DEVELOPMENT OF AN ONLINE SYSTEM FOR THE REGISTRATON AND DISPENSATION OF DRUGS

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A PROJECT SUBMITTED TO THE DEPARTMENT OF COMPUTER SCIENCE AND MATHEMATICS, COLLEGE OF BASIC AND APPLIED SCIENCES,
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DECLARATION

I hereby declare that this project has been written by me and is a record of my own research work. It has not been presented in any application for a higher degree of this or any other University. All referrals and sources of knowledge are clearly acknowledged by means of references.

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Date

CERTIFICATION

This is to certify that the content of this project entitled '**Development of an online system for the registration and dispensation of drugs'** was prepared and submitted by **OLAWALE-OLAKUNLE OLUWAPELUMI DEBORAH** in partial fulfillment of the requirements for the degree of **BACHELOR OF SCIENCE IN COMPUTER SCIENCE.** The original research work was carried out by her under supervision and is hereby accepted.

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DEDICATION

I would like to dedicate this project to God Almighty for being faithful and merciful throughout my four years studying in this Institution, and for seeing me through thus far. I also dedicate this work to my Father, Mr. OLAWALE-OLAKUNLE and my mother, Mrs. OLAWALE-OLAKUNLE OLAJUMOKE and my siblings, OLAWALE-OLAKUNLE OLAOLUWA and OLAWALE-OLAKUNLE IYIOLA for their great supports. I finally dedicate this project to my dearest friend ATORO TOLUWANI DANIEL for being supportive and encouraging.

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ABSTRACT

This study's objective is to develop an online system required for the registration and dispensation of drugs using computer programs that obtains drugs supplies, distribution of drugs and monitors the drug stock management using Mountain top university as a case study. The study identified the various user and system requirements, specified the system design and implemented the system.

A review of the literature was being done to identify and understand existing registration and dispensation of drugs using online systems.The system and the user specifications of the systems were identified from system users using informal interviews. The database of the system was implemented using Local db (Mysql). The execution of the frontend was done using pug view template and CSS. The backend was implemented using Node JS, Express JS Decentralized application (dab) and Transaction MEAN.

The results of the system showed the implementation of the system's database for storing the information alongside the front-end of the web and mobile application. The results revealed that the system was able to uniquely identify each user's profile, drugs.

The study concluded that using the system within the School, Mountain Top University mitigate most of the challenges associated with monitoring the students usage of drugs especially with the rules on curbing the abuse of illegal drugs or substances within the School premises.

Keywords: *Information system, online system, Database management system, Pharmacy.*

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CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Information technology explained the use of computers and its related devices to manage processes. It is challenging to imagine a process, business, or action today that could not have benefited from the many advantages of the computer system. Since the development of the computer, using a computer to control processes or equipment has been commonplace. Using computers, 20th-century inventors attempted to simplify procedures. Secondly, computerization has been heavily utilized in controlling processes that call for regular action, such as drug administration, management, delivery, and ordering in the clinic using online systems.

This project, which is a developing an online system for the registration and dispensation of drugs, creates an affordable, user-friendly application with key data integrity and system security features suitable for use in the clinic department. The main objective of this project is processing data as efficiently and quickly as possible in order to run a standard application. Data consistency and integrity will all be guaranteed by this method.Chemical substances known as drugs are given to patients for prophylactic and curative purposes. Given that it is a essentialcomponent of healthcare, it is also referred to as a medicine.Computers are useful in management operations because they can store and retrieve information very quickly and effectively. Drug delivery, monitoring, ordering and information management are all part of the drug management process. While drug procurement refers to the actions carried out by the organization's medical department in terms of ordering drugs, drug distribution refers to the distribution of medications throughout the various medical departments or units inside a Medical center. The continuous examination of the

actual quantity of pharmaceuticals kept in the hospital pharmacy or any other drug warehouse/store is an issue with drug management. Additionally, it manages stock levels.

The hospital's pharmaceutical unit handles drug management tasks. By creating an annual, monthly, weekly, or daily list of the pharmaceuticals needed and management reports, they fulfill the task of choosing the right drugs to use. However, some hospital pharmacies still operate using a manual approach, which might result in inappropriate drug management mistakes since it is difficult to handle a significant amount of paperwork quickly. Due to this, data may become easily inaccessible, and medicine deliveries may result in the loss of patient records.

1.2 Statement of problem

The normal activities of drug acquisition, monitoring, administration, and information management are carried out in numerous hospitals across Nigeria. There are several issues with this manual approach to these routine tasks, from improper handling of student drug data, a lack of an effective information storage system for drugs and drug dispensaries, delays, to the challenge of retrieving student records and drug-related data. It becomes vital to develop an online system for the registration and dispensing of pharmaceuticals in light of all these issues.It is vital to establish an online system for the registration and administration of pharmaceuticals in light of all these issues. By computerizing the normal procedures in our medical centers, this research initiative aims to remedy this.

1.3 Aims and Objectives of the study

This research project's objective is to create and put into place a computerized online system, monitoring system for drug acquisition, and administration system.

The intended outcomes are to:

i.   identify existing studies;

ii.   identify the criteria for users and systems

iii.   design the system according to the requirements

iv.   implement the system

v.   test the system

1.4 Methodology of the study

To fully accomplish the objective, the following methods were adopted.

a. A review of literature was been done to identify and understand existing online systems for the registration and dispensation of drugs.

b. The system and user requirements of the system were identified from system users using formal interviews.

c. The system design was specified using Use case diagram.

d. The database as implemented using Local db (MySQL)

e. The execution of the frontend was done using pug view template and CSS while the backend was implemented using Node JS and Express JS.

1.5 Significance of the study

The following are some advantages that can be derived from this work:

a. It will deliver dependable healthcare services.

b. It will assure the administration of the school and the students of receiving real and secure drugs.

c. It will provide an effective and uniform drug distribution system.

d. It will offer a data base for keeping records of the pharmaceuticals that are bought and given out at any given time.

1.6 Scopeand Limitation of the study

The scope of this research work was based on creating an online system for the registration and dispensation of drugs. The study proposes to construct a web application that could be used to manage proper monitoring of the students intake of drugs, registration and dispensation of medications in the School premises. A mobile application that will be used by the users will be developed during the study of this research work.

The limitation of this study include

a. Time limitation

b. Because of the School's rigorous policies, there was reluctance to divulge crucial information that would harm the School's reputation.

1.7 Definition of terms

a. **Database:**is a grouping of data that is logically related and intended to satisfy an organization's information needs.

b. **Database Management Systems (DBMS):**these programs let users create, manage, and control databases.

c. **MENU**: These are list of options that is displayed on the screen, with a short code and a longer description of each option's functions following.

d. **Drug:** a chemical substance that is given to patients in an effort to treat them.

e. **Node. JS:**is a platform designed to make it simple to create quick and flexible network applications. It is built on Chrome's JavaScript runtime. Node. js is lightweight and efficient, making it ideal for data-intensive genuine applications that are running across dispersed devices. It uses an occurrence, no blocking I/O mechanism.

f. **Registration officer:**(Medical staff) is responsible for the final registration of the drugs the students are registering into the health center for proper approval and dispensation, which will be verified by the hostel officer and the admin.

g. **Student:**is a learner who is registered in an institution or other academic environment and whose learning objectives include knowledge acquisition, professional development, and employment in a desired field.

h. **Pharmacy:**a location at a hospital where drugs or other chemicals are housed, produced, and stored.

i. **Management information system:** a group of individuals, a database, and tools created for the purpose of giving managers and other organizational decision-makers access to routine information.

j. **Express JS:** is a backendNode.js web app architecture. It is designed

for building web applications and APIs.

2.1 History of Digital medical files

One of the initial significant health institutions to use an EHR was theClinic Mayo in Rochester, Minnesota, in the 1960s. EHRs were so expensive in the 1960s that the government only employed them in collaboration with healthcare groups. Only the largest hospitals were permitted to utilize them, and they were used for scheduling and billing into the 1970s.

A new method to health records (still on sheet) started to emerge around the same time, in the 1960s. This method, known as the "problem-oriented" health record, provided more detailed information about the patients and eventually developed into the electronic healthcare records we use today. This method marked a development in medical transcription. In the past, medical records often simply contained a patient's condition and the care they received.

The "real concern" of health record required practitioners to start gathering and keeping information about a patient's background. When successfully implemented, this approach provides medical teams a better way to communicate while also making it easier to coordinate upkeep and preventive treatment. EHRs were created with fields that could be filled in with clinical data and saved as an electronic medical record as they became more accessible and affordable in the 1980s.

2.2Review of an onlinemedical system

According to (Aishwarya Nandagawali, 2017)a doctor or hospital can treat a patient online using an online medical system, which is a web gateway. Doctors and hospitals post diseases, symptoms of such diseases, pairs of symptoms, real

diagnoses, treatments, and diet control on this portal. Symptoms or pairs of symptoms can be chosen for therapy based on their age. The patient receives the prescription and a list of local medical stores when the payment has been made, and then chooses the most suitable one. Medicines are delivered to patients' homes. PCs, laptops, and mobile devices can access the service. By downloading an app, users of mobile devices can access this portal's services.

2.3 Review of Information system for pharmacies

According to (Sakineh Saqaeian Nejad Isfahani, 2011) the study, which was conducted on the pharmaceutical information system in use at the chosen institutions, is a practical, descriptive, and analytical investigation. All users of information systems for clinics in the chosen hospitals were included in the research population. The research population and the research sample are identical. The U.S. Society of Health-System Pharmacists, the Australian Pharmaceutical Society, and the Therapeutic Guidelines of the Drug Commission of the German Medical Association served as the foundation for the self-designed checklist that researchers used to collect data. Research directors as well as users and pharmacists of thepharmaceutical information system evaluated the validity of the checklist.

The questionnaires were given out to users and pharmacists of thepharmaceutical information system in order to gather data aside from observation. Last but not the least, SPSS software was used to analyze the data.

Three hospitals had automated pharmaceutical information systems, while 16 had semi-automated ones. With a mean rating of 32.75 in regards to the standards in the guidelines published by the Association of Pharmacists, the Welfare Services affiliated hospitals achieved the highest position in adhering to the input conditions.

While teaching hospitals received the greatest marks for processing standards (total mean of 29.15) and output standards (mean score of 43.95), private hospitals received the lowest ratings (mean numbers of 23.32, 17.78, and 24.25, correspondingly) for these standards.

According to the results, the hospitals that were the subject of the study only partially complied with the input, output, and processing standards connected to the pharmaceutical information system. It is suggested that the formation of a team made up of operational managers, computer experts, nursing informatics managers, pharmacists, and healthcare professionals may help to advance the skills of pharmacy information management so that they can concentrate on the needs of users and health workers.

