

Software Requirements Specification (SRS)

Clinico: The Healing Hand Initiative

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1. Introduction

1.1 Purpose

This Software Requirements Specification (SRS) document serves as the authoritative reference for all functional and non-functional requirements for Clinico: The Healing Hand Initiative. It defines the comprehensive healthcare platform that addresses the critical gap between physical and mental healthcare accessibility through innovative technology and structured volunteer expertise.

1.2 Intended Audience

Primary Stakeholders:

- Development Teams: Software architects, developers, and QA engineers

- **Project Management:** Project managers, product owners, and technical leads
- **Healthcare Professionals:** Medical advisors and volunteer coordinators
- **Business Stakeholders:** Investors, NGO partners, and regulatory consultants
- **End Users:** Patient representatives and community health workers

1.3 Project Scope

Platform Capabilities:

- Unified healthcare ecosystem connecting patients with volunteer professionals
- Multi-agent AI system providing 24/7 health assistance and mental wellness support
- Hyperlocal discovery engine for physical healthcare providers
- Comprehensive health record management with e-prescription capabilities
- Community health facilitation through structured NGO partnerships

Scope Boundaries:

- **Included:** Telemedicine platform, AI health assistance, appointment management, secure messaging
- **Excluded:** Direct medical device integration, payment processing (third-party), physical infrastructure management
- **Future Considerations:** IoT health device integration, advanced analytics dashboard, international expansion

1.4 Product Overview

Clinico addresses the fragmented healthcare landscape by creating a unified platform that:

- Bridges the accessibility gap between urban and rural healthcare
- Combines scalable AI technology with empathetic human expertise
- Reduces healthcare costs through volunteer-driven professional network
- Eliminates stigma barriers in mental health support
- Provides structured framework for community health initiatives

1.5 Definitions, Acronyms, and Abbreviations

Term	Definition
AI	Artificial Intelligence
ASHA	Accredited Social Health Activist
CHW	Community Health Worker
EHR	Electronic Health Records
IVR	Interactive Voice Response
MCP	Multi-Criteria Personalization

NGO	Non-Governmental Organization
OTP	One-Time Password
RAG	Retrieval-Augmented Generation
SRS	Software Requirements Specification
UVP	Unique Value Proposition
WCAG	Web Content Accessibility Guidelines

2. Overall Description

2.1 Product Perspective

Clinico operates as a comprehensive healthcare ecosystem with four primary components:

2.1.1 User Interface Layer

- **Mobile Applications:** Native iOS and Android apps for patients and CHWs
- **Web Dashboard:** Professional interface for healthcare providers and administrators
- **Admin Console:** System management and monitoring interface

2.1.2 Application Layer

- **API Gateway:** Request routing, authentication, and rate limiting
- **Microservices:** User management, appointments, AI engine, communication, payments
- **Integration Layer:** Third-party service connectors and data transformers

2.1.3 Data Layer

- **Primary Database:** PostgreSQL for transactional data
- **Vector Database:** AI knowledge base and semantic search
- **File Storage:** Medical documents and multimedia content
- **Cache Layer:** Redis for performance optimization

2.1.4 External Integrations

- **Communication:** Video calling (WebRTC, Twilio), SMS services
- **Payments:** Gateway integrations (Razorpay, Stripe)
- **Location Services:** Google Maps API, geocoding services
- **Cloud Infrastructure:** AWS/Google Cloud for scalability

2.2 Business Context Analysis

2.2.1 Problem Statement Alignment The platform directly addresses identified healthcare accessibility challenges:

- **Financial Barriers:** Freemium model with volunteer-driven cost reduction
- **Infrastructure Gaps:** Technology-enabled remote consultation capabilities
- **Professional Shortages:** Structured volunteer network with efficient matching
- **Fragmented Systems:** Unified platform for physical and mental health needs

2.2.2 Market Positioning

- **Target Market Size:** 500M+ underserved individuals in target regions
- **Competitive Differentiation:** AI-human hybrid approach with volunteer focus
- **Value Proposition:** Comprehensive care accessibility at affordable cost points
- **Revenue Model:** Sustainable through freemium, partnerships, and grants

