



Digital Health Management in Nigerian Tertiary Institutions: An Integrated Web-Based eHealth Platform

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ABSTRACT

Digital health management integrates electronic health records, web-based information systems, digital appointment services, automated reporting, and data-driven management to strengthen healthcare administration and information access. This study developed an integrated web-based eHealth management platform for Nigerian tertiary-institution health centres to address fragmented records, appointment management, pharmacy monitoring, and administrative processes. A design-and-development software-engineering methodology was adopted, following requirements analysis, system and database design, interface development, module integration, testing, and deployment. The platform employs a three-layer architecture comprising presentation, application/business-logic, and database layers and integrates authentication, patient, doctor, appointment, billing, pharmacy, staff/department, reporting, and dashboard functions. The developed system provides centralized management of interconnected records and generates patient demographic, doctor-specialization, appointment-status, and pharmacy-inventory information. Technical evaluation focused on functional, integration, performance, accessibility, and security testing rather than human-subject outcomes. The results demonstrate the feasibility of consolidating major health-centre administrative functions within a single digital environment and converting stored information into dashboard-based management indicators. The study contributes an integrated and accessibility-oriented software platform that provides a technical foundation for digital health-centre management in Nigerian tertiary institutions and can be further extended through mobile access, interoperability, advanced analytics, and AI-assisted administrative decision support.

1 Introduction

1.1 Background to Digital Health Management in Tertiary Institutions

Digital transformation is increasingly reshaping healthcare management through electronic health records (EHRs), web-based information systems, digital appointment services, automated reporting and data-driven management. The World Health Organization (WHO) identifies digital health as an important component of strengthening health systems, improving service efficiency, supporting informed decision-making and promoting equitable access to healthcare. Its current global strategy emphasizes integrated digital systems, interoperability, people-centred services and the effective use of digital technologies within national health systems (World Health Organization [WHO], 2021, 2025).

For tertiary institutions, digital health management is particularly relevant because institutional health centres coordinate multiple activities involving patients, clinicians, appointments, medical records, pharmacy services and administrative



reporting. Electronic systems can provide centralized access to health information and improve the organization of healthcare processes. In Nigeria, however, the adoption of electronic medical records (EMRs) remains uneven. Akwaowo et al. (2022) found that Nigerian healthcare facilities continue to experience limited EMR adoption, with organizational, contextual and infrastructural factors influencing implementation. They further emphasized the importance of system usefulness, awareness and alignment with healthcare operations.

Recent Nigerian evidence also demonstrates the practical value of digital records. Olukorode et al. (2024), in a systematic review of Nigerian studies, reported a substantial improvement in data quality following the introduction or improvement of EMR systems, although evidence regarding patient satisfaction and other patient-level outcomes remained limited. Similarly, Babatope et al. (2024) identified financial constraints, inadequate ICT resources, interoperability limitations, unreliable electricity, and inadequate internet connectivity as important barriers to effective EHR implementation in Nigeria. These findings reinforce the need for systems that are appropriately designed for the operational and infrastructural realities of Nigerian institutions.

The importance of appropriate system design extends beyond digitizing existing processes. A systematic review by Negro-Calduch et al. (2021) found that technological developments can improve the optimization of EHR and personal health record systems, while implementation challenges include scalability, security, privacy, cost, usability, and interoperability. In low- and middle-income countries, sustainability is additionally influenced by infrastructure, internet connectivity, electricity, system usability, institutional support, and the capacity to maintain digital interventions over time (Kaboré et al., 2022).

Within the context of Nigerian tertiary institutions, therefore, a centralized web-based health management platform can provide a common digital environment for coordinating patient records, medical personnel, appointments, billing, pharmacy inventory and administrative reporting. The present project responds directly to the approved proposal, which identifies slow manual processes, congestion, record-management difficulties and administrative inefficiencies as key motivations for developing an online health-centre management system. Accessibility, operational efficiency and resource optimization are consequently treated as core software-design requirements, rather than as clinical or human-subject outcomes.

1.2 Problem Statement

Despite the increasing availability of digital health technologies, many health-centre management processes in Nigerian tertiary institutions remain susceptible to fragmentation and inefficient manual procedures. Paper-based or partially digitized records can make information retrieval, updating and centralized management difficult. Evidence from Nigeria indicates that EMR adoption remains constrained by inadequate ICT resources, infrastructure, financial limitations, interoperability challenges and unreliable internet and electricity services (Akwaowo et al., 2022; Babatope et al., 2024). The absence of an integrated management platform can also result in separate and poorly coordinated processes for patient registration, doctor management, appointment scheduling, billing and pharmacy inventory. Consequently, health-centre administrators may have limited access to real-time operational information required for monitoring appointments, patient records, available medical personnel, revenue and medicine stocks. The problem is therefore not simply the absence of electronic records, but the lack of an integrated platform capable of connecting major health-centre administrative functions within a unified information environment.

The reviewed literature further indicates that digital health systems in low-resource settings must address usability, infrastructure, interoperability and sustainability during system design (Negro-Calduch et al., 2021; Kaboré et al., 2022). The present project consequently addresses the technical gap through the development of an integrated eHealth management platform incorporating patient, doctor, appointment, billing, pharmacy, and management-dashboard functions.

1.3 Aim of the Study

This study aims to design and implement an integrated digital health management platform for improving the administration and accessibility of health-centre services in Nigerian tertiary institutions.



The study specifically seeks to address the following objectives:

1. Design the architecture of an integrated eHealth management platform for tertiary-institution health-centre operations.
2. Develop modules for patient, doctor, and appointment management.
3. Develop pharmacy inventory and billing/administrative management functions.
4. Implement dashboards for health-centre monitoring, visualization, and reporting.
5. Incorporate accessibility-oriented and user-friendly interface features into the platform.
6. Test the functional and technical performance of the developed system.

These objectives are deliberately restricted to software design, development, implementation, and technical testing. They do not seek to measure clinical outcomes, patient satisfaction, behavioural responses, or other human-subject outcomes.

