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Health Data Information & Management System (HDIMS)

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Abstract: ***The Health Data Information & Management System (HDIMS) is a comprehensive web-based healthcare management platform designed to digitize and integrate all critical healthcare workflows under a unified system. Many small to medium-sized healthcare facilities continue to rely on paper-based records, disconnected spreadsheets, and siloed information systems, leading to delays in diagnosis, prescription errors, duplication of tests, and poor patient experiences. HDIMS addresses these challenges by providing a centralized digital platform built on ASP.NET Web Forms with a C# backend and Microsoft SQL Server database. The system integrates appointment management, clinical prescription and diagnosis documentation, laboratory test management, pharmacy billing, and telemedicine consultations through five role-specific modules: Administrator, Doctor, Patient, Medical Staff (Pharmacy), and Lab Staff. Key features include real-time slot-based appointment booking, a structured prescription writing module with a temporary staging buffer, color-coded medication timing display, digital lab report upload and status tracking, automated pharmacy bill generation from prescription data, and Jitsi Meet-based video consultation with real-time chat. All 30 functional test cases and 5 integration test scenarios passed successfully, with 100% task completion in user acceptance testing. The system demonstrates how modern web technologies can be applied to build a secure, scalable, and efficient healthcare information management solution suitable for small to mid-size clinics and hospitals.***

Keywords: Health Data Management System, Electronic Health Records (EHR), Web-Based Healthcare System, Online Appointment Booking, Digital Prescription Management, Telemedicine, ASP.NET Web Forms, C#, SQL Server, Role-Based Access Control, Pharmacy Billing, Laboratory Information System.

I. INTRODUCTION

The healthcare industry is one of the most data-intensive sectors in the world. Hospitals, clinics, and medical facilities generate enormous volumes of patient data every day, spanning from initial registration and clinical examination to prescription records, laboratory reports, and billing information. Managing this data efficiently and securely is not only a logistical challenge but a critical requirement for delivering quality patient care.

In many small to medium-sized healthcare facilities, data management continues to rely on paper-based records, disconnected spreadsheets, and siloed information systems that do not communicate with each other. These fragmented approaches lead to delays in diagnosis, prescription errors, duplication of tests, and poor patient experiences. The lack of integrated digital infrastructure hampers both clinical and administrative efficiency.

The Health Data Information and Management System (HDIMS) addresses these challenges by providing a unified, web-based platform that integrates all critical healthcare workflows under a single system. The system supports five distinct user roles — Administrator, Doctor, Patient, Medical Staff (Pharmacy), and Lab Staff — each with a dedicated module, login system, and role-specific dashboard.

The motivation for HDIMS stems from three key observations: first, the absence of a centralized patient record system creates information gaps when patients visit multiple departments; second, manual appointment and prescription systems are prone to errors and are not scalable as patient volumes grow; third, the rise of telemedicine during and after the COVID-19 pandemic has demonstrated the need for remote consultation capabilities even in local healthcare settings.

The system is built on ASP.NET Web Forms with C# and SQL Server, following a three-tier architecture with ASPX pages as the presentation layer, C# code-behind files handling business logic, and SQL Server as the data layer. The project scope covers doctor and patient registration, appointment booking, digital prescription writing, lab test management, pharmacy billing, telemedicine via Jitsi Meet, real-time chat, and online payment processing.

II. LITERATURE REVIEW

A substantial body of research supports the design principles underlying HDIMS. Bates et al. [1] demonstrated that electronic medical record systems reduce non-intercepted serious medication errors by 55% in hospital settings, justifying HDIMS's structured prescription entry module. Hayrinen, Saranto, and Nykanen [2] established that a comprehensive EHR must integrate clinical notes, medication records, laboratory results, and administrative data within a unified patient record — an architecture directly reflected in HDIMS's linked prescription, lab, and billing modules.

Sunyaev and Schneider [4] identified that browser-based systems outperform desktop-installed alternatives in multi-role healthcare environments, supporting the choice of ASP.NET Web Forms. Dey et al. [5] demonstrated that a multi-tier web architecture improves system maintainability and scalability, consistent with HDIMS's three-tier design.

Gupta and Denton [7] identified that time-slot-based scheduling with real-time availability filtering reduces appointment conflicts significantly. Cayirli and Veral [8] found that patient self-scheduling reduces administrative workload by 40% on average — directly addressed by HDIMS's patient-facing booking module. Ekeland et al. [10] confirmed that video consultation platforms produce outcomes comparable to in-person consultations, justifying Jitsi Meet integration. Hjelm [12] concluded that WebRTC-based solutions such as Jitsi Meet offer clinically adequate quality at significantly lower infrastructure costs.

