***The World Islamic Sciences and Education University***

جامعة العلوم الاسلامية العالمية

Faculty of Information Technology

كلية تكنولوجيا المعلومات

****

GRADUATION PROJECT

**Title**

*E-Pharma*

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May God bless you all and thank you.

# Abstract

This project presents E-Pharma, a secure, AI-integrated web platform designed to modernize pharmaceutical services. It addresses challenges in traditional pharmacies such as medication shortages and limited access by enabling real-time inventory tracking, digital prescription verification, and role-based user interfaces.

Developed using Node.js, Express, PostgreSQL, and HTML/CSS/JS with EJS templates, was evaluated through simulated testing and internal review, demonstrated strong usability and reliability. E-Pharma enhances healthcare delivery and sets a foundation for future integration with telemedicine and mobile platforms.

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# List of abbreviations

|  |  |
| --- | --- |
| WISE | The world Islamic Science & Education University |
| IT | Information Technology |
| AI | Artificial Intelligence |
| HTML | Hypertext Markup Language |
| CSS | Cascading Style Sheets |
| JS | Java Script |
| SQL | Structured Query Language |
| ER | Entity Relationship |
| UI | User Interface |
| SCIN | Security and Confidentiality of Information and Networks |
| CS | Computer Science |
| SDLC | Software Development Lifecycle |
| UML | Unified Modeling Language |
| ERD | Entity Relationship Diagram |
| GDPR | General Data Protection Regulation |
| HIPAA | Health Insurance Portability and Accountability |

# CHAPTER 1

# INTRODUCTION

## Overview

Access to essential medications and healthcare services is a critical component of public health, yet traditional pharmacies often fall short in meeting the needs of modern consumers due to issues like long wait times, limited geographical reach, and stock shortages. Our project, proposes a full-stack, AI-powered e-pharmacy platform designed to address these limitations by enabling users to search, purchase, and manage medications digitally.

The platform supports functionalities such as real-time inventory tracking, AI assistance’s, secure prescription upload and validation, medication scheduling, and interactive dashboards. Built using Node.js, Express, PostgreSQL, and HTML/CSS/JS with EJS templates, the system implements a secure, scalable, and user-centric architecture. Role-based access control ensures that patients, pharmacists, and administrators have dedicated interfaces and privileges, enhancing both usability and compliance.

## Problem Statement

Traditional pharmacies pose several challenges that impede effective access to medication:

* Long queues in physical pharmacies lead to time-consuming experiences, especially during peak hours or health emergencies.
* Frequent stock shortages make it difficult for patients to find essential medications when needed.
* Limited accessibility affects elderly individuals, people with disabilities, and residents of rural or remote areas who may struggle to reach physical pharmacy locations.
* Inefficient inventory management systems in traditional pharmacies often result in misinformation about product availability.
* Lack of reliable digital platforms leaves patients with no option to verify prescriptions, place orders online, or access pharmacy services remotely.
* Absence of real-time order tracking contributes to customer frustration and reduces trust in the delivery process.
* No automated prescription verification increases the risk of human error and misuse of medications.
* Security risks in handling sensitive medical and financial data deter users from trusting online platforms.

The lack of automation and digital infrastructure leads to inefficiencies in service delivery, potentially compromising patient health and satisfaction. These challenges underscore the need for a comprehensive digital solution that ensures accessibility, reliability, and security.

## Project objectives

The primary aim of this project is to develop an E-Pharmacy platformthat addresses the limitations of traditional pharmacies by leveraging digital transformation. The specific objectives include:

* Develop a user-friendly digital platform allowing users to order medicines online without physical visits
* Implement a real-time inventory management system to ensure availability and accurate stock updates.
* Design the platform with accessibility features and optimize it for low-bandwidth environments.
* Enable online ordering and nationwide delivery to ensure access from anywhere.
* Automate stock tracking and alerts using smart systems that update availability in real time.
* Build a secure, AI-integrated e-pharmacy platform with essential services like browsing, prescription upload, and order placement.
* Integrate an AI-powered system for automatic prescription validation, reducing manual errors.
* Use encryption protocols and secure payment gateways to protect personal and financial data, secure payment integration (Stripe).

## Research strategy

The research strategy for this project is designed to ensure a comprehensive understanding of the challenges in traditional pharmacies and the effective implementation of an e-pharmacy system. This involves a combination of qualitative and quantitative research methods, along with a structured software development approach to ensure the successful execution of the system.

1. **Software Development Methodology**

For the development of the e-pharmacy system, the Agile methodology is adopted due to its flexibility, iterative nature, and ability to accommodate changes based on user feedback. Within Agile, the Scrum framework is applied to organize work into short development cycles (sprints), ensuring continuous improvement and feature enhancements.

Key reasons for choosing Agile and Scrum include:

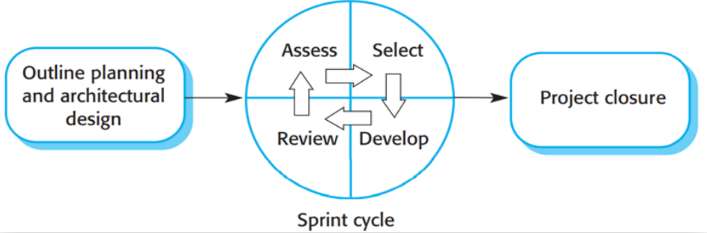
* **Adaptability:** Ability to respond quickly to user feedback and regulatory changes.
* **Collaboration:** Regular team meetings ensure smooth communication and efficient problem-solving.
* **Incremental Development:** Features such as user authentication, prescription verification, and real-time inventory updates are developed and tested iteratively.

Figure Sprint Cycle

1. **Security and Compliance Considerations**

Given that the e-pharmacy system deals with sensitive user data, the research also focuses on:

* **Data Encryption Techniques:** Implementing security measures to protect personal and financial information.
* **Healthcare Regulations:** Ensuring compliance with pharmaceutical and data protection laws.

This research strategy ensures that the project is not only technologically sound but also aligns with healthcare industry standards, user needs, and security best practices.

## Scope

* **The system targets multiple stakeholders:**
* **Admins:** manage users, and generate reports.
* **Patients:** To browse, order, upload prescription .
* **Pharmacist:** To verify, fulfill and manage prescriptions/medications
* **Features include:**
* Delivery tracking
* Medicine catalog and stock tracking
* Prescription upload and verification
* Real-time notifications
* Role-based dashboards
* Secure login and registration
* Shopping cart and payment
* Ai Services

## Gantt chart

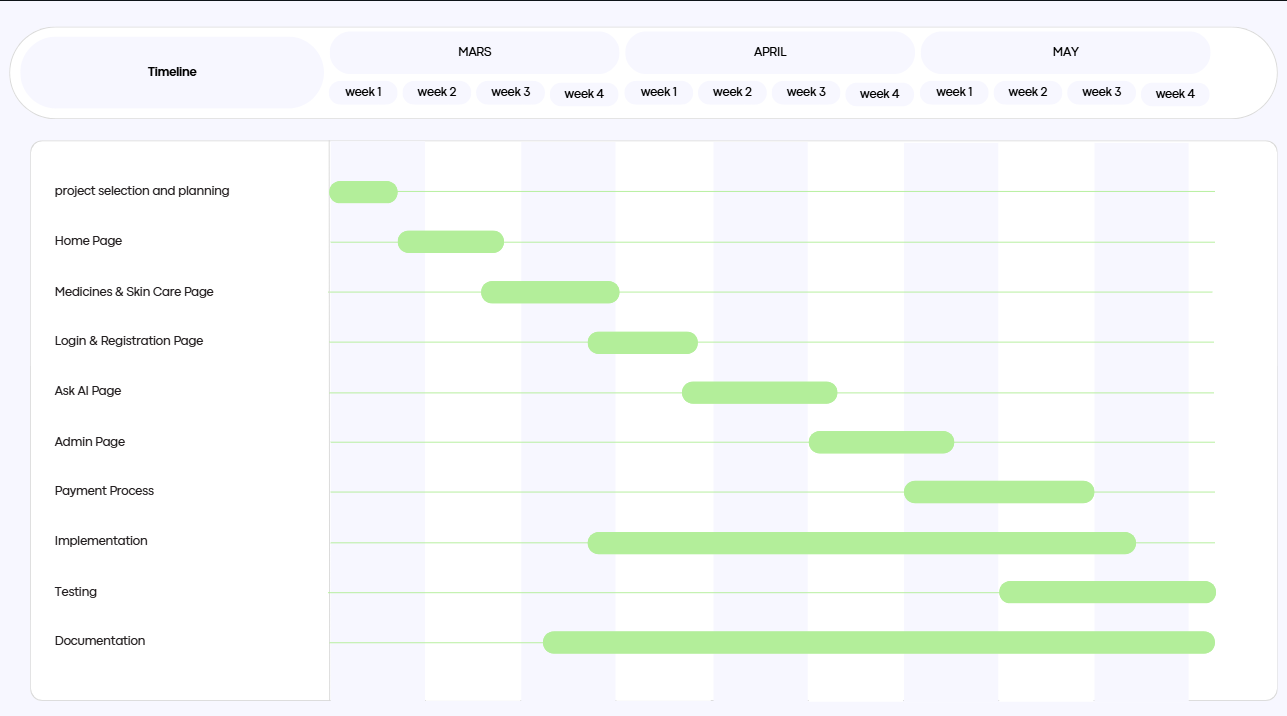


Figure Gantt Chart

## Project outline

**Chapter 1: Introduction**

* Presents the problem statement, objectives, and scope of the e-pharmacy platform.

**Chapter 2: Literature Review**

* Analyzes existing e-pharmacy solutions, gaps in current systems, and relevant academic/industry research.

**Chapter 3: Methodology**

* Details the SDLC approach (e.g., Agile), tools (Node.js, PostgreSQL), and feasibility studies.

**Chapter 4: Design Models**

* Includes UML diagrams (use case, ERD, data flow) to visualize system architecture.

**Chapter 5: Experiments & Results**

* Covers testing methodologies (unit, integration) and outcomes (e.g., AI prescription validation accuracy).

**Chapter 6: Conclusion & Future Work**

* Summarizes achievements, limitations, and potential enhancements (e.g., mobile app integration).

# CHAPTER 2

# LITERATURE REVIEW

## Overview

This chapter reviews existing studies on e-pharmacy systems and how they improve access to healthcare by addressing issues like delays, shortages, and limited reach. Platforms such as Amazon Pharmacy, NetMeds, 1mg, and PillPack highlight trends in online ordering and AI-based prescription verification. However, many still lack real-time tracking, accessibility, or strong security. By analyzing these systems, this chapter identifies key gaps and insights to guide the development of a more reliable and user-friendly e-pharmacy platform.

## Related Work

The development of e-pharmacy systems has been explored in various studies, highlighting their impact on accessibility, efficiency, and healthcare compliance. This section reviews existing research and similar projects to understand the technologies used, the challenges encountered, and the strategies implemented to address these challenges.