2.4 Review of tracking system for drug administration and purchase

Not enough emphasis can be placed on the importance of computers in our culture. Health care services have benefited greatly from computing good effects, which have greatly benefited society. The fundamental issue in health development, as medications play a important part in health development technology, is the procurement, delivery, and management of drugs, claims (Silverman, 1990). A process for designing a system for making medical decisions that is based on a variety of concepts for information processing was disclosed by (Jay, 1983).Less than ten years after the dawn of the current electronic computer age, they said, many have tried to use computers' capabilities in the challenging process of making medical decisions.

2.4.1 Drug management system computerization

Computerization simply is the process of changing a manual activity into a mechanical or technological activity so that collected information is no longer done by hand. Integrating cloud computing to medical centers can save prescription costs, improve treatment storage, and prevent the repetition of information, according to a number of works and research. It offers security, quickness, and unique identification of healthcare data. According to specialists, methods for delivering drugs can also give patients particular information about dosage, possible drug reactions, and prescription costs. Computer technology could enhance daily operations in a limited space like the school's health facility. The management of complexity would be simplified. To simplify the manual way of recording data and guarantee sufficient prescriptions of pharmaceuticals to each ward, computerization may be efficiently implemented in prescription stocking, medication acquisition, and drug administration, respectively.

2.4.2 Drug information management system.

Prior to the putting into operation of the National Health Services Corporation, the hospital drug management system involved a clinical medication and diagnostic commission before referring to a healthcare system.

As part of a comprehensive evaluation study on the management of drugs, this committee established a research project on drug management. The committee's goal was to provide a description of the clinic's present medication management system. In 1997, a non-general hospital served as the case study. Their research was focused on administrative levels. The pharmacological department received more or less attention, and this seemed to point to some differences between the responsibilities of pharmacist and doctors in drug administration. This system will offer a drug stock

management system that helps with medicine ordering decisions. Orderable medications were categorized based on how well they worked as treatments. The hospital in the Netherlands adopted this system. Issues with the organization of schools connected to scarce budgetary resources, medicine shortages, and supply shortages. The provincial pooled procurement program (PPPP) was established in 1998 on account of inconsistent drug costs, non-health sectors, and non-compliance with the government drug formulary (PNDF)of the Philippines. The staffs were to check to see that high-quality medications were routinely purchased at discount prices. Drug management information systems can be beneficial in decreasing these errors, which are the most frequent causes of harmful effects on patients (Daniel)

2.4.3Review on Procurement of drugs

In order to reduce supply interruptions and prevent overstocking, medicine purchases should be made on time and in an appropriate quantity. Special medications should only be received and handled by people who have obtained the appropriate training, and all procurement processes should be carried out by trained personnel. Important details about the drug, including its private label and biochemical name, effectiveness, prescription form, registration number, etc., should be compared to the sales contract throughout the drug receiving procedure. A medicine audit should also include the expiration date, package sizing, drug appearance, and handling and storage. Drugs won't be purchased if there are any non-conformity with the drug's appearance, packaging sizing, quantity, etc.(Daniel, auomated drug inventory control system BSc project work, 1997).

2.4.4 Review of Delivery of medications

One of the vital important procedures in clinics is drug delivery. The procedure includes the full range of medication administration, including prescriptions, evaluating, manufacturing, and delivering. The pharmacist verifies the data and delivers a firm medication order in the patient's name to the medical ward when the doctor has prescribed a drug in the patient's name at a specific dosage to support his treatment. Based on this specific instruction, a physician will provide the patient the medications and record the actions. The medical industry labels the medicine packaging with the meds, dosage, sample, and expiration date in order to make the drug distinguishable. The medicine order starts the flow of materials.Drugs are bought from a distributor or the pharmaceuticals company, brought to the clinic, where they are preserved, and then administered to the patient. Either the clinical unit or the regional pharmacists may dispense the medication. When a medication is provided, the patient's information and the medication's information are combined and recorded as a distribution trend.(Colen, 2008).

2.4.5 Softrex medication

The Softrex program, created by pharmaceutical technologies and software in the United States in 2002, is a pharmacy management tool that offers help and assistance to a range of healthcare organizations, including local pharmacies and clinics.

This program has digitized the medicine administration system at this location, which includes:

a. **Patient prescriptions registration;** the prescriptions registration responds as quickly as you type.

b. **Tracking:** The software has an incorporated report writer that is simple to use and enables quick and simple form and report customization.

c. **Inventory;** reporting, purchasing, and delivering are all capabilities of the software.

Its medications, administration, and management of all medical services follow normal contracting.

Additionally, this program offers a mechanism for detecting pharmaceutical errors, quality therapeutic medication, enhanced pharmaceutical productivity, and improved quality control independent of workload or operating conditions. Billing, drug wholesalers, point care medication safety system, and medicine are just a few of the major businesses that Softrex interfaces with. The most complete hospital drug management system now in use is Machines Softrex. It makes it possible to instantly get up-to-date information, proving crucial data that may be quickly presented or printed.

2.4.6 Management information system

It is a well-organized data collection, online databases, persons, databases, and tools designed to give managers in an organization the regular data that they require to make decisions. The transaction processing system's information and details are used to generate a standard report. These management information systems, which first emerged in the 1960s, are distinguished by their utilization of data to generate administrative reports that can be created on an everyday, weekly, month by month, or annual basis (ralph, 1998).

2.4.7 Benefits ofan information system for management

According to (Enwere, 1992),the breakdown of record management programs in organizations has resulted in ineffective administration and the loss of crucial information required for hospital decision-making. Administration of data should therefore be linked with the clinic in order to maintain accurate drug records:

a. A database is viewed as an information warehouse where a lot of data can be kept(O'Brien, 1999). Examples of data that is frequently used in industrial applications include manpower and inventory records. Administration of data is frequently utilized by the average person without them even being aware of it.

b. Changes to the table's schema are possible and independent of platform.

c. (Date, 2003)States that a table's specific data attribute is given a primary key.

d. A number of users can access the database at once. The same information can be accessed simultaneously by several users. Depending on the privileges given to users, the database's data may also be updated.

e. Information security: The most valuable asset, according to (Kenny, 2008), is data. Cyber security is therefore necessary. A database administration system aids with data security.

2.5 Review of Literature

The minds and ideas of researchers and experts on this topic have been reviewed in few related projects that have been worked on. To educate the public especially those in the medical line on how to accurately register and dispense drugs/medications employing scientific and intelligent methodologies. Below are some of these research articles that have been discussed:

2.5.1 An overview of the research on electronic prescribing and its recommended categorization

According to (Tremblay, 2015)a review of literature was done using the e - Journals of Internet of Sciences. Both participants reviewed Studies conducted, mainly quantitative and qualitative, between January 2008 and December 2014 were sought after in the online databases.

Increasing the potency and impact of prescribing and dispensing pharmaceuticals, decreasing prescription errors, and cost savings in the healthcare industry were all cited as important advantages of e-prescribing. Inadequate e-prescribing system implementation can also lead to new kinds of errors that decrease workflow effectiveness, raise drug costs, and endanger patient safety. In this investigation, four major groupings of factors influencing possible errors were identified (human, technical, interaction and organizational errors).

2.5.2 Review on pharmaceutical management system

According to (Onuiri Ernest E.)The administrative system utilizes stringent controls to safeguard users from outsiders or intrusions. One of these metrics is a person's inability to prospective user to sign up for an account on the system without the management' consent. All required information, including identity, residence, tax

records, payment options, and any necessary licenses, must be given to the manager for verification in order to sign up on the site. The administrator creates the customer's account and sends the login information to the management program once the validity of these documents has been established.Additionally, because the drugs ordered through the platform are for pharmaceutical purposes and are therefore ordered in larger quantities, the managers are informed if a little quantity of medication is ordered. They then confirm the order with the pharmacy to make sure an imposter has not obtained their login details.

Online Pharmaceutical Management Systems were the subject of this study. It is crucial that the system provide all parties a trusted, reliable, and certified platform to assist close the communication barrier and deliver legal pharmaceuticals. Security measures have been incorporated to the selected design due to the fact that medications can be hazardous when they are abused or misused by people or organizations. Therefore, careful monitoring and supervision of how pharmaceuticals are distributed as well as a reduction in the distribution of fake drugs will occur if all guidelines are strictly followed.

The result of the Electronic Pharmacological Control System was invented with the intention of limiting personal use. Drug misuse has already been lessened with the use of the program because it is created for pharmacies as a whole rather than being customized for individual use. Furthermore, orders for pharmaceuticals from drug makers can only be placed by authorized users on the program. The system stores every transaction that is made in order to maintain records. Findings from this research indicates that little awareness of or sensitivity to the possibility of using online medicinal apps. Additionally, there isn't much use of these readily available programs (as described in the section on works that are closely related).

2.5.3 Review of online pharmacy: A breakthrough venture

Pharmacists need to be up to speed with the software programs that can further the profession as internet-based technologies is constantly growing. For instance, automated prescriptions, in which your prescription is uploaded over the web or a questionnaire based on your medical problem is filled out on an online platform, anticipated to become considerably widespread in the ensuing decades. The use of electronic medical records (EMR) and other new internet-based applications like direct care are both experiencing tremendous expansion.

Patients can now electronically email their prescriptions to pharmacies thanks to e-prescribing. The practice of transmitting prescriptions through the internet has reduced medication and prescribing errors and led to a decrease in the number of calls that pharmacies make to doctors for clarification. The act of issuing and receiving prescriptions electronically has simplified therapeutic interventions. Patient satisfaction and compliance have improved as a result. The most significant benefit is the reduction in paperwork and associated errors that could arise from relying solely on handwritten prescriptions. E-prescribing aids in streamlining and improving the efficiency of treatmentcare.

(Pooja Gupta, 2022)Reviewed that the level of interaction among doctors and clients significantly changed the outcome of the deployment of an EMR. The quantity of requests for clarification and inadvertent dosing messages has decreased after the deployment of the EMR. The fact that the quantity and proportion of clarification enquiries, interaction notices, and notifications of wrong doses were fewer following

the conducting of the EMR system implies that the EMR improves prescribing safety and is capable of modifying the prescription patterns.The result is, more people requested new medications and more refills were accepted.

2.5.4 Review on automated systems for administering drugs

(Claire Chapuis, 2010)Aimed to evaluate how a medication dispensing mechanism would affect the frequency of pharmaceutical errors associated with drug selection, preparation, and administration in a medical intensive care unit. Additionally, we evaluated consumer satisfaction and the clinical importance of these errors.

The introduction of an integrated dispensing machine decreased overall medication mistakes in the intensive care unit related to drug selection, preparation, and administration. Additionally, the majority of nurses preferred the new medicine dispensing arrangement.