Birkhead et al. [13] found that digital prescription systems reduce drug interaction errors by 53%. Ammenwerth et al. [14] demonstrated that visual timing indicators significantly improve medication adherence, informing HDIMS's color-coded timing pill design. Agrawal [15] highlighted the necessity of temporary prescription storage before final commit, addressed by HDIMS's Temp_prescription staging table. Georgiou et al. [18] reported a 27% reduction in lab test turnaround time through electronic ordering, consistent with HDIMS's Doctor Ordered Tests status tracking system. Kohn et al. [20] emphasized that billing systems linked directly to prescription records reduce discrepancies between prescribed and billed medicines — achieved in HDIMS by deriving bill items directly from saved prescriptions. Appari and Johnson [23] established role-based access control as the dominant security model in healthcare IT, reflected in HDIMS's role-specific session management.

Ref.	Author & Year	Methods / Contribution	Future Scope
[1]	Bates et al. (1998)	CPOE system reduced serious medication errors by 55% in hospital settings; demonstrated value of structured data entry.	Alert mechanisms for drug interactions, broader EHR adoption across facility types.
[2]	Hayrinen et al. (2008)	Systematic review defining EHR scope: clinical notes, medications, lab results, and administrative data in a unified longitudinal record.	Standardization of EHR data models across national health systems.
[7]	Gupta & Denton (2008)	Time-slot scheduling with real-time availability filtering reduces appointment conflicts and no-shows vs. manual booking.	Dynamic demand-capacity matching; AI-based scheduling optimization.
[10]	Ekeland et al. (2010)	Systematic review: video consultation produces clinical outcomes comparable to in-person for dermatology, psychiatry, and chronic disease management.	Real-time remote patient monitoring; integration with wearable devices.
[14]	Ammenwerth et al. (2008)	Visual timing indicators for drug dosage significantly improve medication adherence; electronic prescribing reduces adverse drug events.	Clinical decision support integration; AI-assisted drug interaction alerts.
[20]	Kohn et al. (2000)	IOM report: structured billing linked to prescriptions reduces discrepancies between prescribed and billed medicines.	Automated insurance claim processing; integration with national health exchanges.

Table I. Literature work

III. PROBLEM DEFINITION AND REQUIREMENTS

The core problem addressed by HDIMS is the absence of an integrated digital platform for managing healthcare workflows in small to mid-size medical facilities. Specifically, patient records are maintained on paper or in disconnected spreadsheets; appointment scheduling is done manually, resulting in double-bookings and wasted doctor time; prescriptions are handwritten and unsearchable; laboratory test orders are communicated verbally with no life cycle tracking; pharmacy billing is manual with no link to the prescription; no remote consultation capability exists; and no unified dashboard exists for operational monitoring.

1) Functional Requirements

The Doctor module requires: admin-managed doctor registration with speciality and photo; appointment slot management with conflict-free booking; structured prescription writing with symptom, diagnosis, medicine, and lab test capture; a temporary prescription buffer; prescription history per patient; lab report viewer; and per-appointment video consultation links.

The Patient module requires: self-registration and session login; doctor search by name, address, or speciality; appointment booking from real-time available slots; online payment support; formatted Rx card prescription history with print capability; and video consultation access.

The Pharmacy module requires: patient list with prescriptions ready for billing; medicine-by-medicine prescription view; price entry with auto-calculated totals; printable formatted bills; and searchable bill history.

2) Non-Functional Requirements

The Lab Staff module requires: display of all pending test orders with clinical context; report upload supporting PDF, Word, JPG, and PNG formats; automatic status update from Pending to Report Uploaded; and searchable report history.

Requirement	Description
Performance	Pages must load within 3 seconds under normal load conditions.
Security	Role-based session management must prevent cross-role data access.
Usability	All interfaces must be operable without technical training.
Reliability	Database operations must be transactionally consistent.
Scalability	Database schema must support future addition of new modules.
Data Integrity	Prescription data must not be deletable once confirmed.

IV. OBJECTIVES

The primary objectives of HDIMS are:

1) Design and implement a centralized, multi-role web-based healthcare management platform integrating appointment, prescription, laboratory, and billing workflows.
2) Eliminate paper-based record keeping by providing structured digital forms for all clinical and administrative operations.
3) Implement a real-time appointment booking system that prevents scheduling conflicts through slot-level availability tracking.
4) Develop a structured prescription writing module capturing symptoms, diagnosis, medications, and lab test orders in a consistent, searchable format.
5) Enable telemedicine consultations by integrating Jitsi Meet video sessions accessible from within the clinical workflow.
6) Automate pharmacy billing by deriving bill line items directly from saved prescriptions, removing manual transcription.
7) Provide laboratory staff with a complete test order management workflow including status tracking and multi-format report upload.
8) Present patients with a readable, color-coded prescription history supporting medication adherence.

