HOSPITAL MANAGEMENT SYSTEM

Solving the world's toughest medical problems

— one person at a time

CBAP Project

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Introduction

The Mayo Clinic Hospital Management System (HMS) is a comprehensive digital platform designed to streamline patient care and administrative workflows across the hospital. It enables efficient management of patient registration, appointments, admissions, electronic medical records, billing, and insurance processing, all while ensuring compliance with healthcare regulations such as HIPAA. By integrating clinical, financial, and operational processes into a single system, HMS reduces redundancy, improves accuracy, and supports the Mayo Clinic's mission of delivering world-class, patient-centered healthcare.

Built to serve clinicians, nurses, administrative staff, and patients alike, the system enhances coordination between departments and provides real-time access to critical information. Patients benefit from faster service and greater transparency through self-service portals, while healthcare providers gain tools that improve decision-making, reduce documentation burden, and ultimately enhance patient outcomes. The Mayo Clinic HMS is not just a management tool, it is a foundation for innovation, efficiency, and exceptional care delivery.

With its scalable design, the Mayo Clinic Hospital Management System is built to adapt to future needs such as telemedicine, mobile health applications, and advanced analytics. The platform ensures secure data exchange with external partners, research teams, and insurance providers, fostering collaboration while maintaining strict patient privacy. By uniting technology with Mayo Clinic's tradition of excellence, the HMS empowers the hospital to continuously innovate and deliver compassionate, high-quality care to every patient.

The Mayo Clinic Hospital Management System also provides leadership with powerful reporting and analytics capabilities, enabling data-driven decision-making across clinical, operational, and financial domains. From monitoring bed utilization and patient volumes to identifying revenue trends and staff efficiency, the system transforms raw data into actionable insights. This not only helps optimize resources and reduce costs but also supports strategic initiatives such as research, training, and continuous quality improvement. By aligning technology with Mayo Clinic's long-term vision, the HMS strengthens its ability to remain the nation's leading healthcare provider.

AS-IS vs TO-BE:

ASPECT	AS-IS (Current State)	TO-BE (Future State with HMS)
Patient Records	Paper-based, hard to store/retrieve	Electronic Health Records stored securely in cloud
Appointments	Manual/phone booking	Online booking with doctor schedules visible; SMS/email reminders
Bed Management	Manual lists, updated ad-hoc	Centralized dashboard; updated every 6 hours with real-time visibility
Billing	Separate departmental bills, manual consolidation	Automated, consolidated billing at discharge/consultation
Diagnostics (Lab/Radiology/Blood Bank)	Paper test orders/results, manual delivery	Electronic orders, results uploaded directly into HMS for doctor access
Staff Scheduling	Managed locally by wards	Centralized staff management (nurses, ward boys, timings, ward assignments)
Doctor Instructions for Nurses	Written on paper charts	Entered in HMS; nurses view digitally for treatment and medicines
Insurance	Paper/manual claim handling	Insurance details stored in HMS for claim processing
Reporting to Management	Manual aggregation; limited visibility	Automated reports: bed occupancy, revenue by doctor/department, OPD/IPD counts, lab/radiology revenue
System/IT	Fragmented/manual systems, limited integration	Web-based HMS, MySQL DB, Windows 2016, 500 concurrent users, error logs, high usability, 24/7 availability

1. Stakeholder Analysis

Internal:

- Executive Sponsor (CIO / CMIO)
- Project Steering Committee
- Hospital Administrators (Ops managers)
- Department Heads (Cardiology, Oncology, ER, Radiology, etc.)
- Doctors / Physicians
- Nurses and Clinical Staff
- Reception & Front-desk staff
- Admission/Discharge team
- Billing & Finance team
- Laboratory staff
- Pharmacy staff
- Radiology technicians
- IT Support / DevOps
- Clinical Informatics / EMR team

External:

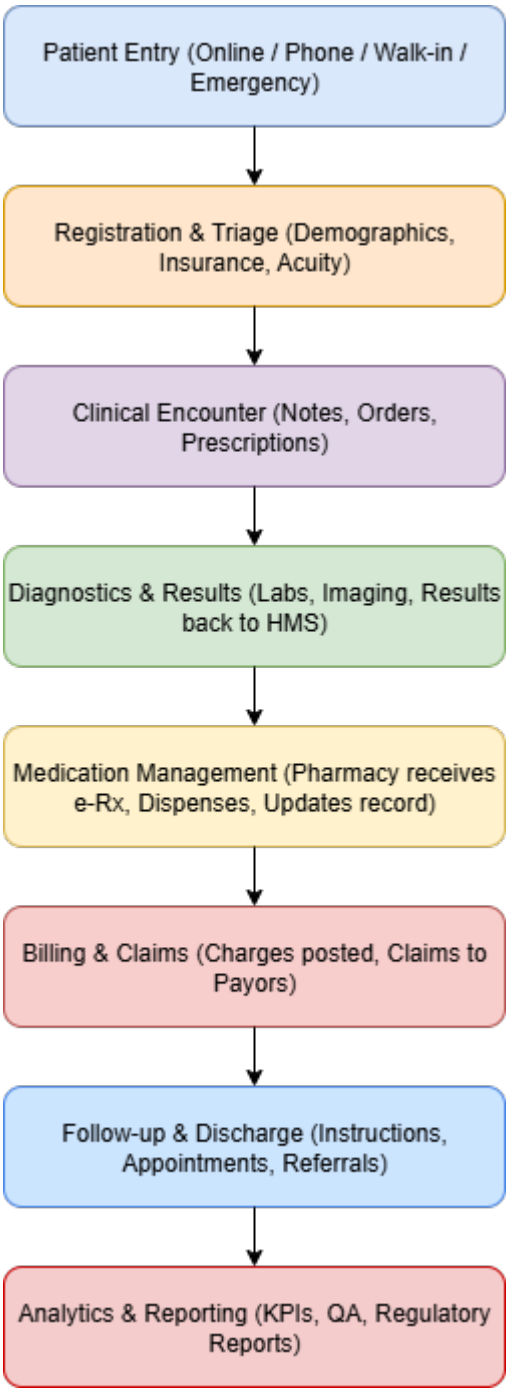
- Patients and Family Caregivers
- Insurance providers / Payors
- Regulatory Bodies (e.g., CMS, HIPAA auditors)
- Third-party vendors (lab systems, imaging, pharmacy, telehealth)
- External laboratories and diagnostic centers
- Local public health authorities
- Medical device suppliers
- Data analytics / research team

