APPROVAL

Supervisor Name: Ali Hilowle Ali

Signature: _____

Date:_____/_____/2025

Dean of faculty:

Signature: _____

Date:_____/_____/2025

R&D office:

Signature: _____

Date:_____/_____/2025

DECLARATION

We hereby declare that we have carefully read and thoroughly reviewed this senior project entitled "Vaccine Management System", and in our professional opinion, this work meets the required academic standards in terms of both scope and quality. We believe it is suitable for the partial fulfillment of the requirements for the award of the Bachelor of Computer Science and Information Technology, and therefore accept it for submission to the examining panel.

Furthermore, we declare that all the information, analyses, system designs, and implementations presented in this project are original and a result of our own efforts, unless otherwise stated and properly referenced. The content has been developed with academic integrity and in accordance with the university’s ethical guidelines.

We affirm that the information provided in this document is true, accurate, and complete to the best of our knowledge and belief. We acknowledge that any misrepresentation, plagiarism, or fabrication of data will not only lead to academic penalties but may also carry legal consequences under applicable institutional or national laws.

ACKNOWLEDGEMENT

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Lastly, we extend our deepest thanks once again to our families for their emotional and financial support, patience, and understanding throughout our studies. This achievement is as much theirs as it is ours.

ABSTRACT

The Vaccination Management System is a web-based application designed to automate and streamline the processes involved in managing immunization records across healthcare facilities. In many clinics and hospitals—especially in regions like Yaqshid—vaccination data is still recorded manually using paper-based systems. This outdated method is time-consuming, prone to errors, and lacks proper security and accessibility, often leading to data loss, redundancy, and inefficiencies in service delivery.

This project introduces a centralized digital Vaccination Management System that enables efficient handling of vaccine inventory, patient registration, vaccination scheduling, dose tracking, and report generation. By minimizing manual data entry, the system enhances data accuracy, strengthens security, and ensures real-time access to vaccination records for both healthcare providers and administrators.

The system empowers medical staff to manage patient information, monitor vaccine availability, send appointment reminders, and generate statistical reports essential for health planning and decision-making. It also includes password recovery, multi-user access, and responsive web functionality—features rarely found in existing desktop-based systems used locally.

By replacing traditional paper systems with a secure and user-friendly digital platform, this project contributes to the digital transformation of public health infrastructure, supporting better coordination, transparency, and data-driven strategies in vaccine administration.

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CHAPTER ONE

Vaccine Management system

1.0 Introduction

Vaccination is one of the most effective public health strategies for preventing the spread of infectious diseases and reducing mortality. Over the years, vaccines have saved millions of lives by protecting individuals and communities from deadly illnesses such as measles, polio, and most recently, COVID-19. However, the process of managing vaccines — including their storage, distribution, and administration — remains a major challenge in many healthcare systems, especially in low-resource settings (World Health Organization, 2021).

In many clinics and hospitals, vaccine records are still kept on paper or outdated systems, making it difficult to track doses, monitor expiry dates, and avoid wastage. These issues can result in missed vaccinations, errors in patient data, and even dangerous health risks. To solve this, there is a growing need for digital tools that can streamline vaccine-related processes and provide real-time, accurate information.

This project proposes the development of a Vaccine Management System (VMS) — a web-based application that allows healthcare providers to manage vaccine stocks, register patients, monitor usage, and generate detailed reports. The system is designed to help reduce human error, avoid expired vaccine administration, and improve overall efficiency. Features such as automated alerts, inventory tracking, and digital vaccination cards aim to modernize how vaccines are handled in both rural and urban healthcare centers.

By using digital technology, the Vaccine Management System supports global health efforts and aligns with goals set by organizations like WHO and UNICEF, who encourage innovation in vaccine delivery systems (UNICEF, 2022). The solution also contributes to achieving Sustainable Development Goal 3, which focuses on ensuring healthy lives and promoting well-being for all at all ages (United Nations, 2023).

1.1 Background of the System

Vaccination remains one of the most impactful public health interventions globally. The World Health Organization (2021) estimates that vaccines prevent 4 to 5 million deaths each year by protecting against diseases such as measles, polio, hepatitis, and more recently, COVID-19. However, while the science of vaccine development has advanced rapidly, the systems responsible for managing vaccine logistics—particularly in developing regions—have not kept pace.

In many healthcare facilities, especially in rural or underserved areas, vaccine management is still conducted through manual, paper-based methods. These systems are vulnerable to human error, data loss, and inefficiencies in tracking vaccine inventory, patient records, and expiration dates (UNICEF, 2022). As a result, patients may miss essential doses, receive expired vaccines, or be vaccinated multiple times unnecessarily due to lack of reliable documentation.

Moreover, vaccines are highly sensitive to temperature changes and must be stored within a strict "cold chain" to remain effective. According to the Centers for Disease Control and Prevention (2021), failure to maintain this chain due to inadequate monitoring can render vaccines ineffective, posing a significant threat to public health. The lack of digital systems further limits the ability of health workers to track real-time stock levels, receive alerts for low inventory, or ensure proper storage.

The COVID-19 pandemic highlighted these systemic weaknesses. Many countries experienced vaccine wastage and delays not because of shortages, but due to poor recordkeeping and fragmented logistics systems (Gavi, 2021). This crisis underscored the urgent need for digital vaccine management tools that offer real-time tracking, reporting, and accountability.

To address these challenges, this project proposes the development of a Vaccine Management System (VMS)—a web-based platform designed to streamline and automate vaccine distribution, inventory tracking, patient registration, and reporting. The system aims to reduce errors, prevent vaccine wastage, and enhance the overall efficiency of immunization programs.

Furthermore, the proposed system aligns with the United Nations Sustainable Development Goal 3, which advocates for improved health and well-being through the integration of innovative digital technologies (United Nations, 2023).

1.2 Problem Statement

vaccination programs would be managed using a centralized digital system that ensures efficiency, accuracy, and accessibility. This system would allow healthcare providers to access up-to-date vaccination records for every patient, regardless of the healthcare center they visit. Automation would help schedule vaccinations, send timely reminders, and track progress in real-time. For example, when a vaccination is due, the system automatically sends notifications to both the patient and the healthcare provider, reducing the risk of missed appointments.

The digital system would also allow healthcare workers to generate comprehensive reports that track vaccination coverage across different regions. These reports would provide valuable insights, helping public health authorities make data-driven decisions to improve vaccination programs and prevent outbreaks. Overall, the ideal system would reduce human error, improve communication, and ensure that everyone has access to their complete vaccination history at any time. In the current reality, many vaccination programs still rely on manual methods, such as paper records, spreadsheets, or outdated software. These methods are time-consuming, prone to human errors, and difficult to manage. When healthcare workers must search through paper records or spreadsheets, mistakes can occur, leading to missed vaccinations or incorrect information. The lack of a centralized system means patients often struggle to maintain a consistent vaccination history, especially when they visit different healthcare centers.

Additionally, the absence of automatic reminders results in many individuals forgetting their vaccination appointments, which leads to delays and missed doses. Healthcare providers often cannot track vaccination progress effectively, making it difficult to monitor vaccination rates and identify areas where coverage is lacking. Without real-time reports, it is hard to understand the overall performance of vaccination programs, making it difficult to address problems quickly or plan for future needs. These challenges reduce the efficiency of vaccination programs, lower vaccination rates, and leave populations at risk of preventable diseases.

1.3 Purpose of the Project

The purpose of this project is to design and develop a Vaccination Management System that facilitates efficient management of vaccination records and processes. The system aims to:

1. To centralize all vaccination data in one secure and accessible platform.
2. To streamline scheduling, automated reminders, and real-time reporting processes.
3. To ensure high standards of data accuracy, integrity, and security.
4. To strengthen communication between healthcare providers and individuals.

By achieving these goals, the system will contribute to improved vaccination coverage and better public health outcomes.

1.4 Project Objectives

The objectives of the Vaccination Management System are as follows:

1. To develop a user-friendly interface for healthcare providers and individuals.
2. To enable secure registration and management of vaccination records.
3. To automate appointment scheduling and reminders via email or SMS.

1.5 Project Scope

The Vaccination Management System will focus on automating vaccination record management, appointment scheduling, and reminders to ensure better healthcare delivery. It will be implemented in healthcare centers in Mogadishu, District of Yaqshiid, with the goal of improving vaccination tracking. The system will include secure data management, role-based user access, and real-time reporting features.

Time Scope:

The development and implementation of the Vaccine Management System was planned over a period of six months, beginning in January 2025 and concluding in June 2025. The timeline was divided into three major phases, each with specific goals and deliverables to ensure a successful and efficient rollout of the system.

• Phase 1: Planning & Development *(January – April 2025)*

During this phase, the foundation of the system was established. The main activities included:

- Finalizing the system's functional and non-functional requirements.
- Designing the system architecture and database schema.
- Developing the core features, such as:
    - Vaccination record management
    - Appointment scheduling
    - Automated reminders and notifications
- Conducting early-stage testing to verify that key modules were functioning as expected.

• Phase 2: Testing & Training *(May 2025 – First 2 Weeks)*

This phase focused on ensuring the system's stability and preparing users for full deployment:

- Performing extensive system testing to evaluate reliability, security, and performance under different scenarios.
- Gathering feedback from test users and applying refinements to enhance usability and fix bugs.
- Training healthcare personnel on how to effectively use the system, including:
    - Registering patients
    - Managing vaccination schedules

- Generating real-time reports and statistics

• Phase 3: Deployment & Support *(May 2025 – Last 2 Weeks)*

In the final phase, the system was introduced into real-world environments:

- Full deployment across selected healthcare centers.
- Monitoring system performance, gathering live feedback from users.
- Offering technical support, bug fixes, and maintenance services to ensure smooth operation post-deployment.

Geographical Scope:

The Vaccination Management System will initially be implemented in the District of Yaqshiid, Mogadishu, targeting healthcare centers within this district. The system will be rolled out in select healthcare centers within Yaqshiid District for testing and initial use. Based on successful implementation and feedback, the system may be expanded to additional districts in Mogadishu or other regions of Somalia.

1.6 Significance of the Project

The Vaccination Management System is significant because it addresses key challenges in vaccination program management, such as manual record-keeping, errors in data entry, and difficulties in tracking vaccination schedules. By automating processes like appointment scheduling, reminders, and reporting, the system ensures that healthcare providers can offer more efficient and accurate services. This will ultimately increase vaccination coverage, reduce missed appointments, and help prevent the spread of vaccine-preventable diseases. The system will also provide a valuable tool for decision-making by generating real-time reports on vaccination progress, allowing health officials to identify gaps and improve overall vaccination efforts in the region. By implementing the system in Mogadishu, District of Yaqshiid, the project will lay the foundation for future expansion to other regions, potentially improving public health on a larger scale.

1.7 Report Organization

This report is organized as follows:

- Chapter One: Introduction – Provides an overview of the project, including the background, problem statement, purpose, objectives, scope, and significance.
- Chapter Two: Literature Review – Discusses related work and existing systems to provide context and justification for the proposed system.
- Chapter Three: System Analysis and Design – Describes the system requirements, architecture, and design specifications.
- Chapter Four: Implementation – Details the development process, tools used, and features implemented in the system.
- Chapter Five: Testing and Evaluation – Presents the results of testing and evaluates the system's performance.
- Chapter Six: Conclusion and Recommendations – Summarizes the findings and provides recommendations for future work.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Vaccination remains a powerful and essential tool in preventing infectious diseases and saving millions of lives every year. Despite its proven effectiveness, many healthcare systems—particularly in developing nations—continue to rely on manual, paper-based vaccine tracking methods. These outdated systems often lead to human error, poor recordkeeping, stock mismanagement, and in some cases, the administration of expired or duplicate vaccine doses (World Health Organization, 2021). Such inefficiencies can severely disrupt immunization schedules and reduce public trust in health programs.