V. METHODOLOGY AND SYSTEM DESIGN

A. Development Approach

HDIMS was developed using an iterative waterfall approach, combining the structured phases of the classical waterfall model with the flexibility to revisit earlier phases based on testing feedback. The development phases were: Requirements Analysis, System Design, Module-wise Implementation, Integration Testing, and Deployment Preparation. Each module was developed and tested independently before cross-module integration testing was performed.

B. System Architecture

The system follows a three-tier architecture: the Presentation Layer comprises ASPX Web Form pages with Master Page templates for consistent navigation; the Business Logic Layer consists of C# code-behind files handling validation, business rules, and session management; and the Data Layer is a SQL Server database accessed through ADO.NET with parameterized queries to prevent SQL injection. A communication layer interfaces with Jitsi Meet for video consultation and provides file I/O for lab report uploads stored in the Lab/Reports/ server folder.

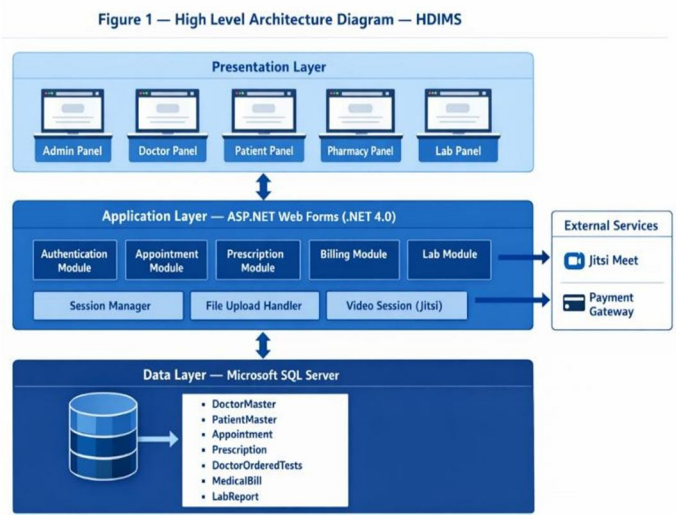


Fig. 1: High-Level System Architecture Diagram

C. Database Schema Design

The HDIMS database contains 18 tables organized across five functional groups, following third normal form (3NF) to minimize data redundancy. Key design decisions include: separate master tables for each user role (Doctor-master,Patient-master, Medical Staff Master, Lab Staff Master); a Temp_prescription staging table preventing premature commits; Doctor Ordered Tests with a status field (Pending / Report Uploaded / No Tests) tracking the lab order life-cycle; a Medical Bill / Medical Bill Details header-detail pattern for itemized billing; and a Video Session Data table storing Jitsi room links.

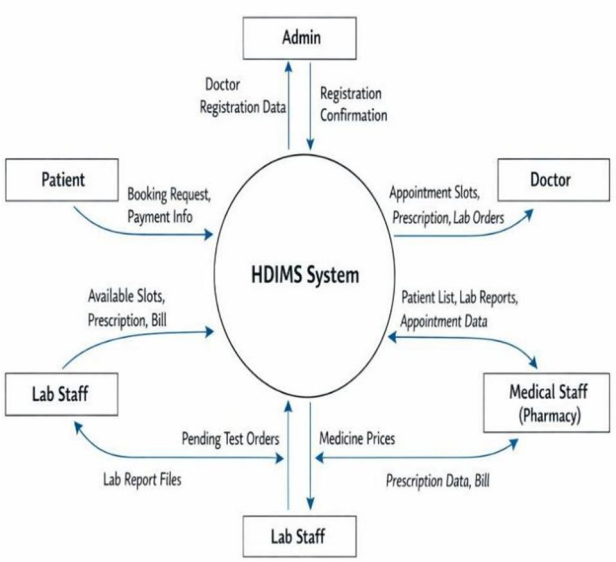
Table Name	Primary Purpose	Key Fields
DoctorMaster	Stores doctor profiles	did, dname, speciality, dusername, dfees, dphoto
PatientMaster	Stores patient profiles	pid, pname, pmobile, pusername, pemail
Appointment	Doctor sets available slots	dusername, date, time_slots
PatientApppointmentSlots	Patient books a slot	pid, did, date, time_slot
Temp_prescription	Staging for in-progress prescriptions	did, pid, medicine, qty, timing
Prescription	Final saved medicines	pid, did, date, medicine, qty, timing
DoctorOrderedTests	Lab test orders and status	pid, did, tests, symptoms, diagnosis, status
LabReport	Uploaded lab files	pid, did, report_file, upload_date
MedicalBill	Bill header per patient	bill_id, pid, did, date, total
MedicalBillDetails	Medicine-wise bill lines	bill_id, medicine, qty, price
VideoSessionData	Jitsi room links	pid, did, video_link, session_date
ChatData	Chat messages	sender, receiver, message, msg_time