**Existing E-Pharmacy Systems:**

Several e-pharmacy platforms have been developed worldwide, offering users the ability to purchase medications online. Some notable examples include:

* **Amazon Pharmacy:** A digital pharmacy service that allows customers to order prescription medications online with home delivery options. It integrates secure payment processing and prescription verification to ensure compliance with healthcare regulations.
* **NetMeds and 1mg (India):** These platforms provide an extensive range of medicines, healthcare products, and online doctor consultations, making healthcare more accessible in remote areas.
* **PillPack (by Amazon):** A service that focuses on medication management by pre-sorting doses for patients with chronic conditions, improving adherence and reducing errors.

Each of these platforms incorporates key features such as secure authentication, AI-driven prescription verification, and real-time inventory management, which serve as valuable references for developing an effective e-pharmacy system.

### 2.3.1 Discussion

The rise of digital healthcare solutions has led to the development of various e-pharmacy platforms aimed at addressing challenges in traditional pharmaceutical services. Researchers and developers have worked on different aspects of e-pharmacy systems, focusing on improving accessibility, efficiency, and compliance with healthcare regulations.

Several studies have highlighted the limitations of conventional pharmacies, such as long waiting times, medication shortages, and restricted access pharmacy **systems** have been introduced, integrating modern technologies to enhance user experience and streamline operations.

**Existing Solutions and Their Approaches:**

1. **Online Medicine Delivery Services**

* Platforms like NetMeds, 1mg, and Amazon Pharmacy provide home delivery of medicines, reducing the need for physical visits to pharmacies.
* These services allow users to upload prescriptions, which are verified before dispensing the medications.
* Many of these platforms incorporate real-time inventory tracking to ensure customers are informed about product availability.

1. **AI-Powered Prescription Verification**

* Some e-pharmacy systems integrate machine learning algorithms to analyze and verify prescriptions, reducing the chances of human errors and improving efficiency.
* AI-based systems help detect fraudulent or incorrect prescriptions, ensuring compliance with legal and healthcare standards.

1. **Telemedicine and E-Consultation Services**

* Some e-pharmacy platforms, such as 1mg and PharmEasy, offer virtual consultations with licensed pharmacists and doctors, allowing users to receive medical advice before purchasing medicines.
* This feature enhances patient safety and promotes responsible medication use.

1. **Security and Data Protection in E-Pharmacies**

* Given the sensitivity of medical data, e-pharmacy platforms implement end-to-end encryption, secure payment gateways, and authentication mechanisms to protect user privacy.
* Compliance with global data protection regulations such as HIPAA (Health Insurance Portability and Accountability Act) and GDPR (General Data Protection Regulation) is a priority for online pharmacies.

While these solutions have improved pharmaceutical accessibility, there are still gaps and challenges that need to be addressed, such as enhancing AI accuracy, ensuring widespread adoption, and improving security frameworks. This project builds upon these advancements while introducing enhanced prescription verification, stronger security measures, and an optimized user experience tailored to the needs of both patients and pharmacists.

### 2.3.2 Issues and challenges faced by the other project

While existing e-pharmacy systems have introduced significant improvements in pharmaceutical accessibility and convenience, they still suffer from critical gaps and inefficiencies. This section evaluates these shortcomings and identifies how this project aims to bridge those gaps, enhancing security, usability, and compliance.

* 1. Gaps in Regulatory Compliance and Prescription Verification

**Identified Gap:** Many e-pharmacy platforms lack robust prescription verification, making them vulnerable to fake prescriptions and legal violations.

**Example:** PhilRx (a U.S.-based online pharmacy) was fined for failing to verify prescriptions, leading to illegal medication sales and regulatory scrutiny.

**Proposed Solution:**

* AI-powered automated prescription verification cross-checked with official medical databases.
* Mandatory pharmacist approval before dispensing medications.
* Strict compliance with healthcare regulations to prevent illegal sales.
  1. Gaps in Security and Data Privacy

**Identified Gap:** Some platforms suffer from weak encryption and authentication, making them vulnerable to data breaches and cyberattacks.

**Example:** NetMeds (an Indian e-pharmacy) faced a data breach in 2020, exposing customer details and medical history due to inadequate cybersecurity protocols.

**Proposed Solution:**

* Multi-factor authentication (MFA) for secure logins.
* Regular security audits to detect and fix vulnerabilities.
  1. Gaps in Inventory Management and Drug Availability

**Identified Gap:** Many e-pharmacies experience inventory mismanagement, leading to stock shortages and inaccurate availability statuses.

**Example:** 1mg (a major Indian e-pharmacy) has frequently faced complaints about medicines showing as available, only for users to find them out of stock after ordering.

**Proposed Solution:**

* Alternative medicine recommendations when a drug is unavailable.
* Real-time inventory tracking to automatically update stock levels.
  1. Gaps in User Experience and Accessibility

**Identified Gap:** Many e-pharmacy platforms have complicated interfaces, making them difficult for elderly and non-tech-savvy users.

**Example:** Walgreens Online Pharmacy has been criticized for its complex checkout process, which makes it challenging for elderly users to complete their orders.

**Proposed Solution:**

* Simplified user interface with easy navigation.
  1. Gaps in Delivery Efficiency and Tracking

**Identified Gap:** Some e-pharmacies fail to provide real-time delivery tracking, leading to delays and lost packages.

**Example:** Capsule Pharmacy (a U.S. online pharmacy) faced customer complaints about long delivery times and lack of real-time tracking.

**Proposed Solution:**

* Partnerships with reliable delivery services for faster shipping.
* Express delivery options for urgent medications.

By addressing these critical gaps in security, compliance, inventory management, user experience, and delivery, this e-pharmacy project aims to create a more efficient, secure, and user-friendly online pharmaceutical service.

Table Compare our project with similar projects

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Feature/project** | **NetMeds** | **1mg** | **Capsule Pharmacy** | **Walgreens Online** | **Proposed Project(E-pharma)** |
| AI-Based Prescription Verification | **✖** | **✖** | **✖** | **✖** | **✓** |
| Strong Regulatory Compliance | **✖** | **✓** | **✓** | **✓** | **✓** |
| End-to-End Data Encryption | **✖** | **✓** | **✓** | **✓** | **✓** |
| Real-Time Inventory Tracking | **✖** | **✖** | **✓** | **✓** | **✓** |
| Simple and Elderly-Friendly Interface | **✖** | **✖** | **✓** | **✖** | **✓** |
| Real-Time Delivery Tracking | **✖** | **✖** | **✖** | **✓** | **✓** |
| Live Pharmacist Consultation | **✖** | **✓** | **✖** | **✖** | **✓** |
| AI Assistant for Medical Questions | **✖** | **✖** | **✖** | **✖** | **✓** |

## 2.4 Summary

Existing literature validates the demand for e-pharmacy systems but reveals shortcomings in automation, compliance, and user experience. E-Pharma addresses these gaps by implementing AI-based prescription validation, encrypted data handling, accessibility features, and real-time service delivery.

# CHAPTER 3

# METHODOLOGY

## 3.1 Overview

This chapter outlines the methodological approach employed in the development of the E-commerce/Pharmacy System. The methodology encompasses the entire software development lifecycle.

## 3.2 Feasibility Study

The feasibility study evaluates the viability of developing E-Pharma a web-based pharmacy system that allows users to order medicines, view availability, and track orders online. It considers technical, operational, and economic factors to ensure the project can be implemented effectively with available resources.

E-Pharma addresses key gaps in traditional pharmacies by offering digital access to medications, especially for users in remote or underserved areas, through a secure and scalable platform.

### 3.2.1 Technical feasibility

A technical feasibility study reviews the technical resources available for the project, which determines if the right equipment, enough equipment, and the right technical knowledge are provided to complete this project's objectives.

Table Technical feasibility

|  |  |
| --- | --- |
| **Main costs** | **Costs Financial** |
| Development cost | 500JD |
| Maintenance cost | 350JD |
| Marketing cost | 90JD |
| Total cost | 940JD |

### 3.2.2 Operational feasibility

An operational feasibility study evaluates whether the organization can complete this project or not. This includes staffing requirements, organizational structure, and any applicable legal requirements. At the end of the operational feasibility study, your team will have a sense of whether you have the resources, skills, and competencies to complete this work.

Table Operational Feasibility

|  |  |
| --- | --- |
| **Process** | **Percentage** |
| Readiness and Training | 85% |
| Maintenance Viability | 75% |
| Workflow Efficiency | 70% |
| Performance | 80% |
| Process Integration | 80% |

## 3.3 Risk Analysis

The risk analysis identified potential threats to project success and established mitigation strategies:

Table Risk Analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Threat** | **Vulnerability** | **Asset and Consequences** | **Risk** | **Solutions** |
| Regulatory Non-Compliance | Weak legal review | Fines, shutdown, damaged reputation | **Critical** | Hire legal experts; integrate compliance checks |
| Server Downtime | Poor scalability | Service interruption, lost revenue | **Critical** | Use cloud servers; load balancing; stress tests |
| Data Breach | Poor encryption, weak authentication | Loss of user data, legal actions | **High** | Encrypt data; apply multi-factor authentication; regular audits |
| AI Misdiagnosis | Incomplete training data | Wrong advice, health risk, loss of trust | **High** | Validate AI with medical experts; improve datasets |
| Low User Adoption | Complex user interface | Low sales, bad reviews | **High** | Simplify design; test with users |
| Scope Creep | Uncontrolled requirement changes | Project delays, budget increase | **High** | Define clear requirements; apply change control process |
| Third-Party Integration Failure | Bad integration with services | Payment failures, delayed deliveries | **Moderate** | Test integrations; prepare backup systems |
| Performance Issues Under High Load | Inefficient system design | Slow service, user frustration | **Moderate** | Conduct load testing; design scalable architecture |
| Budget Overruns | Poor cost estimation | Financial loss, incomplete project | **Moderate** | Monitor budget closely; reserve contingency funds |
| Schedule Delays | Poor planning, changing requirements | Missed deadlines, project risk | **Moderate** | Use Agile practices; add time buffers |

## 3.4 Methodology

To efficiently manage the complex requirements of the E-Pharma project, the Agile methodology, specifically the Scrum framework, was adopted. Agile was selected because its adaptability, iterative methodology, and focus on stakeholder feedback. This methodology allows the development team to deliver functional components in short, manageable cycles (sprints), ensuring continuous progress and quality assurance throughout the project lifecycle. each sprint lasted three to four weeks and included all necessary activities such as analyze, design, code, test, release and output. This process allowed for rapid change adaptability, early risk identification, and integration of new features in response to user and regulatory feedback.