Another major challenge in vaccine delivery is the strict requirement for temperature-controlled storage, known as the cold chain. If this chain is broken at any point, the vaccine's effectiveness can be compromised. In many rural and low-resource areas, there is a lack of proper tools to monitor and maintain cold chain standards, which can lead to spoiled or unsafe vaccines being used (Centers for Disease Control and Prevention, 2021). Without automated systems to track storage conditions and alert staff to potential issues, maintaining vaccine integrity becomes increasingly difficult.

The COVID-19 pandemic revealed the urgent need for stronger digital vaccine management systems worldwide. Many countries struggled not with vaccine supply, but with organizing data, tracking doses, and reporting coverage. This led to missed opportunities, vaccine wastage, and unequal distribution. As a result, global organizations and governments began advocating for modern, tech-driven solutions that allow real-time tracking, inventory alerts, and digital patient records (Gavi, 2021). This literature review explores existing vaccine management challenges and highlights how digital systems can transform immunization processes for greater efficiency, safety, and reliability.

LITERATURE REVIEW MAP

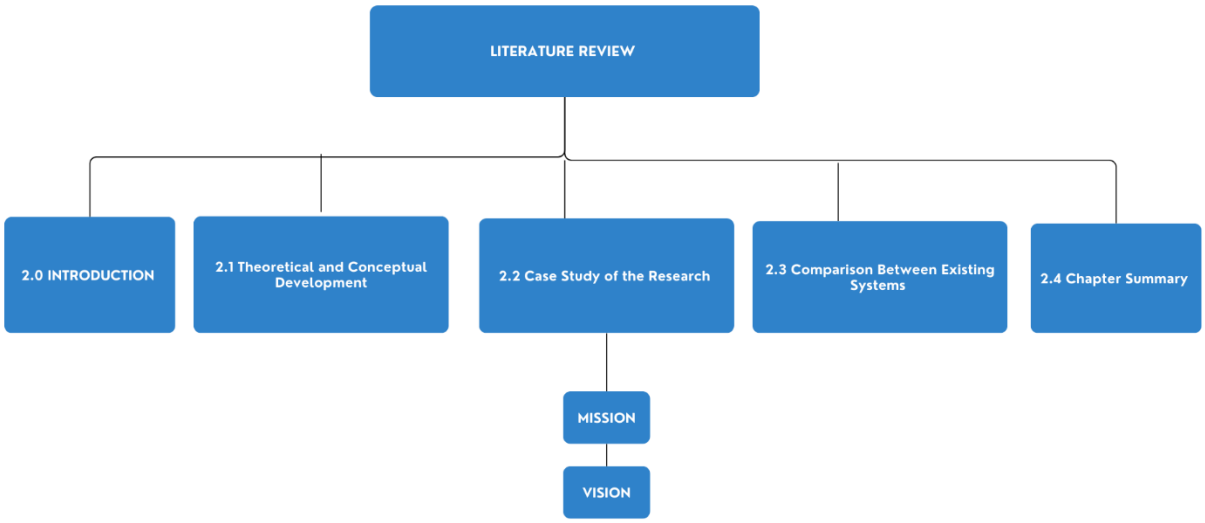


Figure 2.1 literature review

2.1 Theoretical and Conceptual Development

The development of a Vaccination Management System (VMS) is rooted in the principles of health informatics, digital transformation in healthcare, and information management systems. In recent years, technological advancements have significantly improved the efficiency, security, and accessibility of health services, particularly in developing nations where digital solutions help bridge healthcare gaps. The theoretical and conceptual foundation of the VMS is built upon key frameworks that guide its design, development, and implementation.

One of the most fundamental theories underlying this system is Health Information Technology (HIT), which involves the application of computer systems, networks, and software solutions to improve healthcare processes. By integrating digital solutions, HIT enables healthcare providers to efficiently store, manage, and retrieve vaccination records, minimizing errors and reducing

dependency on manual record-keeping. Traditional vaccination programs often rely on paper-based documentation, which is prone to loss, inefficiency, and duplication of records. The proposed VMS eliminates these challenges by introducing a centralized, automated system that ensures real-time access to vaccination data for both healthcare professionals and patients.

Another essential theory that informs the system's development is Systems Theory, which emphasizes the interconnectivity of different system components to achieve a common goal. A Vaccination Management System consists of various modules, including patient registration, vaccination scheduling, automated reminders, reporting, and data security mechanisms. These elements must function seamlessly and interdependently to create a comprehensive and efficient vaccination management process. Without such integration, inefficiencies may arise, leading to delays, missed appointments, or inaccurate record-keeping.

Furthermore, the Diffusion of Innovations Theory, developed by Everett Rogers, explains how new technologies and digital innovations are adopted within organizations. This theory is particularly relevant to the implementation of digital vaccination systems in developing regions such as Mogadishu, Somalia, where digital transformation in healthcare is still evolving. Factors such as ease of use, perceived usefulness, compatibility with existing workflows, and system reliability influence how quickly healthcare professionals and institutions adopt new technologies. By designing a user-friendly, accessible, and efficient system, the Vaccination Management System aims to ensure smooth adoption by healthcare providers.

The conceptual development of the Vaccination Management System is also based on modern software engineering principles, ensuring scalability, security, and interoperability. The system is designed to be accessible via both web and mobile platforms, allowing healthcare workers, administrators, and patients to access vaccination records from any location. Additionally, the system incorporates secure authentication mechanisms to protect patient data and prevent unauthorized access.

A well-developed Vaccination Management System will ultimately streamline vaccination processes, reduce administrative workload, improve patient compliance, and enhance public health outcomes.

2.1.1 Definition of Vaccine

A vaccine is a biological preparation that provides active acquired immunity to a particular infectious disease. It typically contains weakened or killed forms of the microorganism, its toxins, or one of its surface proteins, which stimulate the body's immune system to recognize and combat the pathogen if encountered in the future. Vaccines have played a crucial role in eliminating and controlling deadly diseases such as polio, measles, and smallpox. They are a cornerstone of public health efforts and are administered through structured immunization programs worldwide.

2.1.2 Management

Management refers to the organization, coordination, and control of processes to achieve specific objectives efficiently and effectively. In the context of healthcare, management involves the planning, execution, and monitoring of medical services, including vaccination programs. Effective management ensures that resources are utilized optimally, services are delivered efficiently, and public health goals are met. Vaccination management specifically focuses on ensuring that vaccines are administered timely, records are maintained accurately, and healthcare facilities are well-equipped to handle immunization programs.

2.1.3 Management System

A management system is a structured framework that helps organizations plan, implement, monitor, and improve processes to achieve specific goals. In healthcare, management systems are essential for data organization, workflow automation, and service coordination. A Vaccination Management System (VMS) is designed to track vaccination records, schedule appointments, send automated reminders, and generate reports, ensuring a seamless vaccination process for both healthcare workers and patients. By leveraging digital technology, management systems improve efficiency, accuracy, and security in handling sensitive healthcare data.

2.1.4 How the System Works

The Vaccination Management System follows a structured process to ensure smooth and accurate vaccination program execution. The system operates through the following key steps:

1. Patient Registration: Patients are registered in the system with their personal details, medical history, and vaccination records. This enables healthcare providers to track immunization progress and plan future vaccinations accordingly.
2. Vaccination Scheduling: The system schedules vaccinations based on age, health condition, and recommended immunization timelines. This ensures that patients receive the correct vaccine at the right time.
3. Automated Reminders and Notifications: The system sends SMS or email reminders to patients and caregivers about upcoming vaccination appointments. This feature helps reduce missed vaccinations and improves overall immunization coverage.
4. Vaccination Record Management: Each vaccination is recorded in the system, including vaccine type, batch number, administration date, and healthcare provider details. This data is securely stored and can be accessed when needed.
5. Reporting and Analytics: The system generates real-time reports and analytics, allowing healthcare providers to monitor vaccination coverage, track trends, and identify gaps in immunization programs.
6. Security and Data Protection: The system employs encryption, authentication mechanisms, and access control to ensure that patient data is protected from unauthorized access.

2.2 Case Studies in Somalia

This case study focuses on the implementation of the Vaccination Management System at MCH Centers in Yaqshiid District, Mogadishu.

2.2.1 Users of the System

1. Healthcare Providers (Doctors, Nurses, and MCH Center Staff):
    - Enter vaccination data for patients into the system.
    - Schedule vaccination appointments and send reminders to patients or caregivers.
    - Access updated patient records to ensure that vaccines are given at the right time.
2. MCH Center Administrators:
    - Monitor vaccination progress in the Yaqshiid district.
    - Generate reports on vaccination rates and coverage.
    - Manage vaccine inventory to prevent shortages or wastage.
3. Patients and Caregivers:
    - Receive reminders for upcoming vaccinations through SMS or email.
    - Access their vaccination records, ensuring that they don't miss any vaccines.
4. Public Health Authorities:
    - Use the system's data to track vaccination coverage in the district.
    - Generate reports to inform decisions about resource allocation and public health strategies.

2.2.2 How the System Will Help in Yaqshiid District

1. Improved Record-Keeping:
    - The system will store all vaccination records digitally, reducing the chances of lost or misplaced data.
2. Reminder System:
    - Patients will receive automated reminders about upcoming vaccinations, which will help ensure that no vaccinations are missed.
3. Better Vaccine Tracking:
    - Administrators will be able to easily track vaccine inventory, helping to avoid shortages or waste.

2.3 Comparison between Existing Systems

To identify the gaps addressed by the proposed Vaccination Management System, a comparison of existing systems is presented:

While Somalia's current systems offer valuable features, they often lack mobile accessibility, fully automated reminders, and high customization. The proposed system aims to address these limitations, providing a more comprehensive solution for vaccination manageme

Feature	Existing Systems	Proposed System
Platform	Mostly desktop-based, limited mobile support	Web and mobile-based for better accessibility
Appointment Scheduling	Manual or semi-automated	Fully automated with reminders (SMS, email, push notifications)
User Interface	Basic and less user-friendly	Intuitive, user-friendly, and responsive UI
Data Security	Standard encryption, limited role-based access	Advanced security with end-to-end encryption and multi-factor authentication
Scalability	Limited expansion capabilities	Designed for scalability and future upgrades

2.4 Chapter Summary

This chapter explored the theoretical and conceptual foundations of digital vaccine management systems, with particular attention to the healthcare context in Somalia. It reviewed key models and real-world case studies that demonstrate how digital tools have improved vaccine tracking, inventory control, and data accuracy in immunization programs. Through comparative analysis, the chapter identified critical gaps in existing systems—especially in areas like mobile accessibility, automation, and adaptability to local needs.

CHAPTER 3

SOFTWARE PLANNING AND ANALYZING

3.0 INTRODUCTION

This chapter outlines the operational framework and system requirement analysis for the Vaccine Management System 3.0. It includes detailed explanations of the functional requirements for the system, which is designed to improve the management of vaccine distribution, tracking, and scheduling. Based on the existing requirements, we will develop a model of the system to streamline the processes.

This chapter will also introduce the current state of vaccine management systems. We will discuss the feasibility study, which will include technical feasibility, operational feasibility, schedule feasibility, and a comprehensive feasibility report. The objective is to assess the potential challenges and opportunities involved in implementing the proposed system.

The focus of the Vaccine Management System 3.0 will be to enhance the efficiency of vaccine tracking, improve compliance with vaccination schedules, and ensure the effective allocation of resources. The system will minimize delays and errors typically associated with manual processes, ensuring better visibility, process control, and the ability to make more informed decisions. The ultimate goal is to optimize vaccine distribution, reduce operational costs, and ensure a faster, more reliable vaccine management system.