TABLE II. HDIMS Database Tables

D. Module Interaction Flow

The typical end-to-end workflow follows this sequence: (1) Admin registers the doctor in Doctor Master. (2) Doctor sets available appointment slots. (3) Patient registers, searches for doctor, and books a slot. (4) Patient pays online or selects pay at hospital. (5) Doctor writes prescription: symptoms, diagnosis, medicines saved to Temp_prescription, then committed to Prescription table on save. (6) If lab tests are ordered, a Doctor Ordered Tests record is created with status Pending. (7) Lab staff uploads the report and status updates to Report Uploaded. (8) Pharmacy staff views prescription, enters prices, and generates the bill. (9) Patient views their formatted prescription history and Rx card.

Fig. 2: System Workflow / Data Flow Diagram



VI. IMPLEMENTATION

A. Authentication and Session Management

HDIMS uses ASP.NET Session state for authentication. Each role maintains distinct session variable names to prevent cross-role data leakage. All protected pages check for the role-specific session variable in Page_Load and redirect to the login page if absent or expired.

Role	Login Page	Session Variables	Default Page
Doctor	DoctorLogin.aspx	u, p, did, doctor_username	Doctor/Default.aspx
Patient	PatientLogin.aspx	u, p, pid, patient_username	Patient/Default.aspx
Medical Staff	MedicalLogin.aspx	medical_user, mid	Medical/Default.aspx
Lab Staff	LabLogin.aspx	lab_user, lid	Lab/Default.aspx

TABLE III. Role-Based Session Management

B. Doctor Module

DoctorSetAppointments.aspx allows the doctor to define available time slots for a selected date. Time slot check boxes covering 9 AM to 9 PM are rendered with pre-selection of existing slots. Quick-select buttons (Select All, Clear All, Morning Only, Evening Only) are provided. An INSERT or UPDATE pattern handles new and existing slot records. DoctorLatestAppointments.aspx displays today's appointments with three aggregate statistics: today's count, next 7 days count, and total count. DoctorPatientPrescription.aspx is the primary clinical workstation. The left panel handles symptom/diagnosis entry, medicine addition (name, quantity, timing check boxes for Morning/Afternoon/Evening/Night) into a Temp_prescription staging table with preview and delete capability, and lab test ordering (Blood Test, Urine Test, X-Ray, ECG, MRI, CT Scan, Skin Biopsy, Allergy Test). The right panel shows the Video Session button (generating a random Jitsi Meet room URL stored in Video Session Data), a Chat Session button, and the patient's full past visit history.

C. Patient Module

PatientSearchDoctor.aspx displays doctors as cards with photo, name, speciality, address, and fees, with a dynamic search filter. TakeDoctorAppointment.aspx implements a three-step booking flow: step 1 shows doctor info; step 2 queries available slots by subtracting booked slots from configured slots; step 3 confirms booking and inserts into Patient Apppointment Slots.Show Prescription.aspx presents prescription history as formatted Rx cards with color-coded timing pills: Morning (yellow), Afternoon (orange), Evening (green), Night (purple).

D. Pharmacy and Lab Modules

The pharmacy module derives bill line items directly from saved prescriptions. GenerateBill.aspx renders each medicine in an editable price-input row, calculates the total, and inserts Medical Bill and Medical Bill Details records. ShowBill.aspx generates a print-ready formatted bill. The lab module queries Doctor Ordered Tests for Pending records, supports multi-format report upload (PDF, Word, JPG, PNG) to the Lab/Reports/ directory, creates a Lab Report record, and updates Doctor Ordered Tests status to Report Uploaded.

E. Video Consultation and Chat

Video consultation is implemented using the Jitsi Meet public API. When the doctor clicks the Video Session button, a random 8-digit room identifier is generated, a Jitsi Meet URL is constructed and stored in Video Session Data, and the session opens in a new popup window. The patient's JoinVideo.aspx retrieves the stored link and opens the same room. The Chat Session button opens ChatGrid.aspx (doctor) or ChatGridPatient.aspx (patient), reading and writing to the Chat Data table for in-session messaging.

VII. RESULTS AND DISCUSSION

HDIMS was successfully implemented with all 18 planned modules operational. All 30 functional test cases passed. Integration testing across all five modules confirmed that data integrity is maintained throughout the full patient visit life-cycle. User acceptance testing with all five roles yielded a 100% task completion rate.

