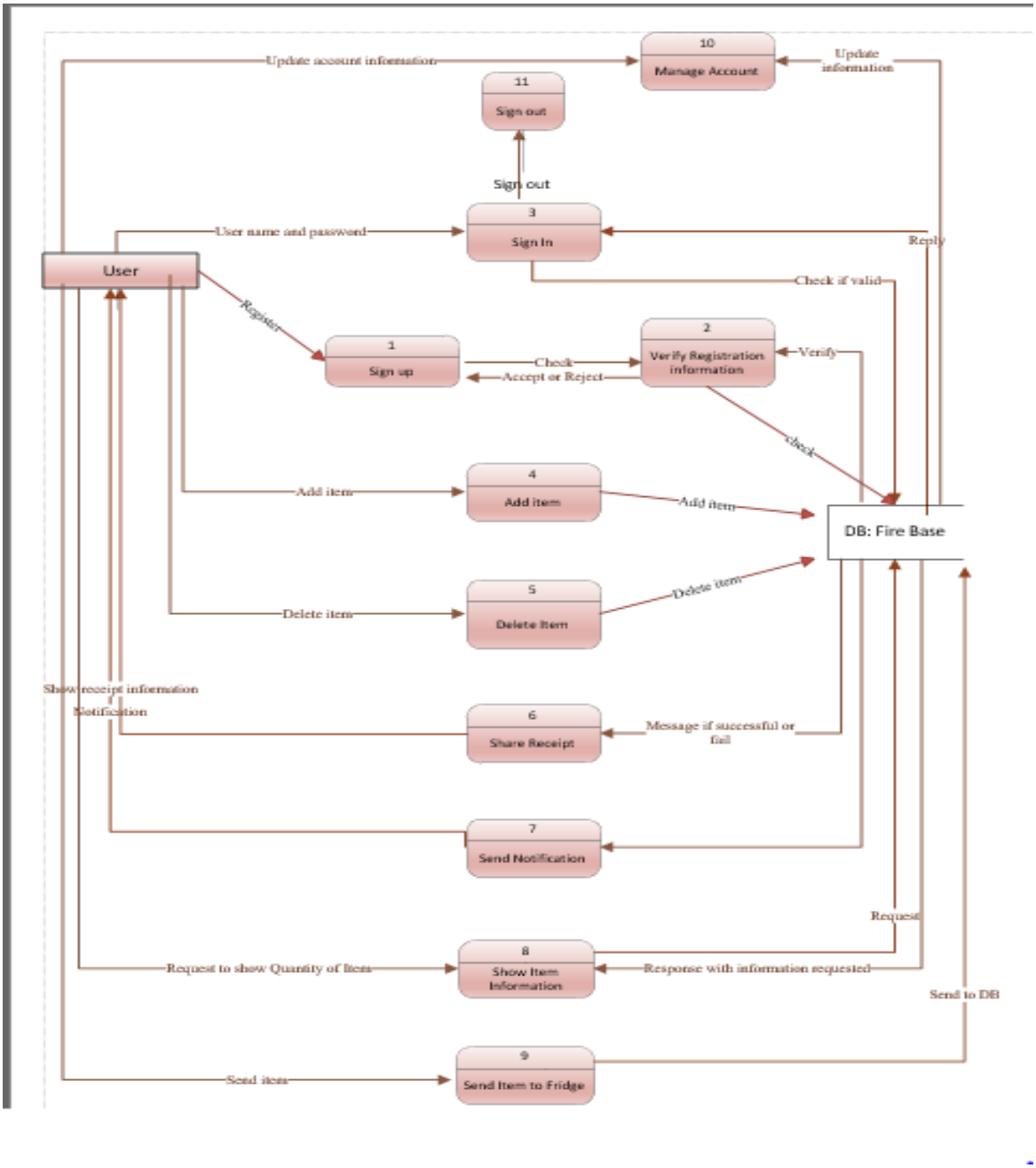

Figure 4.4 Data flow diagram

4.6.4 Use case diagram.

A Use Case Diagram is a vital tool in system design, it provides a visual representation of how users interact with a system. It serves as a blueprint for understanding the functional requirements of a system from a user's perspective, aiding in the communication between stakeholders and guiding the development process.