3.1 OPERATIONAL FRAMEWORK

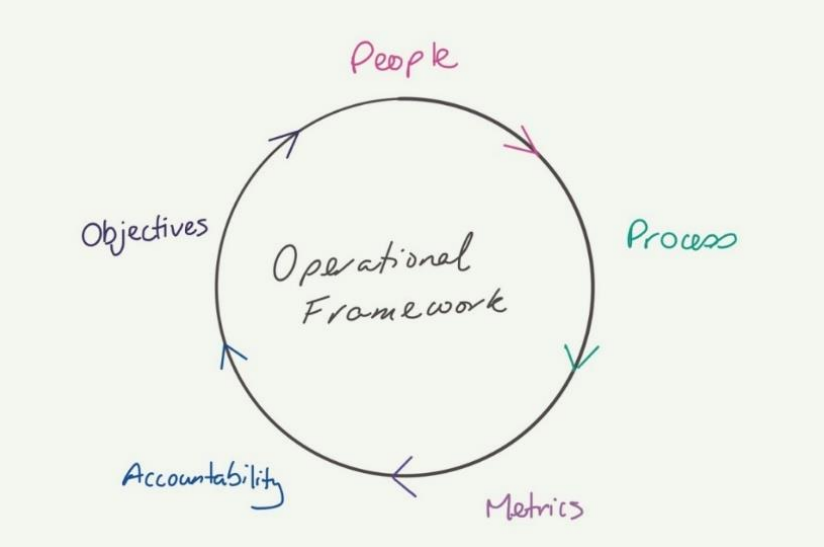
The operational framework for the Vaccine Management System 3.0 will consist of several key stages, each aimed at ensuring the system is developed, tested, and implemented effectively. The process will begin with careful Planning and Proposal, followed by a comprehensive Introduction to the system's objectives and goals. A Literature Review will be conducted to examine existing systems and identify best practices.

Once the foundational research is complete, the system will move into System Development, where the functional requirements will be translated into system

specifications. The Design phase will focus on creating a user-friendly interface, efficient database architecture, and robust security measures.

In the Implementation phase, which includes Coding and Testing, the system will be built, integrated, and rigorously tested to ensure that it meets all necessary standards. This phase will also address any identified bugs or issues.

Finally, the Conclusion phase will evaluate the overall success of the project, and the system will undergo Enhancement based on feedback and ongoing improvements, ensuring it remains relevant and efficient as vaccine management needs evolve.



3.2 Work Breakdown Structure (WBS)

A Work Breakdown Structure (WBS) is a key project deliverable that organizes the team's work into manageable sections. The Project Management Body of Knowledge (PMBOK) defines the WBS as a "deliverable-oriented hierarchical decomposition of the work to be executed by the project team." The WBS visually defines the scope into manageable chunks that a project team can understand, as each level of the WBS provides further definition and detail. The WBS ensures that all aspects of the project are clearly defined and accounted for, helping to prevent scope creep and improve resource allocation. It serves as a foundational tool for project planning, execution, and control, enabling teams to break down complex tasks into smaller, more achievable components.

3.3 System Requirements

The system requirements define the necessary conditions for the successful development, deployment, and operation of the Vaccination Management System. These requirements ensure that the system functions efficiently, meets user needs, and adheres to technical standards. The system requirements are categorized into software requirement specifications and user requirements definition to provide clarity on the system's expected functionality and usability.

3.3.1 Software Requirement Specification

Software	Requirement
Operating system	Windows, Linux, Android, iOS
Database	Mysql,
Programming languages	Php,javascript
Security	Encryption, 2FA, RBAC, Hash

This includes both functional requirements (which define what the system should do) and non-functional requirements (which specify system performance and constraints).

Functional Requirements:

- The system must allow users (healthcare providers and administrators) to register and manage vaccination records securely**.**
- It must provide automated appointment scheduling based on vaccine schedules.
- The system should send reminders via SMS and email to patients regarding upcoming vaccinations.
- A report generation module should allow administrators to track vaccination coverage, missed appointments, and other key metrics.
- The system must allow multi-user access with role-based permissions, ensuring different levels of access for healthcare workers, administrators, and patients.

- It must include search and filtering capabilities for quick access to patient records.
- The system should support both web and mobile platforms, ensuring accessibility for users with different devices.

Non-Functional Requirements:

- Performance: The system should be able to handle multiple concurrent users without slowing down.
- Scalability: The system should be designed to accommodate future growth in the number of users and data.
- Security: It must implement encryption and authentication mechanisms to protect sensitive health information.
- Availability: The system should have a 99.9% uptime guarantee, ensuring it is accessible whenever needed.
- Usability: The interface should be user-friendly, requiring minimal training for healthcare workers to operate.
- Interoperability: The system should be compatible with existing health information systems and databases.

3.3.2 User Requirements Definition

User requirements focus on the needs and expectations of the individuals who will interact with the system. These requirements define how the system should function from the perspective of different users.

- Healthcare Providers: They should be able **to** register patients, schedule vaccinations, update records, and generate reports with ease**.** The system must support quick data entry and efficient retrieval of patient vaccination history.
- Administrators**:** They should have access to analytics, reports, and system configurations to manage the system effectively. They should also be able to assign roles and monitor system usage.

- Patients/Public Users: Patients should be able to view their vaccination records, receive reminders, and request updates if needed. The system should be accessible via a secure login portal.
- Mobile Users: The system should be optimized for mobile devices, ensuring easy access to records and notifications

3.4 Problem Analysis Identification

A thorough analysis of the existing vaccination management process in Mogadishu's Yaqshiid District reveals several inefficiencies and challenges that negatively impact the effectiveness of vaccination programs. The traditional manual record-keeping system used in many healthcare centers, particularly in Maternal and Child Health (MCH) centers, results in inconsistent documentation**,** loss of records, and difficulty in tracking patient vaccination histories over time. Healthcare providers often struggle with retrieving past vaccination records, especially when patients visit different clinics or relocate, leading to missed or duplicate vaccinations.

Another critical issue is the lack of automated scheduling and reminder mechanisms. Since vaccination programs rely on a structured timeline for multiple doses, it is crucial to ensure patients receive timely vaccinations. However, due to the absence of a digital system, many patients either forget their scheduled dates or fail to receive follow-up vaccinations, reducing overall vaccination coverage and increasing the risk of preventable disease outbreaks.

Additionally, limited interoperability and data sharing among healthcare facilities create barriers to effective public health interventions. Without a unified system, healthcare workers rely on manual logs or disconnected spreadsheets, making it difficult to generate accurate reports and analyze vaccination trends. This lack of proper monitoring prevents healthcare administrators from identifying underserved areas or improving resource allocation.

Furthermore, the absence of real-time reporting and analytics means that decision-makers do not have immediate access to critical vaccination data, which delays responses to public

health concerns. Security concerns and data loss risks also arise due to the reliance on paper-based records, which can be easily misplaced, damaged, or accessed by unauthorized individuals.

Given these challenges, there is a clear need for an automated, centralized, and efficient Vaccination Management System (VMS) that enhances record-keeping, automates appointment scheduling and reminders, strengthens reporting and analytics, and improves communication between healthcare facilities and patients. The proposed system will streamline workflows, reduce errors, and ensure higher vaccination compliance through secure data management, real-time tracking, and multi-platform accessibility (web and mobile applications).

3.5 Requirements Gathering Techniques

Gathering accurate and comprehensive requirements is essential for the successful development of the Vaccination Management System. By using various techniques, developers can understand the needs and expectations of different stakeholders, ensuring the system aligns with actual healthcare practices and patient needs. This project employs both interviews and observations to collect data, providing a holistic view of the requirements.

3.5.1 Interview

Interviews are a direct method of gathering detailed information from stakeholders, including healthcare providers, administrators, and even patients. Through structured and semi-structured interviews, key insights into the challenges of current vaccination practices were uncovered. Healthcare workers highlighted issues such as time-consuming data entry, difficulty in accessing complete patient records, and the need for a reliable reminder system to ensure patients attend their vaccination appointments. Administrators expressed concerns about inadequate reporting tools and the challenges of managing vaccination schedules across multiple centers. Patients indicated a preference for receiving reminders via SMS, suggesting this would help them keep track of vaccination appointments. These interviews provided invaluable information that shaped the system's core features, ensuring it meets user needs effectively.

3.5.2 Observation

Observation involves directly watching how vaccination-related tasks are performed within healthcare settings, offering a real-time understanding of workflow and system needs. By observing daily operations at MCH centers in Yaqshiid District, several inefficiencies were noted. Healthcare staff often struggled with organizing paper-based records, leading to delays in patient processing and potential errors in vaccine administration**.** The absence of a centralized digital system was evident, as staff manually cross-referenced records, which slowed down operations. Additionally, the lack of automated systems meant that staff had to manually remind patients of upcoming vaccinations, increasing their workload and risking missed appointments. These observations reinforced the need for an integrated digital system to simplify record management**,** automate reminders**,** and improve overall efficiency**.**

3.6 Process Modeling

Process modeling is a crucial step in system development as it helps visualize the flow of information, interactions between system components, and user activities. It ensures that the system is designed efficiently by identifying potential issues early. The Vaccination Management System will use two primary process modeling techniques: Data Flow Diagrams (DFD) and Unified Modeling Language (UML) diagrams

3.6.1 Data Flow Diagram (DFD)

A Data Flow Diagram (DFD**)** illustrates how data moves within the system, depicting processes, external entities, data stores, and data flows. It provides a graphical representation of how users interact with the system and how information is processed.

For the Vaccination Management System, the Level 0 DFD (Context Diagram) presents an overview of the system, while the Level 1 DFD provides more details about internal processes.

- External Entities: Patients, Healthcare Providers, and Administrators.
- Processes: User Registration, Vaccination Scheduling, Notification System, Report Generation.

- Data Stores: User Database, Vaccination Records, Appointment Information.
- Data Flows: Data transfer between users, processes, and storage systems.

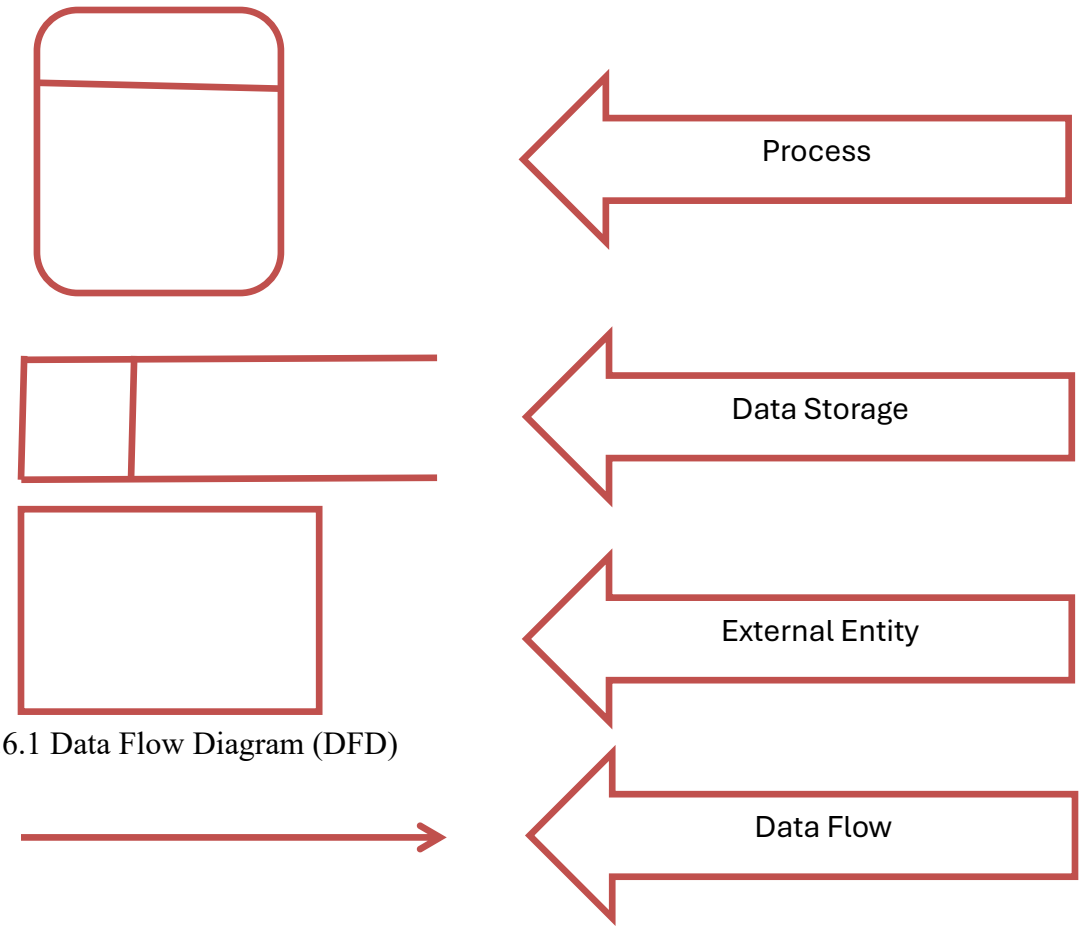


Figure 3.6.1 Data Flow Diagram (DFD)

3.6.2 Unified Modeling Language (UML)

The Unified Modeling Language (UML**)** is a standardized modeling language used in software development to visualize, specify, construct, and document system components. It provides a structured approach to designing and analyzing software systems by representing different system behaviors, interactions, and workflows. UML is widely used because it helps developers and understand the system's architecture, user interactions, and overall functionality before actual development begins.

