**HOSPITAL MANAGEMENT SYSTEM**

**Complete Technical Documentation**

**Version 3.0 - January 14, 2025**

DOCUMENT CONTROL

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SECTION 1: EXECUTIVE SUMMARY

Core Purpose:

A cloud-hosted healthcare management system designed for mid-size multispecialty hospitals, with SkinSpire Clinic (aesthetic, plastic surgery & skin clinic) as the reference implementation. The system supports multi-tenant architecture allowing independent instances per hospital while enabling multiple branches within each instance.

Key Features:

- Multi-tenant architecture

- Branch management

- EMR compliance

- Integrated billing

- Inventory management

- Resource scheduling

1.0 Business Terms & Concepts Guide

This section provides a business-oriented explanation of the Hospital Management System's key components and operations. It helps stakeholders understand how the system supports and enhances their business operations.

1.1 Core Business Areas

1. Patient Management
   1. \*\*EMR (Electronic Medical Records)
      1. Digital version of patient's medical history
      2. Includes diagnoses, medications, treatments, allergies
      3. Helps maintain complete patient history
      4. Ensures data privacy and security
   2. Patient Journey
      1. Registration: Initial entry into the system
      2. Appointment Booking: Scheduling consultations
      3. Consultation: Meeting with healthcare provider
      4. Treatment: Medical procedures and services
      5. Follow-up: Subsequent care and monitoring
2. Clinical Operations
   1. Consultation Types
      1. In-Person: Traditional face-to-face appointments
      2. Video Consultation: Remote healthcare delivery
      3. Emergency: Urgent care requirements
      4. Follow-up: Review of treatment progress
   2. Treatment Planning
      1. Assessment: Initial evaluation of patient condition
      2. Diagnosis: Identification of medical conditions
      3. Treatment Protocol: Defined course of action
      4. Progress Monitoring: Tracking treatment effectiveness
3. Pharmacy Operations
   1. Inventory Management
      1. Stock Level: Current quantity of medicines
      2. Safety Stock: Minimum required inventory
      3. Reorder Point: Level at which to order more
      4. Expiry Management: Tracking medicine expiration dates
   2. Medicine Categories
      1. Prescription Drugs: Require doctor's prescription
      2. Over-the-Counter: Sold without prescription
      3. Emergency Medicines: For urgent care
      4. Consumables: Medical supplies and materials
4. Financial Management
   1. Billing Components
      1. Consultation Fees: Charges for doctor visits
      2. Treatment Charges: Costs for medical procedures
      3. Medicine Costs: Pharmacy purchases
      4. Package Rates: Combined service offerings
   2. Payment Processing
      1. Multiple Payment Methods: Cash, card, online
      2. Insurance Processing: Claim management
      3. Split Payments: Part insurance, part self-pay
      4. Refund Management: Return of excess payments
5. Key Business Processes
6. Appointment Management
   1. Booking Process
      1. Patient requests appointment
      2. System checks doctor availability
      3. Time slot allocation
      4. Confirmation and reminders
   2. Resource Allocation
      1. Doctor scheduling
      2. Room assignment
      3. Equipment booking
      4. Staff allocation
7. Treatment Management
   1. Package System
      1. Pre-defined treatment combinations
      2. Customizable treatment plans
      3. Session tracking
      4. Progress monitoring
   2. Service Delivery
      1. Treatment room preparation
      2. Equipment setup
      3. Procedure execution
      4. Post-treatment care
8. Inventory Control
   1. Stock Management
      1. Purchase planning
      2. Stock receipt
      3. Storage management
      4. Distribution tracking
   2. Supplier Management
      1. Vendor evaluation
      2. Price negotiation
      3. Quality control
      4. Payment processing
9. System Features Explained
10. Multi-tenant Architecture
    1. Allows multiple clinics to use the same system
    2. Each clinic's data remains separate and secure
    3. Shared infrastructure reduces costs
    4. Centralized updates and maintenance
11. Role-based Access
    1. Different user types (doctors, staff, admin)
    2. Specific permissions for each role
    3. Secure access to sensitive information
    4. Audit trail of all activities
12. Document Management
    1. Digital storage of medical records
    2. Secure document access
    3. Version control
    4. Easy retrieval system
13. Reporting & Analytics
    1. Operational reports for daily management
    2. Financial reports for business monitoring
    3. Clinical reports for treatment analysis
    4. Custom reports for specific needs
14. Business Benefits
15. Operational Efficiency
    1. Streamlined workflows
    2. Reduced paperwork
    3. Quick information access
    4. Better resource utilization
16. Financial Control
    1. Accurate billing
    2. Revenue tracking
    3. Expense management
    4. Profitability analysis
17. Patient Care
    1. Better treatment tracking
    2. Improved communication
    3. Enhanced patient experience
    4. Quality care delivery
18. Compliance & Security
    1. Regulatory compliance
    2. Data protection
    3. Audit readiness
    4. Risk management
19. Implementation Considerations
20. System Setup
    1. Initial configuration
    2. Data migration
    3. User training
    4. Go-live support
21. Change Management
    1. Staff orientation
    2. Process transition
    3. Feedback collection
    4. Continuous improvement
22. Maintenance & Support
    1. Regular updates
    2. Technical support
    3. User assistance
    4. System optimization
23. Best Practices
24. Patient Management
    1. Regular data updates
    2. Proper documentation
    3. Clear communication
    4. Privacy protection
25. Clinical Operations
    1. Standard protocols
    2. Quality assurance
    3. Resource optimization
    4. Treatment monitoring
26. Financial Management
    1. Regular reconciliation
    2. Proper documentation
    3. Clear pricing policies
    4. Timely reporting
27. System Usage
    1. Regular backups
    2. Security measures
    3. User training
    4. Process compliance