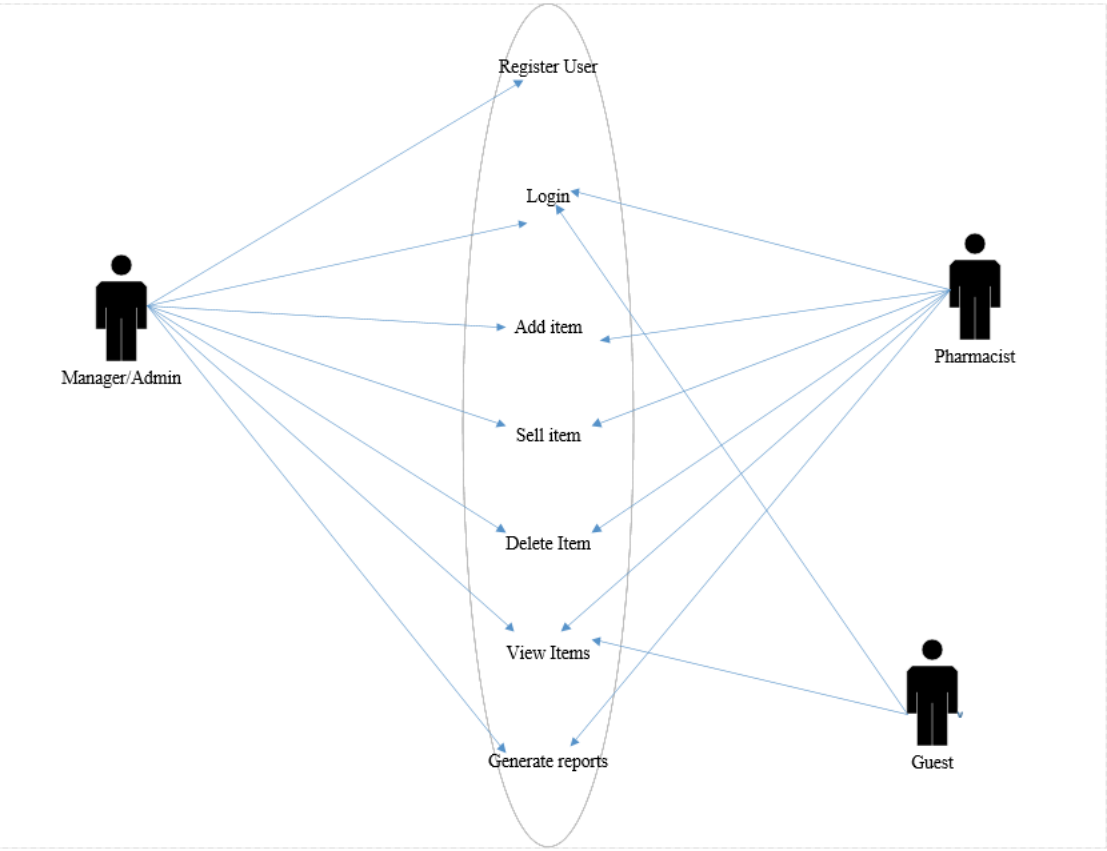

Figure 4.5 Use case Diagram

4.6.5 Entity relationship diagram (ERD).

This diagram illustrates the interrelationship between different in the system. The ERD for my case consist of the entities and their attributes as shown below:

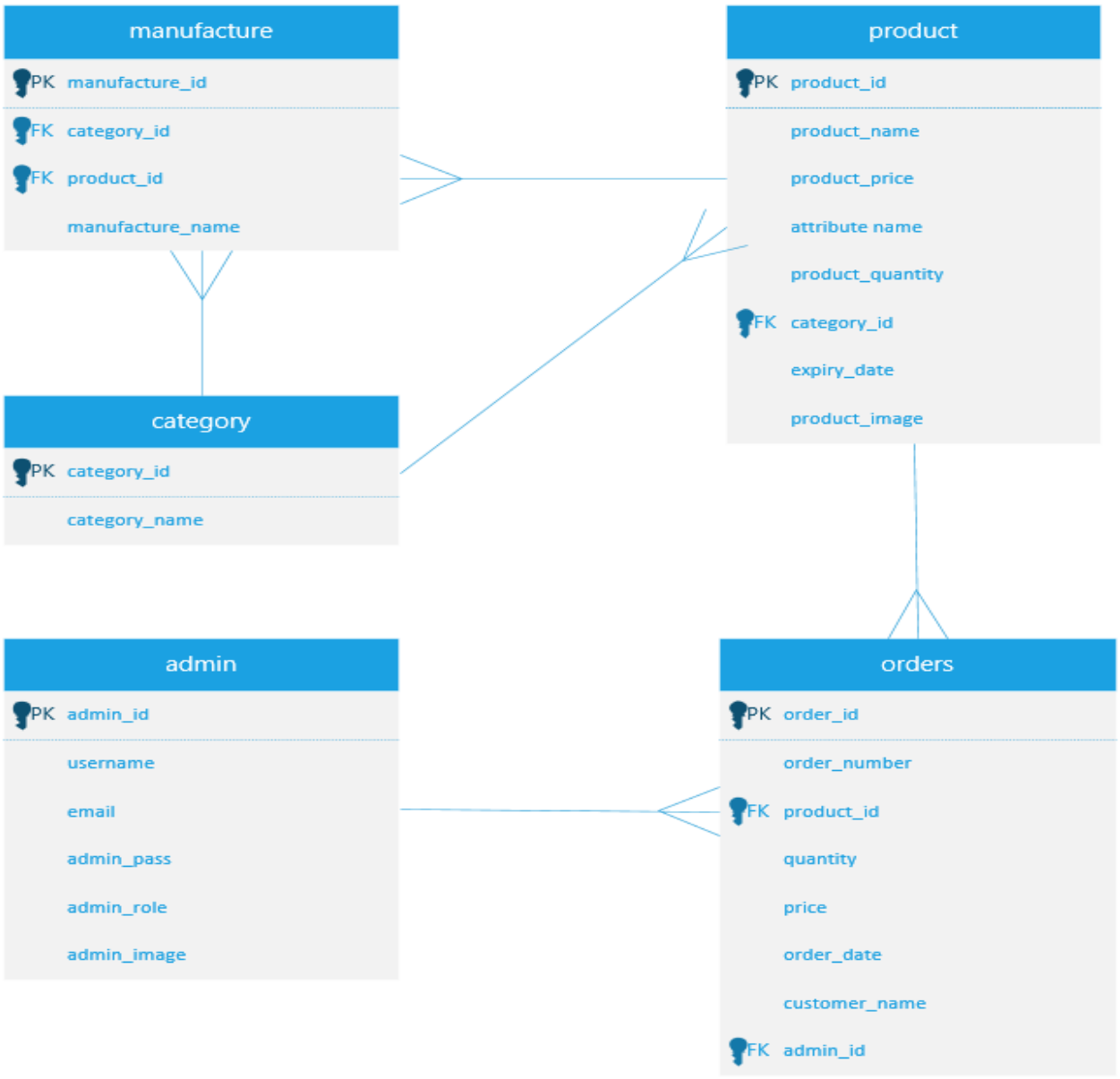

Figure 4.6 Entity Relation Diagram

CHAPTER FIVE

IMPLEMENTATION

5.1 Introduction.

This chapter introduces the research findings and the actual presentation of the final system. It further shows the various interfaces that the users and going to interact with.

5.2 Access/ security.

This is the login page of the system where users prove their authenticity to gain access and use the system

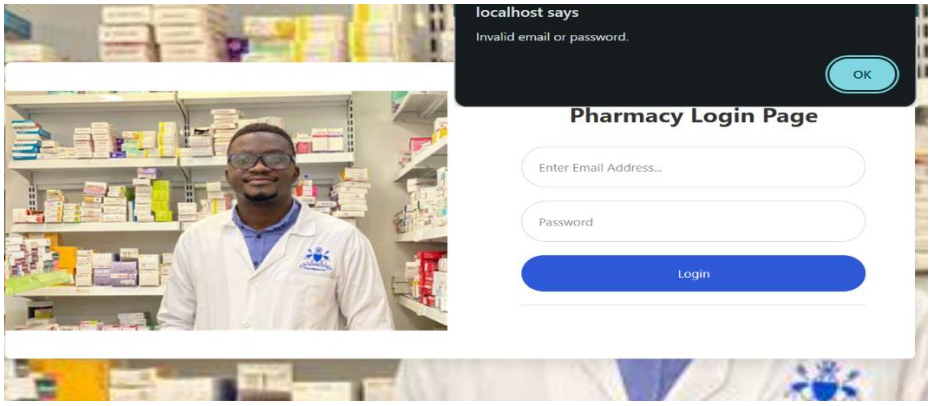

Figure 5.1 Login Form

The user is required to prove his/ her authenticity by entering his/her email and password as shown above. The system them compares it with what is stored in the database, If it does not match then error message is displayed as invalid email or password denying access to the system and the user is prompted to enter correct email or password.

5.3 Dashboard.

The dashboard displays the summary of current status of the pharmacy's inventory value