1.4 Contribution of the Study

The study contributes a practical, integrated eHealth management platform designed around the operational requirements of tertiary-institution health centres. Unlike fragmented solutions that address individual healthcare functions, the developed platform brings together patient management, doctor management, appointment scheduling, billing, pharmacy inventory, and administrative analytics within a centralized digital environment. This approach is consistent with the broader emphasis on integrated and interoperable digital health systems identified in contemporary digital-health literature (WHO, 2021, 2025; Negro-Calduch et al., 2021).

The principal contributions are therefore: (i) an integrated architecture for tertiary-institution health-centre management; (ii) centralized digital administration of patients, doctors and appointments; (iii) pharmacy inventory and billing functionality; (iv) dashboard-based operational monitoring and reporting; (v) accessibility-oriented interface design; and (vi) a deployable software architecture that can provide a foundation for adaptation to other Nigerian tertiary institutions. The platform thus provides a technical response to documented challenges surrounding fragmented and inefficient health-information management in Nigeria (Akwaowo et al., 2022; Babatope et al., 2024).

1.5 Organization of the Paper

The remainder of the paper is organized into four sections. Section 2 reviews relevant literature on digital health management, eHealth systems, electronic health records, accessibility, and related existing systems, and presents the conceptual framework. Section 3 describes the methodology, system requirements, architecture, database design, interface design, and implementation of the proposed platform. Section 4 presents the developed system, functional and technical testing results, and discusses the findings in relation to the study objectives and existing literature. Section 5 concludes the study and presents its major contributions, limitations, recommendations, and possible directions for future software development.

2 Related Literature and Conceptual Framework

This section reviews recent literature on digital health management, electronic health records, web-based health platforms, dashboards, and software accessibility. The review prioritizes literature published between 2021 and 2026, with emphasis on studies relevant to Nigeria and low- and middle-income countries (LMICs). Recent literature was identified from scholarly sources including Google Scholar, Scopus, Web of Science, and PubMed, and bibliographic details were cross-checked against publisher or indexed records.

2.1 Digital Health Management Systems

Digital health management systems integrate information and communication technologies into healthcare processes to support information capture, storage, retrieval, reporting and administrative decision-making. Electronic health records (EHRs) constitute a major component of such systems because they facilitate structured digital documentation and



improve the availability and management of healthcare information. Negro-Calduch et al. (2021) observed that advances in digital technologies have expanded the capabilities of EHR systems while simultaneously creating requirements for effective data processing, storage, exchange, security, and usability.

Evidence from LMICs indicates that EHRs can improve healthcare information management, although implementation is affected by infrastructure, technical capacity, financing, and organizational factors. Woldemariam and Jimma (2023), in a systematic review of EHR adoption in low-income countries, identified both opportunities for improving healthcare quality and persistent implementation challenges. In Nigeria specifically, Akwaowo et al. (2022) reported that EHR adoption is influenced by technological, organizational, and contextual factors, while Olukorode et al. (2024) found evidence of substantial improvements in data quality following the introduction or improvement of EMR systems in Nigerian healthcare settings.

Digital transformation is therefore more than replacing paper records with electronic files; it involves integrating operational processes into a coherent information environment. Open-source EHR research similarly demonstrates the importance of functionality, customization, interoperability, reporting, and sustainability when developing systems for healthcare organizations (Shaikh et al., 2022). For tertiary institutions, this supports an integrated approach in which patient, medical personnel, appointments, pharmacy, and administrative information can be managed through a centralized platform.

2.2 eHealth Systems in Tertiary Institutions

Health information systems within tertiary institutions commonly support patient registration, clinical documentation, appointment management, personnel administration, pharmacy services, reporting and other administrative processes. However, evidence specifically addressing integrated health-centre systems in Nigerian universities is comparatively limited. Consequently, evidence from Nigerian healthcare facilities and broader LMIC digital-health implementations provides an appropriate technical basis for the present study.

A Nigerian implementation study involving OpenMRS demonstrated how an electronic health system can incorporate databases, clinical modules, reporting and system customization. The implementation also illustrated the importance of adapting system architecture to local infrastructure; a planned cloud configuration was modified to a local-area-network deployment because of inadequate internet connectivity. More broadly, OpenMRS has been reported as a scalable open-source medical-record platform supporting healthcare efficiency, data availability, reporting, and interoperability (Mamlin et al., 2021).

The literature consequently indicates that institutional health systems should provide more than isolated electronic records. They should integrate operational functions while allowing appropriate customization, reporting, and scalability. Existing implementations also reveal limitations associated with fragmented systems, infrastructure dependence, sustainability, interoperability, and inadequate technical support (Akwaowo et al., 2022; Woldemariam & Jimma, 2023). These limitations provide a rationale for developing a platform specifically structured around tertiary-institution health-centre operations.

2.3 Web-Based Health Management Platforms

Web-based architecture provides a practical mechanism for connecting different healthcare-management functions through a common application environment. A centralized database can maintain shared records, while application-level controls can provide different privileges for administrators, doctors, and other authorized users. Recent reviews of EHR systems emphasize functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability as important software-quality characteristics (Al Ani et al., 2022).

Contemporary digital-health platforms increasingly combine electronic records with patient portals, appointment services, reporting and management information. Patient portals, for example, can provide access to health records, appointment scheduling, medication-related services, and health information (Corey et al., 2023). Interoperability is also important because patient portals and EHRs must exchange information consistently if integrated digital health environments are to function effectively (Fennelly et al., 2024).

Dashboard functionality provides an additional management layer. Helminski et al. (2024) found that healthcare dashboards are commonly used for performance monitoring, resource management, financial tracking, utilization monitoring, and other administrative purposes. Their review also showed that dashboards are frequently implemented as websites or integrated with EHR systems. Thus, the dashboard implemented in the present platform, displaying



patient statistics, doctor information, appointments, revenue, and pharmacy alerts, represents a recognized approach to converting stored health-management data into actionable administrative information.

