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**COLLEGE OF TECHNOLOGY AND BUILT**

**ENVIRONMENT**

**SCHOOL OF INFORMATION TECHNOLOGY AND**

**SOFTWARE ENGINEERING**

**HEALTH NET**

**Project Proposal Section 1**

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## TABLE OF CONTENTS

### Contents

TABLE OF CONTENTS.....	iii
Contents.....	iii
ABSTRACT .....	iv
1. INTRODUCTION.....	1
1.1 Background 1	
1.2 The Existing System.....	1
1.3 Statement of the Problem.....	2
1.4 Objective of the Project.....	3
1.4.1 General Objective.....	3
1.4.2 Specific Objective .....	3
1.5 Proposed System .....	4
1.6 Feasibility Study .....	5
1.6.1. Economic Feasibility .....	5
1.6.2. Technical Feasibility.....	5
1.6.3 Schedule Feasibility .....	6
1.7 Scope 6	
1.8 Methodology .....	7
1.9 Project Management plan .....	10
1.9.1. Time Management plan .....	10
1.9.2. Quality Management Plan .....	11
1.9.3. Communication Management.....	12
APPENDIX .....	xiv
REFERENCE .....	xv

## **ABSTRACT**

In Ethiopia, patient health records are often stored on paper across separate health facilities, making it difficult for healthcare providers to access complete medical histories. This fragmented system leads to repeated tests, treatment delays, and medical errors, especially in emergencies. To address these challenges, our project, HealthNet, proposes a unified National Electronic Health Record (EHR) system that provides secure, centralized access to patient information across all levels of health care.

HealthNet introduces an innovative QR-code-based emergency access, first responders to instantly retrieve a patient's critical health data—such as allergies, medications, and major conditions—without compromising privacy. The system will feature a Unique Patient Identifier (UPI), a secure provider dashboard, and role-based access control (RBAC) to ensure data protection.

The project includes the design of a secure, scalable system architecture, a working prototype demonstrating key features, and a strategic roadmap for future national implementation.

## 1. INTRODUCTION

### 1.1 Background

Our aim is to solve the critical problem of inaccessible and fragmented patient health records in Ethiopia. Currently, health information is stored on paper in separate clinics, making it difficult for doctors to see a patient's full medical history. This leads to dangerous medication errors, repeated tests, and treatment delays, especially during emergencies.

Our system, "HealthNet," will create a single, national digital health record system. It is innovative. While other digital health projects exist, they operate in isolation. Our project introduces a unique emergency access feature, allowing first responders to instantly retrieve a patient's critical health information via a QR code scan during a crisis.

This project will establish a modern, unified health information system to improve patient safety, increase healthcare efficiency, and provide better data for national health planning. It will cost moderately due to open-source technologies and take approximately 4 months. Key organizations involved include Menelik II Hospital, Tikur Anbesa Hospital, and Yekatit Hospital. The system will also benefit other projects focused on emergency response and healthcare digitization.

### 1.2 The Existing System

Many hospitals and clinics in Ethiopia are highly dependent on paper-based manual recording to capture and process patient data at the time. The traditional method has several serious drawbacks. First, retrieval and updating are slow and ineffective, especially in emergency cases where quicker access to medical history could be a matter of life and death. Second, paper-based records are highly prone to human errors like bad handwriting, misplaced files, and incomplete data entries, which would have adverse effects on the quality of patient care.

Yet another major issue is that there is no single or common system by which healthcare organizations can share patient data securely. As a result, each hospital maintains its own independent file, and it is difficult for doctors to access the patient's past medical history when the patient is visited at another

center. As such, patients must carry records or memorize to provide their medical history, thus making them vulnerable to misdiagnosis, redundant tests, and delay in treatment.

This discontinuous and imperfect documentation system highlights the need to adopt a digital health record platform that ensures timely, accurate, and distributable patient information among all healthcare organizations.

### 1.3 Statement of the Problem

In Ethiopia, it has been difficult for doctors to provide the best care because they cannot access a patient's complete medical history. Records are paper-based and stay in one clinic, leading to:

**Medical Errors:** Treating patients without knowing their allergies or current medications.

**Inefficient Care:** Repeating tests that were already done at another facility.

**Dangerous Emergencies:** First responders have no health information to guide life-saving decisions.

Elements	Description
The problem	Lack of a centralized digital system for patient health records across different health facilities.
Affects	Doctors, nurses, and patients at all levels of the healthcare system, from health posts to specialized hospitals.
And results in	Poor patient safety, inefficient use of resources, and hindered public health planning.
Benefits of a solution	A digital system provides instant access to patient histories, prevents errors, saves costs, and enables faster emergency response.