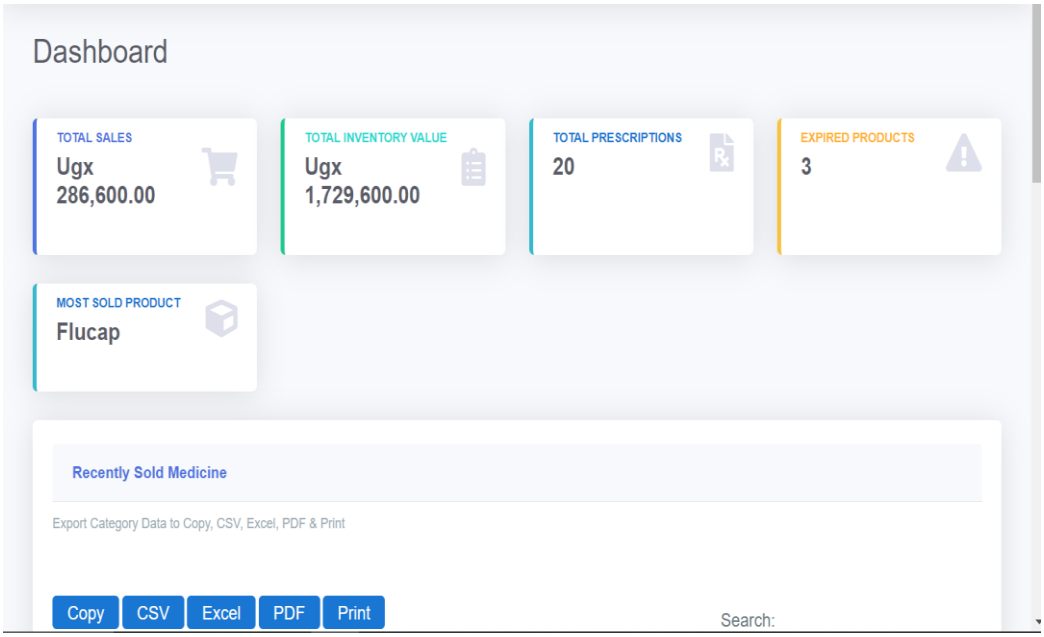

Figure 5.2 Dashboard

How it works

It provides alerts for expired drugs, tracks prescriptions from the moment they are received, provides detailed sales report and tracks inventory value

5.4 Registration form.

This is where new user's information such as username, email, password role and image are provided by the admin,

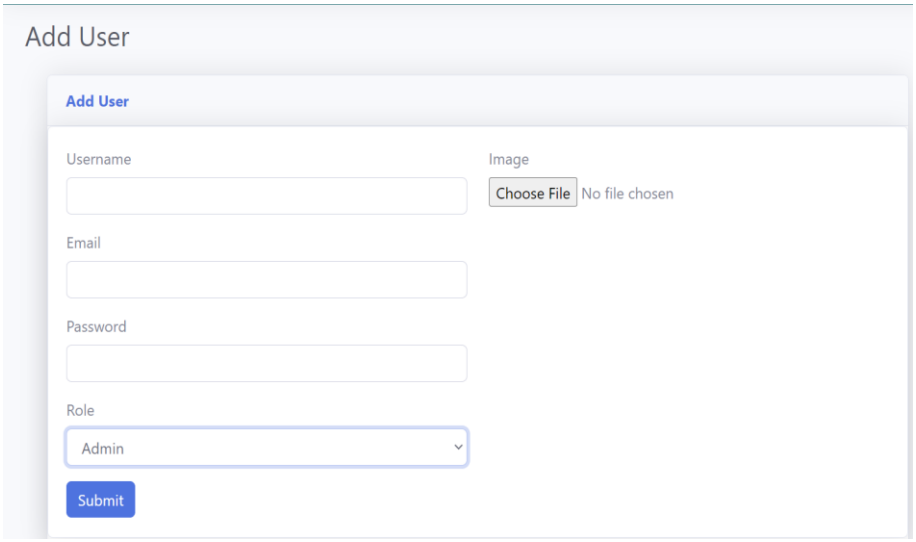

Figure 5.3 Registration Form

How it works

The form has input fields mandatory in nature with validation checks in e-mail input field which ensures correctness of the e-mail address when user information is being collected. Once all the required information is collected, the admin can submit the form by clicking on submit button, this information is then stored securely in the systems database. The email and password are then used for future access to the system.

5.5 Add product Form

This form allows authorized users to input information about new products by typing in the products details in the fields provided as shown below