A. Screenshot Gallery

The following screenshots illustrate the key interfaces of HDIMS:

Fig. 3: Doctor Registration Page

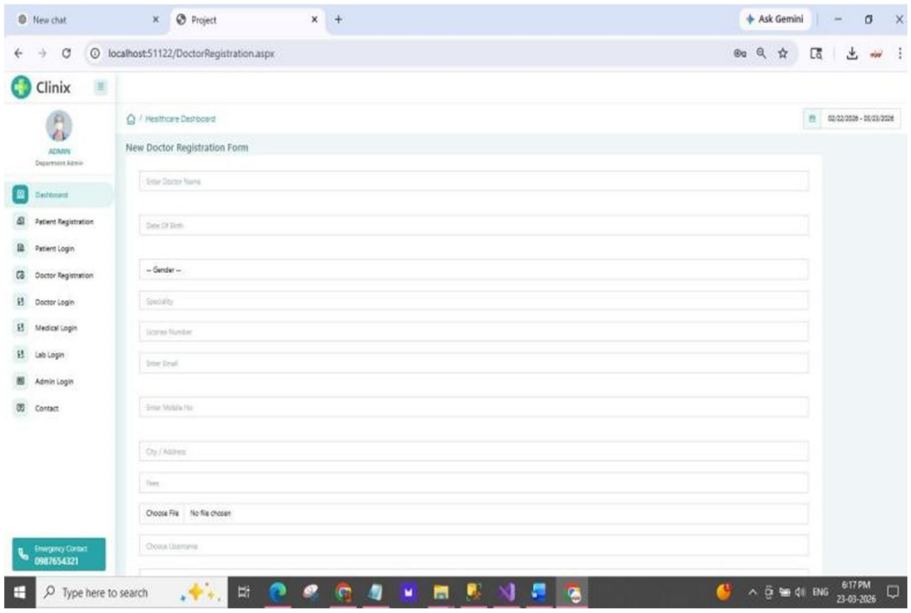


Fig. 4: Patient Registration Page

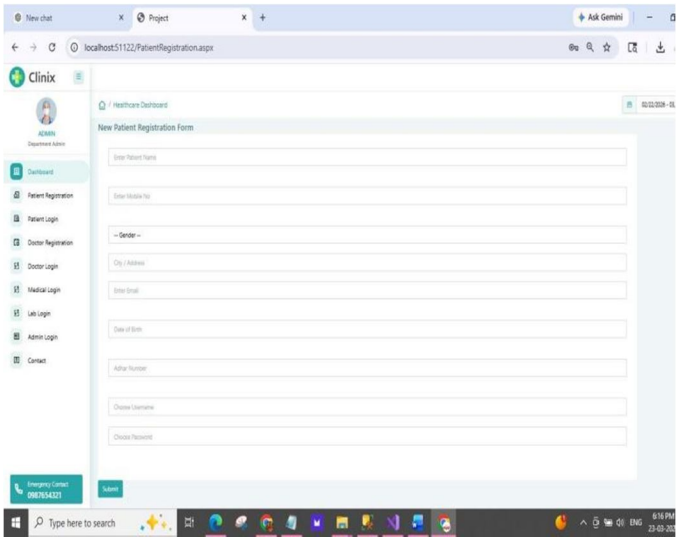


Fig. 5: Doctor Dashboard with Sidebar Navigation

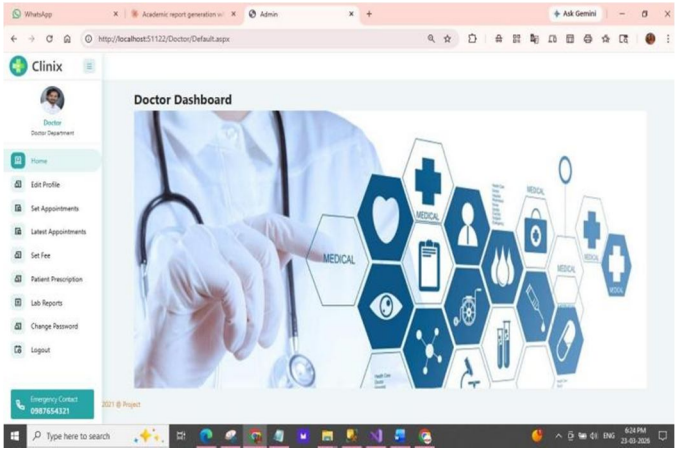


Fig. 6: Set Appointments with Time Slot Checkboxes

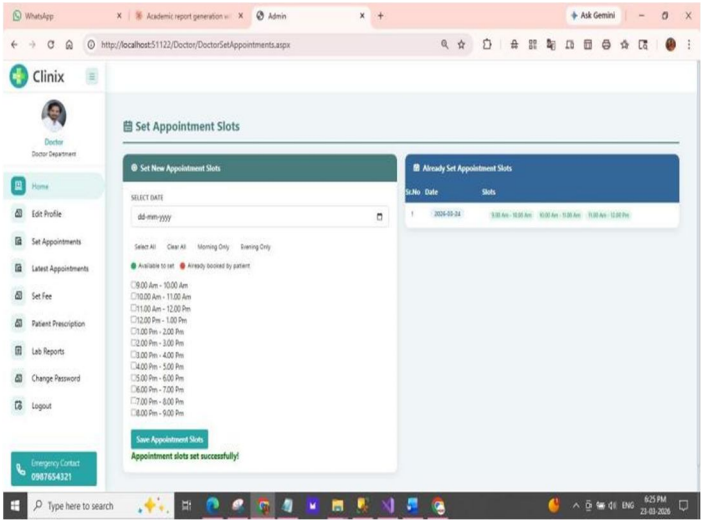


Fig. 7: Write Prescription with Medicine Builder

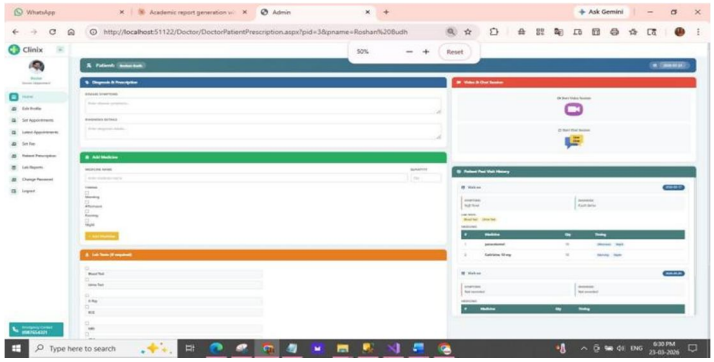


Fig. 8: Patient Search Doctor with Cards

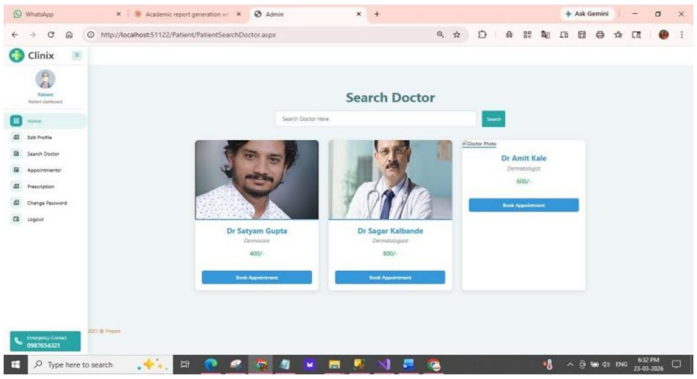


Fig. 9: Book Appointment with Available Slots

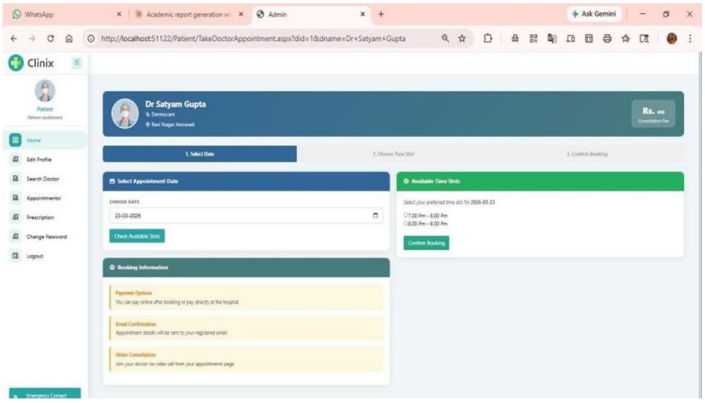


Fig. 10: Patient Prescription View with Timing Pills

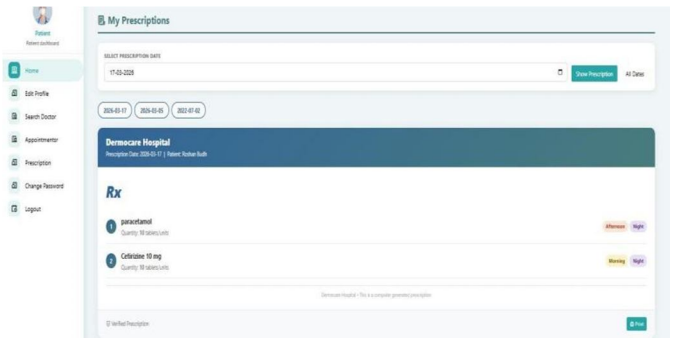
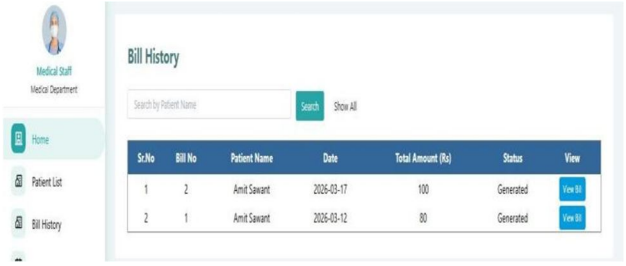


Fig. 11: Pharmacy Bill Generation and Printable Bill



B. Test Results

Test Case ID	Description	Expected Result	Status
TC-AUTH-01	Doctor login with valid credentials	Session set, redirect to Doctor/Default.aspx	Pass
TC-APT-03	Patient checks slot availability	Only unbooked slots shown	Pass
TC-APT-05	Booked slot not shown to next patient	Previously booked slot absent	Pass
TC-PRE-03	Save prescription with lab tests	Prescription saved, DoctorOrderedTests Pending	Pass
TC-PRE-05	Patient views prescription with timing	Rx card with colored timing pills shown	Pass
TC-LAB-03	Status updates after upload	DoctorOrderedTests status = Report Uploaded	Pass
TC-PHR-03	Bill total calculated correctly	Total = sum of (qty × price)	Pass