## **1.4 Objective of the Project**

### **1.4.1 General Objective**

The overarching general aim of the HealthNet project is to design, develop, and propose a detailed, actionable framework for the implementation of a secure, centralized National Electronic Health Record (EHR) system for Ethiopia. This integrated system is envisioned to bridge the critical information gaps that currently exist across all tiers of the healthcare system—from remote health posts in rural woredas to specialized teaching hospitals in major urban centers. By creating a single, shared source of patient truth, the system will directly enhance the quality and safety of patient care, drive measurable improvements in health outcomes, strengthen national public health surveillance capabilities, and optimize the use of limited healthcare resources.

### **1.4.2 Specific Objective**

To achieve the general aim stated above, this project will systematically pursue the following specific, actionable objectives:

1. To conduct a comprehensive analysis of the existing health information landscape in Ethiopia. This will involve meticulously mapping current data flows and reporting pathways, identifying and engaging all key stakeholders (including the Federal Ministry of Health, regional health bureaus, public and private hospitals, and primary clinics), and thoroughly documenting the specific functional and operational limitations of the current paper-based and siloed digital systems.
2. To author a detailed specification of the functional, non-functional, and technical requirements for the HealthNet system. This critical deliverable will include defining core software modules for patient registration, clinical data entry (encompassing diagnoses, medications, allergies, and laboratory results), and the design of a unique patient identifier system. A pivotal component will be the detailed technical and operational design of the Emergency Access Module, explicitly specifying how vital, life-saving information can be securely and rapidly retrieved by authorized emergency personnel during crisis situations.
3. To architect a scalable, sustainable, and highly secure system architecture that is technically feasible and appropriate within the context of Ethiopia's existing and projected technological infrastructure. This architectural design will comprehensively encompass the adoption of international data standards to ensure interoperability, the development of a robust and normalized central database schema, and the implementation of a stringent, multi-layered security protocol featuring role-based access control, comprehensive audit trails, and data encryption to rigorously protect patient privacy.

4. To develop a functional, user-testable software prototype of the HealthNet system. This prototype will serve as a proof-of-concept to demonstrate the core functionalities, including a simulated end-to-end patient registration process, an intuitive clinical dashboard for healthcare providers to view and enter data, and a working demonstration of the emergency access feature, potentially utilizing a secure QR-code-based mechanism for rapid identification.

5. To propose a viable, phased, and cost-effective implementation and sustainability roadmap for the national rollout of HealthNet. This comprehensive plan will include a staged deployment strategy prioritizing high-impact areas, a preliminary analysis of the project's economic and technical feasibility, and concrete recommendations for necessary policy frameworks, continuous capacity building programs, and nationwide public awareness campaigns to ensure long-term system adoption, utilization, and success.

## 1.5 Proposed System

Our proposed system will solve the identified issues by creating an integrated health information ecosystem. It will connect facilities from health posts to specialized hospitals, ensuring a unified view of a patient's health journey.

As for the functionalities and features:

- For Patients: Each citizen will have a Unique Patient Identifier (UPI) linked to a QR code on their national ID or a bracelet. This QR code will be the key to accessing their centralized digital health record.
- For Healthcare Providers: Doctors and nurses will have a secure web dashboard to register patients, view longitudinal health records, enter clinical data (diagnoses, medications, allergies), and manage electronic referrals between facilities.
- For Emergency Responders: A dedicated emergency access portal will allow authorized first responders to scan a patient's QR code. This will instantly display only critical, life-saving information (allergies, major conditions, current medications) on a simple, clear interface, without revealing the full medical history.
- For Public Health: The system will aggregate anonymized data to provide the Ministry of Health with real-time insights for epidemic response, resource allocation, and evidence-based policy-making.



## **1.6 Feasibility Study**

The study evaluates the project from five perspectives: technical, economic, operational, legal, and schedule feasibility. Each aspect is analyzed to ensure that the system is practical, affordable, efficient, and achievable within the available resources.

### **1.6.1. Economic Feasibility**

The Digital Health Recording System is economically feasible because the overall development cost is minimal. Most of the software tools required such as code editors, database systems, and frameworks are free and open-source. The system can also be hosted temporarily using free hosting services during the development phase.