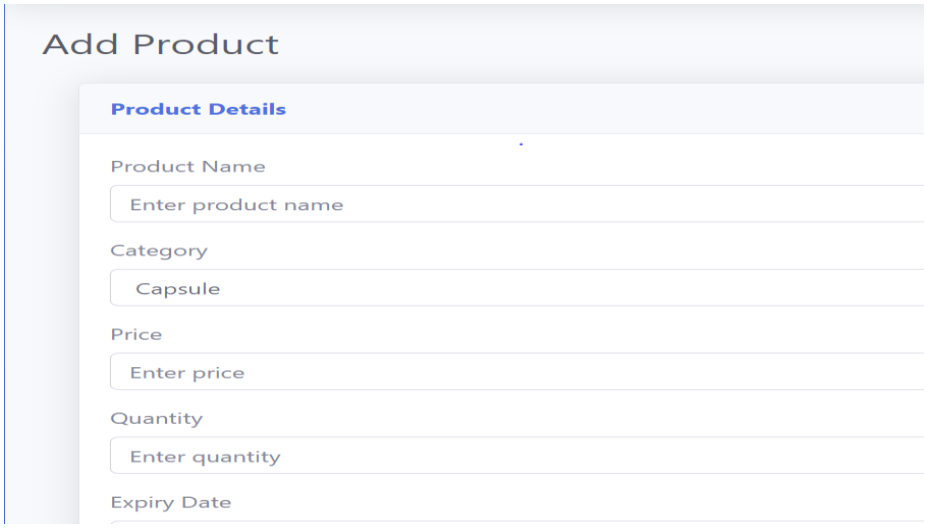

Figure 5.4 Add product Form

How it works

Authorized users access the add product form through the inventory management section.

The form contains various fields to capture detailed information of the product. Once this information is entered and submitted, it is then stored in the pharmacy's database and can be used for inventory management, sales and other purposes in the pharmacy.

5.6 Order form

This is a form used to place orders for medications for patients.

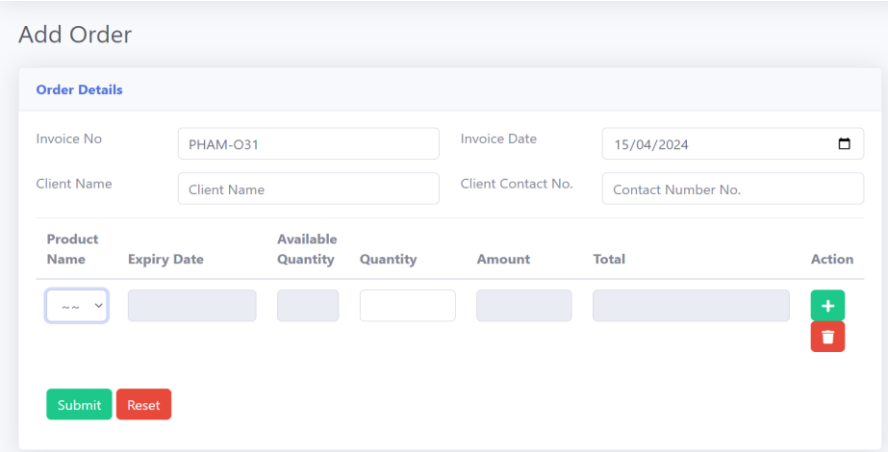

Figure 5.5 Order Form

How it works

Users enter customers/ clients name and contact number, selects the product name from the dropdown list, the system displays the selected product's expiry date, available quantity and amount, user enters quantity requested by the customer and the total amount to be paid is auto calculated. One the user submits, the order is stored in the database and can be printed to PDF.

5.7 Reports

5.7.1 Sales report

Sales report provides an overview of sales activities over a specified period.

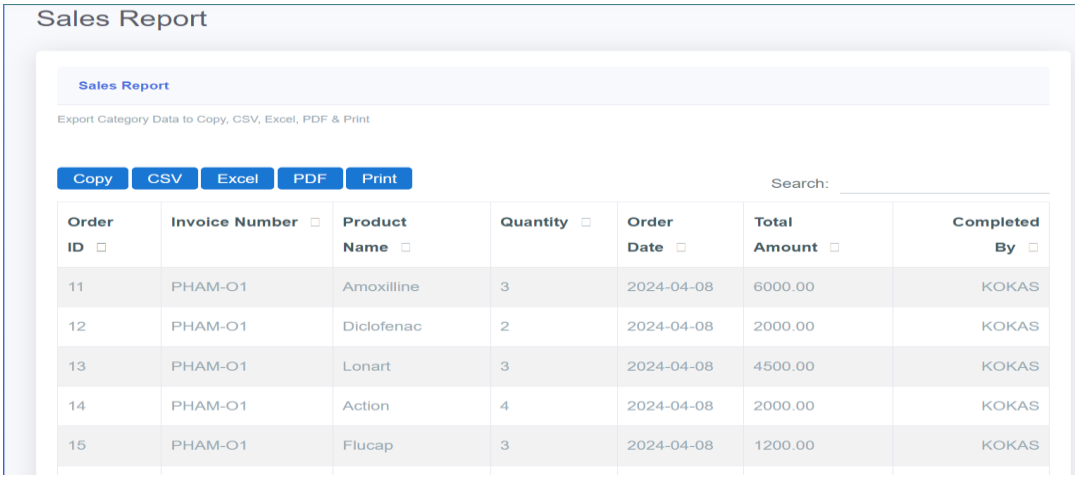

Figure 5.6 Sales Report

How it works

The user configures the report by selecting various parameters like date range, sales categories, once and the parameters are set, the system retrieves and processes the relevant data from the database. The processed data is then used to generate sales report which can be directly displayed on the dashboard or exported to various formats such as PDF, Excel or CSV for further analysis or sharing.