Pharmacy functionality is similarly relevant. A systematic review by Alfian et al. (2023) found that digital health technologies can support pharmaceutical-care processes in LMICs, although implementation and contextual factors influence their effectiveness. Consequently, integrating pharmacy inventory management with patient and administrative information can reduce functional fragmentation and provide a more comprehensive institutional health-management environment.

2.4 Accessibility in Digital Health Interfaces

Accessibility is an important software-design consideration because digital health applications must accommodate users with different devices, abilities, and levels of digital experience. Henni et al. (2022) found that people with impairments encounter technology-related barriers when using digital health solutions and emphasized inclusive and universal-design approaches.

Usability literature further identifies navigation, visibility of system status, flexibility, efficiency, and consistency as important characteristics of health-application interfaces. Galavi et al. (2024), for example, identified 20 usability heuristics relevant to health applications, including navigation and user engagement. A 2024 umbrella review likewise identified usability as a critical design consideration and highlighted issues associated with flexibility, efficiency, and minimalist interface design (Galavi et al., 2024).

For the present platform, accessibility is therefore operationalized as a software-design requirement, including responsive layouts, mobile compatibility, readable content, clear navigation, accessible forms, consistent interface elements, and support for users with disabilities. These requirements are consistent with the original project proposal, which specifies multilingual interfaces, mobile compatibility, user-friendly design, and support for individuals with disabilities.

2.5 Review of Existing Systems

The reviewed literature indicates that existing digital-health platforms generally emphasize particular functions rather than providing the complete combination proposed in this study. OpenMRS emphasizes electronic medical records and customizable clinical modules; DHIS2 emphasizes health information management, dashboards, analytics, and integration; patient portals emphasize patient-facing information and services; while specialized digital pharmaceutical systems focus on medication-related processes. See Table 1.

Table 1. Comparative synthesis of representative digital-health system approaches

System/Approach	Patient Management	Appointment	Doctor/Staff Management	Pharmacy	Dashboard	Accessibility	Principal Limitation
OpenMRS	✓	Configurable	✓	Configurable	✓	Configurable	Primarily EHR-oriented; extensive customization may be required
DHIS2	✓*	Limited/Configurable	✓*	✓*	✓	Configurable	Primarily health-information/programme-management oriented
Patient portals	✓	✓	Limited	Medication-related	Limited	Depends on implementation	Primarily patient-facing rather than complete institutional administration



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Digital pharmaceutical systems	Limited	—	Limited	✓	✓/Configurable	Depends on implementation	Pharmacy-centred rather than institution-wide
Proposed TeTFund–DOU eHealth Platform	✓	✓	✓	✓	✓	✓	Designed specifically for integrated tertiary-institution health-centre management

The comparison demonstrates that the proposed platform is not intended to replace established enterprise or national health-information platforms. Rather, its contribution lies in integrating the principal administrative functions required within a tertiary-institution health centre into a single web-based environment.

2.6 Conceptual Framework for the Proposed Platform

The conceptual framework adopts an integrated information-management model:

Users → Authentication → Core eHealth Modules → Central Database → Analytics/Reports → Management Decision Support

The user layer comprises administrators and authorized health-centre personnel interacting with the platform. Authentication provides controlled access to the appropriate functions. The core eHealth layer contains patient management, doctor management, appointment management, billing, pharmacy inventory, staff and departmental administration. These modules interact with the central database, providing a common source of operational information.

The analytics and reporting layer transforms database records into management information, including patient demographics, doctor specialization, appointment status, revenue, and pharmacy-stock indicators. The final layer provides management decision support through dashboards, reports, alerts, and summarized indicators. This approach is consistent with evidence that dashboards can support performance monitoring, utilization tracking, resource management, and financial monitoring in healthcare settings (Helminski et al., 2024).

2.7 Conceptual Framework

Institutional Health Challenges comprise paper-based records, fragmented information, appointment congestion, difficulty retrieving patient information, inefficient pharmacy monitoring, and limited management visibility.

The eHealth Platform provides an integrated technological response. Its principal Digital Functions include electronic patient records, appointment scheduling, patient management, pharmacy/inventory management, dashboards, and accessible web/mobile interfaces. Figure 1 presents the conceptual framework.