SECTION 2: TECHNICAL ARCHITECTURE

Development Environment:

- Three-tier system: Development, QA, and Production environments

- Built using Python 3.12.8 with Flask 3.1.0 framework

- Data handling with Python/Flask for application Logic PostgreSQL for database

- AI integration planned (voice assistant, voice-to-text, patient analysis)

- IDE: VS Code 1.96.2

- Version Control: GitHub

- AI Integration: Claude platform

- Reporting: ReportLab

**Architecture:**

**Frontend:**

* Python/Flask for server-side rendering
* HTML/JavaScript/Tailwind CSS for client-side interface
* (Flask serves as web framework, not strictly frontend)

**Backend:**

* Python/Flask for application logic and API endpoints
* SQLAlchemy as ORM (Object-Relational Mapper)
* PostgreSQL for database
* Polars can be used for data analysis when needed

**Complete Architecture:**

Frontend Layer:

- HTML/JavaScript/Tailwind CSS

- Browser-based interface

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Web Layer:

- Flask (Web Framework)

- Jinja2 (Template Engine)

↓

Application Layer:

- Python Business Logic

- SQLAlchemy ORM

- Polars (for analytics)

↓

Database Layer:

- PostgreSQL

**Key Components:**

1. **Frontend**
   * HTML/Tailwind CSS for UI
   * JavaScript for interactivity
   * Browser-rendered components
2. **Web Layer**
   * Flask handles routing
   * Session management
   * Request processing
3. **Application Layer**
   * Python business logic
   * Data processing (Polars when needed)
   * API endpoints
4. **Database Layer**
   * PostgreSQL for data storage
   * SQLAlchemy for database operations
   * Data persistence and relationships

System Architecture:

1. Development Environment

2. Quality Assurance (QA)

3. Production Environment

4. Test Instance

Design Philosophy:

1. Modular Architecture

- Frontend modularity

- Backend services

- Component reusability

2. Security Focus

- EMR compliance

- Data encryption

- Access control

3. User Experience

- Responsive design

- Mobile compatibility

- Dark theme support

4.Logging and Error handling system

Multiple Log Types:

* Application logs (general flow)
* Error logs (exceptions and errors)
* Debug logs (detailed troubleshooting)
* Database logs (SQL operations)

Automatic Error Tracking:

* Full stack traces
* Request/response data
* Database operations
* Performance metrics

Easy Troubleshooting:

* Clear error messages
* Detailed context logging
* Request IDs for tracking
* Structured log format