5.7.2 Product report

A product report provides insights about products in the inventory.

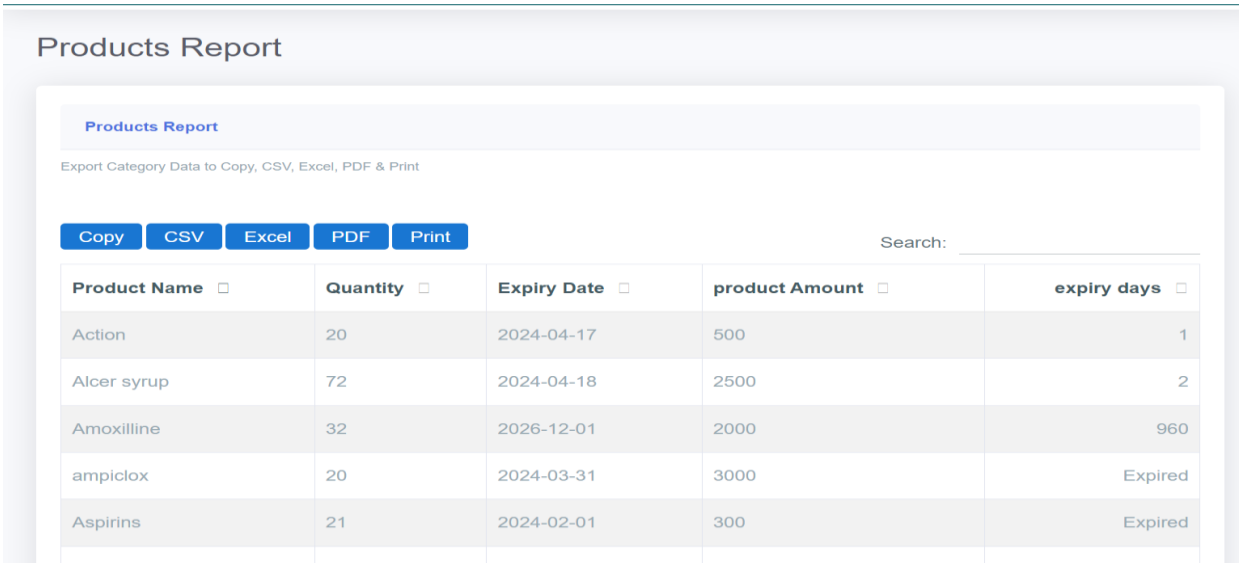

Figure 5.7 Product Report

How it works

The user configures the report by selecting the various parameters like date range, product category or suppliers, once the parameters are set, the system retrieves and processes the relevant data from the database. The processed data is used to generate the report as shown above and can be displayed directly on the dash board or exported to different formats such as PDF, Excel or CSV.

5.7.3 Expired product report

An expired product report tracks and manages products that are nearing or have reached their expiry date