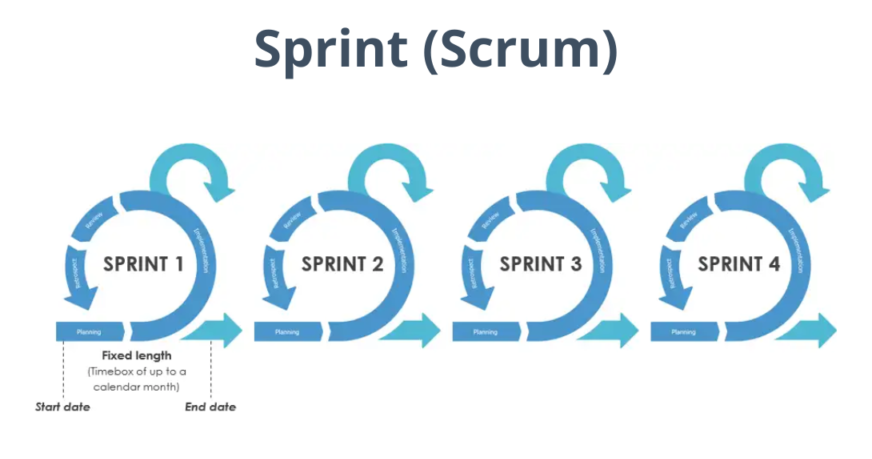


Figure Project Sprints

Table Sprint Process

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sprint** | **Sprint 1** | **Sprint 2** | **Sprint 3** | **Sprint 4** |
| **Duration** | 3 weeks | 4 weeks | 3 weeks | 3 weeks |
| **Analyze** | Analyze pharmacy workflow & user roles | Define backend architecture & data models | Refine dashboard and order workflows | Finalize project scope and prepare testing |
| **Design** | Design use case, ER, and context diagrams | Design authentication & DB schemas | Design dashboards and AI page layout | Design testing plan and final report format |
| **Code** | Implement login, register, and homepage | Code user role logic & inventory backend | Develop dashboards and order modules | Finalize all modules & integrate features |
| **Test** | Unit test auth & homepage UI | Test DB, API endpoints, inventory logic | Test dashboard navigation & permissions | System test with sample user accounts |
| **Release** | First internal demo | Mid-project evaluation | Pre-final feature freeze | Final demo & deployment preparations |
| **Output** | • Core layout (login, register)  • Use Case + ER diagrams | • Auth + inventory modules  • Role-based routing | • Dashboards + order & Ask AI pages  • Enhanced UI | • Full system integration  • Complete testing  • Final documentation |

After evaluating various software development methodologies, the Agile approach using Scrum framework was selected for the following reasons:

* **Adaptability**: Ability to respond to changing requirements and regulatory considerations
* **Incremental** **Delivery**: Ability to deliver functional components early and iteratively
* **Quality** **Focus**: Continuous testing and validation throughout the development process
* **Risk** **Management**: Early identification and mitigation of issues through regular reviews
* **Stakeholder:** Involvement: Regular opportunities for feedback from pharmacists, customers, and regulatory experts

### 3.4.1 Requirements

**Data Collection Methods**

To build a user-centered and regulation-compliant E-Pharmacy system, we adopted a **multi-method approach** to data collection. This ensured the system’s functional and non-functional requirements accurately reflected real-world needs, healthcare constraints, and user expectations across different roles (patients, pharmacists, administrators).

* 1. **Interviews:**

Structured and semi-structured interviews were conducted to gain qualitative insights from multiple stakeholder groups:

* **Patients:** Explored users' online shopping behaviors, expectations from an e-pharmacy, concerns about data security, and issues faced with medication access.
* **Pharmacists:** These interviews aimed to understand current workflows, prescription handling practices, inventory challenges, and pain points in traditional systems. Pharmacists also advised on legal compliance in handling prescriptions digitally.
  1. **Questionnaires & Surveys**

Quantitative data was collected through online and in-person surveys to validate assumptions and generalize user preferences:

* **Online patient survey:** Collected data on preferred delivery methods, trust in online medicine purchases, and device usage (mobile/desktop).
* **Pharmacy staff questionnaire:** Focused on ease of inventory tracking, time spent on manual tasks, and willingness to adopt new systems.

**Types of Requirements:**

* + - * 1. **Functional Requirements**

**User Management:**

FR1: Support user registration/login with email

FR2: Role-based access

FR3: Profile management

**Order and Payment:**

FR4: enable Stripe payments and track order status

FR5: secure checkout with real-time validation of prescription

FR6: provide a cart with quantity and price management

**Product and prescription management:**

FR7: link prescriptions to corresponding medicine orders

FR8: upload and verify prescriptions digitally

FR9: display product details with availability and categories

**Administration**:

FR10: inventory management tools with low stock alerts

FR11: generate real-time reports

FR12: view system logs and activity reports

* + - * 1. **Non-Functional Requirements**

**security:**

NFR1: encrypt all sensitive data at rest & in transit

NFR2: JWT/XSS/CORS security

NFR3: comply with HIPAA and GDPR for data handling

**reliability:**

NFR4: backup and recovery plan in place

NFR5: 99.9% uptime with failover systems

**usability:**

NFR6: easy to navigate the interface

NFR7: comply with WCAG 2.1 accessibility standards

**performance:**

NFR8: support numeric concurrent users with <2s response time

NFR9: complete transactions within 3 seconds

**compliance:**

NFR10: ensure PCI DSS compliance for payment security

NFR11: meet local and international pharmaceutical regulations

### 3.4.2 System Design

The iterative nature of agile allowed it to be possible for system design to progress from high level architecture into specific implementation models in tandem with requirements.

1. **Architectural Design**
   * RESTful APIs enabled communication between frontend, backend, and external services
   * Microservices architecture for scalability and modularity.
2. **Database Design**

PostgreSQL used with Sequelize ORM for managing:

* + users
  + orders
  + prescriptions
  + inventory

1. **User interface design**

* the user interface was repeatedly examined to guarantee accessibility and usability
* wireframes and user journeys developed using Figma.

1. **Security design**

* activity logs and audit for system actions
* bycrypt for password hashing
* session management
* CORS configuration
* CSRF and XSS protection
* JWT authentication and authorization

Table Used Tools

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Tool type** | **Document program** | **Coding program** | **Diagram**  **/Figure** | **AI** | **Programing language** | **Web-Browser:** | **Hardware** |
| **Tool** **name** | Office365 | Visual studio code | Canva  Draw.io | Together AI  GitHub Copilot | HTML, CSS, JS, Node.js, Express.js, PostgreSQL | Google chrome  Opera | Laptop  pc |

### ****3.4.3 Implementation****

The implementation process following the scrum practices with a focus on providing functional features in short sprints. Each sprint includes:

1. **Sprint planning**

* creating sprint objectives in line with project completion dates
* backlog selecting features and prioritization
* effort estimation for each task

1. **Development**

* continuous integration using GitHub and CI tools
* team programming for core features
* regular stand-up discussions to monitor challenges and mange efforts

1. **Code audit**

* review and sync from peers for every pull request
* integration testing post merge

# CHAPTER 4

# DESIGN MODELS

## 4.1 Overview

This chapter present design models for the E-Pharma system. These models include the Context diagram, Data Flow diagram, Use Case diagram, Entity-Relationship diagram, Sequence diagram and Relational model. Each of these model is important for understanding the system's architecture, data flow, user interactions, and database structure.

## 4.2 Context diagram

Context diagram is a visual representation that shows the scope of a system and its interactions with external entities. It provides a high-level overview of a system as shown below in figure 4:

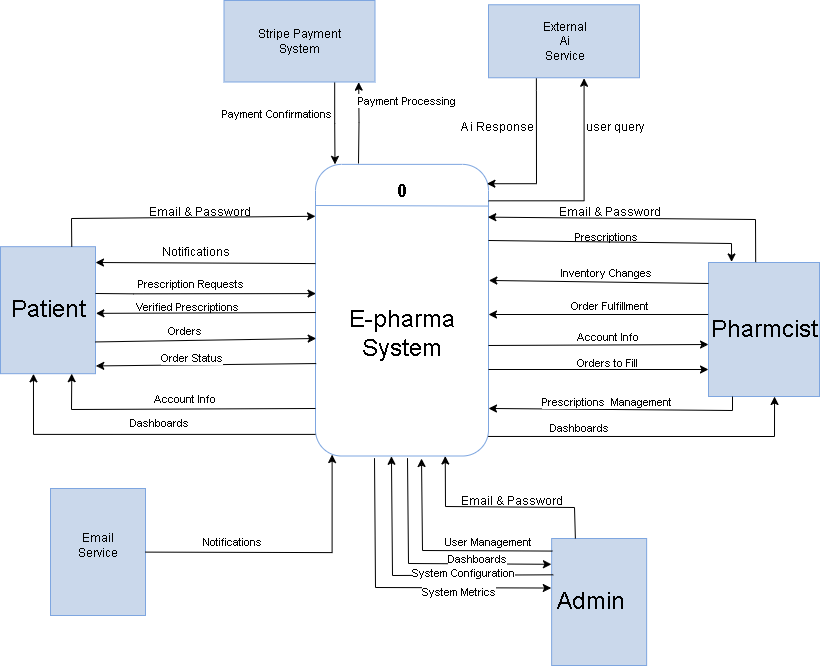


Figure Context diagram

## Data flow Diagram

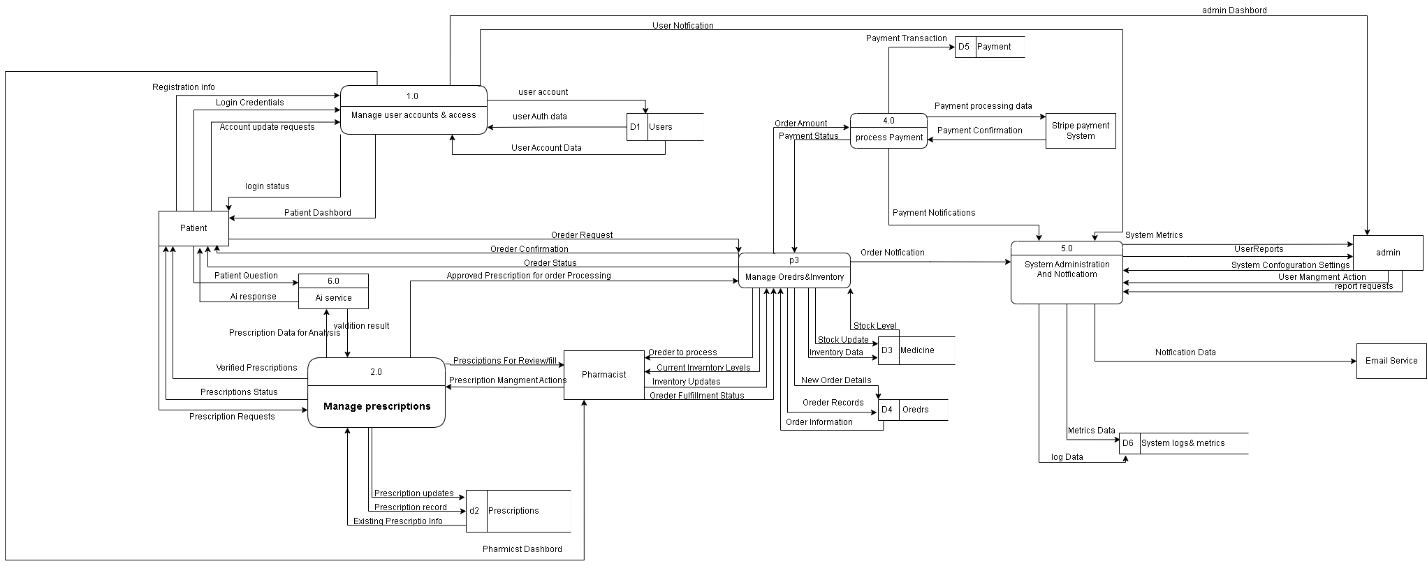
 A visual representation of the flow of data through an information system or business process. DFDs make complex systems easier to understand and are a popular resource for software engineering. As shown below in figure 5:

Figure Data Flow Diagram

## Use Case Diagram

A use case is a methodology used in system analysis to identify, clarify and organize system requirements. The use case is made up of a set of possible sequences of interactions between systems and users as shown below in figure 6:

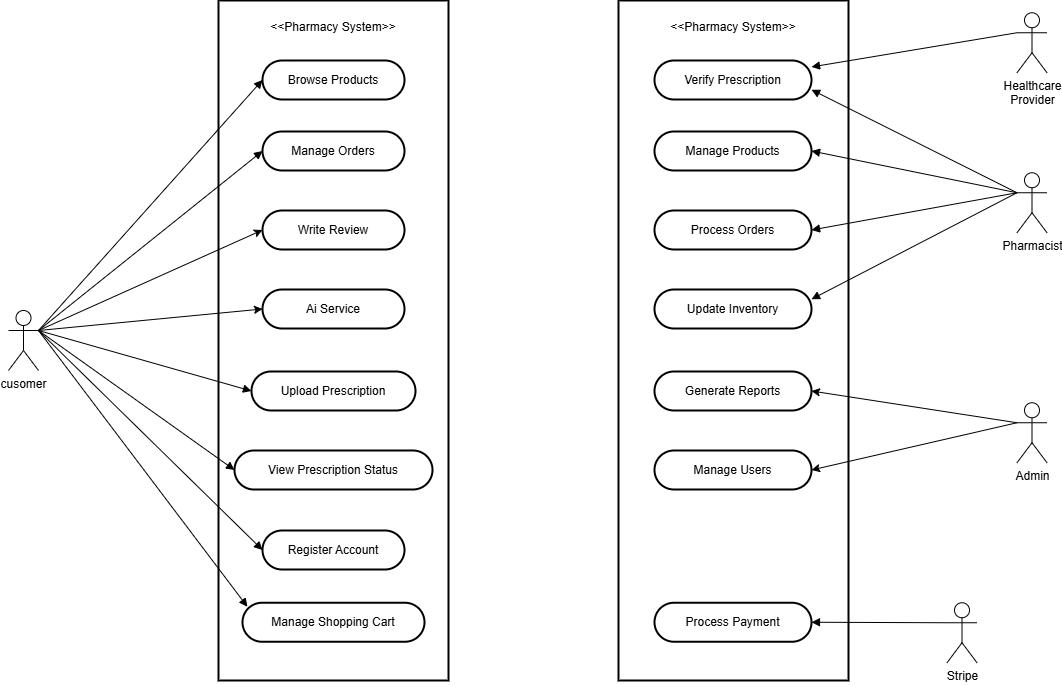


Figure Use Case Diagram

## Sequence diagram

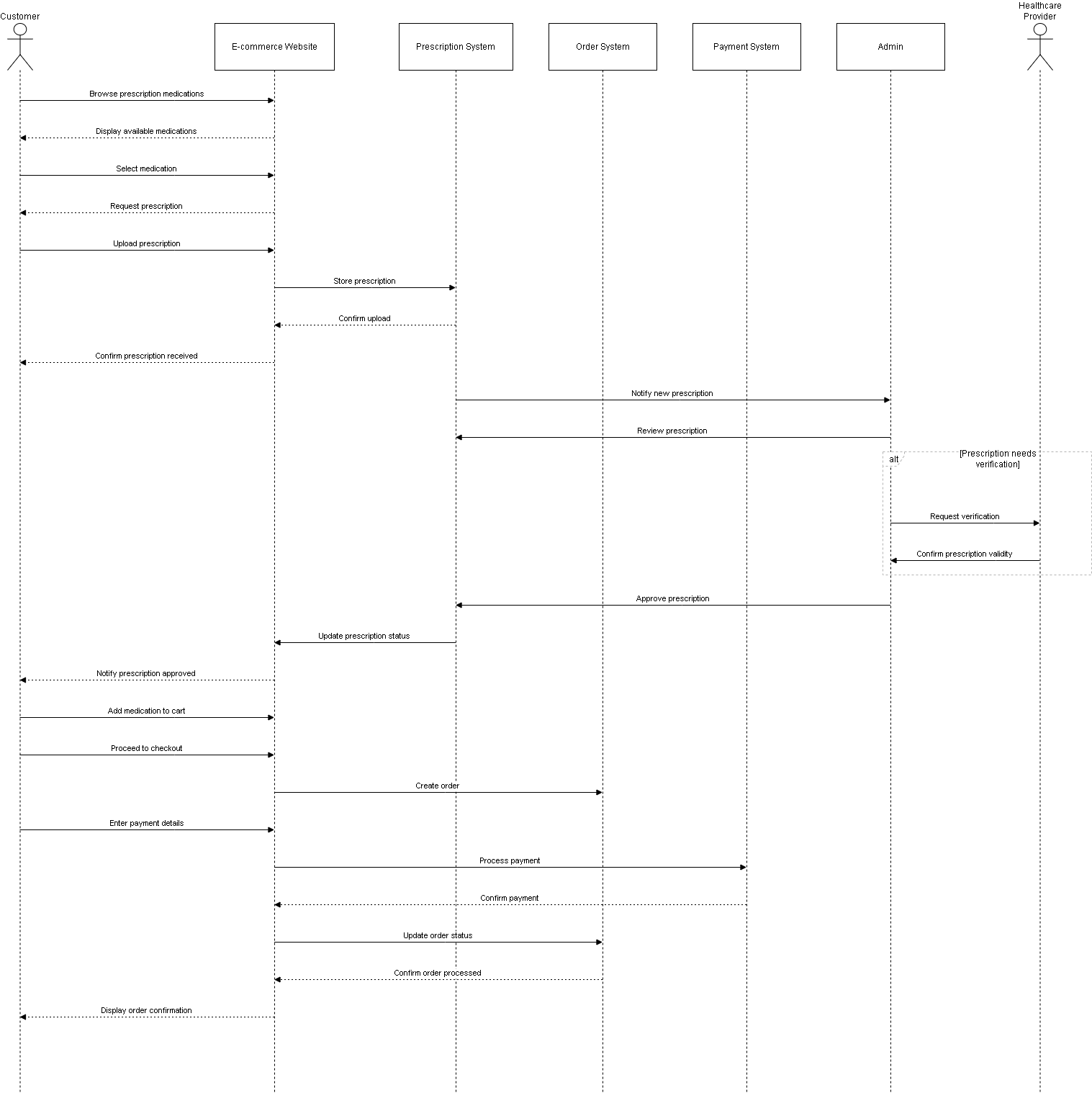
A sequence diagram consists of a group of objects that are represented by lifelines, and the messages that they exchange over time during the interaction. As shown below in figure 7:

Figure Sequence Diagram

## 4.6 ER Diagram

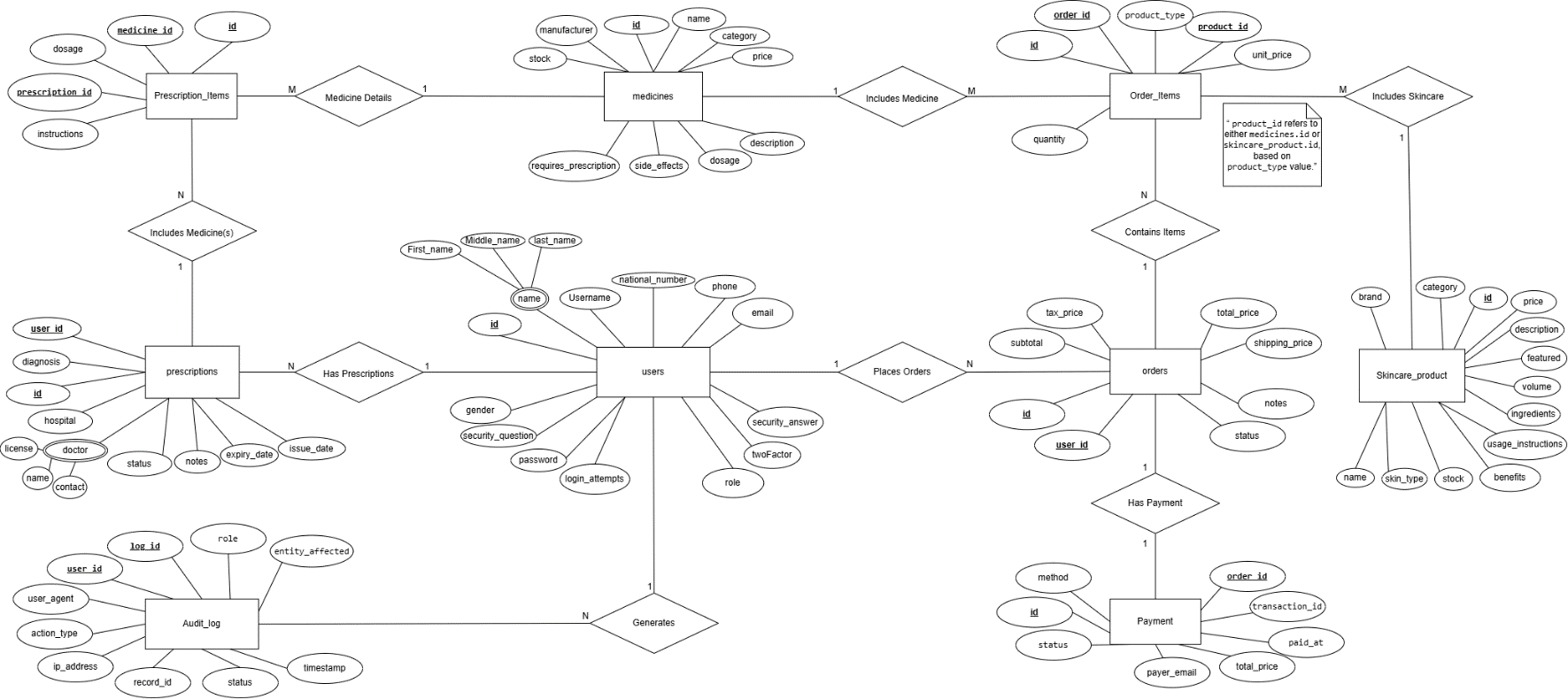
an Entity Relationship Diagram is a graphical representation that depicts relationships among people, objects, places, concepts or events. As shown below in figure 8:

Figure Entity Relationship Diagram

## 4.9 Relational Model

The relational model is a diagram that converts entities and relationships from ERD into tables used in a database. It includes primary and foreign keys to maintain data integrity. In E-Pharma, it defines the logical data structure. As shown below in figure 9:



Figure Relational Model

# CHAPTER 5

# EXPERIMENTS AND RESULTS

## 5.1 Overview

This chapter presents the testing phase of the E-Pharma system to validate its reliability, functionality, and readiness to be deployed. many testing strategies were used to ensure the system performs properly under different situations to make sure it satisfies user and meet the technical requirements.