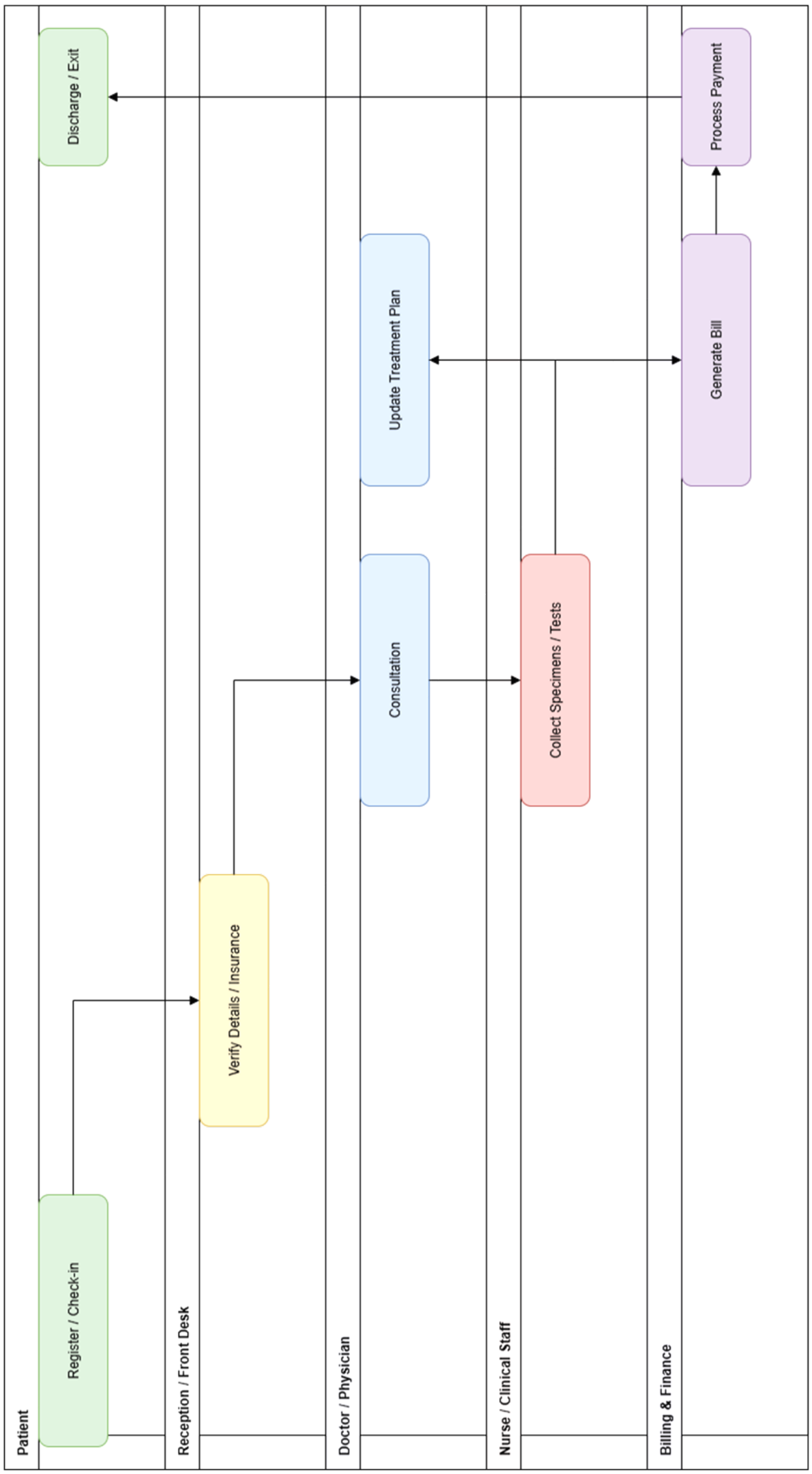
Internal Stakeholders	External Stakeholders
Executive Sponsor (CIO / CMIO)	Patients and Family Caregivers
Project Steering Committee	Insurance providers
Hospital Administrators (Ops Managers)	Regulatory Bodies (CMS, HIPAA auditors)
Department Heads (Cardiology, Oncology, ER, Radiology, etc.)	Third-party vendors (Lab Systems, Imaging, Pharmacy, Telehealth)
Doctors / Physicians	External laboratories and Diagnostic centers
Nurses and Clinical Staff	Local Public Health authorities
Reception & Front-desk staff	Medical Device suppliers
Admission / Discharge team	Data Analytics / Research team
Billing & Finance team	
Laboratory staff	
Pharmacy staff	
Radiology technicians	
IT Support / DevOps	
Clinical Informatics / EMR team	

2. Proposed System Workflow

- **Patient enters system**: Appointment booking (online/phone/walk-in) or Emergency admission.
- **Registration & Triage**: Front-desk captures demographics & insurance; triage nurse assesses acuity.
- **Clinical Encounter**: Clinician documents notes, orders labs/imaging, prescribes medications.
- **Diagnostics & Results**: Lab/radiology systems receive orders, perform tests, push results back to HMS.
- **Medication Management**: pharmacy receives electronic prescription, dispenses medicine, updates record.

- Billing & Claims: Charges posted, claims submitted to payors.
- Follow-up & Discharge: Discharge instructions generated; appointments/follow-ups scheduled.
- Analytics & Reporting: Operational and clinical KPIs, regulatory reports, QA.