2.5.5 Assessment ensuring pharmaceutical safety by only dispensary data

(Roughead, 2018)Researched on big populations, automated dispensing databases are becoming more and more accessible, especially in nations where medicine is universally covered. These data are frequently used in drug safety studies to detect workforce instances of inappropriate medication use that may be related to well-known safety concerns. The practical application of these data for determining medicine safety may be constrained by the lack of classified diagnoses, inability to identify outcomes, and data on confounders. Studies have taken use of the fact that symptoms of drug side effects can be treated with other medications, such as antidepressants to treat depression or oxybutynin to treat urine incontinence, to get around these problems.

2.5.6 Systematicreview on quality of websites and online pharmacies providing prescription medicines

(Grazia Orizio, 2011)Their study objective was to conduct a current and thorough evaluation of the scientific journals with a focus on the bigger picture of online pharmacies by searching many institutional and scholarly databases without regard to when the articles were published.The findings demonstrate that random samples without any restrictions on the need for a prescription discovered that at least some webpage provided drugs without one and that an online survey was a common method to replace a prescription. Geographical attributes data indicate that many websites can hide this information. The research of medicine offers revealed that consumers can buy almost anything online. Researchers frequently discovered incorrect branding and packaging when it came to medicine quality, but only a small percentage of the study samples had chemical compositions that were consistent with expectations. The majority of research studies on consumers discovered that less than 6% of such sampling had purchased medications online.Due to inherent challenges brought on by the ineffable and ephemeral nature of the Internet and its global scope, their conclusion was that online pharmacies are indeed a significant phenomena that is spreading despite some restrictions. A two-level strategy could be used to maximize the advantages and decrease the hazards associated with online pharmacy. The first stage should be centered on policy, with international laws governing the phenomenon. The individual must be the main emphasis of the second level. The goal of this strategy should be to raise health literacy, which is necessary for choosing healthy options, identifying dangers, and taking use of the many opportunities presented by the medical world 2.0.

2.5.7 Drug evaluation with fiscalized substance distribution and health education and *pharmacogilance*

In Colombia, health problems brought on by the use of drugs laced with taxed substances, including prohibited narcotics, are now a prevalent issue. This issue explained variety of factors, including self-medication given that getting these substances may be simpler. The fact that these medications are safer than illegal ones is also not widely known. Drug misuse, addiction, overdose, and eventually harmful health effects might result from using these medications without a valid prescription and subsequent medical care. To ensure proper medication use and reduce prescription errors so that outpatients can better manage their pharmacotherapy, pharmacy staff is crucial. Because of this, it's essential to improve the knowledge, abilities, and attitudes of the pharmacy personnel. According to(Mauricio Ceballos, 2020)their method wasa retrospective, constellation, linear, multinational trial of pharmacies and drugstores is being conducted in this study (ambulatory pharmacies). The study's objective is to assess the efficacy of a medicine in pharmacies and retail locations with fiscalized substance dispensing, health programs, and pharmacovigilance programs for continuing education. One of the study groups will be randomly assigned to the pharmacy personnel (intervention or control).

For the duration of more than a year, the experimental group will get education and training. The only specific instructions for using complicated dosing schedules correctly will be given to the control group. The main goal isassessing how well a continuing education program works in enhancing pharmacy staff competencies (understanding, abilities, and behaviors) to enhance ambulatory (outpatient) pharmacy

services, including prescription dispensing, education services, and pharmacovigilance of medications containing fiscalized compounds.

The result of this research trial determined continuing education session for the proper use of medications containing fiscalized compounds which enhanced the knowledge of pharmacy staff members regarding these medications.

2.5.8 Teaching Future Pharmacists to Dispense and Check Medication in an Elevated Clinical Setting

(Hamde Nazar, 2019)their aim was to explain how high-fidelity training in drug administration and medical monitoring methods and procedures has been implemented, together with the experiences of student pharmacists.Undergraduate pharmacists had the chance to gain information and skills about the methods and procedures of distributing medications and doing medical checks in a real pharmacy in a large academic hospital. A pharmacy technician team member led the sessions, which were under the direction of a faculty. Students had to fill anonymous hospital prescriptions and perform legal and medical inspections. Students' blogged about their encounters in their forms of assessment, where they were then shared biweekly with the academic staffs. To further understand the student experience, a semantic examination of the blogs was done. According to their result throughout the period of 20 weeks, from September to April, 48 students participated in 30 hours of administering sessions. When 102 blog entries were analyzed for content, it became obvious that students were sharing insights and experiences that corresponded to the three elements of communities of practice: the pharmacy practice domain, the dynamics of a professional community at work, and the common understanding of practice and shared range of skills of resources.

The development of Knowledge of pharmacist trainees and abilities is aided by the high-fidelity instruction of the prescribing and monitoring process to students in a real-world dispensary setting. Students get the opportunity to participate in and observe the professional practice-based community thanks to this approach's work-based foundation.

2.5.9 Review onA tertiary hospital implementing a tele-pharmacy program that includes guided delivery and mobile medicine dispensing.

According to (Esther Vicente-Escrig, 2004)In an ambulatory pharmacological care facility of a tertiary hospital, where about 5000 patients are treated annually, this study sought to detail the steps taken to set up a telepharmacy program with residential medicine dispensing and informed delivery. By examining the findings and gauging patient happiness, it also sought to support the program's applicability and advantages.In addition to the necessity for cooperation with the medical team and patient organisations, we also recognized the organizational, logistic, technical, and legal requirements. A standardized operating procedure that outlined the remote administration concept and the characteristics of patients who qualified for telepharmacy was created. Between July 2020 and January 2021, care activity was assessed. 2536 prescription drug deliveries totaling 2854 dispensing were made during the course of 144 days of work, with a mean of 18 (SD: 6) deliveries each day (1.1 medication per each delivery). Deliveries of pharmaceutical formulations totaling 197 different types and 123 active components were made. The maximum distance and duration conserved per client were 66 km and 90 minutes, respectively, with an inter - quartile (IQR) of 122 km and 90 minutes. This amounts to a decrease in environmental impact of 25 kg of CO_2 each participant and 16.5 tones overall

throughout the study period. The 134 patients who participated in the satisfaction survey said that they were extremely satisfied with the pharmaceutical treatment (9.88) out of 10.

The Extremely acute respiratory epidemic (COVID-19) has given the pharmacy service the chance to create and implement a patient-beneficial telepharmacy program, allowing for better unit organization and increased accessibility for patients who attend in person. It is a repeatable procedure that may be used for different pharmacy services with comparable features and specifications.

2.5.10 a review of Green nanomedicine medication delivery methods based on ecological chemical reactions and nanostructures

(Jahangirian H, 2017)In a new topic known as "green nanomedicine," this review analyzes the effects of ecologically friendly and green chemistry on the administration of drugs based on nanotechnology. According to studies, nanoparticles polymers, and biological agents are among the examples of ecological nanotech medication delivery systems that are attracting the most attention. Additionally, environmentally friendly chemical reactions or the use of natural biomaterials (such botanical extracts and microorganisms) in ecological nanodrug delivery systems are currently developing revolutionary materials that are transforming the industry. The utilization of green chemical design, synthesizing, and implementation principles, as well as environmentally friendly synthesis approaches with minimal side effects, is covered in this review. The analysis concludes with an explanation of important forthcoming initiatives that must be made for this sector to keep expanding.The main contenders for the improvement of more efficient environmentally benign techniques for the manufacture of nanodrug delivery trucks are nanostructure polymers, low-molecular-

weight compounds, and the biologically active molecules listed here. Most green process innovations have produced low-toxic, highly biocompatible materials that were created using botanicals and bimolecular like fatty acids and proteins. As a result, green chemistry techniques have assisted in avoiding one of the major issues that modern NP drug delivery methods face: toxicity. Despite the research that has been highlighted here, it is obvious that much more work needs to be done to create safe NPs for use in medicine, both in terms of the finished item and the method utilized to create such potent NPs.

2.6 Summary

When only drug dispensing data are available, the use of medication beginning as a stand-in for the emergence of harmful incidents can aid in the production of evidence about the safety of medications. The accuracy and responsiveness of the substitute medication for the adverse event, however, should be carefully considered, as well as the possibility of time-varying confounding brought on by trends in the use of medications. Safety assessments could be improved by data-mining techniques that use dispensing data, but further research is needed to address the problem of unmeasured interference with these techniques.

CHAPTER THREE

METHODOLOGY OF THE STUDY

3.1System design and implementation

The corpus of concepts, regulations, beliefs, techniques, and procedures known as the Software Engineering Methodology (SWEM) is used to govern software development projects(O.E, 2009).

He divided software development into the subsequent groups:

a. The method of practical system analysis and design (SSADM)

b. Myths surrounding object-oriented analysis and design (OOADM)

c. Prototyping Techniques

d. Master System

3.1.1 Methodology for structured analysis and design

This process was used to produce the project work (SSADM). Investigating the current system, defining the new system, establishing constraints, and detail design documentation that should include the following are all part of the pragmatist scheme design and evaluation technique.

a. Cost-benefit-schedule reports are provided for each appropriate system.

b. A database is needed

c. Hardware and staff physical requirements

d. The need for conversion

The SSADM methodology incorporates innovations like system flow diagrams, task stages, and programme descriptions that improve organization for computer implementation.

a. Prototyping Techniques

b. Methodology for Object-Oriented Analysis and Design

c. Methodology for pragmatic system design and evaluation

3.1.2 Expert System

Expert system approach is a form of software development methodology where a collection of algorithms misrepresents coded information to address issues in specialized fields that typically call for human subject matter experts. This method collects knowledge from authoritative sources and encodes it in a way that is usable by systems. It required extensive training and work in a specialized field, such as system configuration and medical.

Some expert system flaws include the fact that understanding rather than data was employed to guide the problem-solving procedures. The information was represented symbolically and preserved as a separate entity from the control program, together with meta information (information about information).

3.1.3 Prototyping

A software development approach known as prototyping allows developers to work on larger chunks of the solution to test functionality and make necessary adjustments before creating the final product. It produces a "throw away" solution that is made specifically to test user functionality and demonstrate capability, therefore it is somewhat comparable. The development phase can check comprehension of the requirements and verify that the suggested solution is in line with business requirements by using prototypes. This kind of methodology is frequently employed

or works exceptionally well with web-based business intelligence analytic requirements and transaction processing system (TPS) development.

Some of the steps or ages of a traditional computer system's services include:

a. Problem identification/recognition

b. Possibility analysis

c. Assessment

d. Execution

e. Validating

f. Renovation

Programming is done throughout the system development process' implementation step. Checking, computer virus, conversions, trade, anda change in ownership. While maintenance looks after making sure the system is functional following the switch from the old system to the new one(O.E, 2009)

3.2 Data collection

There are two main types of data collecting used in this project's study work: primary collection and secondary collection. These two types of data collecting were used to create this study.