The project does not require any physical materials, reducing expenses significantly. In a real-world scenario, implementing a digital health recording system would lead to major cost savings for healthcare institutions. It would reduce paper use, printing expenses, and the need for physical storage space. It would also save time by automating tasks that were previously done manually.

Any minor costs, such as domain registration or paid hosting after deployment, are optional and minimal. Considering its long-term benefits and low implementation cost, the system is economically sound and worth pursuing.

### **1.6.2. Technical Feasibility**

The digital health recording system is technically feasible, with all required resources readily available. It will be developed using HTML, CSS, and JavaScript for the frontend, and PostgreSQL for secure and reliable database management. No specialized hardware is needed—standard computers and local servers are sufficient. Data protection will be ensured through encryption, user authentication, and role-based access for doctors, nurses, and administrators. All development tools are open-source, minimizing costs and allowing the team to focus on implementation. Regular testing will ensure stability and early error detection, making the project both achievable and sustainable.

### 1.6.3 Schedule Feasibility

We have been provided with about 3 months to finalize this project. Although it is a tight schedule, with proper planning of our time and resources, we believe that we can complete it in due time. A detail description of our time management schedule will be provided later in this document.

## 1.7 Scope

### a) Project Objectives and Goals:

- To design a secure, scalable architecture for a National EHR system tailored for Ethiopia.
- To develop a functional prototype demonstrating patient registration, clinical data viewing, and the QR-code-based emergency access feature.
- To ensure the system design adheres to the highest standards of data security and patient privacy.

### b) Deliverables:

- A comprehensive System Requirements Specification (SRS) and architectural design document.
- A working software prototype with a functional user interface for healthcare providers and the emergency access portal.
- A complete project report and presentation.

### c) Features and Functionalities:

- Centralized patient registry with a Unique Patient Identifier (UPI).
- Secure web dashboard for healthcare providers to view and update patient records. Clinical data modules for diagnoses, medications, allergies, and lab results.
- Emergency Access Module with a secure QR-code-scanning interface for first responders.
- Role-Based Access Control (RBAC) to ensure data privacy for different users (doctors, nurses, emergency personnel).

### c) Exclusions:

- The actual large-scale national rollout, deployment, and maintenance across Ethiopia.
- Procurement and setup of nationwide hardware infrastructure (servers, computers, network hardware).

- The enactment of new national data protection laws or policies (though we will recommend them).
- Full-scale integration with all existing vertical health programs (e.g., HIV/TB databases) and private health facilities.

## 1.8 Methodology

We will adopt a structured, multi-phase approach that integrates rigorous research to ensure the HealthNet system is both evidence-based and practically viable. This methodology is designed to move systematically from understanding the problem and user needs to building, validating, and deploying a robust solution.

### Phase 1: Requirement Gathering and Analysis

#### Objective:

To conduct a comprehensive analysis of the existing health information landscape and establish precise system specifications based on the needs of all key stakeholders.

#### Stakeholder Analysis and In-Depth Interviews:

**Aim:** To understand national health priorities, regulatory constraints, clinical workflows, and existing technical infrastructure.

**Target:** Conduct interviews with policymakers from the, healthcare providers (doctors, nurses) from various facility levels, Health IT administrators, and patients.

### Phase 2: System Design and Prototyping

#### Objective:

To formulate a scalable, secure, and user-centric design blueprint for the platform, resulting in a functional prototype.

**Architecture and Data Model Design:**

We aim Create the high-level system architecture, data model, and database schema. A core focus will be the detailed design of the Emergency Access Protocol and the user interface specifications for both the clinical dashboard and the emergency mode.

**Phase 3: System Development****Objective:**

To build the core features of the HealthNet platform using the waterfall model, following a clear sequence from requirements to deployment while maintaining code quality and design alignment.

**Technology Stack Selection:**

**Selection:** The frontend will use React.js for a responsive user interface. The backend will be built on Node.js and the primary database will be PostgreSQL for its reliability and ACID compliance.

**Waterfall Development Plan**

✓ Aim: Build the HealthNet platform using a structured waterfall approach, progressing through clearly defined phases:

**Phase 4: Testing and Quality Assurance****Objective:**

To rigorously validate the platform's functionality, security, performance, and usability to ensure a reliable and robust system.

**Unit and Integration Testing:**

- ✓ **We** will write and execute tests for individual components and verify that different modules work together seamlessly.