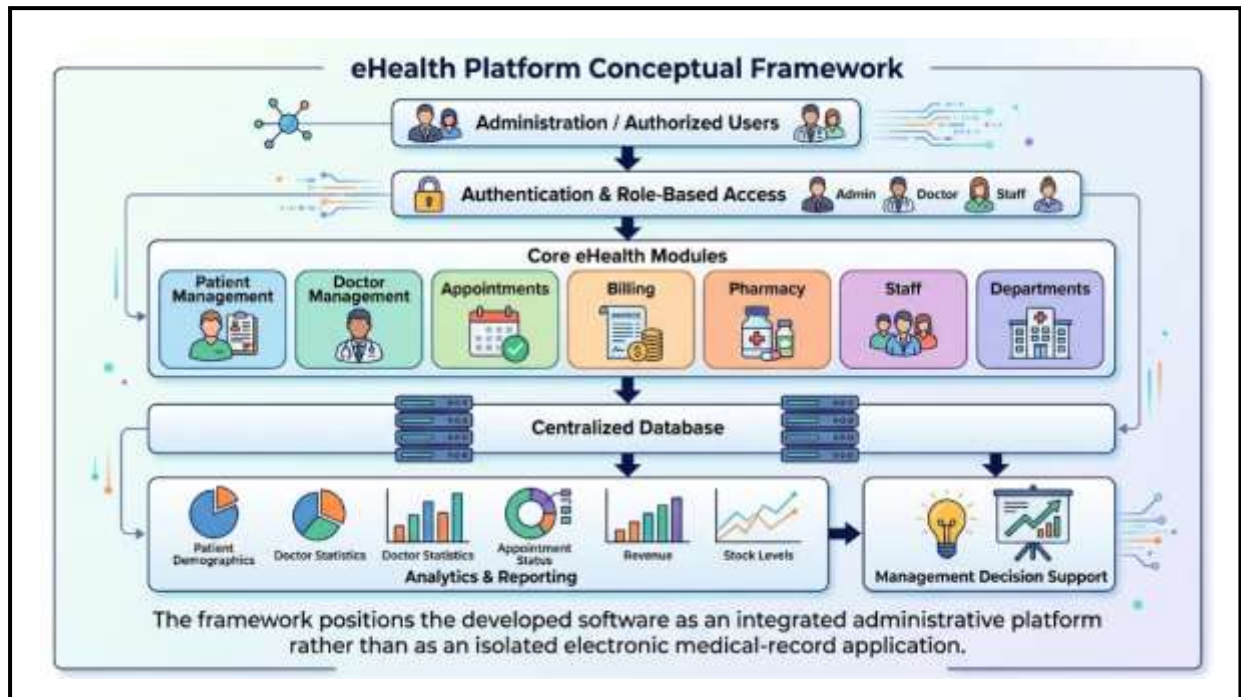


Figure 1: eHealth Platform Conceptual Framework

The framework positions the developed software as an integrated administrative platform rather than as an isolated electronic medical-record application.

2.8 Research Gap

The literature demonstrates the benefits and challenges of EHRs and digital health systems, but several gaps remain relevant to the present project. First, much of the Nigerian literature focuses on EHR adoption and implementation rather than the design and development of integrated health-management platforms specifically for tertiary institutions. Second, existing platforms often emphasize particular functions, such as electronic records, national health information, patient portals, or pharmaceutical services, rather than integrating patient, doctor, appointment, billing, pharmacy, and administrative dashboard functions within one institutional platform. Third, accessibility and usability are not consistently incorporated as explicit software-design requirements, despite evidence that they influence the accessibility and quality of digital health applications (Henni et al., 2022; Galavi et al., 2024).

The research gap addressed by this study is therefore the development of an integrated, accessible, and institution-oriented web-based eHealth management platform that combines core health-centre administrative functions with centralized data management and dashboard-based reporting. The proposed TeTFund–DOU eHealth platform addresses this gap through the integration of patient, doctor, appointment, billing, pharmacy, and administrative-management functions in a unified software environment.

3 Methodology, System Design and Implementation

3.1 Research and Development Approach

The study adopted a design-and-development research approach, implemented through a structured software-engineering lifecycle. The methodology was restricted to the analysis, design, development, integration, testing, and deployment of the proposed digital health management platform. The original project proposed needs assessment, agile development, prototyping, implementation, and evaluation; in the revised scope, these activities were operationalised as software requirements analysis, iterative system design, module development, integration, and technical evaluation.



The development process followed the sequence:

Requirements Analysis → System Design → Database Design → Interface Design → Module Development → Integration → Testing → Deployment.

This approach enabled the individual functional components to be developed and subsequently integrated into a unified web-based health-management platform.

3.2 System Requirements Analysis

Requirements were derived from the functional scope of the proposed platform and the operational requirements identified in the project proposal. The resulting requirements were divided into functional and non-functional requirements.

3.2.1. Functional Requirements

The system was designed to support:

1. user authentication and access control;
2. administrator management;
3. patient registration and record management;
4. doctor registration and management;
5. appointment creation and status management;
6. billing and payment management;
7. pharmacy and medicine inventory management;
8. staff and department management;
9. report generation; and
10. dashboard-based analytics and monitoring.

These functions provide an integrated environment for managing major administrative and clinical-support activities within a tertiary-institution health centre.

3.2.2. Non-Functional Requirements

The platform was designed with the following quality requirements:

- i. Accessibility: information and functions should be accessible to different categories of users;
- ii. Usability: interfaces should support clear navigation and simple interaction;
- iii. Security: access to protected functions and records should be controlled;
- iv. Responsiveness: interfaces should adapt to different screen sizes;
- v. Reliability: system functions should operate consistently;
- vi. Maintainability: modules should support future modification and enhancement;
- vii. Scalability: the architecture should permit additional users and modules; and
- viii. Performance: system operations should be completed within acceptable response times.

Accessibility was also consistent with the original project requirement for mobile compatibility, user-friendly interfaces, and support for users with disabilities.

3.3. System Architecture

The system employs a three-layer web architecture comprising the presentation, application/business-logic, and database layers. See Figure 2.