## 5.2 Testing methodologies

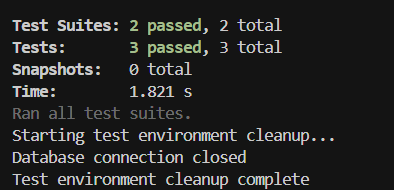
The testing process involved both manual and automatic methods to evaluate the platform modules and workflow. Tools were used for API’s testing, while local testing environment replicated real-world pharmacy situation. Testing ensured that each part behaved as it should be and interacted properly with others in the system.

Figure medicines API’s test

### 5.2.1 Unit Testing Results

Manual testing was implemented to ensure the functionality of the system.

Table Test Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test Case | Description | Decision | Example |
| 1 | Register | | | |
| Tc1.1 | User does not fill all fields | Error message ”fill all field” | Leave the email blank |
| Tc1.2 | User fill all fields | pass | Email : [gassan@gmail.com](mailto:gassan@gmail.com) pass: gassa123@G |
| Tc1.3 | User fill wrong inputs | Error message “input not valid” | Email : “gassangmail.com” |
| 2 | Login | | | |
| Tc2.1 | User enter incorrect email | Error message ”invalid email or password” | [gassan6@gmail.com](mailto:gassan6@gmail.com)  gassa123@G |
| Tc2.2 | User enter incorrect password | Error message ”invalid email or password” | [gassan@gmail.com](mailto:gassan@gmail.com)  gassan2134 |
| Tc2.3 | User enter correct info. | pass | [gassan@gmail.com](mailto:gassan@gmail.com)  gassa123@G |
| 3 | Ask AI | | | |
| Tc3.1 | Write a non-medical question | A respectful rejection of answering | “What’s my name?” |
| Tc3.2 | Write a medical question | Answer the question | “I have headache” |
| 4 | medicines search | | | |
| Tc4.1 | Enter available medicine | Searched Medicine result | “aspirin” |
| Tc4.2 | Enter unavailable medicine | No medicine will show | “apple” |
| 5 | Add/edit medicine (for pharmacist) | | | |
| Tc5.1 | Enter valid input | Medicine will added | “testggg” |
| Tc5.2 | Edit existing medicine | Edit aspirin info. | Increase dosage |
| 6 | Edit users (for admin) | | | |
| Tc6.1 | Edit user role | Edit patient to be pharmacist | Change ahmad to be pharmacist |
| Tc6.2 | Edit user info | Change user info. | Old username “omer” new username  “hamed” |
| 7 | Prescription upload | | | |
| Tc7.1 | Uploading wrong image | Error message  “incorrect file” |  |
| Tc7.2 | Image uploaded | Prescription uploaded | Medicines will be shown and can be added to cart |

### 5.2.2 Acceptance System Results

User Acceptance Testing (UAT), commonly conducted in many IT projects, this important phase of software development involves having the target audience examine the program in a "real world" environment. This phase ensures that the software aligns with the users expectations and requirements before its deployed. As shown in the figures (11~15) the form were created to analysis user satisfaction level.

## 5.3 Discussion and evaluation

The test confirmed the core usability, reliability and integration success. As intended, a large number of functions are carried out in different modules. During the test, minor UI contradictions and bugs were solved. The response highlights the importance of intuitive design and smooth navigation. Overall the E-Pharma system was validated as a reliable and efficient platform.

# CHAPTER 6

# CONCLUSION AND FUTURE WORKS

## 6.1 Overview

This chapter conclude the development of the E-Pharma system by presenting a summary of the project, the achieved objectives, main contributions, limitations, and possible future improvement.

## 6.2 Summary about the project

The E-Pharma system aim to develop a secure, role-based web application that allows users to browse, order, and manage medications online. The system supports many roles: admin, pharmacist and patient, each role with custom access and functionality, developed using Node.js, Express.js, PostgreSQL, and EJS, the system solves some of the major problems in traditional pharmacies.

## 6.3 Achieved objectives

The following key objectives were successfully achieved:

* Ai prescription management
* role-based dashboard.
* conducting testing to ensure functionality, security, and usability.
* enabling real time order tracking and inventory visibility.
* implementing Ai services across the site
* implementing role-based access control across different user types.
* implementing secure payment integration (stripe)

## 6.4 Main contributions of the work

The system contributes to the healthcare field by:

* demonstrate the integration of modern technology to solve real world problems
* highlight the importance of role based design in healthcare platforms
* provide a responsive, secure web based pharmacy model
* offers a digital solution for medicine accessibility

## 6.5 Limitation

As the system achieved most functional objective, there were a few limitations;

* mobile app. development for better mobile experience
* the processes to verifying insurance are not very standardized
* some medicines require manual verification
* 24/7 pharmacist for urgent prescriptions

## 6.6 Future Work

**AI improvements**

* recommendation system for medicine using patient history
* help with symptom analysis and first diagnosis

**Telemedicine improvements**

* wearable device integration for remote monitoring
* secure messages system with end-to-end encryption

**Mobile app**

* biometric authentication for more security
* iOS/Android applications

**Blockchain integration**

* secure medicine source monitoring
* immutable prescription records
* smart contracts for digital insurance handling

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[**https://www.drawio.com**](https://www.drawio.com) **(5/27/2025)**

### Appendices [if any]

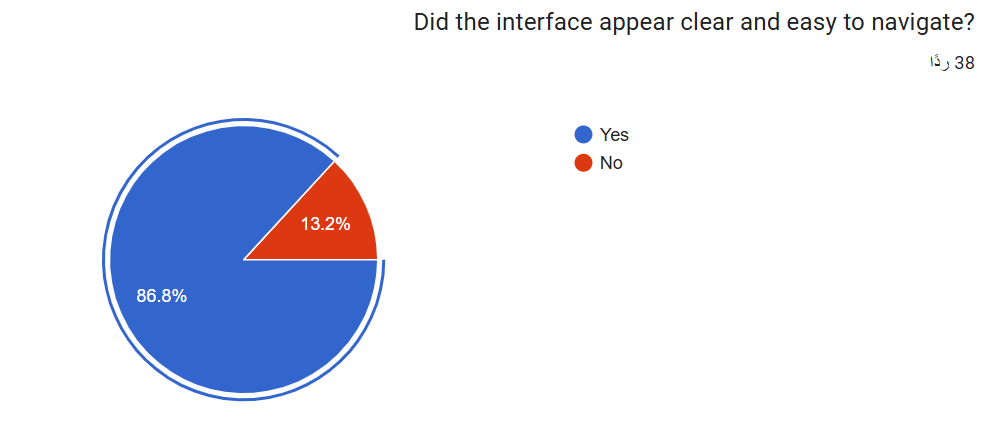


Figure Question 1

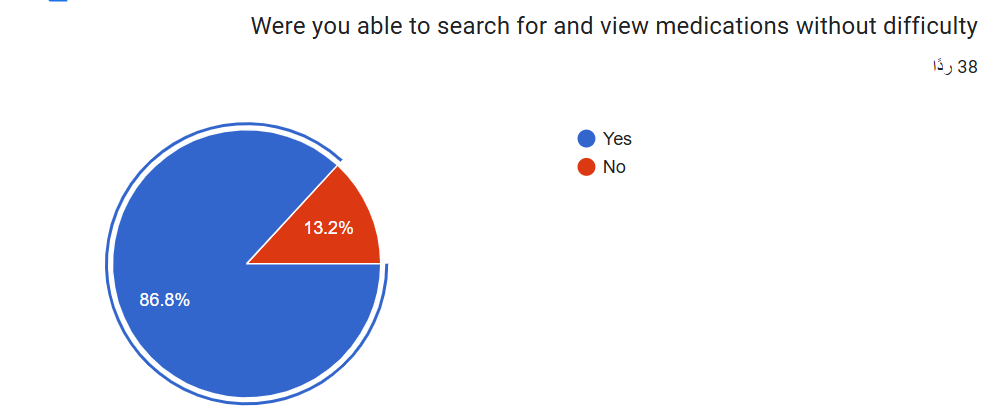


Figure Question 2

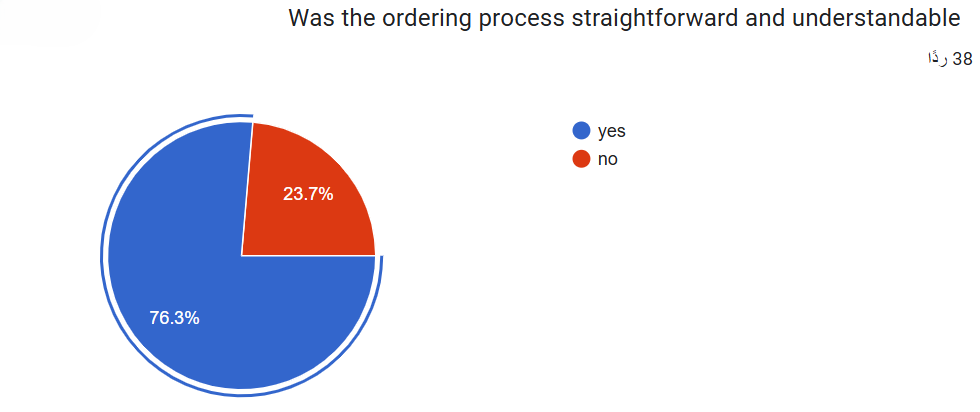
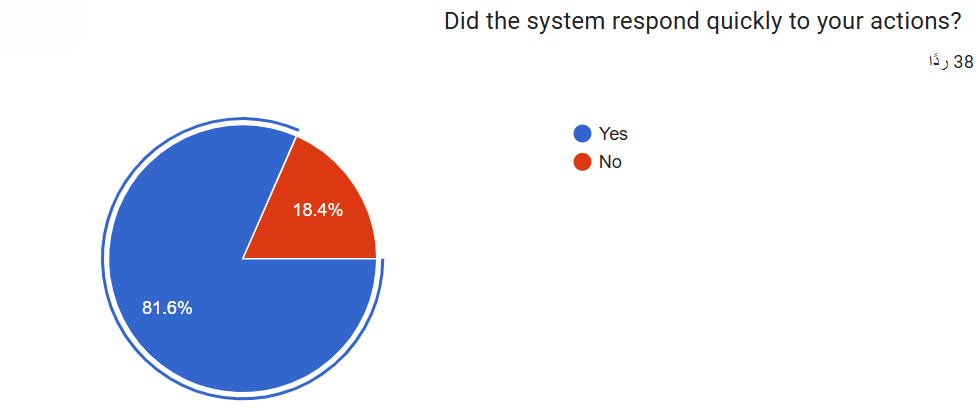