3.2.1 The primary collection

The initial collection of information or research unit from which data is to be acquired firsthand by survey, assessment, observations, and survey questions completion is the primary collection, further known as the interview technique. However, in this instance, the researcher exclusively speaks with the Head Doctors, Nurses, and Medical Staff at the Health Center to review and share their experiences

regarding the issue with the current system. This allows for the collection, analysis, and recording of relevant information. In order to collect crucial data for analysis and recording, questionnaires were also sent to the medical personnel and doctors.

3.2.2 The secondary collection

In contrast to the primary collection, the secondary collection uses an indirect way to gather data. Here, the researcher examines the forms and existing documents. Data was gathered and the medications master listing file as well as patient's medical forms was examined. Use current literature, research reports, internet downloads, and other resources to further your understanding of the diagnosis system.

3.3 Design and evaluation of the existing system

System analysis is the technique of looking into, analyzing, designing, installing, and evaluating an information system in order to make changes. The fundamental goal of a System evaluation will look into the needs of the Health Center by taking into account what the health center is doing, its issues, and potential solutions. Medication information system, with drugs piled up against the system's front (manual).

3.3.1 The Institute of pharmacology

This department oversees the health center's drug distribution, acquisition, and information system. The upkeep and supervision of drug distribution and procurement at the MTU medical center is under the direction of the director of pharmacy. Drug distribution, proper purchase, and inventory management are among this module's functionalities. The pharmacy modules make sure that sufficient supply of medicines,

commodities, and resources for the clients in a manner that neither impedes effective clinical practice nor poses a threat to the pharmacies' capacity to stay in business.When drugs arrive, a inspectors team under the direction of the director of the clinic examines the medications, makes evaluations, and fully supports them before they are required to register and stored in the pharmacy original store. Drugs typically enter the pharmacy department through multination's and also from private nonprofit pharmacies.

3.3.2 Patient drug management

Patients who are admitted to the health center for treatment for a specific amount of time are referred to as inpatients; and obtain their medications from the bedside supplies. The nurses access and review the incompatibilities, potential medication effects, medication dosage, and recordings of all the information in a folder record for patients.

3.3.3 Drug procurement system in the health center

A purchase order is given to the best supplier for the provision of pharmaceuticals after the doctors make a yearly budget demand for drugs to vendors and request several quotes. A team from the controlling body is given medications, including the following, for selection:

    a. The Health Center's performance data

    b. Safety and efficacy demonstrated.

    c. A preference for well-known medications.

3.3.4 The patient medication sheet and treatment

Each document includes details about the medications prescribed to the patients. Each patient's treatment is scheduled by the nurses, who also give out a permanent medication record.

3.3.5 Present system approach to drug management

The health center has a drug supply chain, drug stock management system, and medicine supply system in place at the moment; however drug management is being done manually.

I. **The System for Purchasing**

In addition to buying, procurement also entails determining the needs of the organization. The following are the procurement system's input requirements:

a. Medicine name

b. Cost

c. Quality

d. Deliveries

e. Drug description

f. Drug source

g. Distributor

h. Purchase contract

i. Quantity

j. Date of manufacturing

k. Expiration date

l. Receipt ticket

II.   Drug Inventory and Classification

Drugs are grouped based on how they are used pharmacologically. They are kept in the main company's records, which include:

a.   Medication name

b.   therapeutic use

c.   identification numbers

d.   quantity

e.   place

f.   total yearly usage

g.   unit of measurement

h.   Characteristics

i.   Date of purchase

III.   The Sale of Drugs

a.   The inputs specification

b.   Name of drug

c.   dosage issued and returned

d.   supplier unit

e.   data and the issuing or reissued time

IV.   Treatment and drug histories for patients

a.   Identity of Students,

b.   Level of Students,

c.   Date of Prescription,

  d. Age, Height, and Weight of Students,

  e. Prescription,

  f. Room Number, and

  g. Date of Admissions

3.4 Limitations of the existing system

a. Staff arriving late to work, as a result, medication is delivered to students after it should have.

b. The result of the yearly technique of recording, which is laborious and occasionally results in inaccurate data recordings

c. A lot of files make it challenging to find a specific date or record, which may cause the delivery of medicines to be delayed. Additionally, certain files can go missing.

d. The reality that it is impossible to choose out outdated medications that can endanger students.

e. Keeping precise records on the quantity of drugs and students.

3.5 System design

  The system evaluation is the technique through which data derived from analysis is combined with pertinent knowledge to accomplish the desired result.

A determined effort was undertaken to provide solutions that would be compatible with the goals of the research because the new system is focused on how to construct automated inventory management systems.

  Therefore, the software's design will assist the user in achieving the following goals.

a. Provide a form that can be used to submit data into the system.

b. Create a report that the management will find more useful.

c. Creating menu-driven software to organize and use the forms properly.

d. Design a modular programming interface that will make debugging simple.

e. Create a system that will operate very quickly.

3.5.1 Expectations of the new system

Due to issues found, a new tech will be created to simplify issues with manual drug (information) entry, file placement, patient prescribed monitoring, and document papers for improved administration and distribution of pharmaceuticals, allowing the system to be;

a. Versatile

b. user-friendly

c. simple to use

The following must be achieved;

a. To order medications without accidentally buying more than is necessary.

b. To be aware of the amount of medications still in stock.

c. To stop the sale of outdated medications.

d. To guarantee the accuracy of drug records.

3.5.2 Design of the new system

The construction of a system with creative benefits and enhancements that are superior to those attained over named produces is among the aims of software design, which is a creative work.

Programming languages are used by software developers to create their software and write their programs. I used CSS and pug view template as the front end of my software and Node JS and Express JS as the back end to access my database. It is the main stage of this design that interests me, and at that stage, I focused on the users and the level of complexity of their activities. This design is more of an internet backbone relational model, which establishes relationships and connections between the jobs of different workers.

3.5.3 File specification

3.5.3.1 File operation

Other sub-models, such as payments and drug acquisition, are included in this module. This module regulates all the steps taken during establishing pharmaceuticals and the way they are obtained.

3.5.3.2 Edit menu

This feature functions more like a document management menu where medications can be searched for or seen in the database as well as upgraded, discarded, and added with new features. The upgrade drugs, delete, search, and to save drugs comment section are included.

3.5.3.3 Administrator

The software assets component is another name for this module. It is made up of the administrative set, the log-in and log-out sections, and the Edit authentication of the user comment section. It aids in managing software assets by enabling the initiation, alteration, and termination of passwords. The password as a whole aids in restricting access to the program. Access to the complete menu is provided by this module.

3.5.4 The registration form

All medications must be registered using this form. Using this form, the clinic registers all medications that have been given the go-ahead for usage. Information regarding the drugs, their maker, varieties, administration, and placements are all covered in this form.

3.5.5 Drug statistics and stock balancing

Medication statistical data provide information about the medicines with in the system, their estimated price, the pharmaceuticals that are still available, etc. This relates to the managerial issues.

3.5.6 Program assets

The forms to create, update, and delete passwords are all included in the application assets file. All of these forms assist in limiting each user's access rights by requiring a password. The system's users with access levels that will allow for control are given passwords by the administrator.

3.6 DATABASE FILE

Table 3.1: Login Menus

FIELD NAME	DATA TYPES
User id	Varchar
Pass code	Varchar

Table 3.2: Drug Table

FIELD NAME	DATA TYPES	FIELD SIZE	CONSTRAINTS
Medicine name	Text	25	Primary
Manufacturing date	Text	25	Required
End date	Text	25	Required
Total number	Text	25	Required
Add new	Text	25	Required
Save	Text	25	Required
Delete	Text	25	Required

Table 3.3: Procurement Table

FIELD NAME	DATA TYPES	FIELD SIZE	CONSTRIANTS
Medicine name	Text	25	Primary key
Amount	Text	25	Required
Order	Text	25	Required
Delivery	Text	25	Required

Table 3.4: Drug Distributions

FIELD NAME	DATA TYPES	FIELD SIZE	CONSTRAINTS
Medication name	Text	25	Primary key
Amount issued	Text	25	Required

Table 3.5 Student Medications

FIELD NAME	DATA TYPE	FIELD SIZE	CONSTRAINTS
Name of the student	Text	25	Primary key
Level of the student	Text	25	Required
Dosage of the medicine	Text	25	Required
Card number of the student	Text	25	Required

3.7 Database design of the healthcare management system

The Database design of the healthcare management systemfigure 3.1 described below, presents users of this system and the various actions that they can perform on the system. It also talks about their different roles, and conditions for each actor to perform various activities and for those activities to be termed as successful.
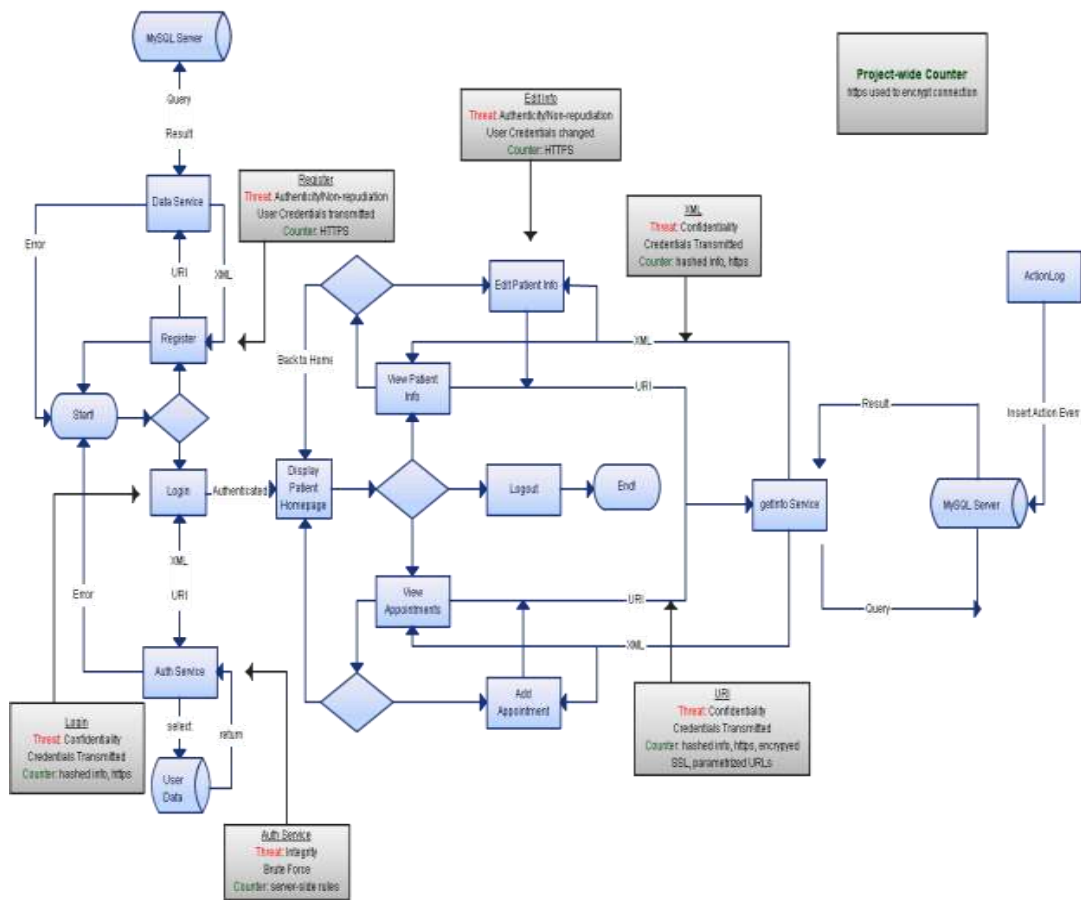
Figure 3.1: Database design of thesystem