In the context of the Vaccination Management System, UML diagrams will play a crucial role in illustrating how different users interact with the system, how processes are structured, and how data flows between different components. The primary goal of using UML is to ensure that the system is well-organized, user-friendly, and meets all functional and non-functional requirements. By visualizing the system through UML diagrams, potential design flaws and inefficiencies can be detected and corrected early in the development process.

UML includes various types of diagrams, such as Use Case Diagrams**,** Class Diagrams**,** Sequence Diagrams, Activity Diagrams, and State Diagrams. However, for the Vaccination Management System, one of the most fundamental and essential UML diagrams is the Use Case Diagram (UCD).

3.6.2.1 Use Case Diagram (UCD)

A Use Case Diagram (UCD) **is a** graphical representation of user interactions with the system**.** It helps define the different roles (actors) involved in the system and the specific actions (use cases) they perform. The main objective of the Use Case Diagram is to show how users interact with the system and what functionalities the system provides**.**

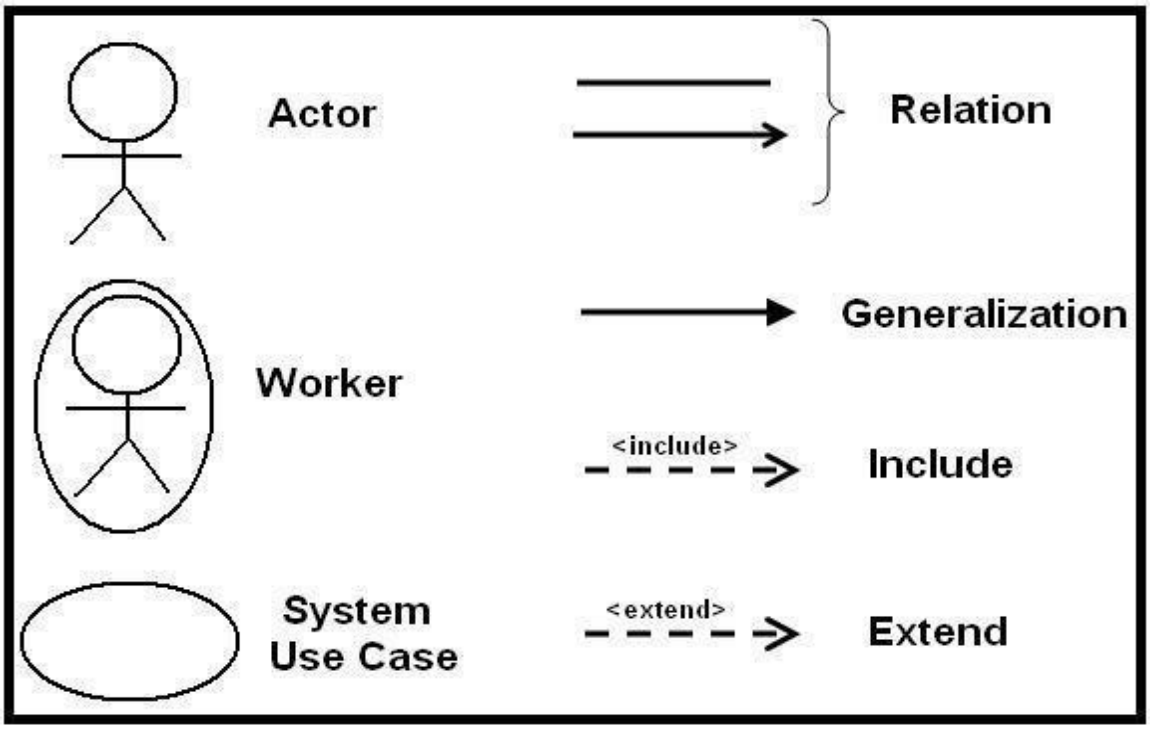


Table figure 3.6.2.1 Use Case Diagram (UCD)

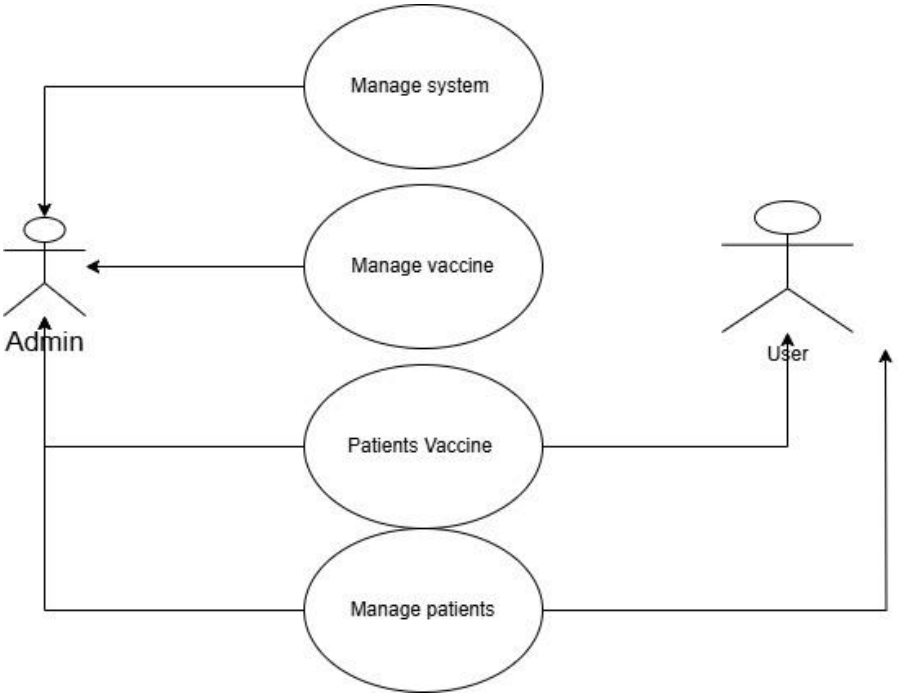


figure 3.6.2.2 Use Case Diagram (UCD)

3.7 DATA MODELING

Data modeling is an essential part of the system design process, ensuring that the database structure is well-organized, efficient, and scalable. It provides a blueprint for how data is stored, managed, and retrieved in the Vaccination Management System (VMS). A well-structured data model improves system performance, prevents data redundancy, and ensures data integrity.

The primary approach used for data modeling in this system is the Entity-Relationship Diagram (ERD), which represents real-world objects (entities) and their relationships in a structured format. The ERD helps in visualizing how patient records, vaccination schedules, and appointments are interconnected within the system.

3.7.1 ENTITY RELATIONSHIP DIAGRAM

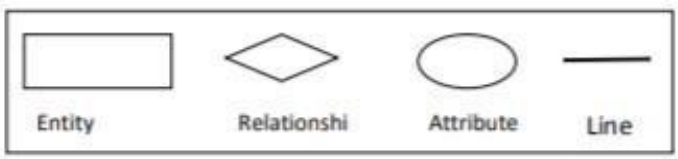
The Entity Relationship Diagram (ERD) is a visual representation of the data structure within the Vaccination Management System. It defines the entities in the system, their attributes, and the relationships between them. The ERD ensures proper database design, preventing redundancy and maintaining data integrity.

In this system, the ERD includes essential entities such as Patients, Healthcare Providers, Vaccines, Appointments, and Notifications. These entities interact through well-defined relationships to facilitate efficient vaccination management.

By mapping out these relationships, the ERD provides a clear framework for how data flows within the system, ensuring that all necessary information is accurately stored, retrieved, and managed.

3.7.1.1 ERD SYMBOLS

Entity-Relationship Diagrams (ERDs) use specific symbols to visually represent the entities, relationships, and attributes in a database system. These symbols help standardize and simplify the modeling process for the Vaccine Management System.



3.7.1.2 TYPES OF RELATIONSHIPS

In an Entity Relationship Diagram (ERD), relationships define how different entities interact with each other in the Vaccination Management System. There are three main types of relationships:

The following table shows the symbols of the different relationship

Relation Type	Representation
One-to-one	
One-to-many	
Many-to-many	
Many-to-one	

3.7.1.3 ERD OF THE PROPOSED SYSTEM

The Entity-Relationship Diagram (ERD) for the proposed Vaccine Management System provides a detailed, logical representation of how the system's database is structured.

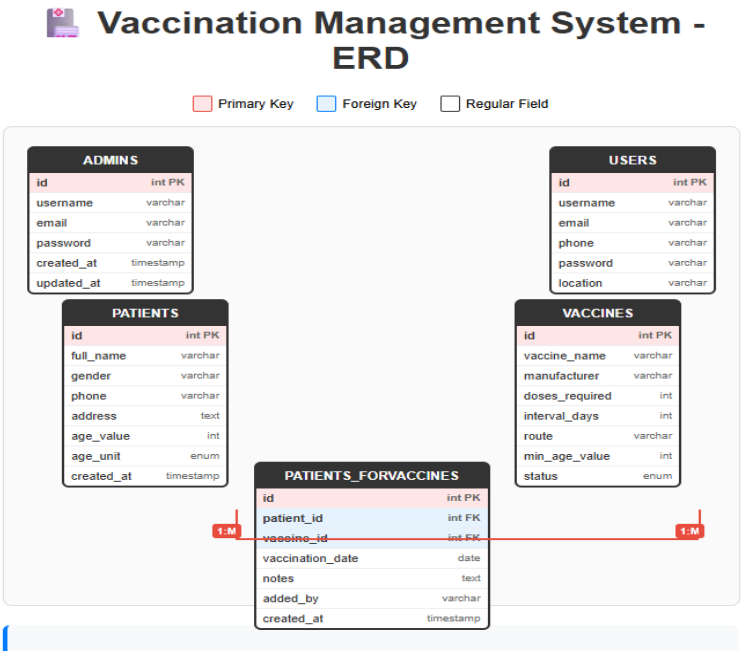


figure 3.7.1.3.1 Erd of the proposed system

3.8 Suitable Solution Strategies of the Proposed System

The proposed Vaccination Management System is designed to address key challenges in vaccination program management by implementing efficient digital solutions. One of the primary strategies is the transition from paper-based record-keeping to a secure and centralized digital database. This ensures that patient vaccination histories can be easily retrieved, updated, and accurately tracked, reducing errors associated with manual data entry. The system will also provide both web and mobile platforms, allowing healthcare providers and patients to conveniently access vaccination information. The inclusion of a mobile application enhances accessibility, ensuring that users can schedule appointments, receive reminders, and track vaccination records seamlessly.