Figure Question 3

Figure Question 4



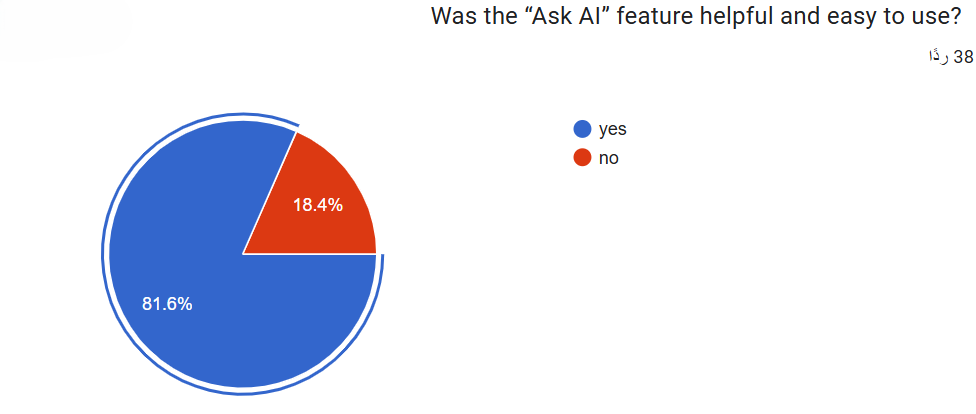


Figure Question 5

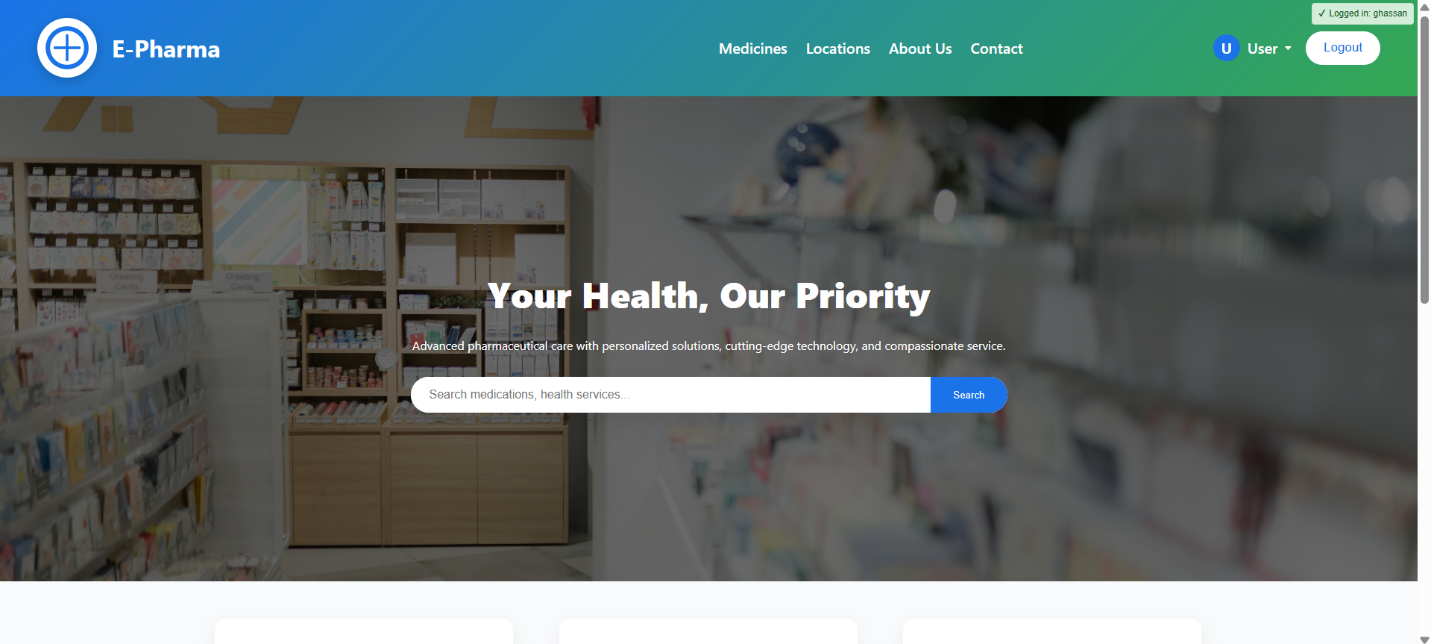


Figure home page 1

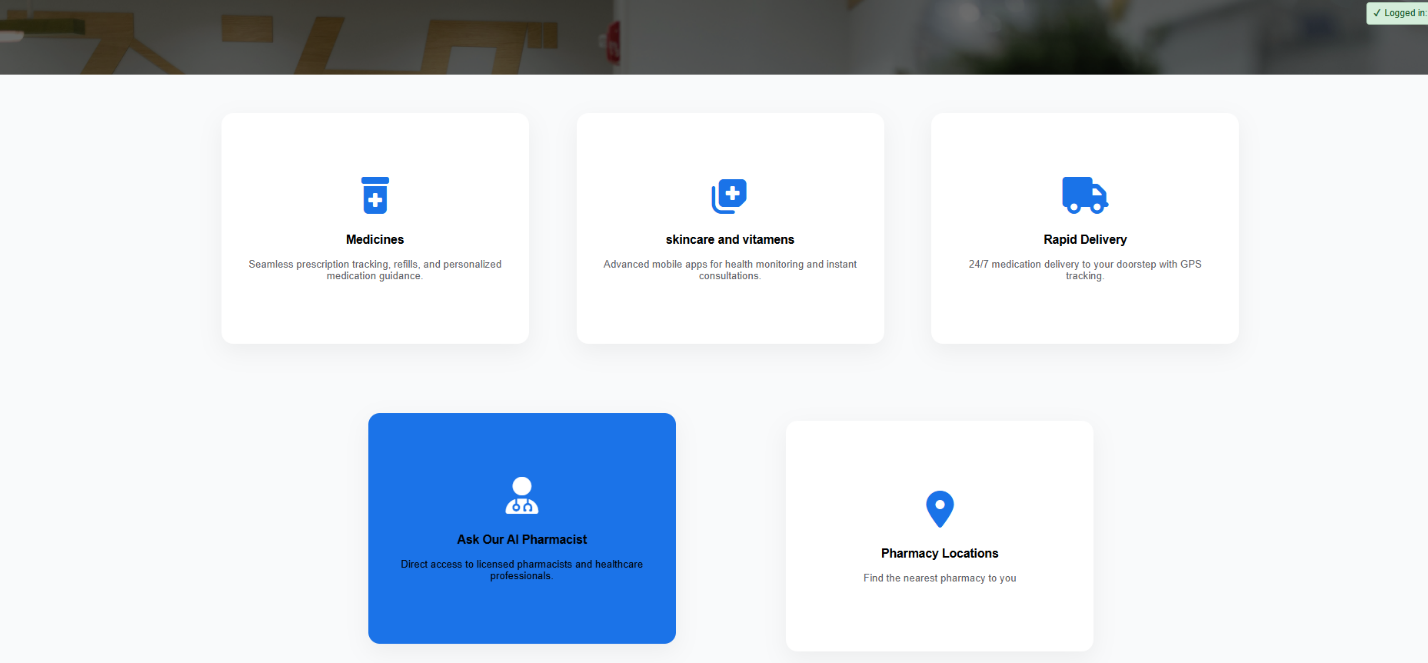


Figure home page 2

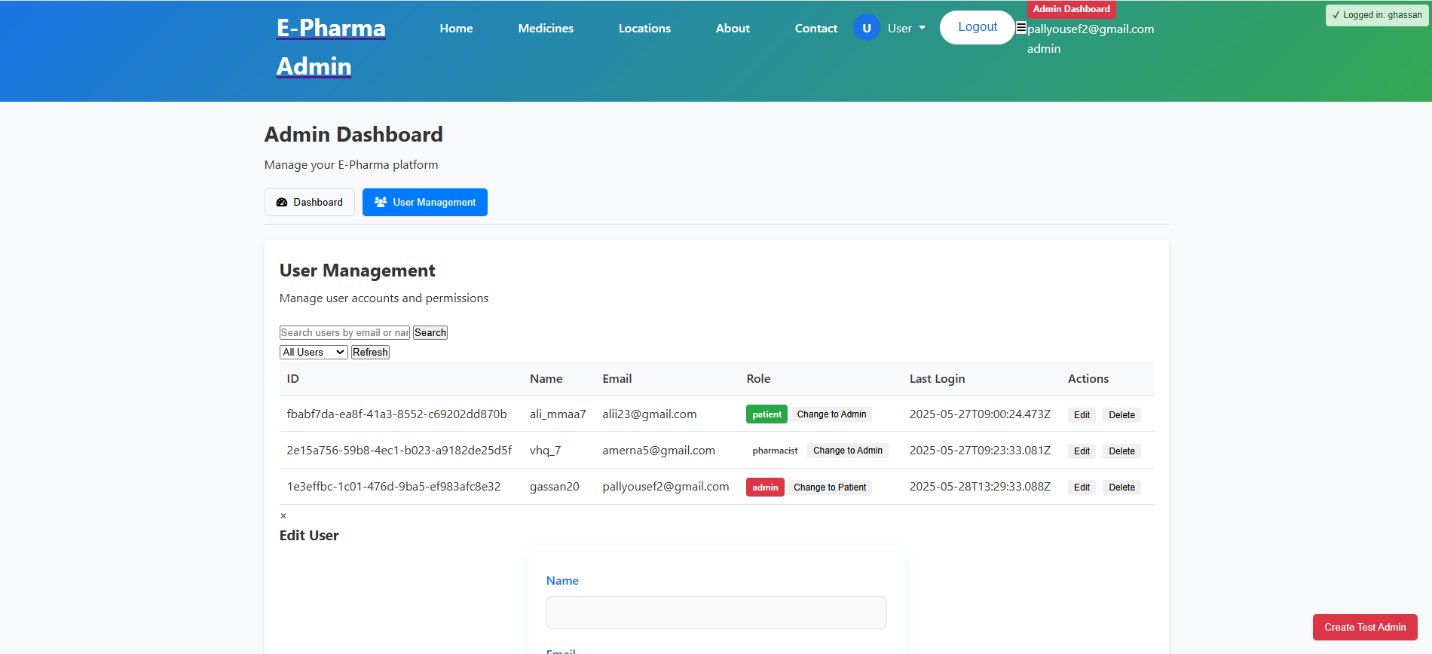