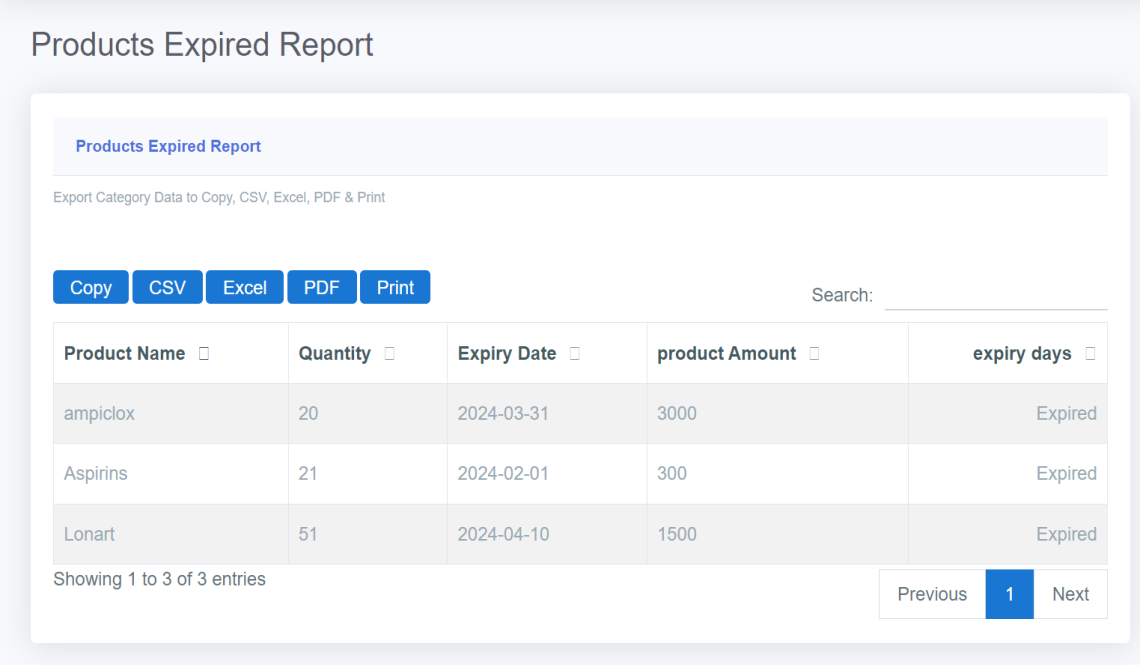

Figure 5.8 Expired Product Report

How it works

The user configures the report by selecting the various parameters like date range, product category or suppliers, once the parameters are set, the system retrieves and processes the relevant data from the database like batch information. The processed data is used to generate the report as shown above and can be displayed directly on the dashboard or exported to different formats such as PDF, Excel or CSV.

5.7.4 Recently sold product report

A recently sold product report provides detailed information on products sold within a specific recent time frame.

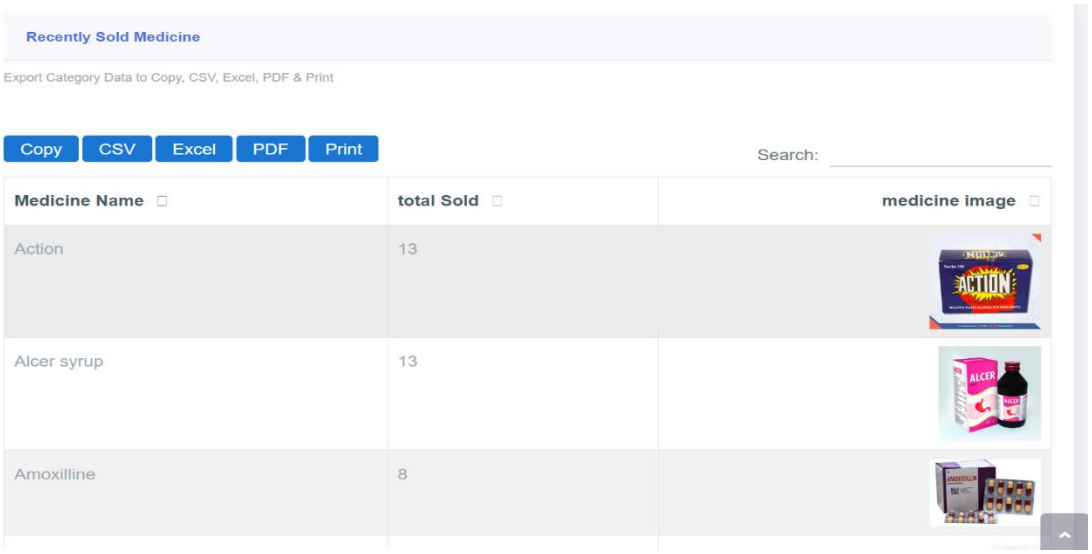

Figure 5.9 Recently sold Product Report

How it works

The user configures the report by selecting the various parameters like date range, product category or suppliers, once the parameters are set, the system retrieves and processes the relevant data from the database like sales details, product details. The processed data is used to generate the report as shown above and can be displayed directly on the dashboard or exported to different formats such as PDF, Excel or CSV.

CHAPTER SIX

CONCLUSION, SUMMARY AND RECOMMENDATIONS

6.1 Introduction.

This chapter presents; discussion, conclusion, recommendation and future work

6.2 Discussion of results.

The discussion of results was guided by the objectives of the study that includes,

(i). Review the literature and determine the requirements for the pharmacy management system.

(ii). Design the pharmacy stock management system for Lodbey pharmacy.

(iii). Implement the system for Lodbey pharmacy.

(iv). Test and validate the functionality and efficiency of pharmacy inventory management system.

The theme in objective (I) was to determine the requirements for the system. In the study, the data were collected and analyzed from which system requirements were determined and broken into functional and nonfunctional requirements. This is presented in chapter 4 section 4.5.1and 4.5.2.

This is in line with the work (Okoli and Schabram 2015) who said that in developing information system, one must first determine the requirements of the system.

The second theme was to design the system. In this study, system design follows these stages; system architecture section 4.6.1, context diagram section 4.6.2, Data Flow Diagram (DFD) section 4.6.3, use case diagram section 4.6.4 and Entity Relationship Diagram (ERD) section 4.6.5.(Nurrahman, Husen *et all*. 2020) stated that to come up with a given system, one must design the system starting from system architecture, context diagram, DFD, use case tables as detailed in chapter 4

The third theme was to implement the system. In this study, the system implementation followed structured analysis and design approach as described in chapter 3. This included coding the system modules, integrating them and performing initial debugging as detailed in section 3.6. According to Sommerville (2016), System implementation involves

translating the system design into executable program, integrating different modules and ensuring that the system operates as intended.