3.8 Design of the system's architecture

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The process of determining the components that makes up a system, as well as the framework for component control and communication, is known as architectural design.
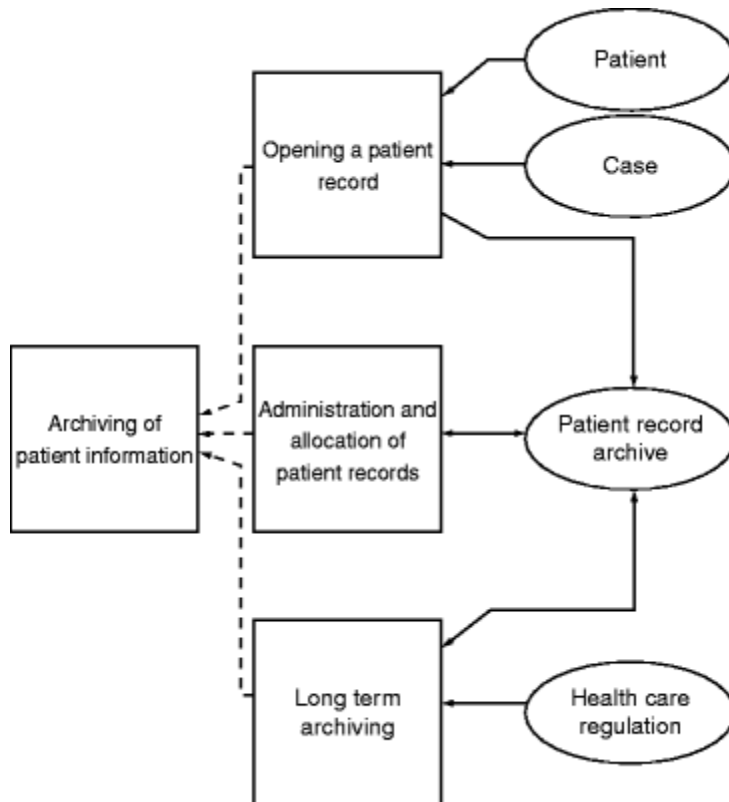
Figure 3.2: Design of the system's architecture

3.9 Flow chart design

A picture that showsa procedure or workflow is called a flowchart. A graphical representation explanation of an algorithm is another way to define a flowchart. or a method for addressing a problem step-by-step.
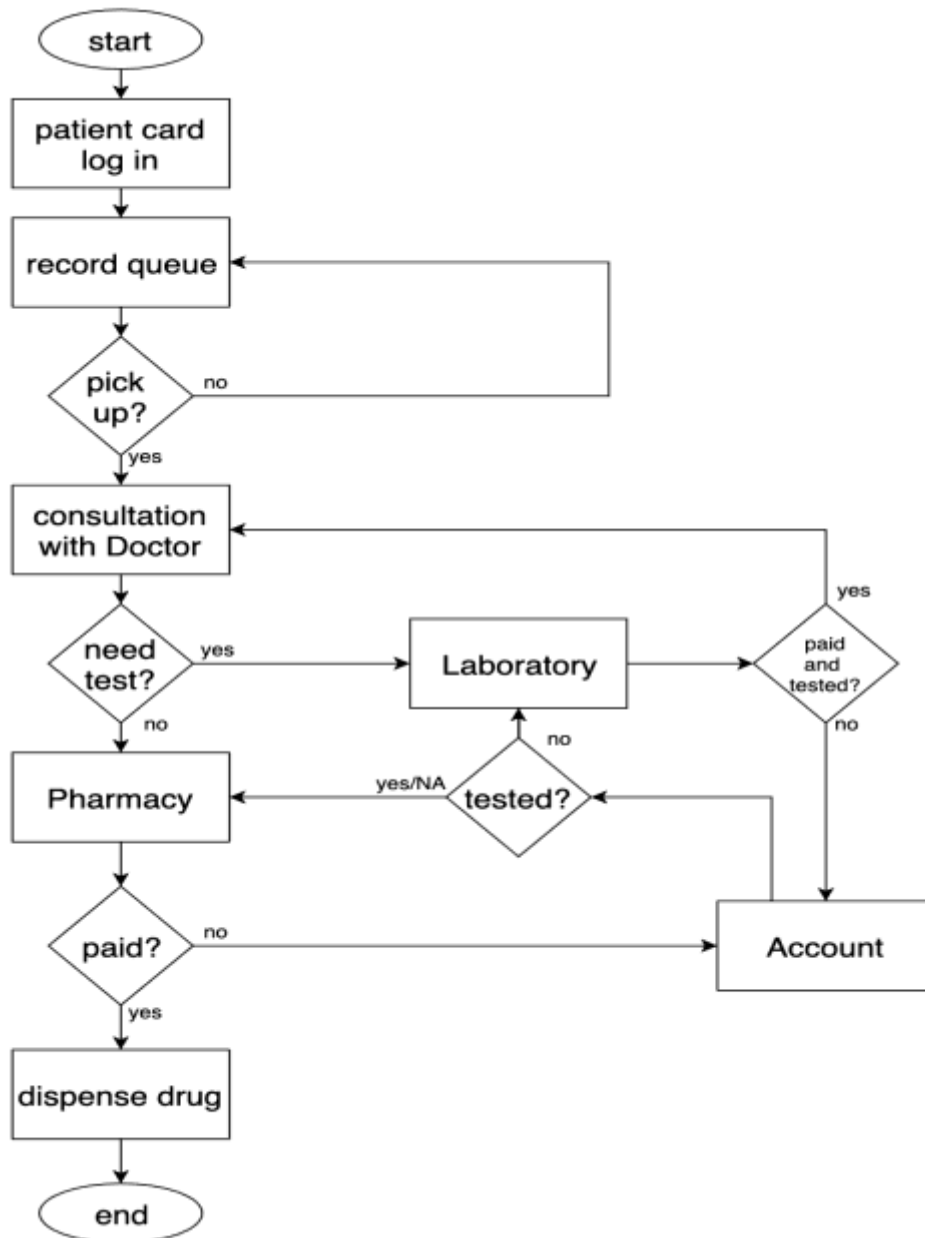

Figure 3.3: Design of the system's flowchart

CHAPTER FOUR

IMPLEMENTATION AND RESULT

To ensure a standardized object oriented program in its entire ramification, Node JS and Express JS was used as the software's front end while the back end using the pug view template CSS. My interest in this design stems from its primary stage, during which I concentrated on the users and the degree of intricacy of their actions. This layout is more akin to the relational backbone of the internet, which creates links and relationships between various workers' jobs.

4.1 Objectives of the design

   i.   To order medications without accidentally buying more than is necessary.

  ii.   To accurately inventory the medications.

 iii.   To stop the distribution of outdated medications

 iv.   To guarantee that drug records are accurately kept

4.2 System Requirements

The main requirements for this system's efficient operation can be divided into two categories: hardware requirements and software requirements.

4.2.1 Software Requirements

The following software must be installed for the new design to be implemented properly:

  a. Vs code IDE.

  b. Xamp fro Mysql database.

  c. Antivirus software (updated).

4.2.2 Hardware Requirements

For the new design to function properly, the following hardware is required.

They consist of:

a. A complete computer system having at least a Pentium II processor and a sizeable hard drive with a minimum capacity of 2GB.

b. A networked setting to ensure that information and documents are gathered and stored on a centralized data storage device.

c. The user-accessible resource, such as printer, faxes, scanner, etc., can also be connected.

d. A 15" colorful svga monitor.

e. An enhanced keyboard.

f. CD-ROM 48X and above, f. 3.5(1.44) FDD Drive,

g. Improved parallel or sequential mouse.

h. Memory of at least 128 megabytes.

4.3 Implementation

System Execution is the act of the actual installment or establishment of a new or upgraded program that has been created to ensure its functionality. If the program is not put into use after design, the academic research will be useless. Thus, there is an endeavor to record all the required measures required to complete the design, as well as the provision of adequate documentation that would aid in the installation of the new software, in order to ensure the successful implementation of this data analysis work on developing an online system for the registration and dispensation of drugs at the clinic for the project.

The two main phases of software design are documentation and implementation.

The goal of documentation is to make future modifications easier by providing a clear description of what the program will achieve. The procedure for changing from an outdated system to a brand-new one is known as implementation. These are critical software development platforms that cannot be compromised.

4.4 User Access and Operation

The various screenshot shown below shows a detailed information on the user dashboard, view the number of people registered from the admin, view orders, view posts made by the staffs at the health center to students, medical staffs making a post, admin and health center staffs accessing the number of students on the portal.