Swimlane Diagram

3. In-scope and Out-of-scope

In-scope:

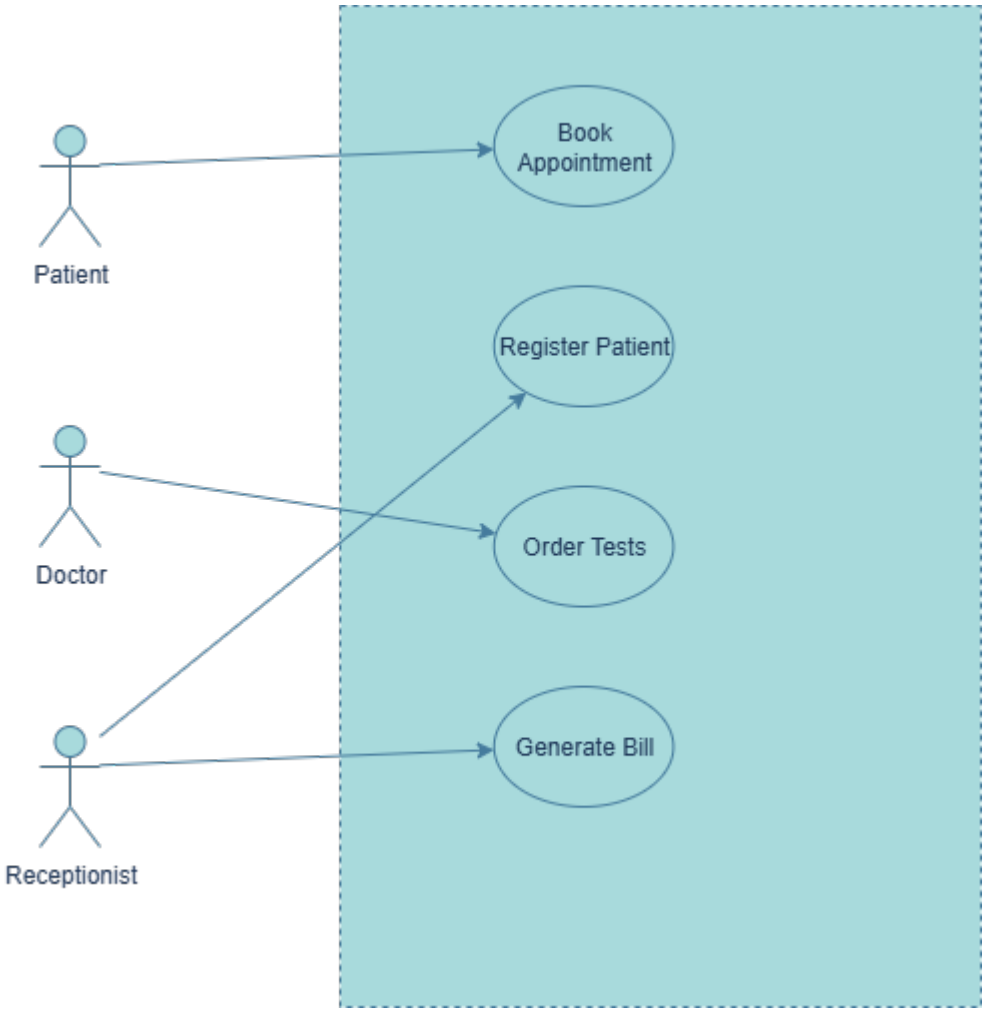
- Patient registration and demographics management
- Appointment scheduling and calendar management
- Electronic medical record (EMR) with encounter notes
- Order entry for labs, radiology, medications
- Results management and notifications
- Pharmacy integration (medication ordering)
- Billing and insurance claim submission module
- Admission / discharge / transfer (ADT) workflows
- Basic clinical decision support (alerts, drug interactions)
- Role-based access control and audit trails
- Reporting and dashboards for operations and compliance
- Patient portal (view records, schedule, bills)

Out-of-scope:

- Full enterprise data warehouse & In-depth research analytics
- Medical device firmware or device-specific drivers
- Advanced AI diagnostics
- National-level health exchange implementations
- Tele-ICU or remote monitoring hardware integrations

4. Use Case Diagram:

Register Patient-Book Appointment-Admit Patient-Triage Patient-Create Clinical Encounter Order Test/Imaging-Receive Test Results-Prescribe Medication-Dispense Medication (Pharmacy)-Generate Bill-Submit Insurance Claim-Discharge Patient-View Reports & Dashboards