2.3 User Classes and Characteristics

2.3.1 Primary User Profiles

User Class	Characteristics	Technical Proficiency	Primary Needs
Patients	Diverse demographics, limited healthcare access	Low to Medium	Affordable care, easy booking, multilingual support
Healthcare Professionals	Licensed volunteers, time-constrained	Medium to High	Efficient tools, patient history access, impact tracking
Community Health Workers	Field workers, digital intermediaries	Low to Medium	Simple interfaces, multi-patient management
Administrators	Platform managers, quality overseers	High	Comprehensive dashboards, user management, analytics
NGO Partners	Community organizations, outreach focused	Medium	Impact reporting, community management tools

2.3.2 User Journey Mapping

- **Patient Onboarding:** Registration → AI interaction → Professional matching → Consultation
- **Professional Onboarding:** Verification → Profile setup → Availability management → Patient care
- **CHW Workflow:** Training → Patient advocacy → Appointment facilitation → Follow-up support

2.4 Operating Environment

2.4.1 Technical Environment

- **Client Platforms:** iOS 13+, Android 8+, Modern web browsers
- **Network Requirements:** 2G/3G compatible with adaptive quality
- **Device Specifications:** Minimum 2GB RAM, camera, microphone access
- **Server Infrastructure:** Cloud-native, auto-scaling architecture

2.4.2 Regulatory Environment

- **Healthcare Compliance:** Regional telemedicine regulations
- **Data Protection:** GDPR-equivalent privacy standards
- **Professional Standards:** Medical licensing verification requirements
- **Quality Assurance:** Clinical supervision and audit protocols

2.5 Design and Implementation Constraints

2.5.1 Technical Constraints

- **Performance:** Sub-3-second response times on low-bandwidth networks
- **Security:** End-to-end encryption for all health data
- **Scalability:** Support for 100K+ concurrent users
- **Reliability:** 99.9% uptime with disaster recovery capabilities

2.5.2 Business Constraints

- **Budget:** Development within allocated resource constraints
- **Timeline:** Phased deployment over 18-month development cycle
- **Regulatory:** Compliance with healthcare and data protection regulations
- **Partnership:** Dependency on volunteer recruitment and NGO collaborations

2.6 Assumptions and Dependencies

2.6.1 Critical Assumptions

- Healthcare professionals maintain consistent volunteer participation
- Target user populations have basic smartphone access and connectivity
- Regulatory frameworks remain stable during development period
- AI technology capabilities continue advancing for health applications

2.6.2 External Dependencies

- **Third-party Services:** Video calling, payment processing, mapping services
- **Infrastructure:** Cloud platform availability and performance
- **Content:** Medical knowledge base accuracy and currency

- **Partnerships:** NGO collaboration and community access facilitation
-

3. System Features

3.1 Identity, Registration & Consent Management

Priority: High | Risk: Medium | Complexity: Medium

3.1.1 Feature Description Comprehensive user identity management system supporting multiple user types with robust consent tracking and privacy controls.

3.1.2 Functional Requirements

FR-1.1 Multi-Channel User Registration

- **Requirement:** System shall support OTP-based registration via mobile number
- **Rationale:** Ensures accessibility for users without email access
- **Acceptance Criteria:**
 - OTP delivery within 30 seconds
 - Support for 10+ regional languages during registration
 - Role selection (Patient, Professional, NGO, Admin)
 - Profile completion wizard with progress tracking

FR-1.2 Secure Authentication System

- **Requirement:** System shall implement multi-layered authentication
- **Rationale:** Protects sensitive healthcare data and user privacy
- **Acceptance Criteria:**
 - OTP-based login for all user types
 - Role-based access control (RBAC) implementation
 - Session management with configurable timeout
 - Failed attempt lockout mechanism

FR-1.3 Dynamic Consent Management

- **Requirement:** System shall provide granular consent controls
- **Rationale:** Ensures compliance with privacy regulations and user autonomy

- **Acceptance Criteria:**
 - Consent collection for data processing, sharing, and analytics
 - Consent withdrawal capability with immediate effect
 - Audit trail for all consent actions with timestamps
 - Regular consent renewal prompts

3.2 AI Care Companion System

Priority: High | Risk: High | Complexity: High

3.2.1 Feature Description Advanced multi-agent AI system serving as the intelligent front door to healthcare services, providing personalized health guidance and mental wellness support.