3.9 System Feasibility

A feasibility study for an information system project is an in-depth look at the project in order to determine whether or not an organization should proceed with its implementation. Feasibility studies provide project managers with an overview of the primary issues related to the project. A feasibility study could be used to test a new working system, which could be used because the Feasibility study is an analysis of possible alternative solutions to a problem and a recommendation on the best alternative. It can decide whether a process be carried out by a new system more efficiently than the existing one. Feasibility study is divided in to four types:

I. Technological feasibility

II. Operational feasibility

III. Economic feasibility

IV. Schedule feasibility

3.9.1 Technical Feasibility

The system is developed using modern web and mobile technologies to ensure efficiency, scalability, and security. It will utilize a relational database (MySQL) for structured data management, while web and mobile applications will be built using Flutter, Firebase, platform compatibility. Security features such as encryption, multi-factor authentication, and role-based access control (RBAC) will be implemented to protect patient records.

3.9.2 Operational Feasibility

The Vaccination Management System aligns with the existing workflows of healthcare providers by automating vaccination records, appointment scheduling, and reminders. Training sessions will be provided to healthcare staff to ensure smooth adoption, with ongoing technical support available to address challenges. The system reduces paperwork, eliminates manual errors, and enhances vaccination tracking, making it a valuable tool for healthcare professionals. Since the system is designed with a simple and intuitive interface, minimal training will be required for effective use.

3.9.3 Economic Feasibility

The cost of developing and maintaining the system is justified by its long-term benefits. Automating vaccination management reduces administrative costs, prevents missed vaccinations, and enhances patient engagement through automated notifications. Additionally, the system minimizes reliance on paper-based records, lowering storage and printing expenses. By optimizing resource allocation and reducing inefficiencies, the system is expected to improve healthcare service delivery while being a cost-effective solution for the MCH center in Yaqshiid District.

3.9.4 Schedule Feasibility

The project is planned for completion within two months, ensuring that all development and deployment phases are executed within the allocated timeframe. The schedule includes system design, development, testing, and training phases. Agile development methodologies will be followed to allow for iterative improvements, ensuring timely delivery. Each milestone has been carefully planned to prevent delays, and contingency measures are in place to address unforeseen challenges, ensuring successful implementation within the given period.

Phase	Timeframe	Key Activities
Phase 1: Planning & Development	January – April 2025	Finalize requirements Design architecture & database Develop core features: vaccination records, scheduling, reminders Early testing of modules
Phase 2: Testing & Training	May 2025 (First 2 Weeks)	System testing (functionality, security, performance) Collect user feedback Train healthcare personnel on usage & reports
Phase 3: Deployment & Support	May (Last 2 Weeks) – June 2025	Deploy system in healthcare centers Monitor real-time usage & performance Provide support, bug fixing & maintenance

Table **3.9.4.1**

3.10 Chapter Summary

This chapter provided a comprehensive analysis of the system requirements and feasibility of the proposed Vaccination Management System for Yaqshiid District MCH. It covered software and hardware requirements, including functional and non-functional aspects, ensuring that the system meets performance, security, and usability standards. The problem analysis and requirements gathering techniques, such as interviews and observations, were discussed to highlight the need for a streamlined vaccination management process.

Additionally, the chapter explored process modeling through Data Flow Diagrams (DFD) and Unified Modeling Language (UML) to define system interactions. Data modeling was also addressed through Entity Relationship Diagrams (ERD) to illustrate database structures and relationships between key system components. The feasibility study examined technical, operational, economic, and schedule feasibility to confirm the project's viability.

CHAPTER FOUR

SOFTWARE DESIGN

4.0 Introduction

This chapter presents the software design of the Vaccination Management System. It focuses on how the system is structured, how users interact with it, and how data is stored and managed efficiently. The design process ensures that the system is easy to use, secure, and reliable for both healthcare workers and patients.

Each section in this chapter describes a specific part of the system. The architectural design shows how the system is built in layers. The user interface design explains how users will interact with the system. The database storage design covers how important data like vaccination records and schedules are safely stored. Finally, the database design gives a detailed look at the tables and relationships used in the system.

4.1 Architectural Design

The architectural design of the Vaccination Management System defines how the system is structured and how its different components interact to deliver a smooth and secure experience. This system is built to manage vaccination records, user roles, and appointment scheduling in a reliable and scalable way.

It follows a client-server architecture. The client side—which can be accessed through a web browser—provides a user-friendly interface for administrators, healthcare workers, and patients. The server side, developed using PHP, handles all the business logic and connects to a MySQL database where all records are stored securely.

Whenever a user performs an action, such as booking an appointment or updating a vaccination record, the request is sent to the server. The server processes the request, communicates with the database, and sends back the result to the client. This separation between the front-end and back-end ensures the system is modular, easy to maintain, and ready for future improvements like SMS notifications, vaccine inventory tracking, or integration with health ministry systems.

4.2 User Interface Design

The user interface (UI) is designed to be simple, clean, and intuitive. Each user type has a specific dashboard tailored to their needs:

- Admin Dashboard: Can register users (nurses, patients), manage vaccine stocks, view reports, and set schedules.
- Nurse Dashboard: Allows adding new vaccination records, updating patient status, and checking vaccine availability.
- Patient Interface: Enables patients to view their vaccination status, upcoming appointments, and personal information.

The design follows responsive principles, ensuring compatibility across different devices (desktop, tablet, mobile). It uses clear icons, buttons, and color-coded elements to help users navigate easily.

4.3 Database Storage Design

The database storage design of the Vaccination Management System defines how data is logically and physically stored in the system. MySQL is used to manage structured data related to users, vaccines, vaccination records, and appointments.

The database is designed with a clear structure to avoid redundancy, maintain data integrity, and allow for fast and efficient retrieval. Tables are normalized to reduce duplication, and relationships between entities (like patients and their vaccination records) are well-defined using foreign keys.

To boost performance, indexes are applied on key columns such as user_id, vaccine_name, and appointment_date. This helps speed up queries when generating reports, checking vaccination history, or managing schedules.

The system also prioritizes data security, especially since it deals with sensitive health information. Access to the database is restricted based on user roles, and regular backups can be set up to protect against data loss.

Overall, the database storage design supports scalability, ensures reliability, and helps the system run smoothly even as more users and data are added over time.

4.4 Database Design

The database design of the Vaccination Management System focuses on organizing information in a clear and efficient way to support the system's core functions. Since it deals with sensitive health data, the database must be carefully structured to ensure accuracy, security, and ease of use.

This design process involves identifying key components of the system and understanding how they relate to each other. By clearly defining these relationships, the system can track vaccinations, manage appointments, and handle user roles effectively.

To keep the data well-organized and prevent repetition, data normalization is applied. This makes the system easier to maintain, reduces errors, and improves overall performance.

The database also supports role-based access to protect sensitive information, ensuring that only authorized users can view or update certain data. This approach keeps the system secure, reliable, and scalable as more users and data are added.

4.4.1 Database Normalization

Database normalization is the process of organizing data to make it more efficient, consistent, and easier to manage. In the context of the Vaccination Management System, normalization helps ensure that the information stored—such as patient details, vaccine types, and appointment records—is clean, reliable, and free from unnecessary repetition.

The goal of normalization is to reduce data redundancy and avoid potential issues like conflicting or outdated information. When data is repeated in multiple places, it not only wastes storage but also increases the chance of errors. By structuring the data properly and defining clear relationships between different parts of the system, the database becomes more stable and easier to maintain.

This process follows a series of established steps (called normal forms), each improving the organization of the data while preserving its meaning and integrity.

4.4.1.1 First normal form (1NF)

First Normal Form (1NF) ensures that each table has:

- A primary key that uniquely identifies each record.
- All fields contain atomic (indivisible) values.
- No repeating groups or multi-valued attributes in any column.

In the Vaccination Management System, the database follows 1NF as shown:

1NF Design Rules Applied:

- Each table has a primary key, such as id in patients, vaccines, and users.
- Each column holds only one value — e.g., phone only has one number per patient (even if it's the same across multiple patients).
- No column contains lists or sets — every value is atomic.
- Repeating data (like multiple vaccines per patient) is handled through the patients_forvaccines linking table, not inside a single row.

Table **4.4.1.1.1 patients**

id	full_name	gender	phone	address	age_value	age_unit
1	Ahmed Ali	Male	0612345678	Mogadishu	2	years
2	Asha Mohamed	Female	0612345678	Hargeisa	6	months
3	Ibrahim Noor	Male	0623456789	Garowe	1	years

4.4.1.2 Second normal form (2NF)

Second Normal Form (2NF) builds upon the rules of First Normal Form (1NF). A relation is in 2NF if it is in 1NF and all non-key attributes are fully functionally dependent on the entire primary key. This means that no non-key column should depend on just a part of a composite primary key.

Conditions for 2NF:

- The table must already be in First Normal Form (1NF).
- No partial dependency of any column on a part of a composite primary key is allowed.
- All non-key attributes must depend on the whole primary key.

Here's a sample table to show 2NF applied in the patients_forvaccines table

Table **4.4.1.1.2** patients

patient_id	vaccine_id	vaccination_date	notes
1	3	2025-07-01	First dose
2	4	2025-07-03	No reaction
1	4	2025-07-10	Mild fever

Here's a sample table to show 2NF applied in the vaccines table

Table **4.4.1.1.3 vaccines**

patient_id	vaccine_id	vaccination_date
1	3	2025-07-01
2	4	2025-07-03
1	4	2025-07-10

4.4.1.3 Third Normal Form (3NF)

A relation is in Third Normal Form (3NF) if:

- It is already in Second Normal Form (2NF)
- All non-key attributes are only dependent on the primary key, and not on any other non-key (non-prime) attribute

This means that the table should not contain any transitive dependencies. A transitive dependency occurs when a non-key attribute depends on another non-key attribute instead of depending directly on the primary key.

Conditions for 3NF:

- The table must already be in Second Normal Form (2NF)
- There must be no transitive dependencies
- Non-key attributes should not depend on other non-key attributes
- Every non-key attribute must depend only on the primary key

Table 4.4.1.3.1 Patients vaccines

id	vaccine_name	manufacturer
1	Polio	BioPharm Labs
2	Measles	HealthMed Corp
3	BCG	BioPharm Labs

4.4.2 Transforming E-R Diagram into Relations

The transformation of the Entity-Relationship (ER) Diagram into relational tables is a crucial step in designing the database for the Vaccination Management System. This process ensures that all entities, attributes, and relationships defined in the ER model are accurately implemented in a relational database structure.

Each entity in the ER diagram is converted into a table, where the entity's attributes become the columns of that table. A primary key is assigned to each table to uniquely identify every record. Additionally, foreign keys are used to represent relationships between different entities, maintaining referential integrity.

For example:

- The Patient entity becomes the patients table, with fields such as patient_id, full_name, dob, and phone.
- The Vaccine entity is transformed into the vaccines table with attributes like vaccine_id, name, manufacturer, and doses_required.
- The many-to-one relationship between vaccination_records and patients is implemented by adding patient_id as a foreign key in the vaccination_records table.
- Similarly, vaccine_id and administered_by are added as foreign keys to link each vaccination record to the specific vaccine and the user (e.g., nurse or doctor) who administered it.

4.4.3 Data Dictionaries

A data dictionary is a centralized reference that defines the structure, attributes, and purpose of each field within the Vaccination Management System's database. It acts as a guide for developers, database administrators, and system users to clearly understand the type of data being stored, how it is formatted, and how it should be used throughout the system.

Each table and its corresponding columns are documented in the data dictionary to ensure consistency, reduce redundancy, and simplify system maintenance. This documentation ensures that every element of the database is well-understood and accurately implemented.