Health center staffs making a post of important information informing students of times the clinic bus will be available, drugs available like inhalers e.t.c
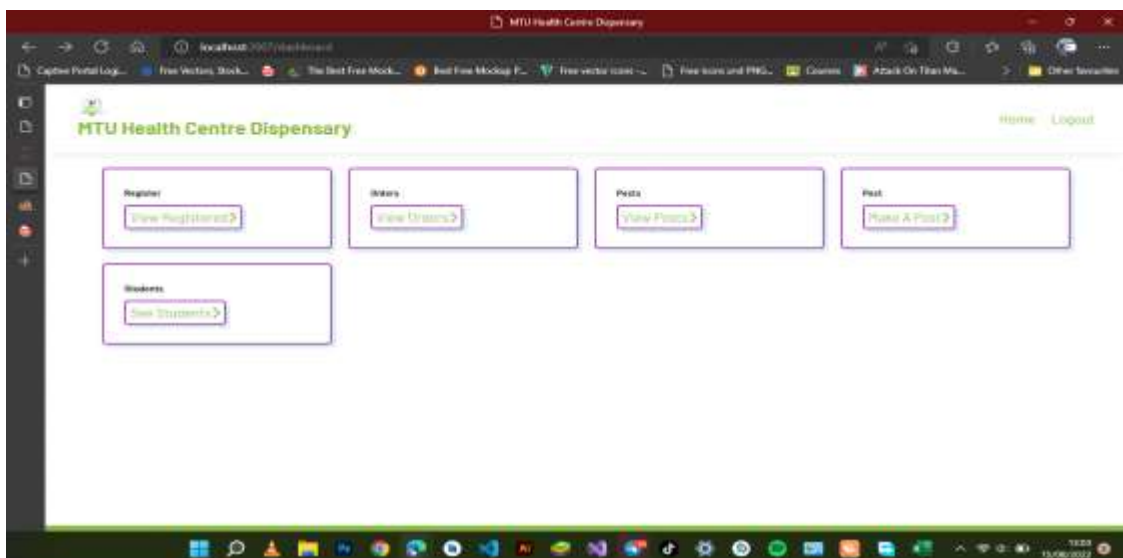
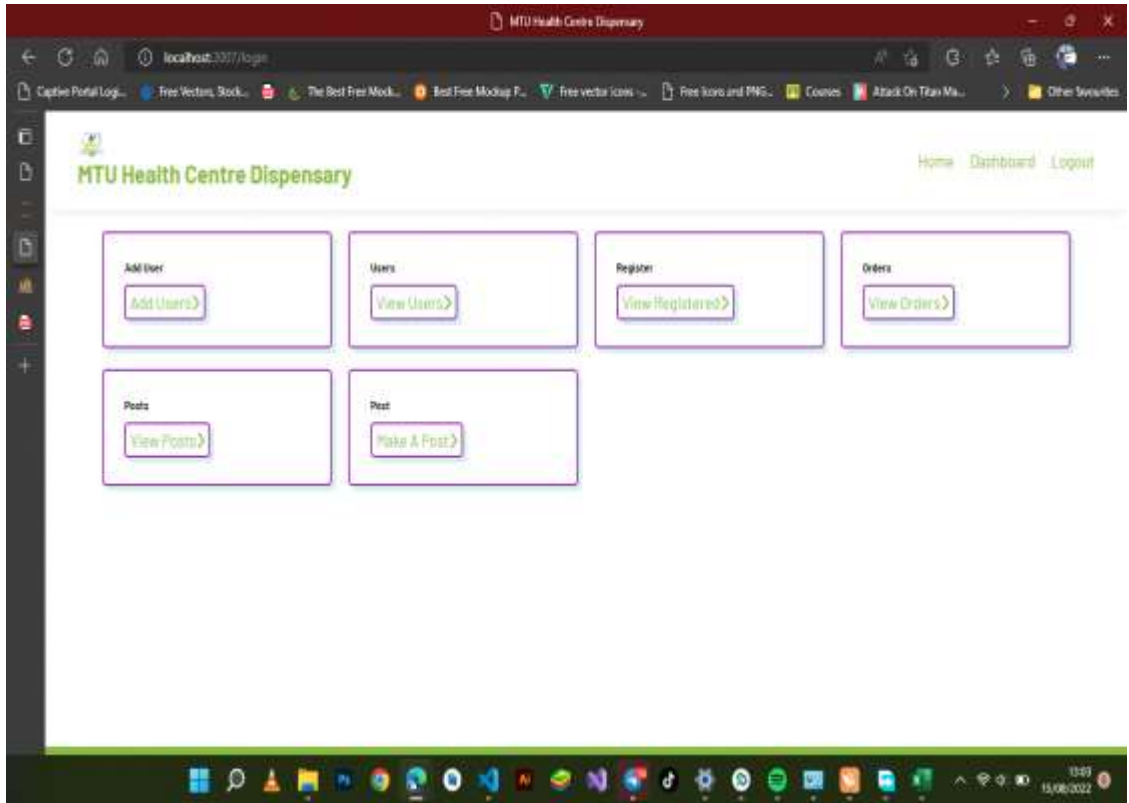**Figure 4.1: Registration Platforms**
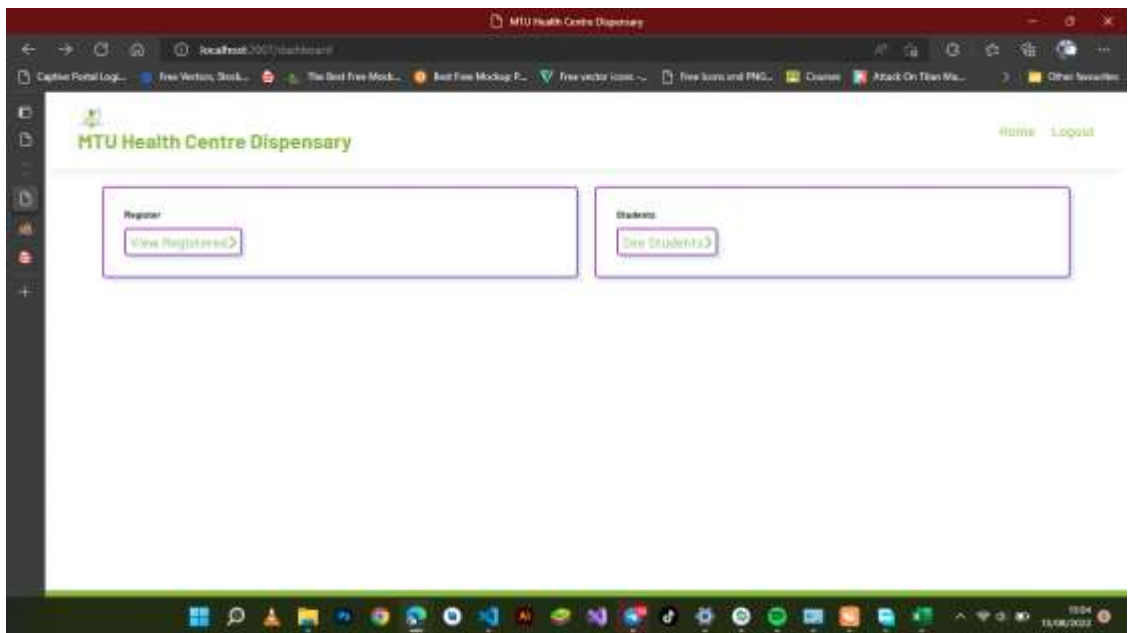
Figure 4.2:User faceDashboard
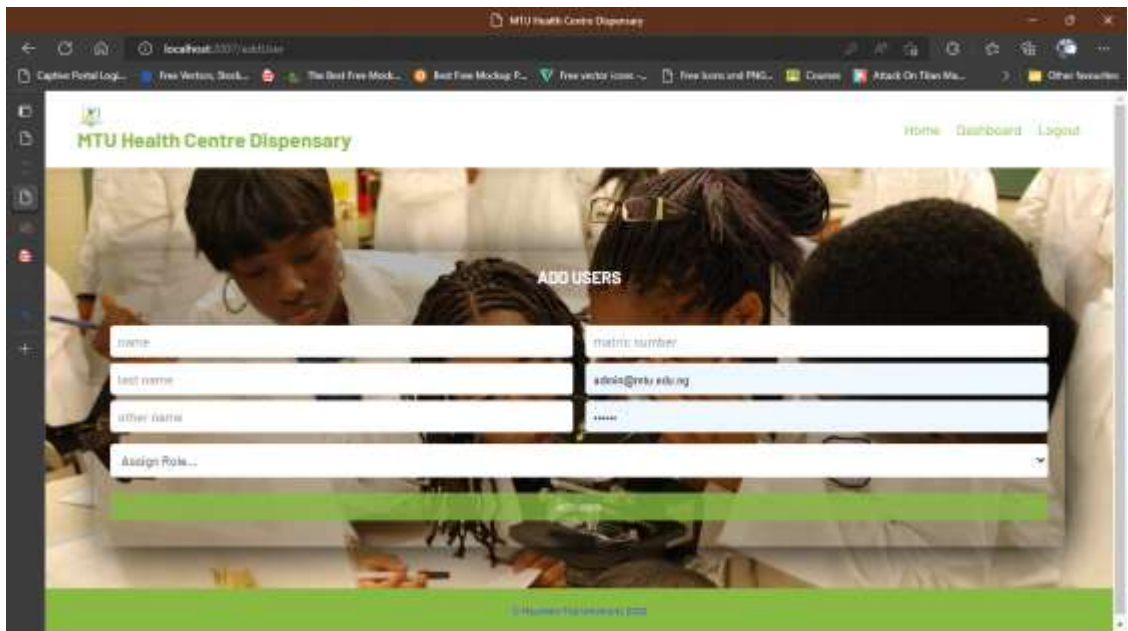
Figure 4.3: Admin Site
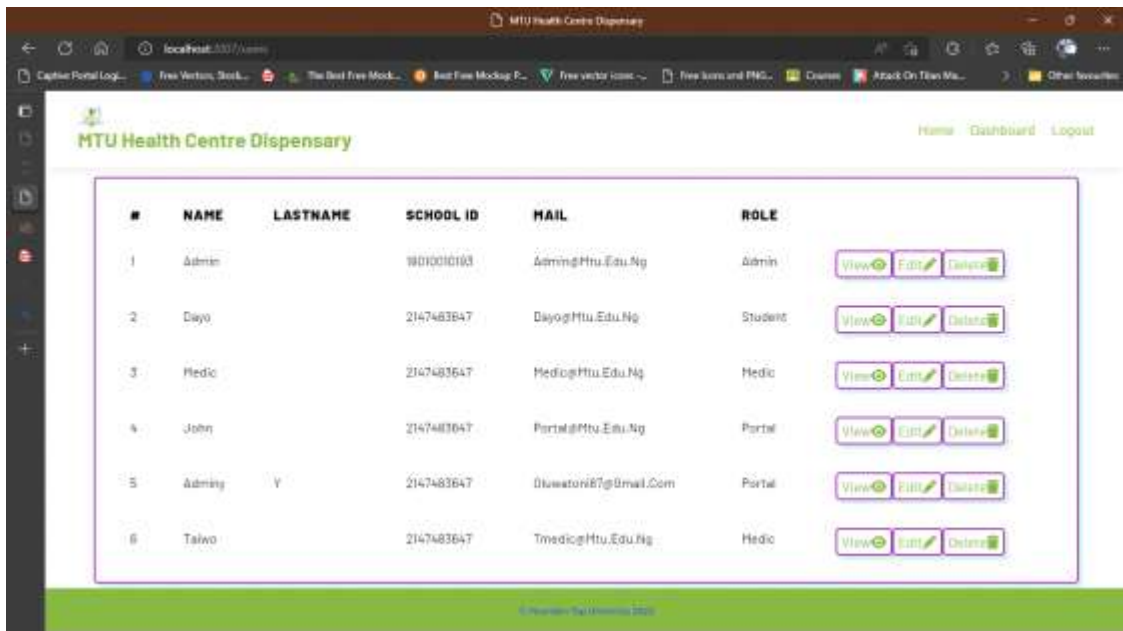
Figure 4.4:Add Users Platform