3.2.2 Functional Requirements

FR-2.1 Multi-Agent Architecture

- **Requirement:** System shall implement specialized AI agent framework
- **Rationale:** Enables focused expertise and improved response quality
- **Agent Specifications:**
 - **AI Orchestrator:** Central coordination and personalization engine
 - **Mental Wellness Agent:** 24/7 empathetic conversational support
 - **Health Inquiry Agent:** Medical information with RAG integration
 - **Care Coordinator:** Professional matching and appointment facilitation
 - **Resource Agent:** Knowledge base management and retrieval
 - **Profile Agent:** User personalization and preference learning
 - **Analytics Agent:** System insights and improvement recommendations

FR-2.2 Retrieval-Augmented Generation Engine

- **Requirement:** System shall generate responses using trusted knowledge base
- **Rationale:** Ensures accuracy and reduces AI hallucinations
- **Acceptance Criteria:**
 - Response generation based on verified medical content
 - Source citation for all medical information
 - Confidence scoring for response quality
 - Regular knowledge base updates and validation

FR-2.3 Mental Wellness Support System

- **Requirement:** System shall provide comprehensive mental health assistance
- **Rationale:** Addresses mental health accessibility gap
- **Acceptance Criteria:**
 - 24/7 conversational support with empathetic responses
 - Guided self-help exercises (mindfulness, CBT techniques)
 - Mood and activity journaling with trend analysis
 - Crisis intervention protocol with immediate resource provision
 - Professional referral triggers based on conversation analysis

FR-2.4 Personalization Engine

- **Requirement:** System shall deliver personalized health experiences
- **Rationale:** Improves engagement and health outcomes
- **Acceptance Criteria:**
 - Multi-criteria personalization (MCP) framework implementation
 - Dynamic user profile updates based on interactions
 - Proactive health nudges and reminders
 - Customized content recommendations
 - Learning algorithm for preference optimization

3.3 Appointment & Teleconsultation Management

Priority: High | Risk: Medium | Complexity: High

3.3.1 Feature Description Comprehensive appointment scheduling and teleconsultation platform supporting both virtual and in-person healthcare delivery.

3.3.2 Functional Requirements

FR-3.1 Intelligent Appointment Booking

- **Requirement:** System shall provide streamlined appointment management
- **Rationale:** Reduces friction in healthcare access
- **Acceptance Criteria:**
 - Calendar-based booking interface with availability display
 - Multi-timezone support for professional scheduling
 - Appointment modification (reschedule/cancel) with notification system
 - Automated reminders via SMS, email, and in-app notifications
 - Group appointment scheduling for community health sessions

FR-3.2 Multi-Modal Consultation Platform

- **Requirement:** System shall support diverse consultation methods
- **Rationale:** Accommodates varying user preferences and connectivity
- **Acceptance Criteria:**
 - High-quality video calling with bandwidth adaptation
 - Audio-only consultation option
 - Text-based chat for asynchronous communication
 - IVR fallback system for low-connectivity areas
 - Screen sharing for document review
 - Consultation recording (with consent) for quality assurance

FR-3.3 Professional Availability Management

- **Requirement:** System shall optimize professional schedule coordination
- **Rationale:** Maximizes volunteer time utilization
- **Acceptance Criteria:**
 - Flexible availability slot configuration
 - Recurring schedule templates
 - Multi-device synchronization
 - Overbooking prevention mechanisms
 - Emergency slot allocation for urgent cases

3.4 Electronic Prescription & Care Management

Priority: High | Risk: Medium | Complexity: Medium

3.4.1 Feature Description Comprehensive digital prescription system with integrated medication management and care plan tracking.

3.4.2 Functional Requirements

FR-4.1 Digital Prescription System

- **Requirement:** System shall provide secure e-prescription capabilities
- **Rationale:** Enables complete digital healthcare workflow
- **Acceptance Criteria:**
 - Streamlined prescription creation with drug interaction checking
 - Digital signature integration for legal compliance

- Multi-format prescription export (PDF, print-ready)
- Pharmacy integration for direct medication ordering
- Prescription history tracking and renewal management

FR-4.2 Medication Adherence System

- **Requirement:** System shall support medication compliance monitoring
- **Rationale:** Improves treatment outcomes and patient safety
- **Acceptance Criteria:**
 - Customizable medication reminder schedules
 - Adherence tracking with visual progress indicators
 - Side effect reporting and monitoring
 - Drug interaction alerts and warnings
 - Family member notification options for critical medications

3.5 Health Records & Communication Management

Priority: High | Risk: Medium | Complexity: Medium

3.5.1 Feature Description Secure health record management system with integrated communication platform for continuous care coordination.