TABLE IV. Selected Functional Test Cases (All 30 Passed)

C. Feature Analysis

Feature	Status	Notes
Appointment Slot Management	Complete	Upsert logic prevents duplicates
Prescription Writing with Staging	Complete	Temp-to-final commit flow verified
Lab Test Ordering & Report Upload	Complete	4 file types supported; status tracking active
Automated Pharmacy Billing	Complete	Bill derived directly from prescription
Jitsi Meet Video Consultation	Complete	Random room URL stored and shared
Color-coded Timing Pill Display	Complete	Morning/Afternoon/Evening/Night pills
Real-Time Chat (Doctor & Patient)	Complete	ChatData persistence across session
Printable Prescription Rx Card	Complete	Print-optimized CSS applied
Role-based Dashboards (all 4 staff)	Complete	Stats displayed per role
Online Payment UI	Complete*	Frontend simulation; gateway not integrated

D. Comparison with Existing Systems

Feature	HDIMS	Generic HMS Systems
Telemedicine Integration	Yes (Jitsi)	Rarely included
Prescription Staging Buffer	Yes	Not common
Color-coded Timing Pills	Yes	Not common
Lab-to-Doctor Status Tracking	Yes	Varies
Automated Billing from Prescription	Yes	Often absent in free systems
Role-specific Master Pages	Yes	Often single template

TABLE VI. Comparison with Existing Systems

E. Limitations