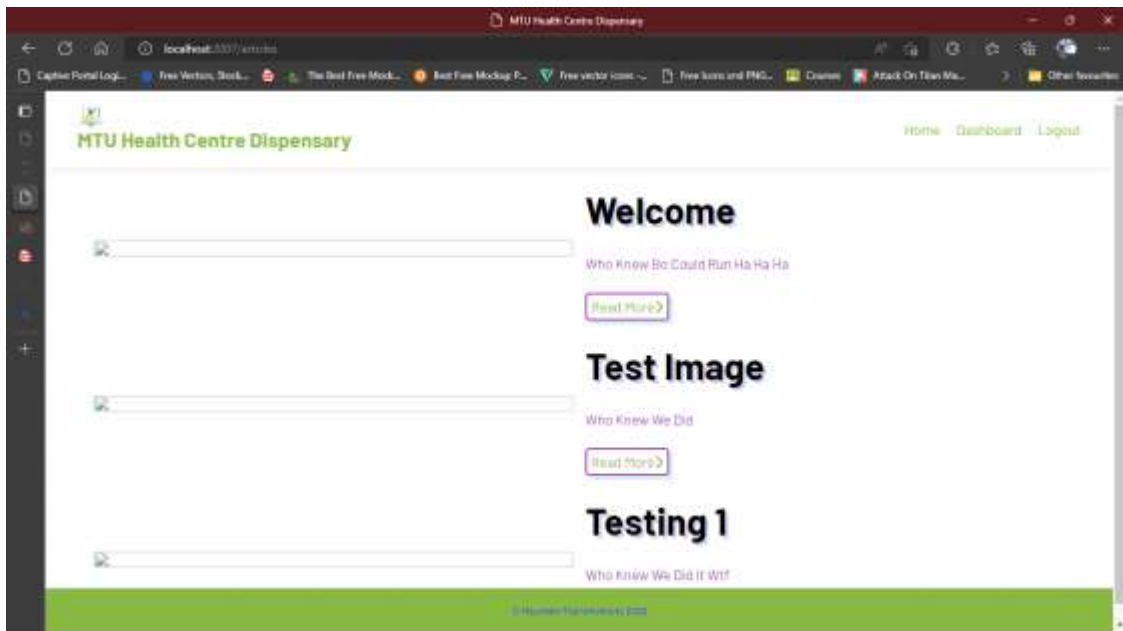**Figure 4.5: Admin Viewing Students Registered**

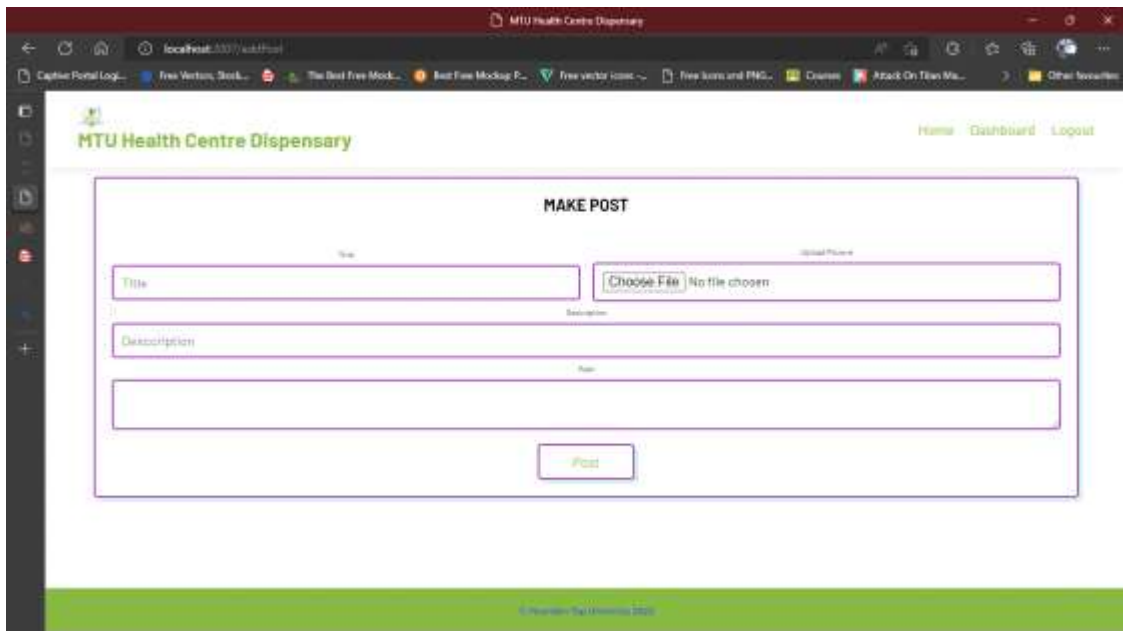**Figure4.6:Testing of the Platform**

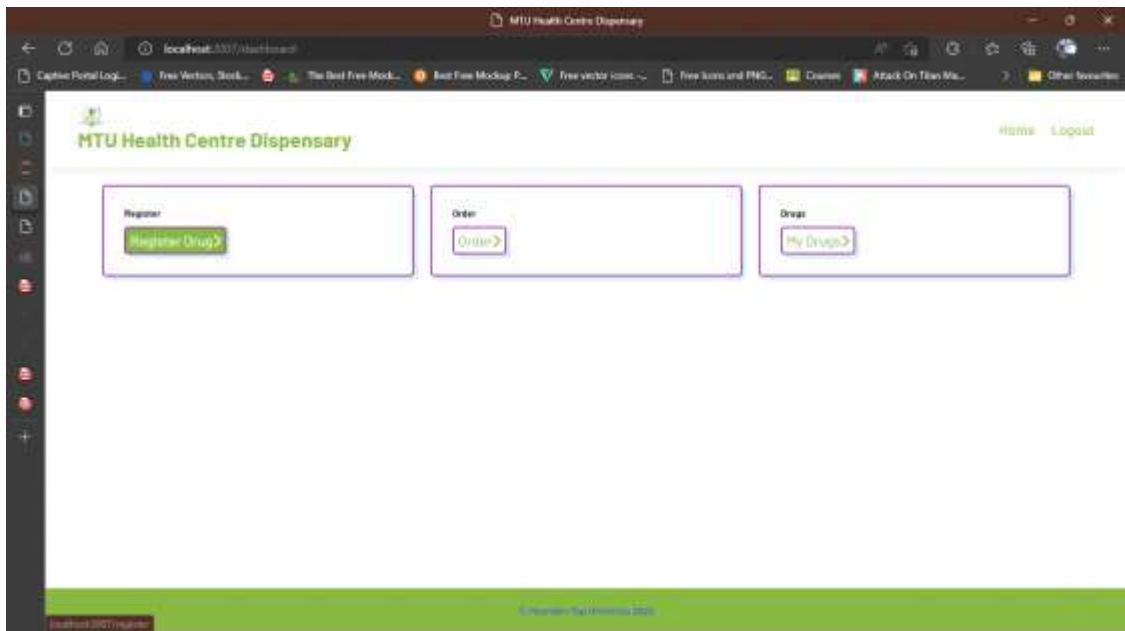**Figure 4.7: Healthcenter staff making a post on Important Information**
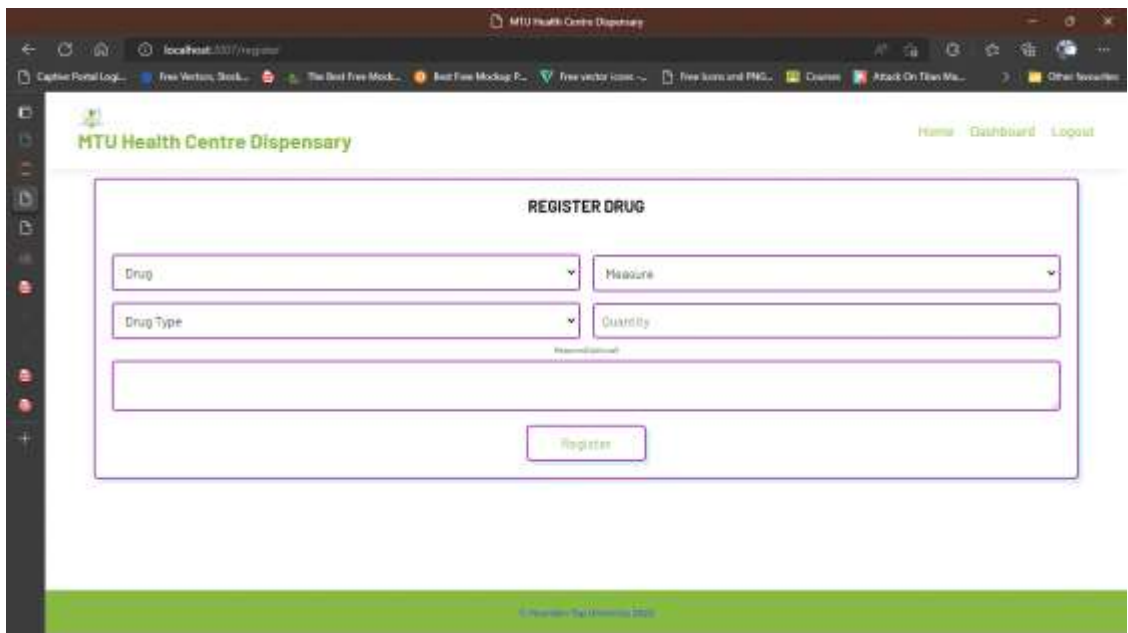
Figure 4.8: Registrationsand Orderof Drugs

Figure 4.9: Registrations of Drugs

CHAPTER FIVE

CONCLUSION, RECOMMENDAION AND FUTURE WORK

5.1 CONCLUSION

By ensuring optimal health and safety, these systems support the establishment of an online system for the registration and dispensation of drug activities. Additionally, it offers quick access to drug-related information, and in contrast to the manual system, database files can be used to determine a drug's present state.

This can be done by employing a computer to assess the efficiency of drug stock management, which aids staff at the health center in taking timely decisions.

5.2 RECOMMENDATION

It is advised to use this study to boost how drugs should be searched. To make work easier, it should contain a drop-down menu with a list of medications, as well as an expiration date and a notice indicating that a medication has run its course.