3.5.2 Functional Requirements

FR-5.1 EHR-Lite System

- **Requirement:** System shall maintain comprehensive health records
- **Rationale:** Enables continuity of care and informed decision-making
- **Acceptance Criteria:**
 - Timeline view of medical interactions and consultations
 - Secure document upload with format support (PDF, images, lab reports)
 - Medical history categorization and search functionality
 - Data export capabilities for external healthcare providers
 - Version control for document updates and modifications

FR-5.2 Secure Communication Platform

- **Requirement:** System shall provide encrypted messaging capabilities
- **Rationale:** Ensures secure and compliant healthcare communication

- **Acceptance Criteria:**
 - End-to-end encrypted chat functionality
 - File sharing with size and format restrictions
 - Message status tracking (sent, delivered, read)
 - Professional-patient communication threads
 - Automated message archival and retention policies

3.6 Hyperlocal Discovery System

Priority: Medium | Risk: Low | Complexity: Medium

3.6.1 Feature Description Location-based healthcare provider discovery system with comprehensive filtering and booking integration.

3.6.2 Functional Requirements

FR-6.1 Interactive Map Interface

- **Requirement:** System shall provide location-based provider search
- **Rationale:** Connects users with nearby healthcare options
- **Acceptance Criteria:**
 - Real-time location-based healthcare provider mapping
 - Color-coded categorization (clinics, hospitals, specialists)
 - Intelligent clustering for high-density areas
 - Quick-view information cards with essential details
 - Driving directions integration with popular navigation apps

FR-6.2 Advanced Filtering System

- **Requirement:** System shall enable precise provider search
- **Rationale:** Helps users find most suitable healthcare options
- **Acceptance Criteria:**
 - Multi-criteria filtering (specialty, distance, rating, price, availability)
 - Insurance acceptance verification
 - Language preference matching
 - Accessibility feature indicators
 - Real-time availability status

3.7 Volunteer & Workforce Management

Priority: High | **Risk:** Medium | **Complexity:** Medium

3.7.1 Feature Description Comprehensive system for recruiting, verifying, and managing volunteer healthcare professionals with quality assurance mechanisms.

3.7.2 Functional Requirements

FR-7.1 Professional Onboarding System

- **Requirement:** System shall verify and onboard healthcare professionals
- **Rationale:** Ensures quality and credibility of volunteer network
- **Acceptance Criteria:**
 - Multi-step credential verification process
 - License validation with regulatory body integration
 - Background check coordination and tracking
 - Professional profile creation with specialty certification
 - Ongoing credential monitoring and renewal alerts

FR-7.2 Quality Management System

- **Requirement:** System shall monitor and improve service quality
- **Rationale:** Maintains high standards of volunteer healthcare delivery
- **Acceptance Criteria:**
 - Consultation quality scoring and feedback collection
 - Peer review system for complex cases
 - Professional development tracking and recommendations
 - Escalation procedures for quality concerns
 - Impact measurement and volunteer recognition programs

3.8 Administrative & Analytics Management

Priority: Medium | **Risk:** Low | **Complexity:** Medium

3.8.1 Feature Description Comprehensive administrative dashboard with advanced analytics for platform management and optimization.

3.8.2 Functional Requirements

FR-8.1 Administrative Control Panel

- **Requirement:** System shall provide comprehensive platform management
- **Rationale:** Enables efficient system administration and oversight
- **Acceptance Criteria:**
 - User management with role-based permissions
 - Content management system for health resources
 - System configuration and feature flag management
 - Audit log review and compliance reporting
 - Bulk operations for user and data management

FR-8.2 Advanced Analytics Dashboard

- **Requirement:** System shall provide actionable insights and reporting
- **Rationale:** Supports data-driven platform improvements
- **Acceptance Criteria:**
 - Real-time usage metrics and performance indicators
 - Health outcome tracking and trend analysis
 - Volunteer engagement and impact measurement
 - Community health reporting for NGO partners
 - Predictive analytics for resource allocation