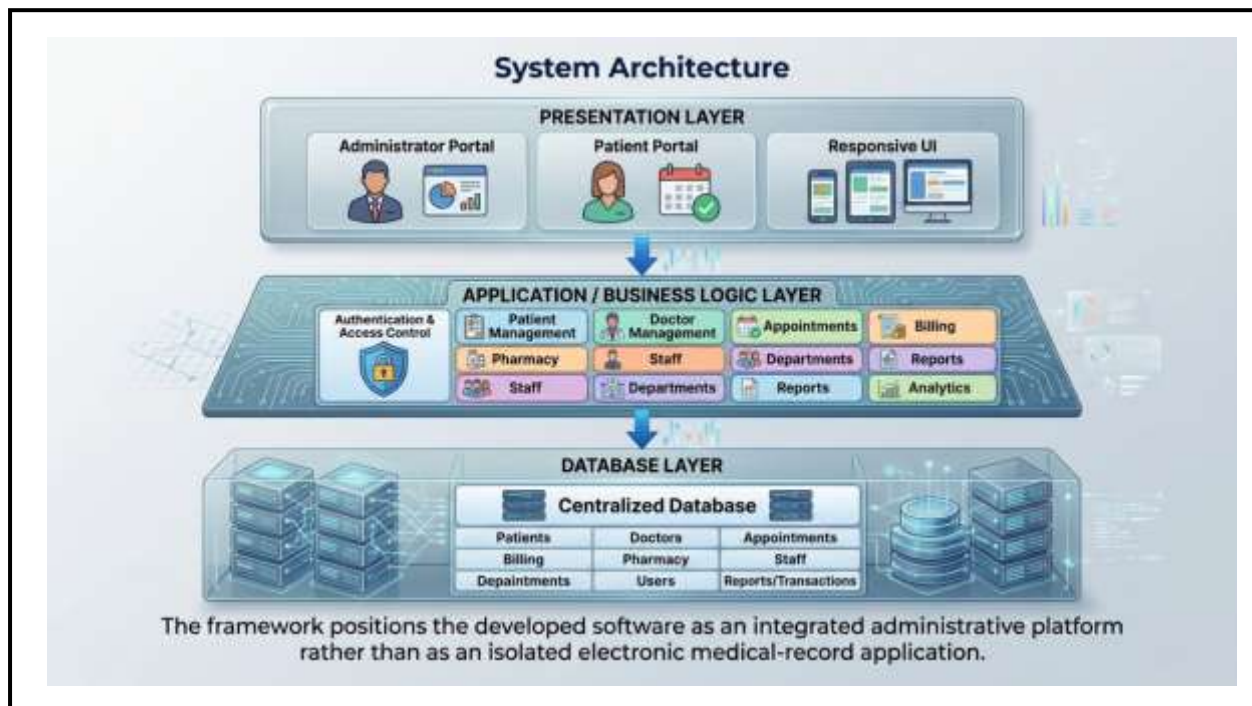


Figure 2: System Architecture and Design

The presentation layer provides user interaction, while the application layer processes business rules and coordinates system operations. The database layer provides persistent storage for user, patient, appointment, billing, pharmacy, and administrative information.

3.4. Database Design

The database was designed around the principal information entities required by the application. These include User, Patient, Doctor, Appointment, Billing/Payment, Medicine/Inventory, Staff, Department, and related transaction records.

The major relationships include patient–appointment, doctor–appointment, patient–billing, and medicine–inventory relationships. These relationships allow information generated by individual modules to be reused by other components of the system. For example, appointment information can be associated with both patient and doctor records, while inventory information can be incorporated into dashboard monitoring.

The database design should be represented using an Entity-Relationship Diagram (ERD) showing the principal entities, primary keys, foreign-key relationships, and cardinalities. Appropriate normalization was applied to reduce unnecessary data duplication and maintain consistency across related records.

3.5. Interface and User Experience Design

The interface was designed as a web-based environment with separate access points for administration and patients. The implementation emphasizes straightforward navigation, consistent page structure, and dashboard-based presentation of operational information.



The principal interfaces comprise:

- a. Landing Page: provides platform branding, service description, administrator sign-in and patient-portal access.
- b. Administration Login: provides email/password authentication, remember-me functionality and password-recovery access.
- c. Dashboard: presents high-level operational indicators and alerts.
- d. Patient Management: provides patient information and demographic visualization.
- e. Doctor Management: provides doctor records and specialization statistics.
- f. Appointment Management: provides appointment records and status categorization.
- g. Pharmacy Inventory: presents medicine categories and stock information.
- h. Reports and Analytics: converts stored operational data into charts, indicators and management information.

3.6. System Modules and Implementation

3.6.1. Landing Page and Portal Access

The landing page establishes the identity and purpose of the TeTFund–DOU eHealth platform. It provides a description of the digital health-management service and directs users to either the Administration Sign-In or Patient Portal. This provides a common entry point while separating administrative and patient-oriented access.

3.6.2. Authentication and Administration Portal

The administration portal provides controlled access through email/password authentication. The interface includes sign-in, remember-me, and password-recovery functions. Authentication provides the initial access-control mechanism through which administrative functions can be protected from unauthorized access.

3.6.3. Administrative Dashboard

The implemented dashboard provides a consolidated view of key operational indicators. The displayed indicators include total patients, number of medical doctors, today's appointments, paid revenue, upcoming appointments, and low-stock alerts. This arrangement allows information originating from different modules to be presented within a single administrative interface.

3.6.4. Patient Management Module

The patient-management module provides facilities for maintaining patient records. The implementation also provides a patient demographic visualization by gender, allowing patient information to be represented graphically rather than solely as tabular records.

3.6.5. Doctor Management Module

The doctor-management module provides facilities for maintaining doctor records and presents a statistical distribution according to specialization. The implemented visualization includes specializations such as Cardiology, Dermatology, General Medicine, and Neurology, thereby demonstrating the conversion of stored doctor information into management-oriented statistics.

3.6.6. Appointment Management Module

The appointment module manages appointment records and categorizes their status. The implemented status categories include Cancelled, Completed, Confirmed, and Pending. This provides an operational mechanism for monitoring appointment activities and their current states.



3.6.7. Pharmacy Inventory Module

The pharmacy module supports medicine-stock management and categorization. The implementation presents inventory according to medicine categories, including Analgesic, Antibiotic, Antidiabetic, Antihistamine, Antimalarial, Cardiovascular, and Gastrointestinal categories. Stock information can also be used to identify low-stock items.

3.6.8. Reporting and Analytics

The reporting and analytics functionality transforms stored operational data into visual indicators and statistical summaries. The implementation includes:

- i. patient demographic charts;
- ii. doctor-specialization statistics;
- iii. appointment-status statistics;
- iv. medicine-stock information;
- v. dashboard indicators; and
- vi. management-oriented reports.

These functions provide a consolidated information layer for monitoring activities within the health centre.

3.7. System Testing and Technical Evaluation

Since the study was restricted to software development, evaluation focused on technical and system-level testing rather than human-subject evaluation. The testing framework comprised functional, integration, performance, accessibility and security testing.

3.7.1. Functional Testing

Functional testing verifies whether individual system functions perform their specified operations. The principal test cases include:

- i. administrator login;
- ii. patient registration and management;
- iii. doctor registration and management;
- iv. appointment creation and management;
- v. billing/payment processing;
- vi. pharmacy inventory operations; and
- vii. report generation.

3.7.2. Integration Testing

Integration testing verifies data exchange and interaction between related modules, particularly:

- a. Patient ↔ Appointment
- b. Doctor ↔ Appointment
- c. Patient ↔ Billing
- d. Pharmacy ↔ Inventory
- e. Dashboard ↔ Database

The purpose is to establish that information entered or modified in one module is correctly reflected in dependent modules.