The following limitations are acknowledged: (1) the payment module is a front-end simulation without a real gateway; (2) no automated email/SMS notifications are sent; (3) the interface is optimized for desktop browsers and lacks a mobile-responsive design; (4) video consultation uses Jitsi public servers — a private instance would be needed for production data privacy compliance; (5) admin functionality is limited to doctor registration; (6) passwords are stored as plain text in the current build.

VIII. CONCLUSION

The Health Data Information and Management System has been successfully designed, implemented, and tested as a comprehensive web-based healthcare management platform. The system integrates five role-specific modules — Doctor, Patient, Medical Staff (Pharmacy), Lab Staff, and Administrator — into a unified platform supported by a centralized SQL Server database.

Key engineering decisions — the temporary prescription staging mechanism, slot-level appointment availability filtering, Doctor Ordered Tests status tracking, and Jitsi Meet video integration — contribute to a system that closely models the operational requirements of a real healthcare facility. All 30 functional test cases and 5 integration test scenarios passed. User acceptance testing across all five roles yielded a 100% task completion rate with no critical usability issues. The project demonstrates how ASP.NET Web Forms and C# can be applied to build a multi-role enterprise healthcare application with structured data workflows, reinforcing key software engineering principles: modular design for managing complexity, structured data entry for clinical error reduction, and iterative testing for validating inter-module dependencies.