4. Non-Functional Requirements

4.1 Performance Requirements

4.1.1 Response Time Requirements

User Action	Target Response Time	Measurement Method
Page/Screen Loading	< 2 seconds	95th percentile
AI Response Generation	< 5 seconds	Average response time
Video Call Establishment	< 10 seconds	Connection success rate
Search Results	< 1 second	Query completion time
File Upload	< 30 seconds	10MB file size

4.1.2 Throughput Requirements

- **Concurrent Users:** 10,000 simultaneous active users
- **Video Consultations:** 1,000 simultaneous calls
- **AI Query Processing:** 50,000 queries per hour
- **Database Transactions:** 10,000 TPS during peak hours
- **File Storage Operations:** 1,000 uploads per minute

4.1.3 Scalability Requirements

- **Horizontal Scaling:** Auto-scaling based on CPU/memory utilization
- **Database Scaling:** Read replica support with eventual consistency
- **CDN Integration:** Global content delivery for multimedia assets
- **Load Balancing:** Geographic and intelligent routing
- **Resource Optimization:** Containerized microservices architecture

4.2 Security & Privacy Requirements

4.2.1 Data Protection Standards

- **Encryption:** AES-256 encryption for data at rest, TLS 1.3 for data in transit
- **Key Management:** Hardware security module (HSM) for encryption key storage
- **Data Classification:** Sensitive health data identification and protection
- **Data Retention:** Automated data lifecycle management and purging
- **Backup Security:** Encrypted backups with geo-distributed storage

4.2.2 Access Control & Authentication

- **Multi-Factor Authentication:** Mandatory for healthcare professionals
- **Role-Based Access Control:** Granular permissions based on user roles
- **Session Management:** Secure token-based authentication with refresh mechanisms
- **API Security:** OAuth 2.0 with JWT tokens for API access
- **Audit Logging:** Comprehensive logging of all security-relevant events

4.2.3 Privacy & Compliance

- **Data Minimization:** Collection of only necessary personal information
- **Consent Management:** Granular consent with easy withdrawal mechanisms
- **Right to be Forgotten:** Complete data deletion capabilities
- **Cross-Border Transfer:** Privacy shield compliance for international operations
- **Regular Audits:** Quarterly security assessments and penetration testing

4.3 Usability & Accessibility Requirements

4.3.1 User Experience Standards

- **Intuitive Navigation:** Maximum 3-click access to primary functions

- **Responsive Design:** Consistent experience across devices and screen sizes
- **Loading Indicators:** Clear feedback for all system operations
- **Error Handling:** User-friendly error messages with suggested actions
- **Help System:** Contextual help and guided tutorials

4.3.2 Accessibility Compliance

- **WCAG 2.1 AA Compliance:** Full accessibility standard adherence
- **Screen Reader Support:** Compatible with popular assistive technologies
- **Keyboard Navigation:** Complete functionality without mouse/touch
- **High Contrast Mode:** Visual accessibility for users with vision impairments
- **Font Scaling:** Support for browser-based text size adjustments

4.3.3 Multilingual Support

- **Language Coverage:** Support for 10+ regional languages
- **RTL Support:** Right-to-left language compatibility
- **Cultural Adaptation:** Region-specific content and imagery
- **Translation Quality:** Professional translation and regular updates
- **Language Switching:** Seamless language change without data loss

4.4 Reliability & Availability Requirements

4.4.1 System Availability

- **Uptime Target:** 99.9% availability (8.77 hours downtime per year)
- **Maintenance Windows:** Maximum 2-hour monthly scheduled maintenance
- **Geographic Distribution:** Multi-region deployment for disaster recovery
- **Failover Time:** Automatic failover within 60 seconds
- **Health Monitoring:** Continuous system health checks and alerting

4.4.2 Data Integrity & Backup

- **Data Consistency:** ACID compliance for critical transactions
- **Backup Frequency:** Continuous incremental backups with daily full backups
- **Recovery Time Objective (RTO):** 4 hours maximum system restoration time
- **Recovery Point Objective (RPO):** Maximum 15 minutes of data loss
- **Disaster Recovery:** Automated disaster recovery with regular testing