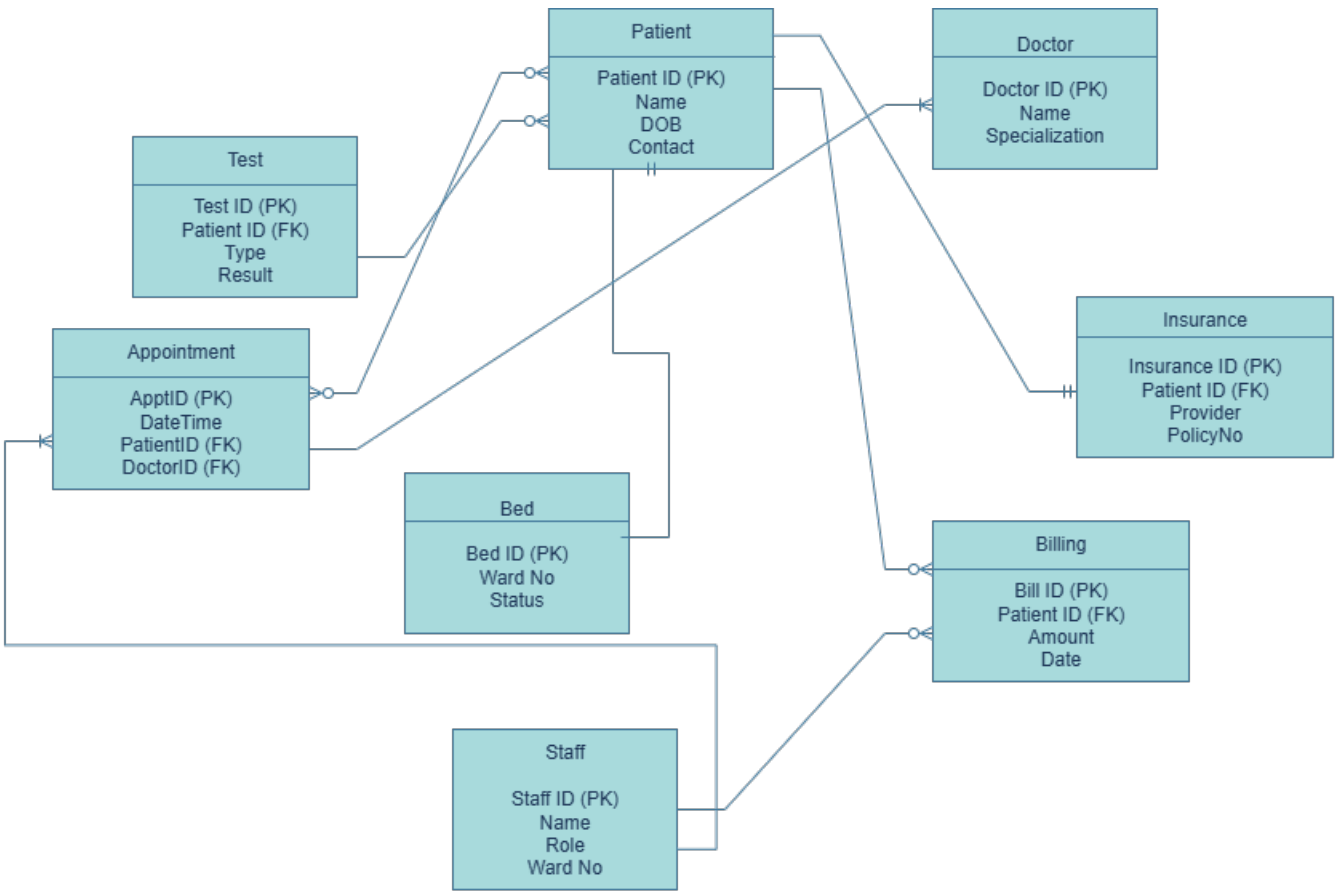


5. Main Features to be Developed:

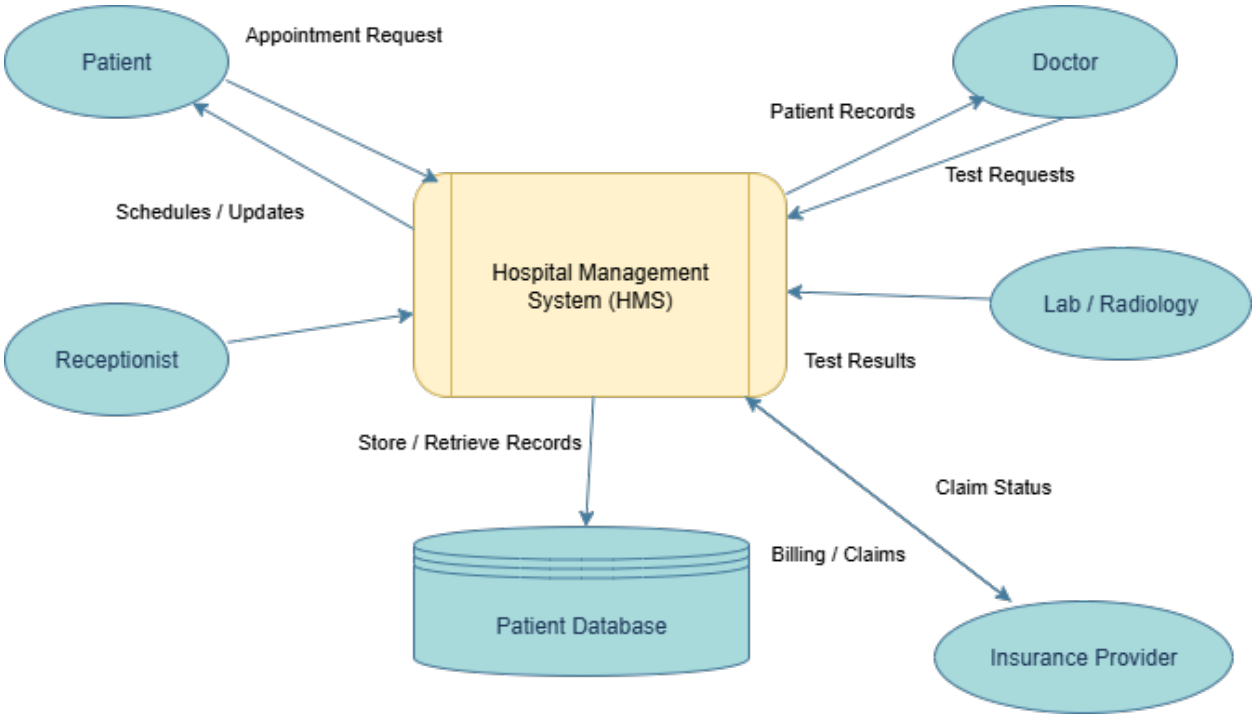
- Patient Registration & Master Patient Index (MPI)
- Appointment Scheduling & Waitlist
- ADT (Admission-Discharge-Transfer) Management
- Electronic Medical Record (encounter notes, vitals)
- Computerized Provider Order Entry (CPOE)
- Results Management (LIS / RIS integration)
- Medication Management & e-prescribing
- Billing, Coding, and Claims Management
- Patient Portal & Notifications
- Reporting & Dashboards (KPIs, compliance)
- Security: RBAC, audit logging, encryption

- Clinical Decision Support: allergy checks, drug interactions, reminders
- Role-based Workflow Engine for routing tasks

6. Entity Relationship (ER) Diagram:



7. Data Flow Diagram:



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8. a) Functional Requirements (Prioritized):

- Patient Registration: The system shall create and maintain patient demographic records and a Master Patient Index.
- Appointment Management: The system shall allow creation, rescheduling, and cancellation of appointments and maintain provider schedules.
- The system shall support admission, transfer, and discharge workflows with appropriate status updates.
- Clinical Documentation: The system shall allow providers to create structured/unstructured encounter notes and record vitals. The system shall allow providers to place orders (labs, imaging, meds) electronically.
- Results Management: The system shall ingest and store lab and imaging results and notify ordering providers.
- Medication Management: The system shall support e-prescribing, allergy checks, and drug-drug interaction alerts.

- Billing: The system shall capture charges, generate claims, and track payment statuses.
- Security & Audit: The system shall support role-based access control, authentication, and audit logs for access and changes.
- Patient Portal: The system shall provide secure portal for patients to view records, appointments, and bills.
- Reporting: The system shall generate regulatory and operational reports on-demand and scheduled.

b) Non-functional Requirements (NFRs):

Performance

System should respond to UI actions within 2 seconds for 95% of operations under normal load.

Batch billing jobs should complete within defined nightly window (e.g., 1 AM-3AM).