The data dictionary for the Vaccination Management System includes:

- Table Name – The name of the database table (e.g., patients, vaccines)
- Field Name – The name of each column within the table (e.g., patient_id, vaccine_name)
- Data Type – The type of data stored in each field (e.g., INT, VARCHAR, DATE)
- Field Description – A clear explanation of the purpose and meaning of the field
- Constraints – Rules or conditions applied to the field (e.g., PRIMARY KEY, NOT NULL, FOREIGN KEY)

Table Name	Field Name	Data Type	Description	Constraints
Patients	Patient_id	INT	Unique customer ID	PRIMARY KEY
vaccines_name	Vacc	VARCHAR(100)	Name of the vaccine	NOT NULL

4.6 Designing Forms and Reports

Forms and reports are essential components of the Vaccination Management System, enabling smooth interaction between users and the database. This section outlines how forms are designed for data input and how reports are structured for data output.

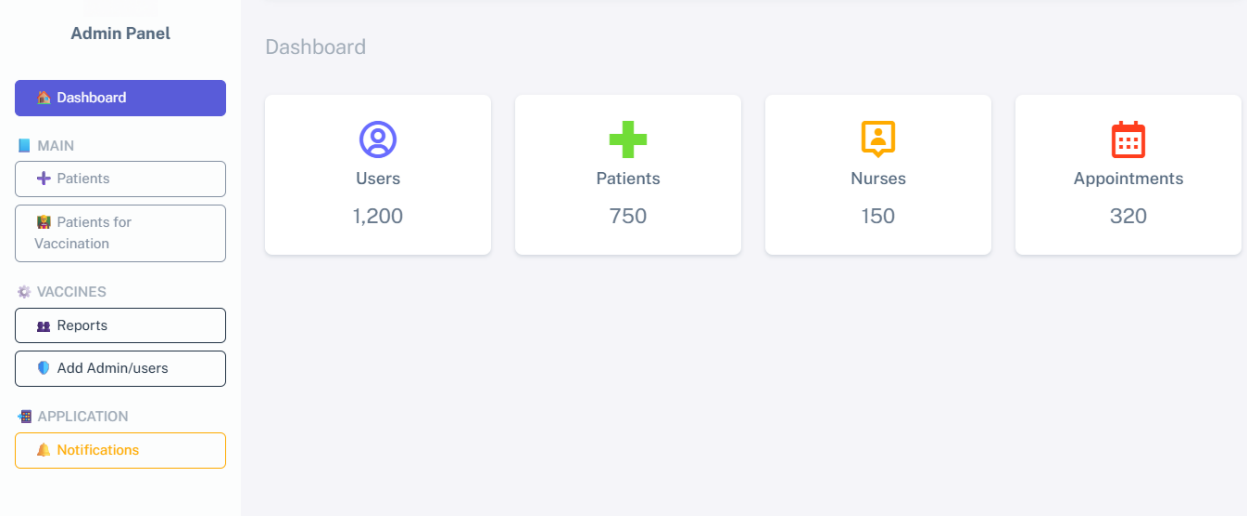


Figure 4.6.1 Home page