Figure admin dashboard

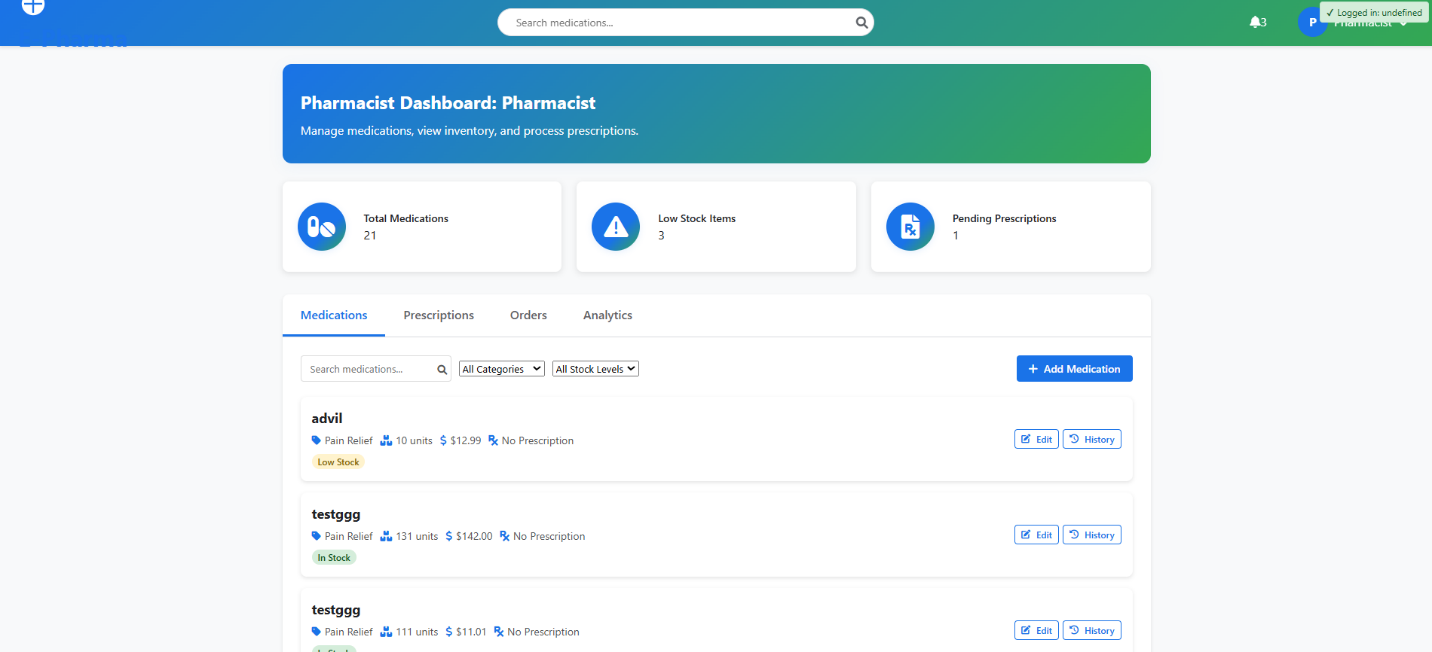


Figure pharmacist dashboard

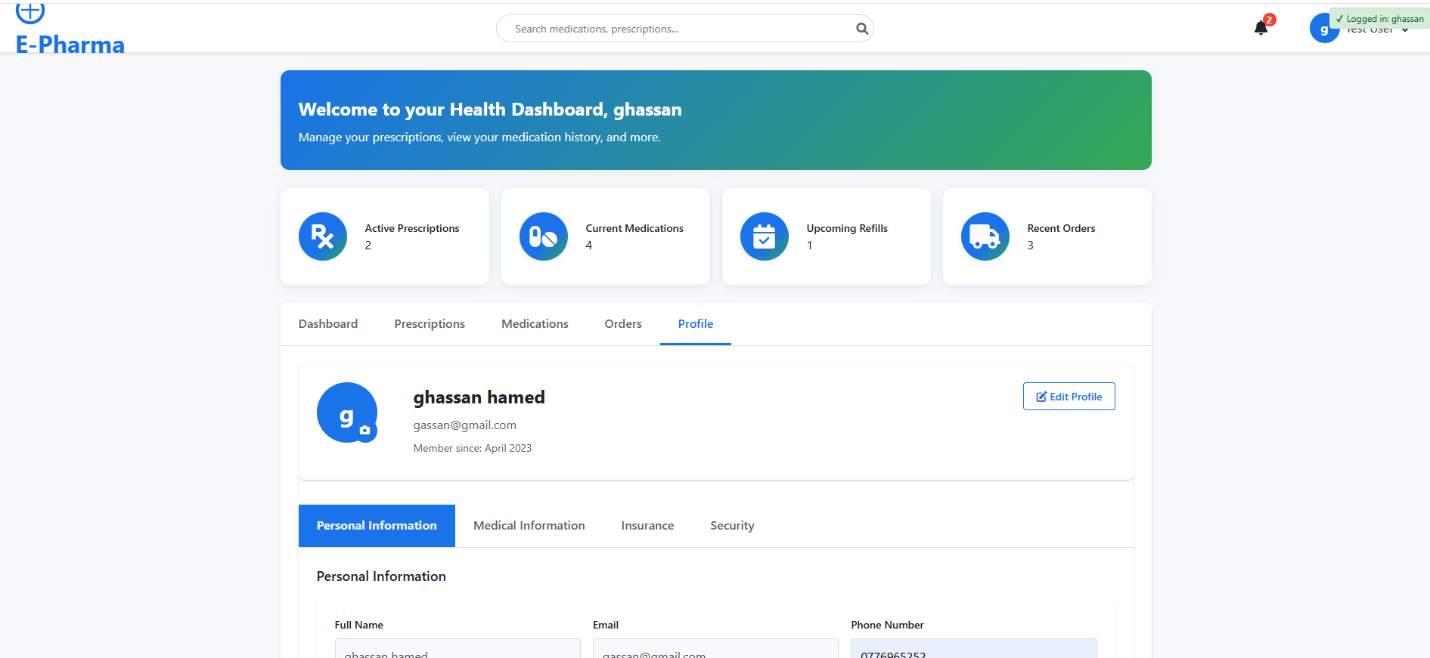


Figure patient dashboard

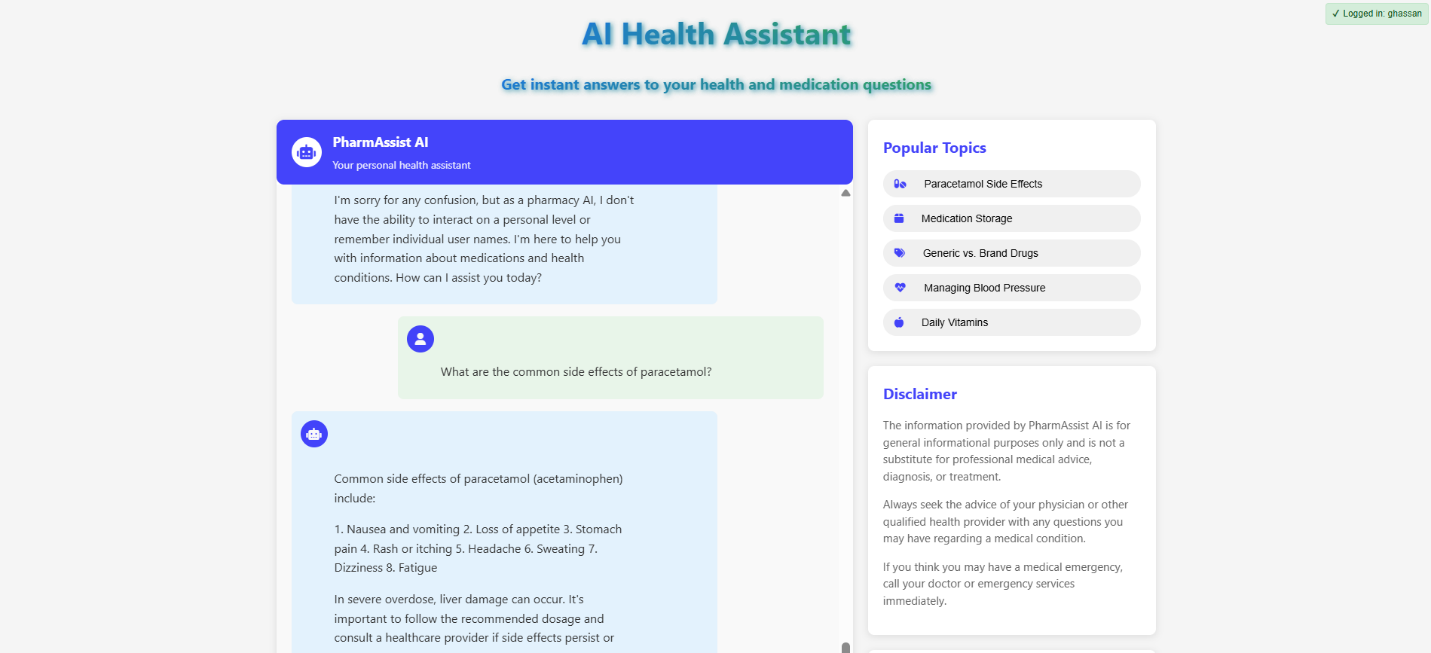


Figure ask ai page