3.7.3. Performance Testing

Performance evaluation should consider page-response time, database-query response time, transaction-processing time, and concurrent-request performance. These measures provide technical evidence regarding the responsiveness and processing efficiency of the application.

3.7.4. Accessibility Testing

Accessibility testing evaluates the interfaces against applicable accessibility principles, including readable content, logical navigation, appropriately structured forms, responsive presentation, and compatibility with different user interaction needs. This is particularly relevant because accessibility and mobile compatibility were identified as requirements in the original project.

3.7.5. Security Testing

Security testing focuses on technical mechanisms for protecting the application and its records. Tests should cover:

- i. authentication;
- ii. authorization and role-based access;
- iii. input validation;
- iv. session management;
- v. password protection; and
- vi. prevention of unauthorized access.

Overall, the methodology establishes a software-development pathway from requirements specification through implementation and technical validation, while avoiding claims about patient outcomes, user satisfaction or clinical effectiveness that would require human-participant evaluation.

4. Results and Discussion

4.1. Developed eHealth Platform

The completed TeTFund–DOU eHealth platform provides an integrated web-based environment for administration and health-centre information management. The implemented modules include authentication, patient management, doctor management, appointments, billing, pharmacy inventory, staff/departments, reporting, and dashboard analytics. The implementation demonstrates the central objective of the project: integrating major health-centre administrative functions within a single digital platform rather than maintaining them as isolated processes. This is consistent with the project's expected outputs of centralized digital records, streamlined appointment administration, resource monitoring, and data-driven management.

4.2. Landing Page and Portal

The landing page establishes the platform identity as **TeTFund–DOU eHealth** and positions the application as a digital health-management platform for tertiary institutions. It provides two principal access routes: **Administration Sign-In** and **Patient Portal**. The interface therefore establishes a common entry point while separating administrative and patient-oriented activities. See Figure 3.

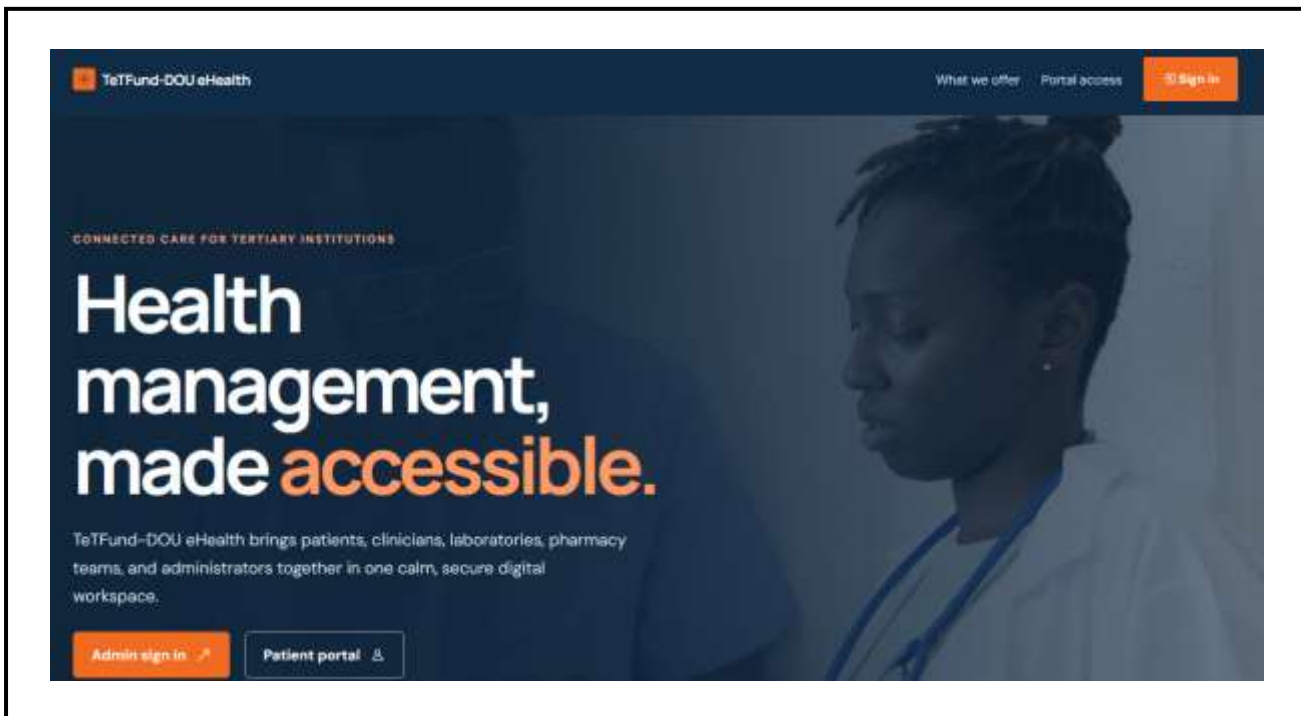


Figure 3: TeTFund-DOU eHealth Landing Page

4.3. Authentication Interface

The administration interface implements email/password authentication together with **Remember Me** and **Forgot Password** functions. The interface provides the entry point to protected administrative functions and represents the first layer of access control within the platform. The admin login interface is presented in Figure 4.