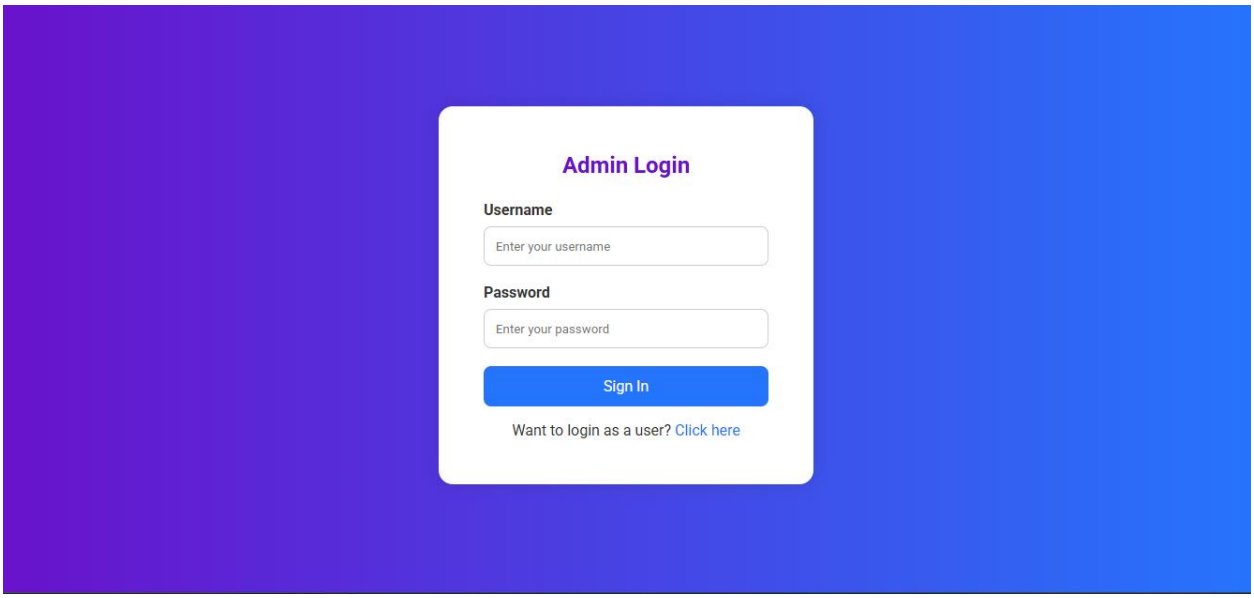


Figure 4.2.2 Login page

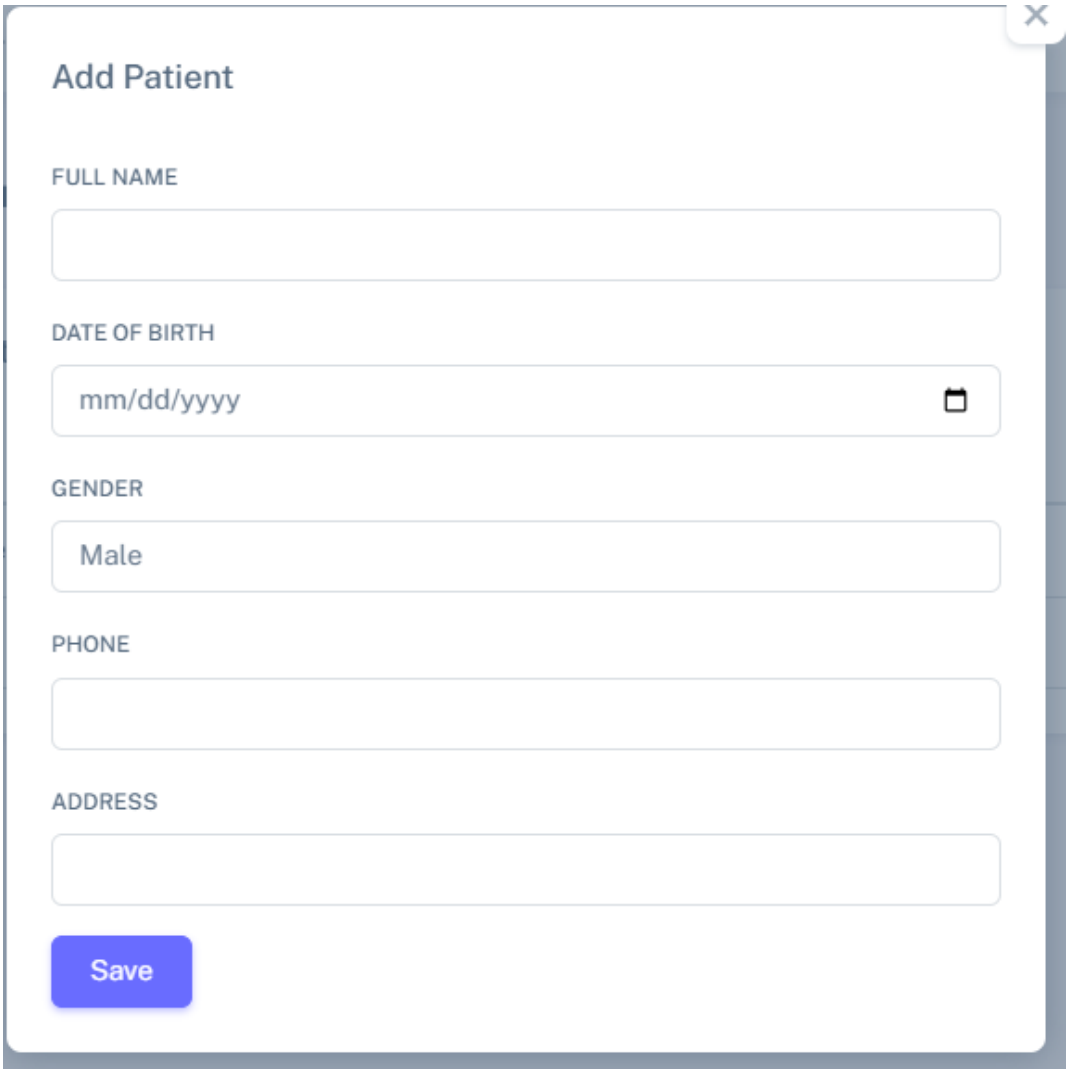


Figure 4.6.3 patient page – add Patients

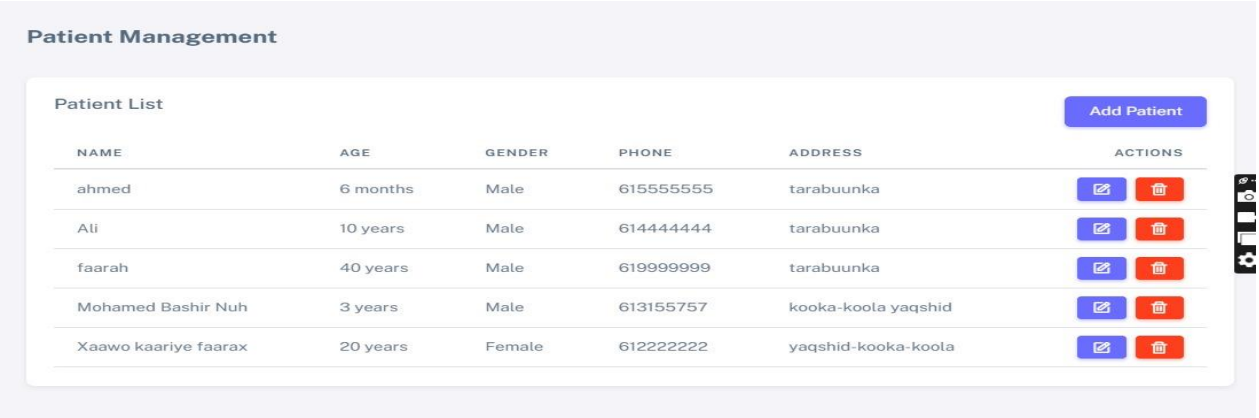


Figure 4.6.4 patient page – Patient History

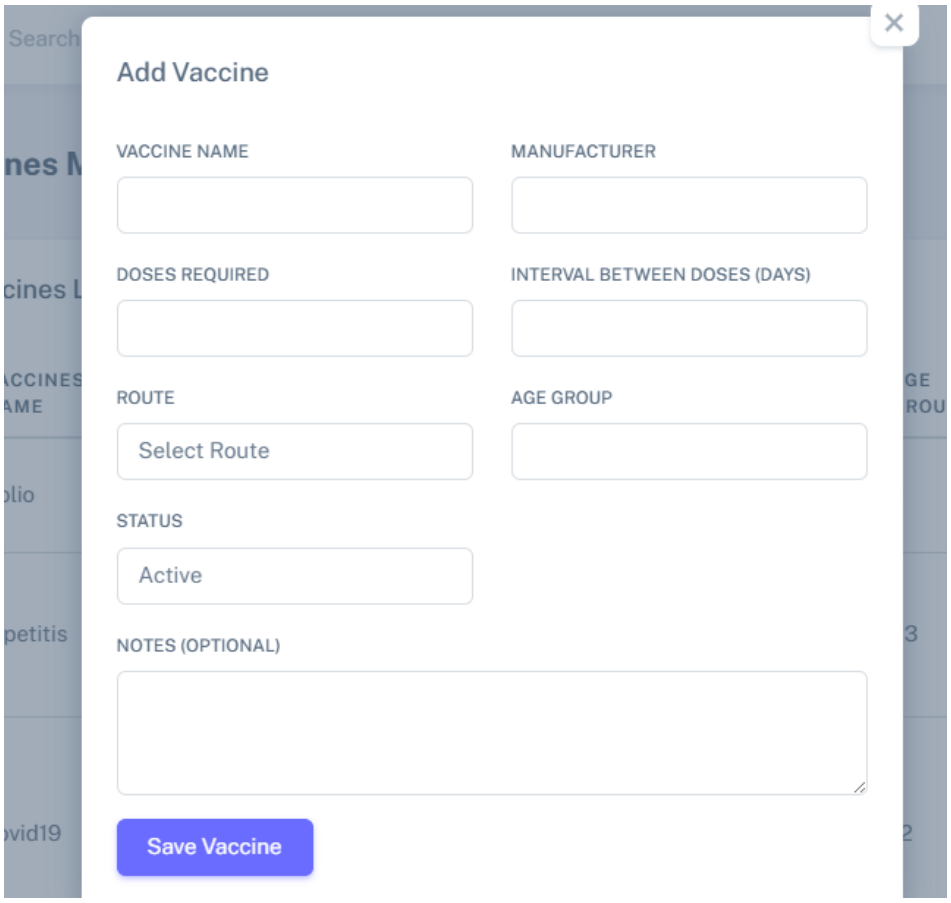


Figure 4.6.5 – Add Vaccines form

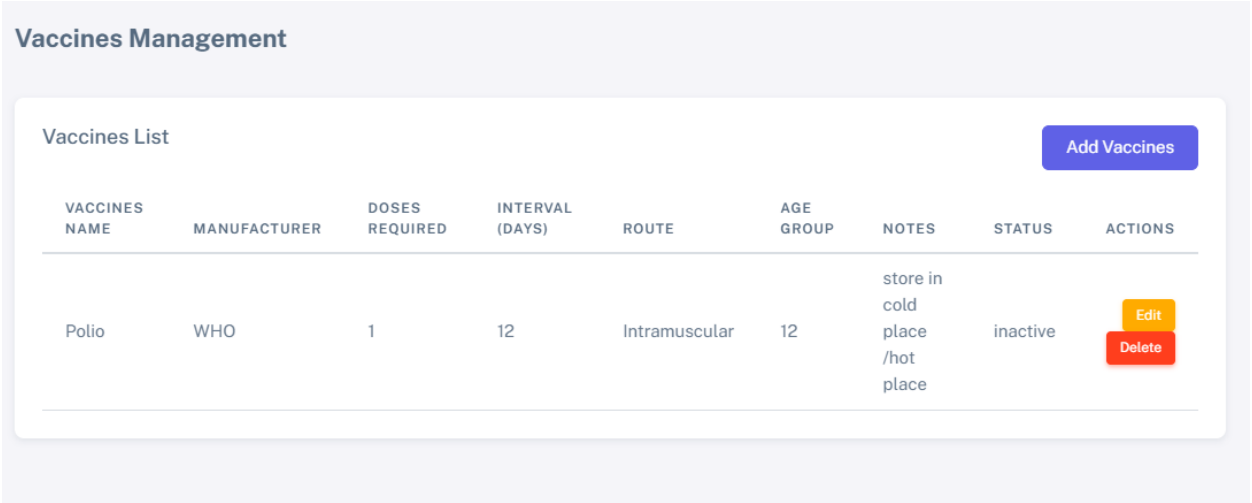


Figure 4.6.6 –Show Vaccines List

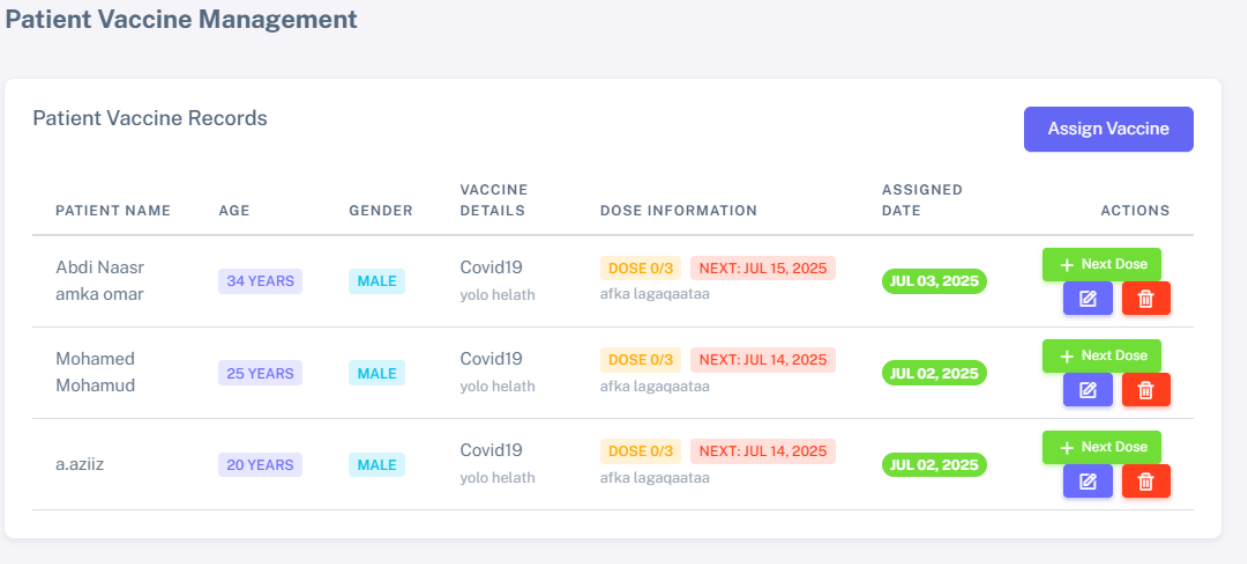


Figure 4.6.7 –Patient Vaccines List

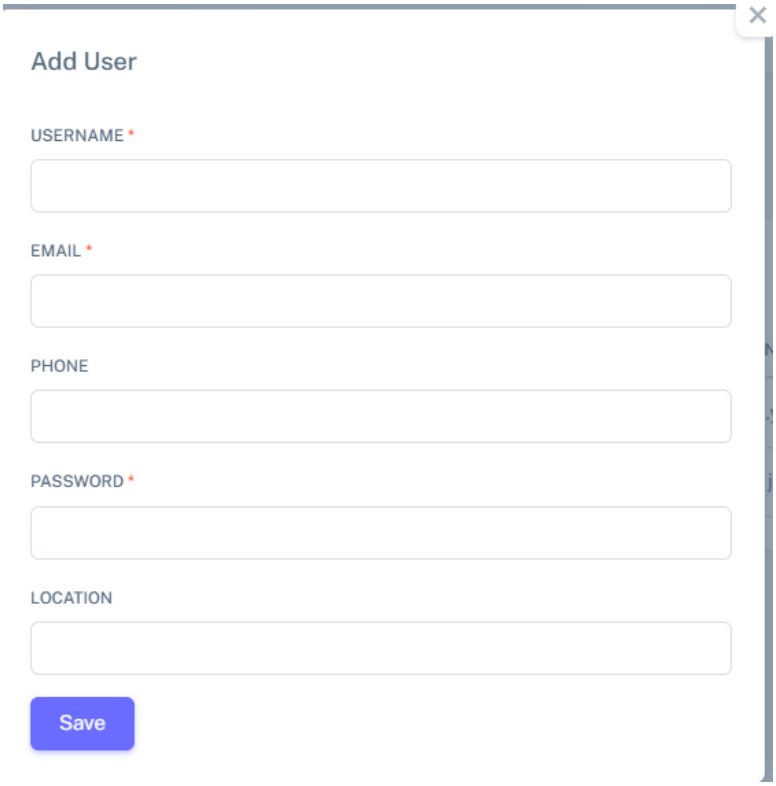


Figure 4.6.8 –Add User

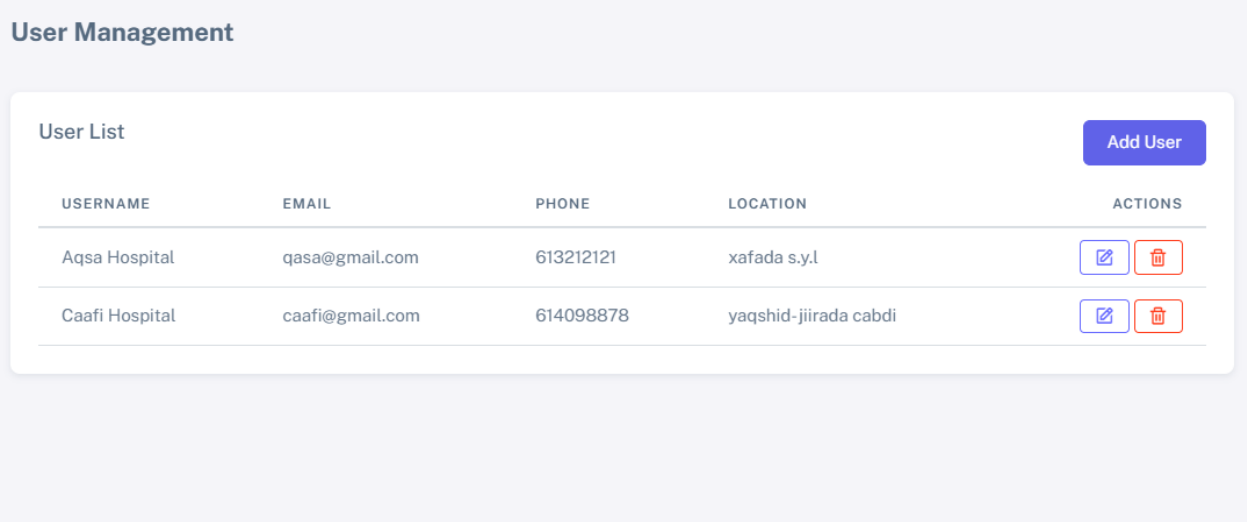


Figure 4.6.9 –User List

Figure 4.6.10 –Add Admin

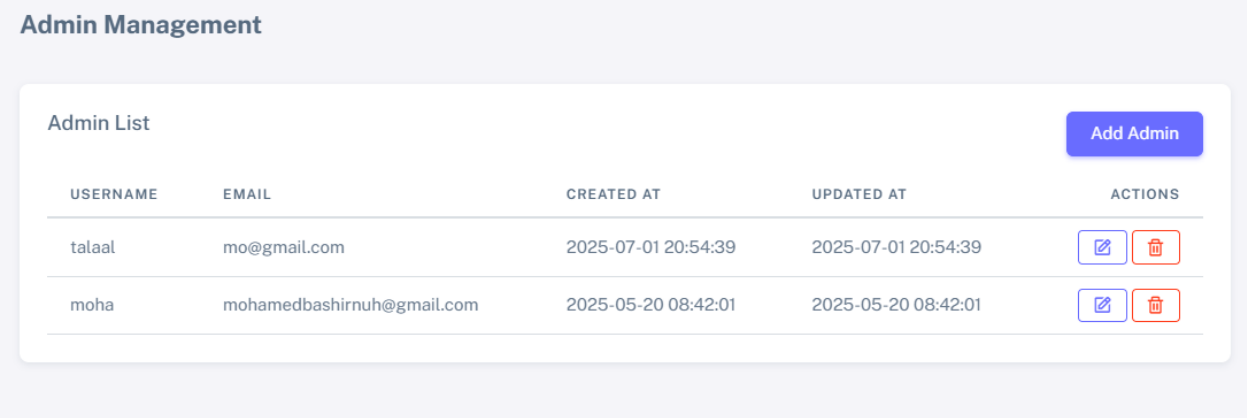


Figure 4.6.11 –List Admin

4.6 Chapter summary

This chapter covered the system design aspects of the project, including architectural design, user interface design, data storage design, database design, normalization, transformation of the E-R diagram into relational models, data dictionaries, form design, and concluded with a chapter summary.