IX. FUTURE SCOPE

Short-term enhancements include: BCrypt password hashing and HTTPS enforcement for security hardening; SMTP/SMS notification integration using the already-stored patient email; and real payment gateway integration (Razorpay, Stripe) with server-side order creation and webhook handling. Medium-term enhancements include: mobile-responsive interface redesign with a potential native Android/iOS patient app; clinical decision support via OpenFDA drug interaction checking; an advanced admin dashboard with operational analytics; activation of the Receptionist module (Receptionist Master table already exists in the schema); and implementation of IPD/OPD modules supported by existing IPDMaster and OPDMaster tables. Long-term enhancements include: migration from ASP.NET Web Forms to ASP.NET Core for cross-platform deployment and REST API architecture; integration with HL7 FHIR and India's Ayushman Bharat Digital Mission (ABDM) framework for national health information exchange; AI-assisted diagnosis support using ML models trained on historical prescription data; and deployment of a private Jitsi server instance for HIPAA and data privacy compliance.

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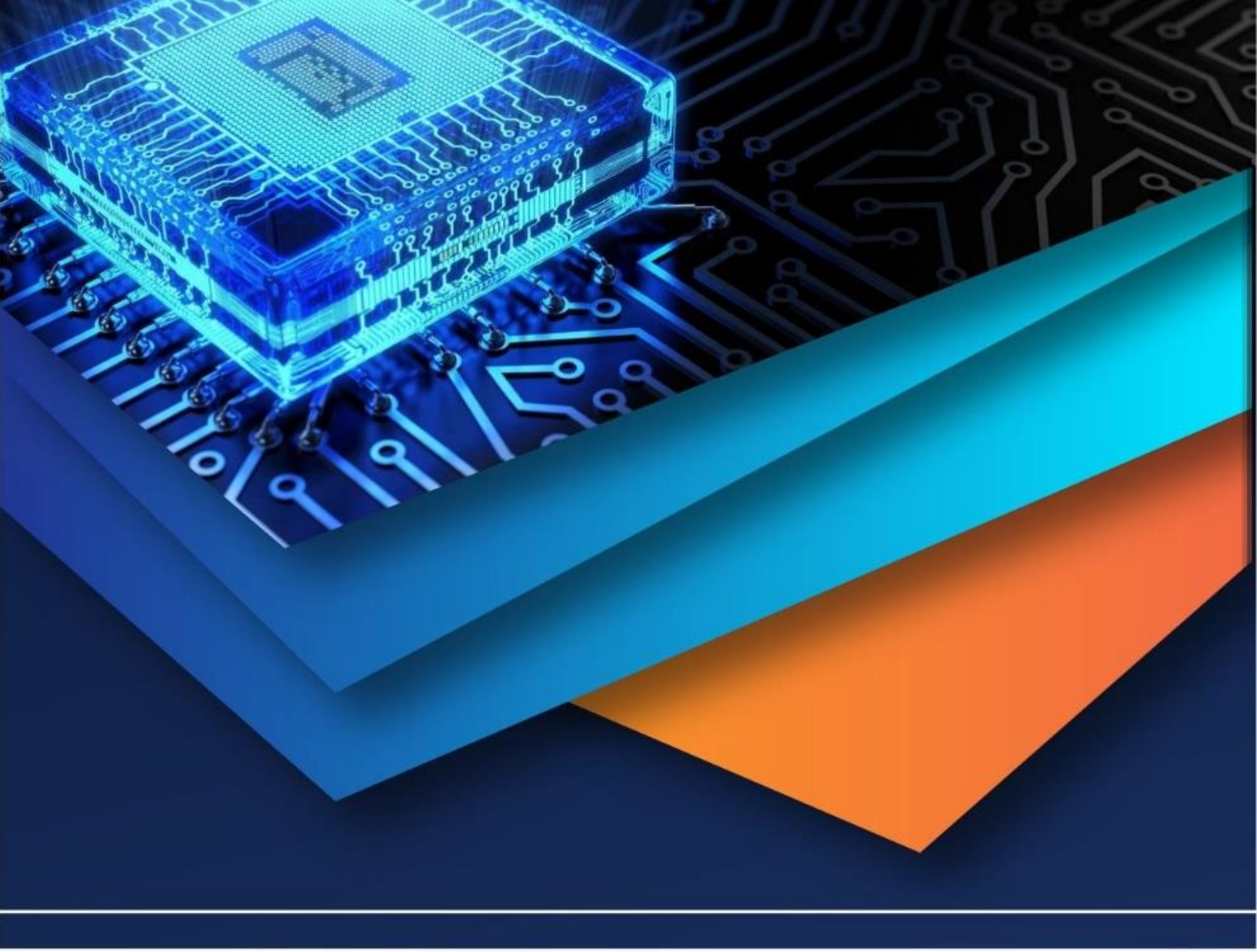

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