Availability & Reliability

System shall provide 99.95% uptime (excluding scheduled maintenance).

Critical clinical functions must be available in read-only mode in case of partial outage.

Security & Compliance

Meet HIPAA and local data protection regulations

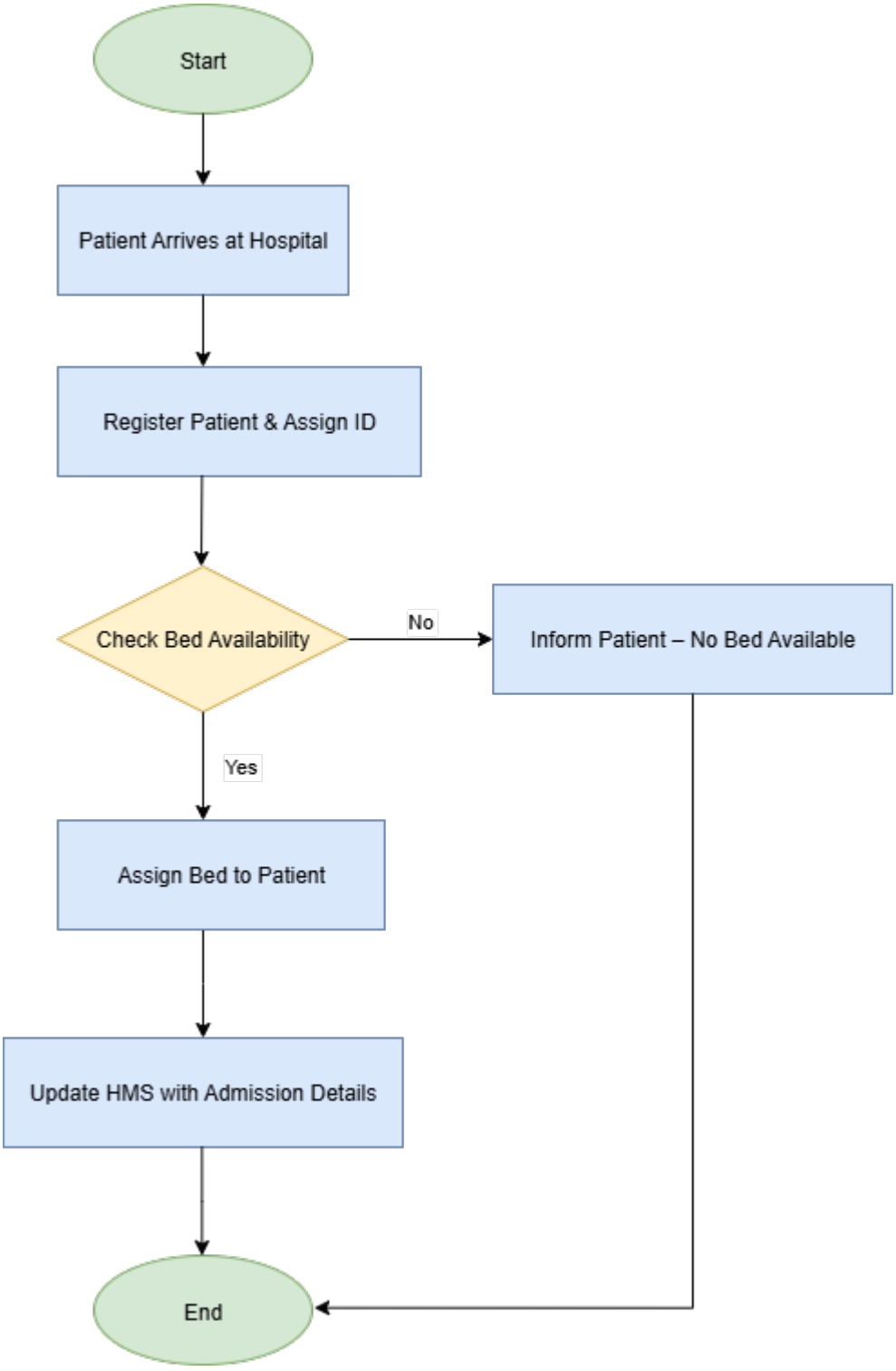
Scalability

Support horizontal scaling to handle surge events (e.g., large influx during disasters).