Development Approach:

* Start with basic features
* Add logging incrementally
* Include error handling
* Monitor and improve

SECTION 3: DATABASE STRUCTURE

A. CORE ENTITIES

1. USER\_MASTER Table

Fields:

- User ID (Phone): int32, Key field

- Password: string, Mandatory

- Role: string, Mandatory

- Name Fields: string, Mandatory

- Status: Active/Inactive

2. STAFF\_MASTER Table

Fields:

- Staff ID: int32, Key Field

- Role: string, Mandatory

- Personal Info: Dictionary (Name, DOB, Gender)

- Contact Info: Dictionary (Phone, Email, Address)

- Professional Info: Dictionary (Specialization, License)

- Employment Info: Dictionary (Join Date, Status)

- Documents: Dictionary (ID Proofs, Certificates)

3. PATIENT\_MASTER Table

Fields:

- Patient ID: int32, Key field

- Personal Info: Dictionary (Name, DOB, Gender)

- Contact Info: Dictionary (Phone, Email, Address)

- Medical Info: Dictionary (Blood Group, Allergies)

- Emergency Contact: Dictionary

- Documents: Dictionary (ID Proofs, Reports)

4 MEDICINE TABLE

-Medicine ID

-Medicine Name

Manufacturer Name

Medicine Category

Tax details

B. TRANSACTION TABLES

4. APPOINTMENT Table

Fields:

- Appointment ID: int32, Key Field

- Patient/Doctor IDs: int32, Mandatory

- Schedule Info: Dictionary (Date, Time, Duration)

- Service Info: Dictionary (Package, Service)

- Status: string (Booked, Completed, Cancelled)

5. CONSULTATION Table

Fields:

- Appointment ID: int32, Key Field

- Clinical Notes: Dictionary

- Vital Signs: Dictionary

- Diagnosis: string

- Treatment Plan: Dictionary

- Follow-up: Dictionary

6. MEDICINE\_PRESCRIBED Table

Fields:

- Prescription ID: int32, Key Field

- Consultation ID: int32, Reference

- Medicine ID: int32, Reference

- Dosage: Dictionary

- Duration: int32

- Instructions: string

7. INVOICE Tables

Header:

- Invoice ID: int32, Key Field

- Invoice Date: date

- Patient ID: int32, Reference

- Total Amount: decimal

- Payment Status: string

Details:

- Invoice ID: int32, Reference

- Item ID: int32

- Item Type: string (Service/Product)

- Quantity: int32

- Unit Price: decimal

- GST Details: Dictionary

- Discount: decimal

8. PURCHASE\_ORDER Table

Header:

- PO ID: int32, Key Field

- Supplier ID: int32, Reference

- Order Date: date

- Status: string

Line Items:

- PO ID: int32, Reference

- Medicine ID: int32, Reference

- Quantity: int32

- Unit Price: decimal

- GST Details: Dictionary

9. SUPPLIER\_INVOICE Table

Fields:

- Invoice ID: int32, Key Field

- PO ID: int32, Reference

- Invoice Date: date

- Payment Terms: string

- Amount Details: Dictionary

10. INVENTORY Table

Fields:

- Stock ID: int32, Key Field

- Medicine ID: int32, Reference

- Batch No: string

- Expiry Date: date

- Quantity: int32

- Unit Cost: decimal

- Location: string

C. MASTER DATA TABLES

1. MANUFACTURER Table

Fields:

- Manufacturer ID: int32, Key Field

- Name: string

- Contact Info: Dictionary

- Product Categories: Dictionary

- Status: string

2. SUPPLIER\_MASTER Table

Fields:

- Supplier ID: int32, Key Field

- Name: string

- Contact Info: Dictionary

- Payment Terms: string

- Performance Rating: int32

3. PACKAGE Tables

Family:

- Family ID: int32, Key Field

- Name: string

- Description: string

- Status: string

PACKAGES:

- Package ID: int32, Key Field

- Family ID: int32, Reference

- Name: string

- Price Info: Dictionary

- Service List: Dictionary

4. SERVICES Table

Fields:

- Service ID: int32, Key Field

- Name: string

- Category: string

- Duration: int32

- Price Info: Dictionary

- Resource Requirements: Dictionary

Configuration Tables:

1. PARAMETER\_SETTINGS Table

Fields:

- Param Code: string, Key Field

- Param Value: string

- Data Type: string

- Module: string

- Is Editable: boolean

2. GST\_RATES Table

Fields:

- GST ID: int32, Key Field

- Category: string

- Rate Details: Dictionary

- Effective Period: Dictionary

3. WORKFLOW\_CONFIG Table

Fields:

- Workflow ID: int32, Key Field

- Module: string

- Status Flow: Dictionary

- Role Access: Dictionary

- SLA Hours: int32

4. GL\_ACCOUNT Table

Fields:

- Account ID: int32, Key Field

- Account Code: string

- Account Type: string

- Parent Account: int32

- Balance Info: Dictionary

5. RESOURCE Tables

Master:

- Resource ID: int32, Key Field

- Resource Type: string

- Resource Info: Dictionary

- Status: string

6. Scheduling:

- Schedule ID: int32, Key Field

- Resource ID: int32, Reference

- Time Slot: Dictionary

- Booking Info: Dictionary

7. HOSPITAL\_CONFIG Table (Highest level partition)

Fields:

- Hospital ID: int32, Key Field

- Basic Information: Dictionary

- System Settings: Dictionary

- License Details: Dictionary

Other configuration tables – to be detailed

1. BRANCH DETAILS (FOR SAME HOSPITAL)
2. AUTHORIZATION
3. ROLE MASTER
4. MEDICINE TYPES
5. PREFIX
6. BLOOD GROUP
7. PREFERED LANGUAGE
8. GENDER
9. MARITAL STATUS
10. CITY
11. FIELD PARAMETERS SETTING (OPTIONAL, MANDATORY, VALIDATION DISABLED / ENABLED, CONDITIONAL VALIDATION)
12. BOOKING STATUS (APPOINTMENT)
13. SERIAL NUMBER GENERATION (CURRENT SR. NO.)
14. SPECIALITY (FOR DOCTORS)
15. CONSULTATION TYPE
16. INVOICE TYPE
17. MEDICINE CATEGORY
18. ASSET MASTER
19. FACILITY MASTER
20. STOCK TYPE
21. Safety stock level (%age stock)
22. SUPPLIER CATEGORY
23. PERFORMANCE RATING
24. CHART OF ACCOUNTS
25. ACCOUNT HEADS GROUPED BY Assets, Liabilities, Income, Expense
26. JV table
27. Bank Account reconciliation
28. PAYMENT GATEWAY SETTINGS
29. REPORT CONFIGURATION (TO BE ANALYSED)

Key Relationships:

1. Patient-centered: (Patient Portal)

- Patients can make appointments (video as well as in person consultations)

- Patients can be users and have their own online account

Patients receive consultations

- Patients are associated with invoices

- Patient can view their own EMR & history

- Patient can view targeted offers

- Patient can make online payments

- patient can initiate whatsapp chat with clinic

2. Staff-centered:

- Staff members can be users

- Staff member is associated with unique role

- Staff provides consultations

- Staff can be a resource for performing a Procedure

- Staff member time is also scheduled

- Staff member will have leave, attendance, salary records

3. Medicines centered:

- Medicines are produced by manufacturers

- Medicines are supplied by suppliers

- Medicines are of difference category (Prescription drugs, Products, Consumables, Misc items)

- Medicines are stored in inventory

- Medicines can be prescribed during consultations

- Medicines are consumed during procedures

4. Inventory centered

* Managing inventory of Medicines (all categories)
* Supplier invoice - input for inventory
* Patient billing for medicines – output for products and prescription drugs
* Consumables - consumed as defined by specific quantity for a procedure
* Opening stock, stock adjustment, ageing analysis, expiry management, safety stock
* Inventory to be valuated based on FIFO