4.4.3 Error Handling & Recovery

- **Graceful Degradation:** Partial functionality maintenance during outages
- **Error Logging:** Comprehensive error tracking and analysis
- **Automatic Recovery:** Self-healing capabilities for common failure scenarios
- **User Communication:** Transparent status communication during incidents
- **Post-Incident Analysis:** Root cause analysis and improvement implementation

4.5 Compatibility & Integration Requirements

4.5.1 Platform Compatibility

- **Mobile Platforms:** iOS 13+ and Android 8+ with backward compatibility
- **Web Browsers:** Chrome 90+, Firefox 88+, Safari 14+, Edge 90+
- **Operating Systems:** Windows 10+, macOS 10.15+, major Linux distributions
- **Device Requirements:** Minimum 2GB RAM, 100MB storage space
- **Network Compatibility:** 2G/3G/4G/WiFi with adaptive quality

4.5.2 Third-Party Integration Standards

- **API Standards:** RESTful APIs with OpenAPI 3.0 specification
 - **Authentication:** OAuth 2.0 and API key authentication
 - **Data Formats:** JSON for API communications, standardized healthcare data formats
 - **Webhooks:** Real-time event notifications for external systems
 - **Rate Limiting:** Fair usage policies with configurable limits
-

5. Database Design

5.1 Data Architecture Overview

The database architecture follows a hybrid approach combining relational and NoSQL databases to optimize for both transactional integrity and analytical performance.

5.1.1 Database Components

- **Primary Database:** PostgreSQL 13+ for transactional data
- **Vector Database:** Pinecone/Weaviate for AI knowledge base and semantic search
- **Time-Series Database:** InfluxDB for metrics and monitoring data
- **Cache Layer:** Redis for session management and frequent access patterns
- **File Storage:** AWS S3/Google Cloud Storage for multimedia content

5.2 Entity Relationship Design

5.2.1 Core Entity Groups

User Management Entities


```

users (
  user_id UUID PRIMARY KEY,
  email VARCHAR(255) UNIQUE NOT NULL,
  phone_number VARCHAR(20) UNIQUE,
  password_hash VARCHAR(255) NOT NULL,
  full_name VARCHAR(255) NOT NULL,
  role user_role_enum NOT NULL,
  verification_status verification_enum DEFAULT 'pending',
  created_at TIMESTAMP DEFAULT NOW(),
  updated_at TIMESTAMP DEFAULT NOW(),
  last_login TIMESTAMP,
  is_active BOOLEAN DEFAULT TRUE
);

patients (
  patient_id UUID PRIMARY KEY,
  user_id UUID REFERENCES users(user_id) ON DELETE CASCADE,
  date_of_birth DATE,
  gender gender_enum,
  address JSONB,
  emergency_contact JSONB,
  medical_conditions TEXT[],
  allergies TEXT[],
  preferred_language VARCHAR(10)
);

professionals (
  professional_id UUID PRIMARY KEY,
  user_id UUID REFERENCES users(user_id) ON DELETE CASCADE,
  license_number VARCHAR(100) NOT NULL,
  specialty specialty_enum[] NOT NULL,
  credentials TEXT[],
  years_of_experience INTEGER,
  verification_documents JSONB,
  consultation_fee_range JSONB,
  languages_spoken VARCHAR(10)[],
  bio TEXT,
  volunteer_hours INTEGER DEFAULT 0
);

```

Appointment Management Entities

```

appointments (
  appointment_id UUID PRIMARY KEY,
  patient_id UUID REFERENCES patients(patient_id),
  professional_id UUID REFERENCES professionals(professional_id),
  clinic_doctor_id UUID REFERENCES clinic_doctors(clinic_doctor_id),
  appointment_type appointment_type_enum NOT NULL,
  scheduled_at TIMESTAMP NOT NULL,
  duration_minutes INTEGER DEFAULT 30,
  status appointment_status_enum DEFAULT 'scheduled',
  consultation_method consultation_method_enum,