5.3 FUTURE WORK

Future research should focus on generating reliable and consistent "proxies" for specific adverse events in order to develop the potential for pharmaceutical safety studies using only dispensing data. One approach to aid in this effort would be to employ co morbidity ratings, which use algorithms of medicine administration to identify clinical disorders. Since the 1990s, there have been pharmacy-based co morbidity metrics that pinpoint certain illnesses based on the patterns of prescription use.

References

Alamelu R, et al. Online pharma retail is promising/unpromising avenue: an indian context. Asian J Pharm Clin Res. 2016;9.

[Google Scholar]

Antai M, et al. Indian online pharmacies and drug stores in legal tug-of-war. eHealth Law & Policy.

Alexander S, et al. The effect of electronic medical record system use on communication between pharmacists and prescribers. BMC Fam Pract. 2015;16:155.

[Crossref][Google Scholar][EBSCO]

Mattijs S, et al. Use of electronic medical records and quality of patient data: different reaction patterns of doctors and nurses to the hospital organization. BMC Med Inf. 2017;17:1-11.

[Crossref][Google Scholar][EBSCO]

Corey B. The implementation of electronic medical records system in health care facilities. Pro Manu. 2015;3:4629-4634.

[Crossref][Google Scholar]

Jose A, et al. Sugar ester surfactants: enzymatic synthesis and applications in food industry. Crit. Rev. Food Sci. 2015;55:595-610.

[Crossref][Google Scholar][EBSCO]

Australian Commission on Safety and Quality in Health Care . *Literature review: medication safety in Australia.* Sydney: ACSQHC; 2013. [Google Scholar]

Milea D, Azmi S, Reginald P, Verpillat P, Francois C. A review of accessibility of administrative healthcare databases in the Asia-Pacific region. J Mark Access Health Policy. 2015;3. [PMC free article] [PubMed]

Pearson SA, Pesa N, Langton JM, Drew A, Faedo M, Robertson J. Studies using Australia's Pharmaceutical Benefits Scheme data for pharmacoepidemiological research: a systematic review of the published literature (1987-2013) *Pharmacoepidemiol Drug Saf.* 2015;24(5):447–455. [PubMed] [Google Scholar]

Wettermark B, Zoega H, Furu K, Korhonen M, Hallas J, Norgaard M, et al. The Nordic prescription databases as a resource for pharmacoepidemiological researcha literature review. *Pharmacoepidemiol Drug Saf.* 2013;22(7):691–699. [PubMed] [Google Scholar]

Horsburgh SMM, Norris P, Harrison-Woolrych M, Tordoff J, Becket G, Heerbison P, Parkin L, Reith D. *Prescribing and dispensing data sources in New Zealand: their usage and future directions.* Dunedin: School of Pharmacy; 2009. [Google Scholar]

Alvarez-Madrazo S, McTaggart S, Nangle C, Nicholson E, Bennie M. Data resource profile: the Scottish National Prescribing Information System (PIS) *Int J Epidemiol.* 2016;45(3):714–75f. [PMC free article] [PubMed] [Google Scholar]

Sinnott SJ, Bennett K, Cahir C. Pharmacoepidemiology resources in Ireland-an introduction to pharmacy claims data. *Eur J Clin Pharmacol.* 2017;73(11):1449–1455. [PMC free article] [PubMed] [Google Scholar]

Lai EC, Man KK, Chaiyakunapruk N, Cheng CL, Chien HC, Chui CS, et al. Brief report: databases in the Asia-Pacific region: the potential for a distributed network approach. *Epidemiology.* 2015;26(6):815–820. [PubMed] [Google Scholar]

Kimura T, Matsushita Y, Yang YH, Choi NK, Park BJ. Pharmacovigilance systems and databases in Korea, Japan, and Taiwan. *Pharmacoepidemiol Drug Saf.* 2011;20(12):1237–1245. [PubMed] [Google Scholar]

Poluzzi E, Raschi E, Godman B, Koci A, Moretti U, Kalaba M, Wettermark B, Sturkenboom M, de Ponti F. Pro-arrhythmic potential of oral antihistamines (H1): combining adverse event reports with drug utilization data across Europe. *PLoS One.* 2015;10(3):e0119551. [PMC free article] [PubMed] [Google Scholar]

Roughead EE, Kalisch Ellett LM, Ramsay EN, Pratt NL, Barratt JD, LeBlanc VT, et al. Bridging evidence-practice gaps: improving use of medicines in elderly Australian veterans. *BMC Health Serv Res.* 2013;13:514. [PMC free article] [PubMed] [Google Scholar]

Pratt NL, Kalisch Ellett LM, Sluggett JK, Gadzhanova SV, Ramsay EN, Kerr M, et al. Use of proton pump inhibitors among older Australians: national quality improvement programmes have led to sustained practice change. *Int J Qual Health Care.* 2017;29(1):75–82. [PubMed] [Google Scholar]

Pratt NL, Kalisch Ellett LM, Sluggett JK, Ramsay EN, Kerr M, LeBlanc VT, et al. Commitment questions targeting patients promotes uptake of under-used health services: findings from a national quality improvement program in Australia. *Soc Sci Med.* 2015;145:1–6. [PubMed] [Google Scholar]

Rochon PA, Gurwitz JH. The prescribing cascade revisited. *Lancet.* 2017;389(10081):1778–1780. [PubMed] [Google Scholar]

Maclure M. The case-crossover design: a method for studying transient effects on the risk of acute events. *Am J Epidemiol.* 1991;133(2):144–153. [PubMed] [Google Scholar]

Farrington CP. Relative incidence estimation from case series for vaccine safety evaluation. *Biometrics.* 1995;51(1):228–235. [PubMed] [Google Scholar]

Hallas J. Evidence of depression provoked by cardiovascular medication: a prescription sequence symmetry analysis. *Epidemiology.* 1996;7(5):478–484. [PubMed] [Google Scholar]

Lai EC, Pratt N, Hsieh CY, Lin SJ, Pottegard A, Roughead EE, et al. Sequence symmetry analysis in pharmacovigilance and pharmacoepidemiologic studies. *Eur J Epidemiol.* 2017;32(7):567–582. [PubMed] [Google Scholar]

Garrison SR, Dormuth CR, Morrow RL, Carney GA, Khan KM. Nocturnal leg cramps and prescription use that precedes them: a sequence symmetry analysis. *Arch Intern Med.* 2012;172(2):120–126. [PubMed] [Google Scholar]

Hallas J, Bytzer P. Screening for drug related dyspepsia: an analysis of prescription symmetry. *Eur J Gastroenterol Hepatol.* 1998;10(1):27–32. [PubMed] [Google Scholar]

Bytzer P, Hallas J. Drug-induced symptoms of functional dyspepsia and nausea. A symmetry analysis of one million prescriptions. *Aliment Pharmacol Ther.* 2000;14(11):1479–1484. [PubMed] [Google Scholar]

22. Pratt N, Andersen M, Bergman U, Choi NK, Gerhard T, Huang C, et al. Multi-country rapid adverse drug event assessment: the Asian Pharmacoepidemiology Network (AsPEN) antipsychotic and acute hyperglycaemia study. *Pharmacoepidemiol Drug Saf.* 2013;22(9):915–924. [PubMed] [Google Scholar]

Hachiken H, Murai A, Wada K, Kuwahara T, Hosomi K, Takada M. Difference between the frequencies of antisecretory drug prescriptions in users of buffered vs.

enteric-coated low-dose aspirin therapies. *Int J Clin Pharmacol Ther.* 2013;51(10):807–815. [PubMed] [Google Scholar]

Fujimoto M, Higuchi T, Hosomi K, Takada M. Association of statin use with storage lower urinary tract symptoms (LUTS): data mining of prescription database. *Int J Clin Pharmacol Ther.* 2014;52(9):762–769. [PubMed] [Google Scholar]

Takada M, Fujimoto M, Hosomi K. Difference in risk of gastrointestinal complications between users of enteric-coated and buffered low-dose aspirin. *Int J Clin Pharmacol Ther.* 2014;52(3):181–191. [PubMed] [Google Scholar]

Kalisch Ellett LM, Pratt NL, Barratt JD, Rowett D, Roughead EE. Risk of medication-associated initiation of oxybutynin in elderly men and women. *J Am Geriatr Soc.* 2014;62(4):690–695. [PubMed] [Google Scholar]

Hashimoto M, Hashimoto K, Ando F, Kimura Y, Nagase K, Arai K. Prescription rate of medications potentially contributing to lower urinary tract symptoms and detection of adverse reactions by prescription sequence symmetry analysis. *J Pharm Health Care Sci.* 2015;1:7. [PMC free article] [PubMed] [Google Scholar]

Corrao G, Botteri E, Bagnardi V, Zambon A, Carobbio A, Falcone C, Leoni O. Generating signals of drug-adverse effects from prescription databases and application to the risk of arrhythmia associated with antibacterials. *Pharmacoepidemiol Drug Saf.* 2005;14(1):31–40. [PubMed] [Google Scholar]

Wahab IA, Pratt NL, Kalisch LM, Roughead EE. Comparing time to adverse drug reaction signals in a spontaneous reporting database and a claims database: a case study of rofecoxib-induced myocardial infarction and rosiglitazone-induced heart failure signals in Australia. *Drug Saf.* 2014;37(1):53–64. [PubMed] [Google Scholar]

Roughead EE, Chan EW, Choi NK, Kimura M, Kimura T, Kubota K, et al. Variation in association between thiazolidinediones and heart failure across ethnic groups: retrospective analysis of Large Healthcare Claims Databases in six countries. *Drug Saf.* 2015;38(9):823–831. [PMC free article] [PubMed] [Google Scholar]

Rasmussen L, Hallas J, Madsen KG, Pottegard A. Cardiovascular drugs and erectile dysfunction - a symmetry analysis. *Br J Clin Pharmacol.* 2015;80(5):1219–1223. [PMC free article] [PubMed] [Google Scholar]

Takeuchi Y, Kajiyama K, Ishiguro C, Uyama Y. Atypical antipsychotics and the risk of hyperlipidemia: a sequence symmetry analysis. *Drug Saf.* 2015;38(7):641–650. [PubMed] [Google Scholar]

Wahab IA, Pratt NL, Ellett LK, Roughead EE. Sequence symmetry analysis as a signal detection tool for potential heart failure adverse events in an administrative claims database. *Drug Saf.* 2016;39(4):347–354. [PubMed] [Google Scholar]

Lai EC, Yang YH, Lin SJ, Hsieh CY. Use of antiepileptic drugs and risk of hypothyroidism. *Pharmacoepidemiol Drug Saf.* 2013;22(10):1071–1079. [PubMed] [Google Scholar]