5. Services centered:

* Three levels of hierarchy.
  + Package Family, 🡪 Packages -> Services
* Price is associated with Packages & Services. Each can be independently sold
* Service is defined by Service owner - Doctor
* Services bill of material needs to be defined.
  + Human Resource: time
  + Consumables: Qty
  + Procedure room : time
  + Equipment : time
* Once service is performed, there will be an inventory debit entry for consumables (medicine type) based on standard quantity and cost

6 Account centric

* Ledger entries will be made based on the following
  + Invoice payment
  + Supplier Invoice payment
  + Misc procurement
  + Bank account reconciliation

7 HR centric

* Staff attendance records. Input from biometric attendance system
* Leave records
* Salary slip

8 Doctor centric (Doctor Portal)

* Voice assistant to open appointments, patient EMR record, Staff HR record, Leave record, Attendance record
* Voice assistant for resource availability
* Hand written prescription capture from IPAD
* Voice assistant to connect staff with intercom
* Doctor Dashboard

SECTION 4: NAVIGATION STRUCTURE

Role based Menu view for the following roles

Doctor

Clinic Manager

Front Desk assistant

Inventory administrator

Patient

System Administrator

CEO

1. Patient Care Portal

1.1 Patient Management

- New Registration

- Update Profile

- Document Upload

- History View

1.2 Appointment Management

- Schedule Appointment

- Video Consultation

- Modify/Cancel

- View History

1.3 EMR Records

- Medical History

- Treatment Records

- Test Reports

- Prescriptions

1.4 Patient Communication

- Notifications

- Reminders

- Feedback

- Messages

2. Clinical Portal

2.1 Consultation Management

- In-Person Consultation

- Video Consultation

- Follow-up Sessions

- Medical History View

2.2 Treatment Management

- Treatment Plans

- Procedure Scheduling

- Resource Allocation

- Progress Tracking

2.3 Prescription Management

- Write Prescription

- View History

- Medicine Instructions

- Allergies Check

2.4 In-Patient Management

- Room Assignment

- Daily Monitoring

- Treatment Updates

- Discharge Planning

3. Pharmacy Portal

3.1 Inventory Management

- Stock Entry

- Stock Adjustment

- Expiry Tracking

- Safety Stock Management

3.2 Purchase Management

- Purchase Orders

- Supplier Management

- Price Management

- Return Processing

3.3 Sales Management

- Counter Sales

- Prescription Sales

- Return Processing

- Billing

3.4 Reports

- Stock Analysis

- Sales Analysis

- Expiry Reports

- Purchase Analysis

4. Administrative Portal

4.1 Staff Management

- Staff Registration

- Role Assignment

- Schedule Management

- Performance Tracking

4.2 System Configuration

- Branch Setup

- User Access Control

- Parameter Settings

- Workflow Configuration

4.3 Master Data Management

- Services Setup

- Package Management

- Price Configuration

- Resource Management

4.4 Audit & Compliance

- Activity Logs

- User Audits

- System Logs

- Compliance Reports

5. Financial Portal

5.1 Billing Management

- Generate Invoice

- Payment Processing

- Refund Management

- Discount Management

5.2 Accounts Management

- General Ledger

- Account Reconciliation

- Financial Reports

- Tax Management

5.3 Insurance Management

- Policy Verification

- Claim Processing

- Settlement Tracking

- Reports

6. Reports & Analytics

6.1 Operational Reports

- Patient Statistics

- Appointment Analytics

- Resource Utilization

- Staff Performance

6.2 Financial Reports

- Revenue Analysis

- Expense Analysis

- Profit/Loss Statement

- Cash Flow Analysis

6.3 Inventory Reports

- Stock Status

- Movement Analysis

- Valuation Reports

- Consumption Patterns

6.4 Custom Reports

- Report Builder

- Saved Reports

- Scheduled Reports

- Export Options

Features of the menu:

- Role based Meu & reports

- Responsive design that works on both desktop and mobile

- Collapsible sidebar with icons and labels

- Clear hierarchy with main sections and subsections

- User profile access in the header

- Dark theme matching the requirements

- Mobile-friendly with hamburger menu

- Listing reports with filters may be offered within view tabs of most of the screens

SECTION 5: BUSINESS RULES

Authentication Rules:

1. Two-factor authentication required for:

- Initial login

- Password changes

- Financial transactions

2. Password Policy:

- Minimum 8 characters

- Mix of uppercase, lowercase

- Numbers and special characters

- 90-day expiry

Appointment Rules:

1. Scheduling:

- Maximum 3 active appointments

- 24-hour cancellation policy

- Automatic reminder system

2. Resource Allocation:

- Doctor availability check

- Room allocation

- Equipment scheduling

SECTION 6: IMPLEMENTATION GUIDELINES

Data Migration:

1. Preparation Phase:

- Data cleanup

- Validation rules

- Migration scripts

2. Execution Phase:

- Master data migration

- Historical data transfer

- Document migration

3. Verification Phase:

- Data validation

- User acceptance testing

- Performance testing

Integration Requirements:

1. External Systems:

- Payment gateways

- Laboratory systems

- Insurance providers (future scope)

- SMS/Email services

- Bank integration for statement download API

- payment gateway integration with POS system

- Biometric attendance system

2. Technical Requirements:

- API specifications

- Data formats

- Security protocols

SECTION 7: SECURITY & COMPLIANCE

Data Security:

1. Encryption Standards

- At rest: AES-256

- In transit: TLS 1.3

- Key management

2. Access Control

- Role-based access

- IP restrictions

- Session management

Compliance Requirements:

1. Healthcare Standards

- EMR compliance

- Data protection

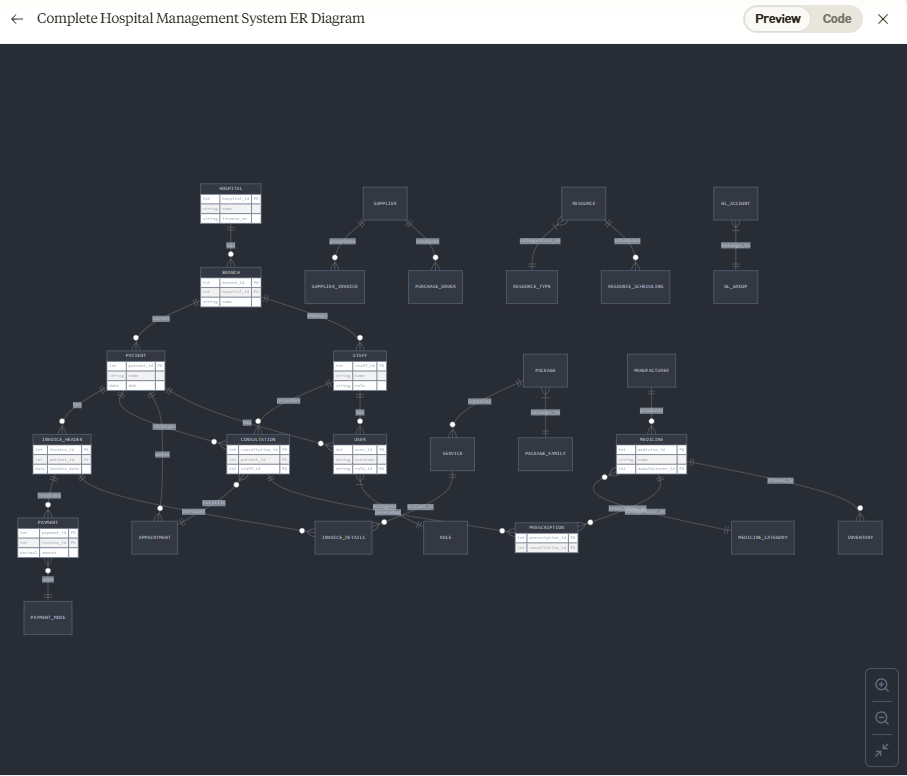
- Privacy regulations

2. Financial Compliance

- Audit requirements

- Transaction logging

- Financial reporting



VERSION HISTORY

Version 3.0 (Current)

- Consolidated documentation

- Added security details

- Enhanced table structures

Version 2.2

- Added configuration details

- Updated workflows

Version 2.1

- Enhanced table structures

- Added business rules

Version 2.0

- Initial detailed specification

- Base architecture

END OF DOCUMENT