```

```

meeting_link VARCHAR(500),
notes TEXT,
created_at TIMESTAMP DEFAULT NOW(),
CONSTRAINT valid_provider CHECK (
    (professional_id IS NOT NULL) != (clinic_doctor_id IS NOT NULL)
)
);

consultations (
    consultation_id UUID PRIMARY KEY,
    appointment_id UUID REFERENCES appointments(appointment_id),
    consultation_notes TEXT,
    diagnosis TEXT,
    treatment_plan TEXT,
    follow_up_required BOOLEAN DEFAULT FALSE,
    follow_up_date TIMESTAMP,
    consultation_rating INTEGER CHECK (consultation_rating BETWEEN 1 AND 5),
    created_at TIMESTAMP DEFAULT NOW()
);

```

5.3 Data Relationships and Constraints

5.3.1 Key Relationships

- **One-to-One:** users ↔ patients/professionals/ngo_users
- **One-to-Many:** patients ↔ appointments, professionals ↔ availability_slots
- **Many-to-Many:** professionals ↔ specialties (via junction table)
- **Polymorphic:** reviews ↔ appointments/clinic_doctors (via target_type/target_id)

5.3.2 Data Integrity Rules

- **Referential Integrity:** Foreign key constraints with appropriate CASCADE rules
- **Business Logic Constraints:** Check constraints for valid data ranges and combinations
- **Unique Constraints:** Email, phone numbers, and license numbers must be unique
- **Audit Trail:** Created/updated timestamps on all major entities

5.4 Performance Optimization

5.4.1 Indexing Strategy

- **Primary Indexes:** UUID primary keys with B-tree indexes
- **Composite Indexes:** Multi-column indexes for frequent query patterns
- **Partial Indexes:** Filtered indexes for specific query optimizations
- **Full-Text Indexes:** GIN indexes for search functionality

5.4.2 Partitioning Strategy



- **Time-Based Partitioning:** Appointments and consultations by date ranges
 - **Hash Partitioning:** User data distribution across multiple partitions
 - **List Partitioning:** Geographic-based data separation for compliance
-

6. System Architecture

6.1 Architectural Overview

The system employs a cloud-native microservices architecture designed for scalability, maintainability, and resilience.

6.1.1 Architectural Principles

- **Microservices:** Domain-driven service decomposition
- **Event-Driven:** Asynchronous communication via message queues
- **API-First:** Consistent RESTful API design across services
- **Cloud-Native:** Container-based deployment with orchestration
- **Security by Design:** Zero-trust security model implementation

6.2 Service Architecture

6.2.1 Core Services

Service	Responsibility	Technology Stack	Scaling Strategy
User Service	Authentication, authorization, user management	Node.js, Express, JWT	Horizontal, stateless
Appointment Service	Scheduling, booking, calendar management	Python, FastAPI, Celery	Horizontal, event-driven
AI Engine Service	Multi-agent AI, natural language processing	Python, TensorFlow, LangChain	GPU-based scaling
Communication Service	Messaging, notifications, video calls	Node.js, Socket.io, WebRTC	Connection-based scaling
Health Records Service	EHR, document management, FHIR compliance	Java, Spring Boot, PostgreSQL	Data-partitioned scaling
Analytics Service	Metrics, reporting, business intelligence	Python, Apache Spark, ClickHouse	Batch and stream processing

6.3 Data Flow Architecture

6.3.1 Request Processing Flow

1. **Client Request** → API Gateway (authentication, rate limiting)
2. **Service Routing** → Load balancer → Target microservice
3. **Business Logic** → Service processes request with database interaction
4. **Event Publishing** → Asynchronous event notification to relevant services
5. **Response** → Formatted response returned through API gateway

6.3.2 Event-Driven Communication

- **Event Bus:** Apache Kafka for high-throughput event streaming
- **Message Queues:** Redis/RabbitMQ for task queuing and processing
- **Event Sourcing:** Audit trail and state reconstruction capabilities
- **CQRS Pattern:** Command and query responsibility segregation for performance

6.4 Infrastructure Architecture

6.4.1 Cloud Infrastructure

- **Container Platform:** Kubernetes for orchestration and auto-scaling
- **Service Mesh:** Istio for service communication and security
- **API Gateway:** Kong/AWS API Gateway for request management
- **Monitoring:** Prometheus, Grafana, ELK stack for observability
- **CI/CD Pipeline:** GitLab/Jenkins for automated deployment

6.4.2 Security Architecture

- **Network Security:** VPC, security groups, network segmentation
 - **Identity Management:** OAuth 2.0, JWT tokens, role-based access
 - **Secrets Management:** HashiCorp Vault for credential storage
 - **Compliance Monitoring:** Automated security scanning and compliance checks
-