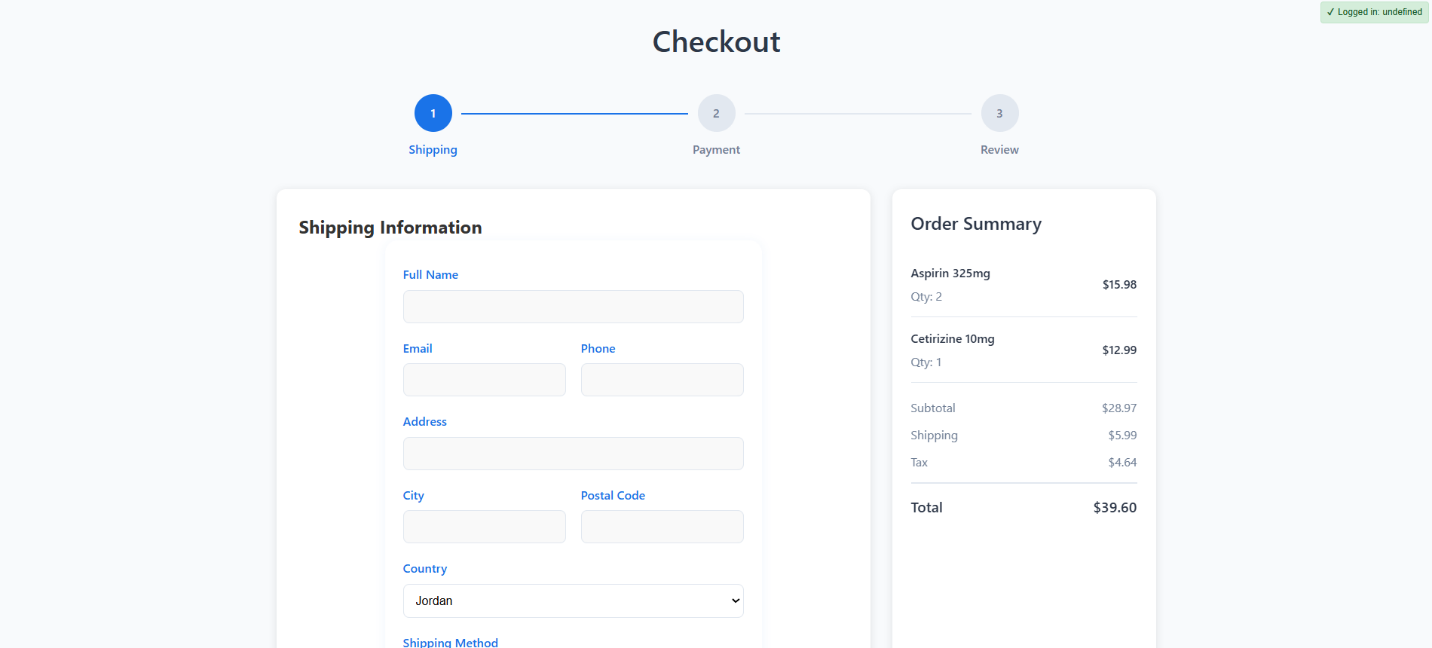


Figure checkout page

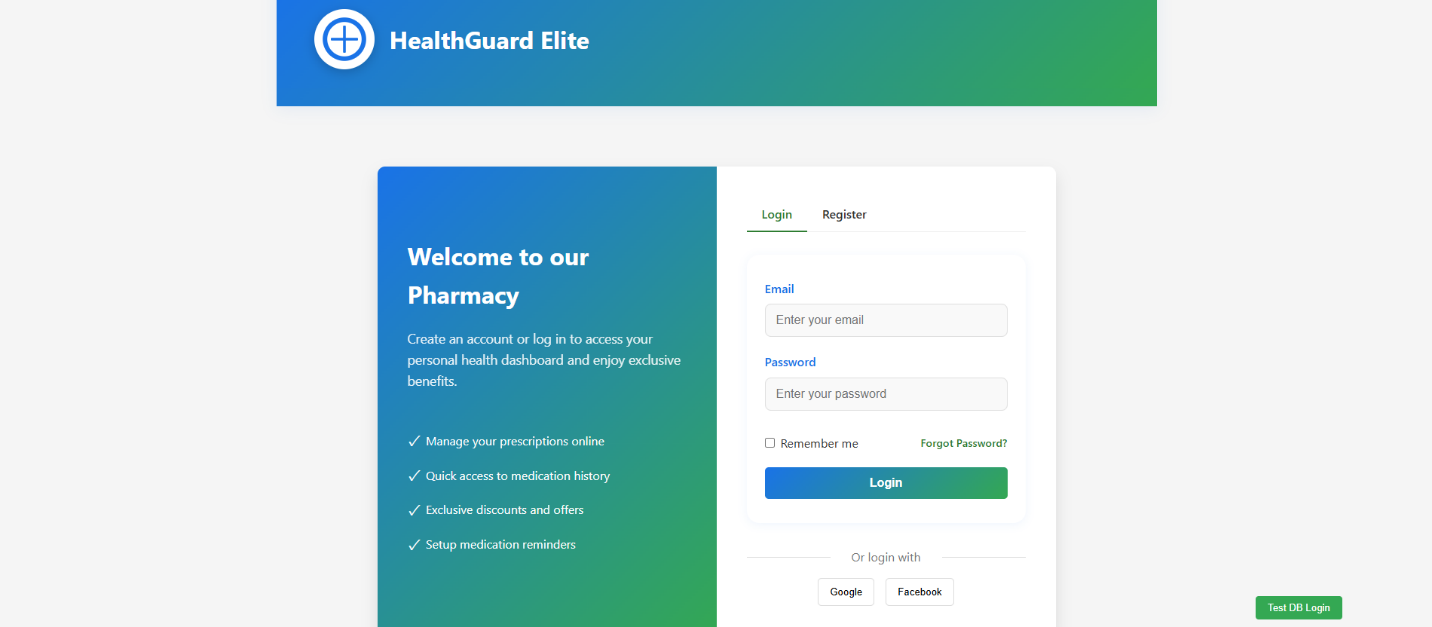


Figure login page

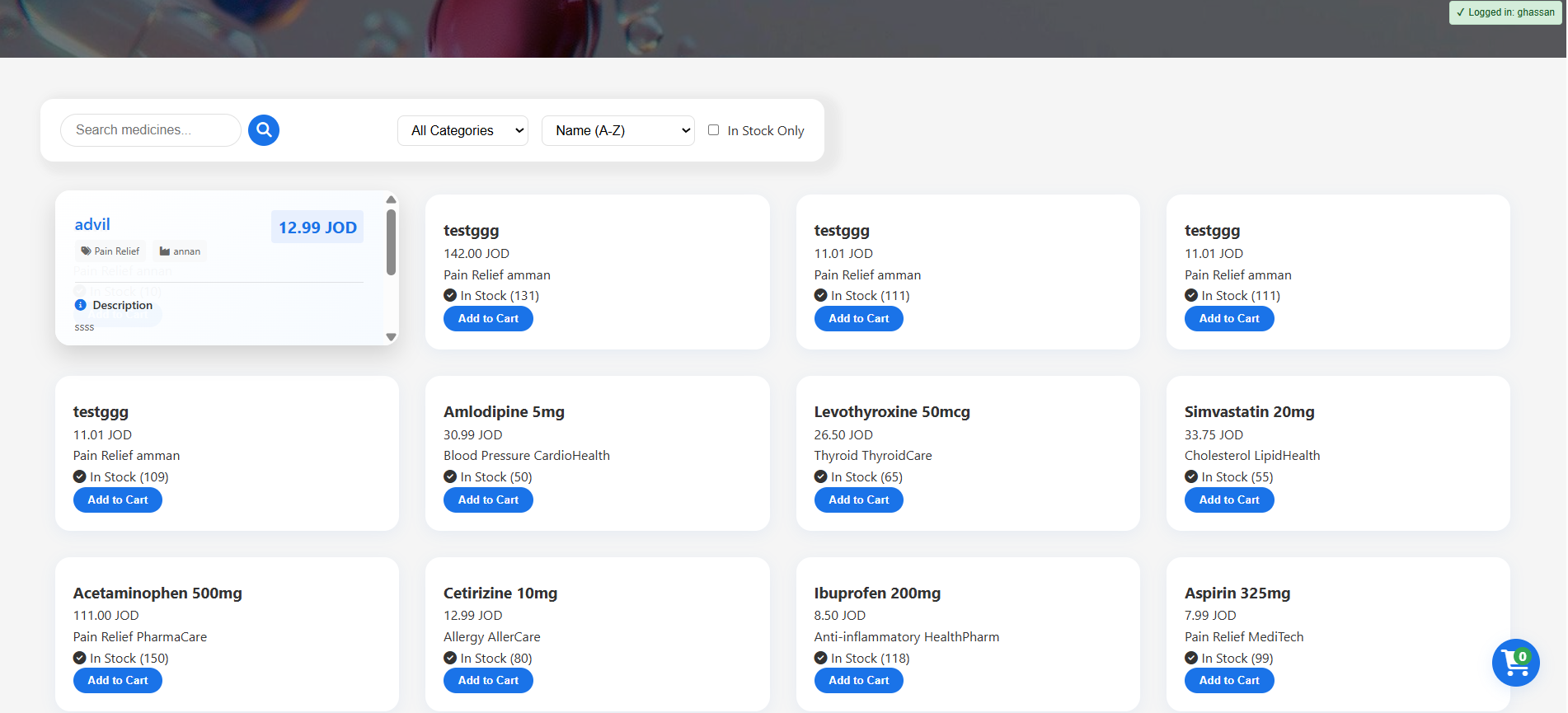


Figure medicines page

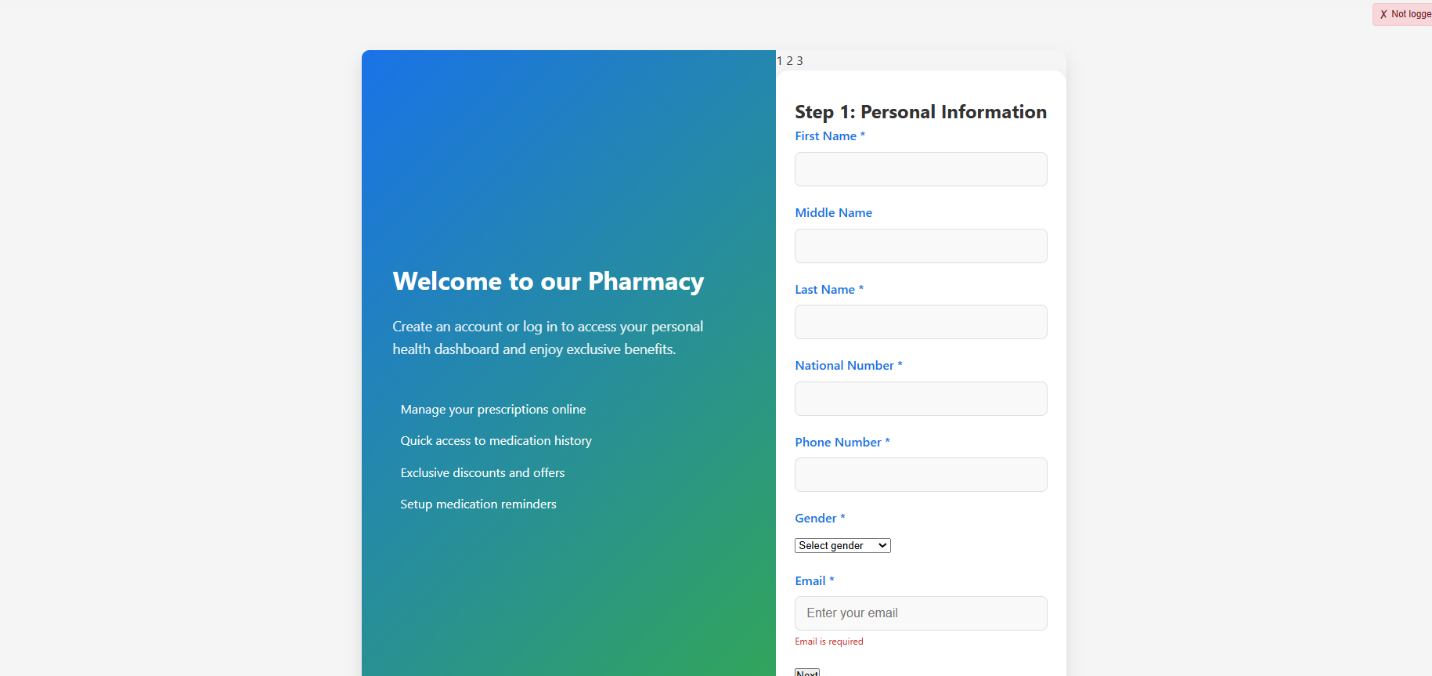


Figure register page