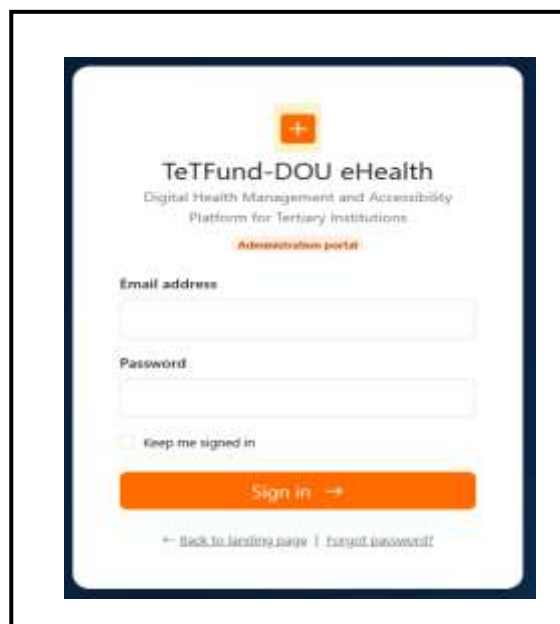


Figure 4: Administration Login



4.4. Administrative Dashboard

The dashboard demonstrates the value of integrating information from different modules into a single management interface. Healthcare dashboards are increasingly used for administrative and clinical monitoring, although their effectiveness depends on appropriate development, implementation, and evaluation. Figure 4 presents the administrative dashboard.

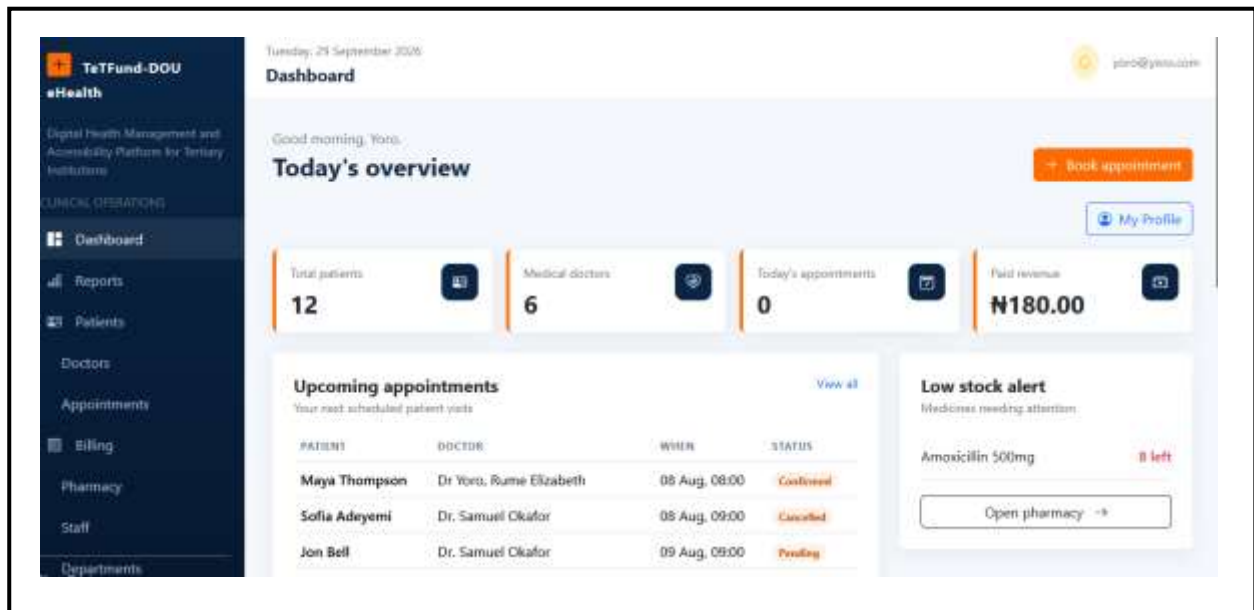


Figure 5: Administrative Dashboard

4.5. Patient Management Results

As shown in Figure 5, patient records can be transformed automatically into demographic summaries. The technical significance is therefore not the particular gender distribution, but the ability of the application to **store structured records and dynamically generate analytical information**.

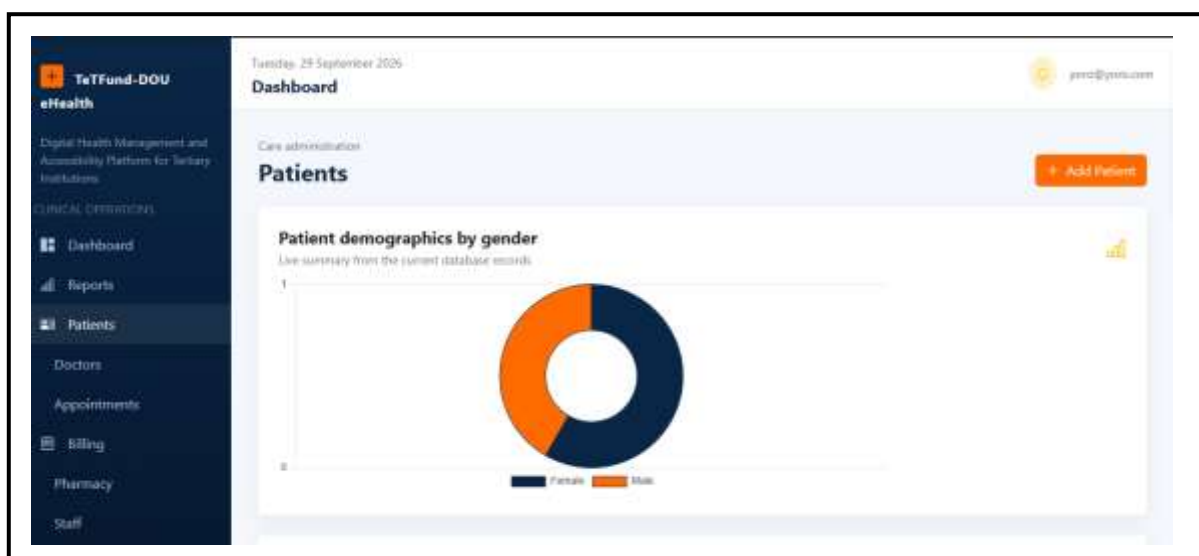


Figure 6: Patient Management/Demographic Interface



4.6. Doctor Management Results

The doctor record management interface is presented in Figure 6. This shows doctors' classification according to specialization and automated visualization for administrative monitoring.