CHAPTER FIVE

SYSTEM IMPLEMENTATION

5.0 Introduction

System implementation is the phase where the developed system transitions from the development environment into actual operation. This stage is all about making the system fully functional for the end users. It includes user training, system deployment, and ensuring a smooth switch from any existing system.

Implementation ensures that users can efficiently operate, manage, and interact with the system. This chapter highlights the main processes involved in implementation — including the coding phase, different types of system testing, the creation of user documentation, and ends with a brief summary.

5.1 Coding Phase

The coding phase focused on translating the system's design into actual functional components using PHP and MySQL. During this stage, several key modules were developed:

- Customer Management
- Product Inventory Tracking
- Sales Transactions
- Stock Restocking
- Report Generation

PHP was chosen for its server-side capabilities, while MySQL handled the secure and structured storage of data. Together, they ensured dynamic interactions and efficient data processing.

All source code and setup instructions are included on the accompanying compact disk (CD). These files provide a complete working version of the system and guidelines for local or server deployment.

5.2 System Implementation Testing

Testing is a critical part of system implementation, ensuring that the developed system meets all requirements and functions as expected. Several levels of testing were conducted:

- Development Testing – Testing was performed during coding to catch bugs early and correct them before proceeding.
- System Testing – The entire system was tested as a whole to ensure that all modules worked together seamlessly.
- Release Testing – The nearly-final system was tested in a simulated real-world environment to assess performance and usability.
- User Testing – End users interacted with the system to confirm that it met their needs, and any feedback was used for final improvements.

These stages helped validate the system's functionality, reliability, and security, ensuring a robust final product.

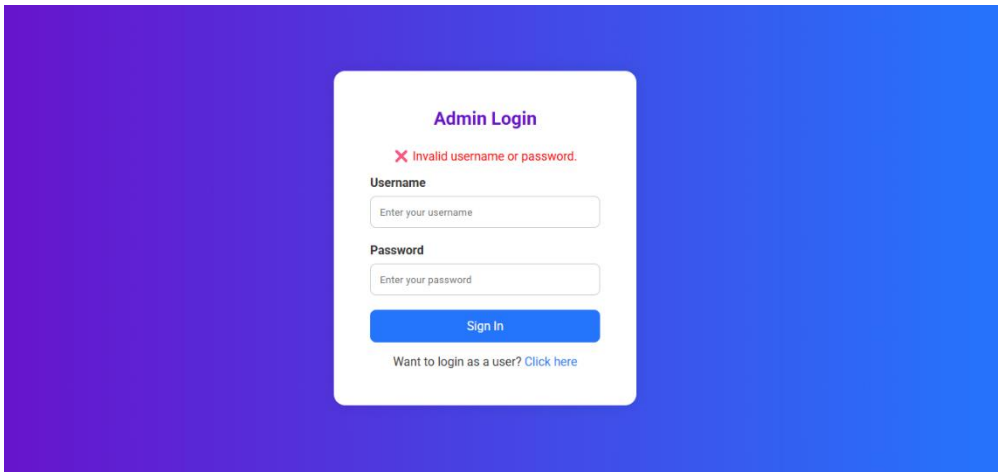
5.2.1 Development Testing

Development testing focuses on identifying and preventing issues early during the coding phase. It involves the developer actively applying defect detection and correction techniques throughout development to ensure a smoother and more secure build process.

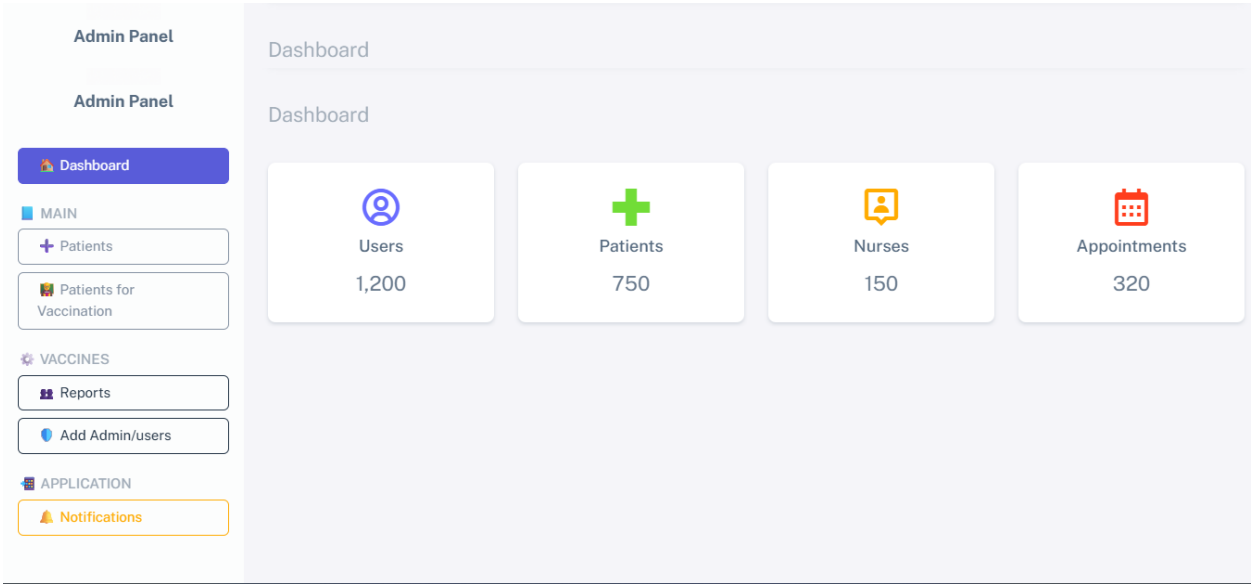
In the context of this Sales Management System, development testing was essential for:

- Ensuring system stability during active development
- Catching errors at the code level before full integration
- Reducing overall development time and cost
- Enhancing security and reliability

  Login Page with validation



Login Page with validation



Home page

5.2.2 Release Testing – Vaccination Management System

Release testing is the final checkpoint before deploying the Vaccination Management System for actual use. The main goal of this phase was to confirm that the complete system met all defined requirements and could operate smoothly in a real-world environment, outside the controlled conditions of development.

Unlike development testing—which was handled during coding—release testing was carried out on the fully integrated system. It aimed to verify that all critical functionalities, such as patient registration, vaccination scheduling, dose tracking, stock management, reporting, and user authentication, were working correctly and without failure.

5.2.3 User Testing

User testing is a vital step during system development that checks how well the system works for the people actually using it. It helps reveal problems early and makes sure the system is simple, clear, and effective before full launch.

In the Vaccination Management System, user testing was done in three stages to make sure everything worked smoothly in real-life conditions:

Alpha Testing
This was the first round of testing, done by the internal development team. It helped spot hidden issues or bugs that weren't caught earlier. This phase focused on fixing errors and improving the overall performance of the system.

Beta Testing
Next, selected users like nurses and reception staff tested the system in a real clinic environment. Their feedback helped improve how the system handled things like registering patients, updating vaccine records, and managing appointments. This stage helped shape the system based on real user needs.

Acceptance Testing
Finally, the system was tested by end users in their actual work setting. This confirmed that the system could be used easily without help from the developers, and that it met all the required functions for daily clinic operations.

5.3 Developing User Manuals – Vaccination Management System

Developing user manuals is an important part of putting the system into action. It helps users understand how to use the system without always needing support from a developer or technician. A good manual breaks down the system's features into simple steps, making everything easier to follow.

For the Vaccination Management System, user manuals were created to guide staff through key functions like logging in, registering patients, recording vaccinations, updating patient information, scheduling appointments, and viewing vaccination history.

The manuals include step-by-step instructions, clear screenshots, and examples to make sure anyone—even those with basic tech skills—can navigate the system confidently and use it correctly in their daily work.

5.4 Chapter Summary

This chapter explained how the Vaccination Management System was implemented and tested. Setting up the system involved configuring a server and deployment environment to ensure the platform was fully accessible and functional for users.

The chapter walked through important steps in the development process—starting with system setup, moving into the coding phase, and then covering various types of testing such as development testing, release testing, and user testing. It also highlighted the creation of user manuals to help users operate the system easily.

In the final part, the successful implementation of the system was described, marking the point where it was fully delivered and ready for real-world use in health centers or clinics.

CHAPTER SIX

CONCLUSION AND ENHANCEMENT

6.0 Introduction

This chapter wraps up the entire project by summarizing the key results and showing how the objectives of the Vaccination Management System were achieved. It also reflects on the development process, lessons learned, challenges faced, and areas for future improvement.

6.1 Objective Achievement

The main goal of this project was to design and develop a web-based Vaccination Management System to simplify and automate the process of registering patients, recording vaccination details, scheduling doses, and maintaining digital health records. These objectives were successfully achieved through the following steps:

- The system was planned and designed using tools like UML diagrams, including use case and class diagrams, to properly visualize the system's structure and functionality.
- The platform was built using PHP for backend logic and MySQL for database management, ensuring a reliable, fast, and secure system.
- Core modules like patient registration, vaccine dose recording, vaccination history, and appointment scheduling were fully implemented and tested.
- The system helped eliminate paper-based records, reduced manual errors, and improved the efficiency of vaccination tracking.
- User feedback was taken into account during development, which made the system more user-friendly and aligned with real needs.

In summary, the project successfully met all the intended goals and delivered a working system that supports healthcare staff in managing vaccinations effectively.

6.2 Weaknesses and Problems of the System

Throughout the development of the Vaccination Management System, several insights and valuable experiences were gained. Researching existing health and vaccination systems helped highlight best practices and common challenges. A big part of the journey was understanding user needs and translating them into system features.

However, a few limitations were observed:

- Security can be improved, especially in areas like protecting patient records and managing access control.
- Scalability might be limited if used in large hospitals with thousands of patients, as the system is currently optimized for small to medium-sized health centers.
- Some modules, like automatic vaccine reminder alerts or analytics dashboards, were planned but not implemented due to time constraints.

Despite these limitations, the system functions well within its intended scope and can be further enhanced in the future.

6.3 Future Work

To improve the system and prepare it for wider adoption, the following enhancements are recommended:

- Improve system security by adding role-based access controls (e.g., admin, nurse, doctor) and encrypting sensitive data.
- Add notification features like SMS or email alerts for upcoming vaccination appointments.
- Expand to support multi-clinic usage, allowing the system to be shared across multiple health centers or regions.
- Integrate data analytics to help visualize vaccination trends, monitor stock levels, and support decision-making.

6.4 Chapter Summary

This chapter highlighted the outcomes of the Vaccination Management System project. It reviewed how the objectives were achieved, discussed some of the system's limitations, and proposed future upgrades to make the system more powerful and scalable. Overall, the project resulted in a working, helpful tool that can play an important role in improving public health through better vaccination tracking.

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APPENDIX A. Interview questions

1. What is Vaccine management system?
2. Is it easy to use the system?
3. Can multiple users use it at the same time?
4. Can this system work every day?

APPENDIX A. Timeframe of the developing the proposed system

TASKS	November				December				January	February	March				April				May			
	1	2	3	4	1	2	3	4	N/A	N/A	1	2	3	4	1	2	3	4	1	2	3	4
Research Proposal																						
Introduction																						
Literature Review																						
Software planning																						
Software design																						
System Development																						
Implementing & Testing																						
Conclusion																						

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