The fourth theme was to test and validate the stem, testing was conducted in two in two major phases: Unit testing and integration testing as detailed in section 3.7. Mayers, Sadler and Badgett (2011) emphasize that thorough testing is crucial for identifying and fixing defects to ensure the sytem meets the specified requirements. Unit testing focused on individual modules integration testing ensured that the combined modules functioned correctly.

Validation user acceptance testing and performance evaluation as detailed in section 3.7. According to Pressman and Maxim (2014), validation ensures the system meets user needs and performs efficiently under real world conditions. UAT involved end-user testing the system to verify that it meets their requirements while performance evaluation measured the system's responsiveness and stability under various load conditions.

6.3 Conclusion.

Effective implementation of this pharmacy inventory management system will take care of the basic requirements of the pharmacy inventory management system because it is capable of providing easy and effective storage of information related to activities happening in the pharmacy. With these, the objectives of the system will be achieved.

In order to allow for future expansion, the system has been designed in such a way that will allow possible modifications as it may deem necessary by the pharmacy management, whenever the idea arises.

6.4 Recommendation.

Based on successful implementation and positive outcomes observed with the pharmacy inventory management system at LodBay pharmacy, I recommend that:

All pharmacies use this system for their inventory management to improve on the operational efficiency.

This work be used as source of literature by other researchers for the next studies on this same area.

Integrate the inventory management system with other pharmacy systems such as point of sales (POS), electronic health records (EHR) and supply chain Management.

6.5 Limitations and future work.

There are some drawbacks and limitations to this system as it is a better release and under further development process.

The study was conducted at singe private pharmacy which may not represent the diversity of operational environments and challenges faced by other pharmacies especially government pharmacies. Therefore future researchers can also carry out their studies on government pharmacies in cooperating AI (Artificial Intelligence) and ML (Machine Learning) that is developing algorithms that predict inventory needs based on historical data, seasonal trends and emerging health threats.

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APPENDICES

Interview questions

The followings are some of the interview questions that I will use for gathering information.

To the manager LODBEY PHARMACY.

Background of the pharmacy

1. When was the pharmacy started?
2. Who started the pharmacy?
3. How long has it stayed in existence?
4. Where is it located?
5. What is the organization structure of the pharmacy?
6. How many are you in the managing committee of the pharmacy (when the manager is not around?)
7. How many workers do you have in your pharmacy?
8. For how many hours do your pharmacy operate?
9. Do you have people who always come to buy drugs from the pharmacies can it be retail or wholesale?
10. What is the estimated number of customers/patients do you always receive per day?
11. How do you always keep your records in the pharmacy?
12. Which kind of services do you always offer?
13. How do you always manage your drugs?
14. What do you always use for advertising your pharmacy so that people from very far can realize that it does exist?
15. How do you always manage your competitors who also have clinics, and other pharmacies around?
16. How do you always get to know that the drugs are out of stock, the alert which always get to know that the drugs are expired?
17. What are the major challenges you always face in the process of managing records, drugs and even your patients?

18. What possible solutions should we jointly as manager and I as a student use to improve the efficiency of the pharmacy?

To the pharmacists

1. How may are you (you as pharmacists exclusive of the manager)
2. How do you realize that the drugs are expired, out of stock?
3. What do you always use to keep your records?
4. Which kind of services do you offer in the pharmacy?
5. What are the major challenges you face as a pharmacist?

To the customers/patients

1. How many times have you bought drugs from this pharmacy?
2. How fair is the pharmacy to you in terms of services?
3. What are the challenges you always face?
4. Do you even receive services at night or it's only for day time?

BUSITEMA UNIVERSITY,

FACULTY OF SCIENCE

AND EDUCATION,

NAGONGERA CAMPUS,

PO BOX 236,

TORORO UGANDA.

THE MANAGER

LODBEY PHARMACY

NAGONGERA

Dear Sir/Madam,

RE: PERMISSION TO CONDUCT RESEARCH IN YOUR PHARMACY

My name is IKWAP Kokas and I'm studying at Busitema University. I am, at present, doing a proposal on developing a software prototype for pharmacy inventory management system based on an android tablet. I am looking for a pharmacy where I could perform a case study for my project and I would be grateful if you could let me use your pharmacy for that purpose.

I trust u will grant me the opportunity and you would be amenable to me using your pharmacy for this purpose. Should you have any question or require further information about the project please don't hesitate to contact either myself, or the University. Thank you

Yours faithfully,

……

Ikwap kokas

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