Figure 7: Doctor Management Interface

4.7. Appointment Management Results

Figure 7 shows that appointments can be associated with patients and doctors while maintaining a discrete operational status. This provides a technical basis for monitoring scheduled activities and distinguishing pending, confirmed, completed and cancelled appointments.

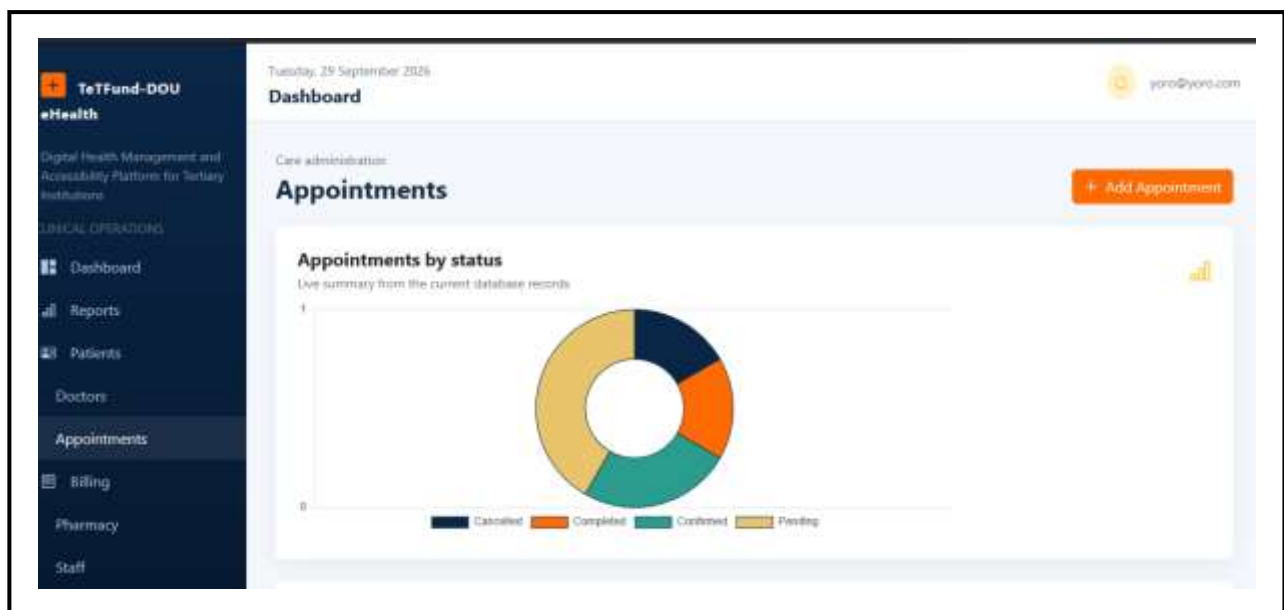


Figure 8: Appointment Management Interface



4.8. Pharmacy Inventory Results

The pharmacy inventory stock form medicines are presented by Figure 8 This demonstrates the technical feasibility of how the ehealth application manages medicine stocking, inventory and dispensary.



Figure 9: Pharmacy Inventory Interface

4.9. Discussion

The developed platform implements the principal functional scope defined for the project. Patient and doctor records can be represented as structured datasets; appointments can be categorized by operational status; pharmacy records can be organized by medicine category and subjected to low-stock rules; and information from these modules can be consolidated within a dashboard.

The principal technical contribution is therefore **integration**. Instead of treating patient management, appointments, doctors, pharmacy and administrative reporting as independent activities, the platform provides a common digital environment through which related information can be stored, processed and visualized. This aligns with evidence from Nigerian EMR literature indicating potential improvements in healthcare data quality following EMR implementation, while also recognizing that evidence for broader patient-level outcomes remains limited.

The dashboard provides an additional management layer by converting underlying records into immediately interpretable indicators. This is consistent with the growing use of healthcare dashboards for administrative and operational monitoring.

The developed platform provides a **technically integrated digital health-management environment** incorporating authentication, patient and doctor management, appointments, billing, pharmacy inventory and dashboard-based analytics. The project demonstrates how interconnected records can generate the principal visualizations and alerts shown by the implemented system.

5. Conclusion, Implications and Recommendations

5.1. Conclusion

This study addressed the limitations associated with fragmented and manual health-centre management processes in tertiary institutions by developing an integrated web-based eHealth management platform. The project adopted a



design-and-development/software-engineering approach, progressing through requirements analysis, system design, database design, interface development, module implementation, integration and technical testing.

The resulting three-layer architecture comprises the presentation, application/business-logic and database layers, providing a structured foundation for integrating major health-centre functions. The implemented platform incorporates authentication, patient management, doctor management, appointment management, billing, pharmacy inventory, staff/departments, reporting and dashboard analytics.

The system demonstrates the ability to manage interconnected records and generate demographic, doctor-specialization, appointment-status and pharmacy-inventory information. The project therefore contributes a practical software artefact that demonstrates how core tertiary-institution health-centre operations can be brought together within a single digital environment.

5.2. Major Contributions

The major contributions of the study are:

1. An integrated eHealth architecture for managing health-centre activities within tertiary institutions.
2. A web-based implementation integrating patient, doctor, and appointment management.
3. Integration of pharmacy inventory and billing functions within the same administrative environment.
4. Dashboard-based analytics for presenting operational and management information.
5. Accessibility-oriented interface design, including responsive and user-friendly interaction considerations.
6. A reusable technical foundation that can be adapted and extended for other Nigerian tertiary institutions.

5.3. Future Development

Future versions could incorporate AI-assisted administrative decision support, predictive pharmacy-stock management, advanced management dashboards, and inter-institutional data exchange. API-based integration could facilitate interoperability with laboratory, payment, identity, and institutional systems. A PWA/mobile implementation could further extend access across devices while retaining the existing web-based architecture.

Overall, the study establishes a technical foundation for integrated digital health-centre management and provides a platform that can be progressively extended as additional institutional requirements and interoperability capabilities are introduced.

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