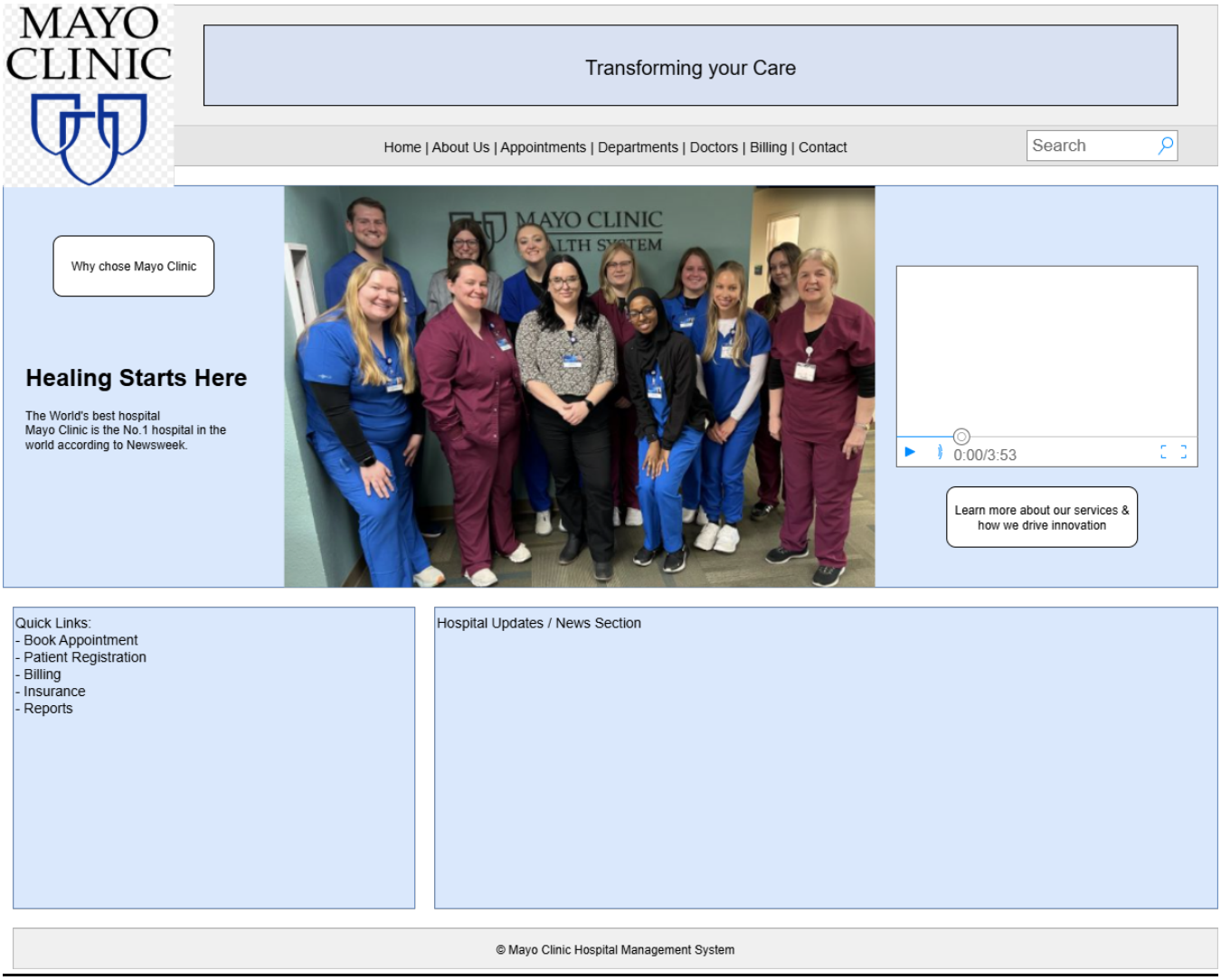
Usability

Key clinician workflows (orders, results) should require no more than 3 additional clicks compared to current standard.

9. Flowchart for Patient Admission Process:



10. a) Wireframe: Mayo Clinic Home page



b) Wireframe: Patient Admission Page