**System and Security Testing:**

- ✓ **We** Perform end-to-end system testing, including penetration testing and vulnerability assessments to safeguard sensitive health data.

**Phase 5: Pilot Deployment and Feedback Integration****Objective:**

To successfully launch the HealthNet platform in pilot sites and establish a framework for continuous monitoring, support, and improvement.

**Pilot Deployment:**

- ✓ **Aim:** Roll out the system to the selected pilot facilities.

**Monitoring and Feedback Collection:**

- ✓ **Aim:** Actively monitor system performance and usage metrics. Collect formal feedback from users to identify issues and refinement needs.
- ✓ **Evaluation Metrics:** Key performance indicators such as reduction in duplicate tests, time saved on record retrieval, user satisfaction scores, and the effectiveness of the Emergency Access Protocol will be tracked to measure initial success and guide the phased national rollout

## 1.9 Project Management plan

### 1.9.1. Time Management plan

#### Project Timeline

- **Start Date:** Wednesday, October 8, 2025
- **Proposal Finalization:** Saturday, October 18, 2025
- **End Date:** Monday, January 6, 2026
- **Total Duration:** ~3 months

Figure 1

Phase	Duration	Dates	Deliverables
Proposal Writing	10 days	Oct 8–Oct 18	Final proposal document
Requirement Analysis	1 week	Oct 19–Oct 25	Interview transcripts, survey results
Design	2 weeks	Oct 26–Nov 8	UI/UX mockups, system architecture
Implementation	5 weeks	Nov 9–Dec 13	Functional modules, backend integration
Testing	2 weeks	Dec 14–Dec 27	Unit, integration, and UAT reports
Deployment	10 days	Dec 28–Jan 6	Live system, backup plan, user training

**Scheduling Tools**

- Gantt Chart for visual tracking
- Milestone-based reviews
- Weekly stand-ups for progress updates
- Task assignments via shared server

**1.9.2. Quality Management Plan**

**Quality Objectives**

- Deliver a reliable, secure, and user-friendly health record system
- Ensure compliance with medical data standards and privacy regulations
- Achieve high user satisfaction among hospital staff and patients

**Risk Management**

Risk	Impact	Mitigation Strategy
Data breach	High	Encryption, role-based access, backups
System downtime	Medium	Load testing, cloud redundancy
User resistance	Medium	Training, feedback loops
Incomplete records	Medium	Validation checks, user prompts

**Testing Strategy**

- Unit Testing: Validate individual modules

- Integration Testing: Ensure smooth data flow between components
- User Acceptance Testing (UAT): Real-world validation with hospital staff
- Load Testing: Simulate emergency traffic scenarios

1.9.3. Communication Management

9.3.1 Internal Communication

Figure 2

Type	Tool/Method	Frequency	Participants
Weekly Meetings	In-person	Weekly	All team members
Milestone Reviews	In-person	Before milestone	All team members
Data Sharing	Shared server	Continuous	All team members



9.3.2 External Communication

Figure 3

Type	Tool/Method	Frequency	Participants
Advisor Reports	Excel sheets	weekly	Team + Advisor
Final Presentation	In-person	End of project	Team + Stakeholders

Communication Goals

- Maintain transparency across all phases
- Ensure timely feedback and issue resolution
- Document decisions and progress for accountability

Project Management Techniques

- Work Breakdown Structure (WBS)
- Critical Path Method (CPM)
- Gantt Chart for phase tracking

## APPENDIX

- **Interview Transcripts:** Notes and summaries from interviews conducted with healthcare professionals and IT staff at Menelik II Comprehensive Specialized Hospital.
- **Volunteer Experience Log:** Observations and reflections from hands-on volunteering at Menelik II Hospital, focusing on patient record handling and emergency response.
- **Survey Results:** Data collected from patients and medical staff regarding the challenges of paper-based records and expectations from a digital system.
- **Design Mockups:** Early UI/UX sketches of the web-based health record system, including patient dashboard, emergency access screen, and admin panel.
- **Technical Diagrams:** System architecture diagrams showing frontend-backend interaction, database schema, and API flow.
- **Gantt Chart:** Visual timeline of project phases including requirements, design, implementation, testing, and deployment.
- **Testing Plan:** Outline of testing strategies including unit testing, integration testing, and user acceptance testing.
- **Code Snippets:** Sample backend logic for secure login and data retrieval.

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