7. Appendices

7.1 Use Case Documentation

7.1.1 Primary Use Case Diagram

Based on the comprehensive use case analysis, the Clinico system supports six primary use case groups:

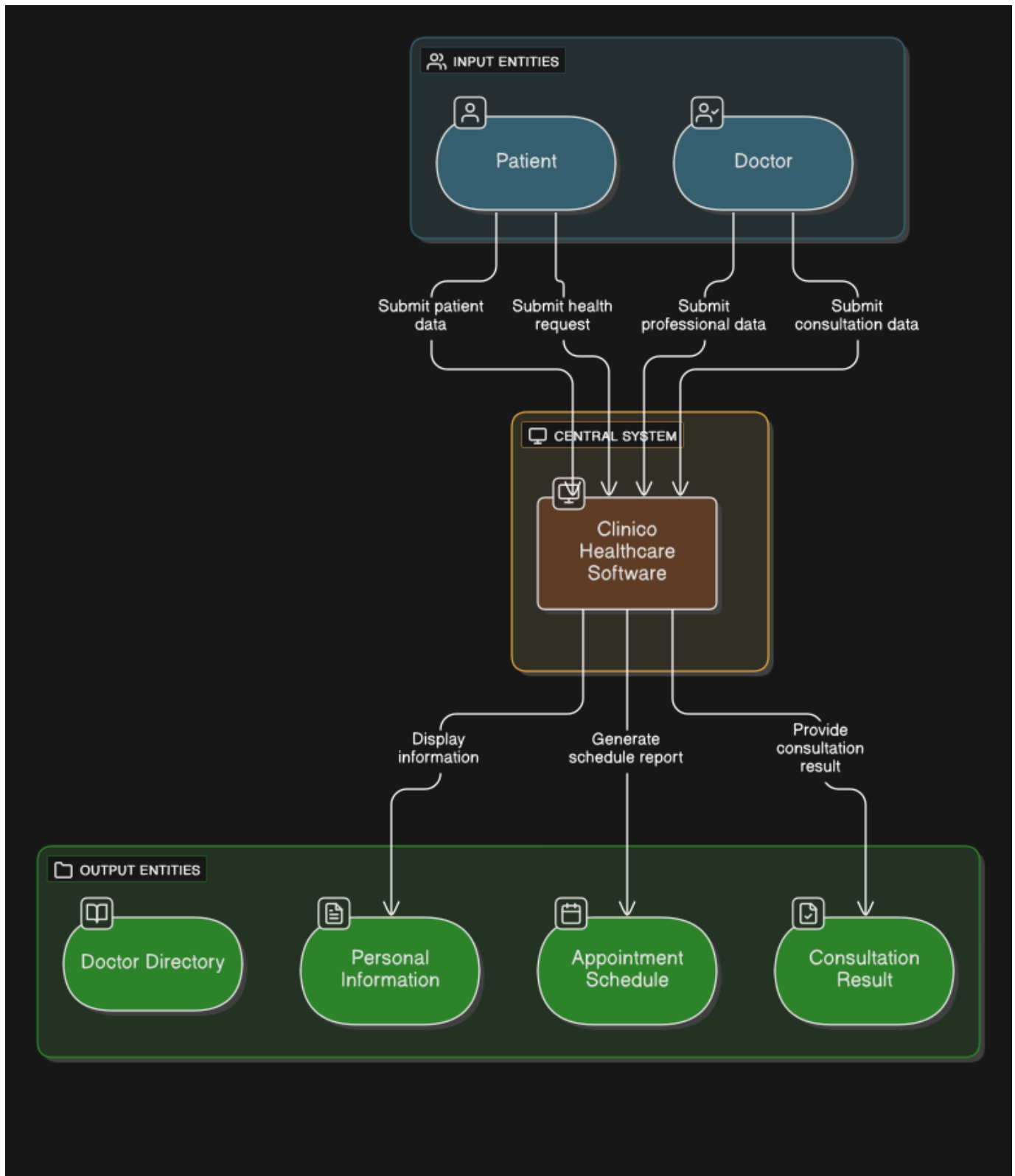


Figure 6.1: Data Flow Diagram – Level 0

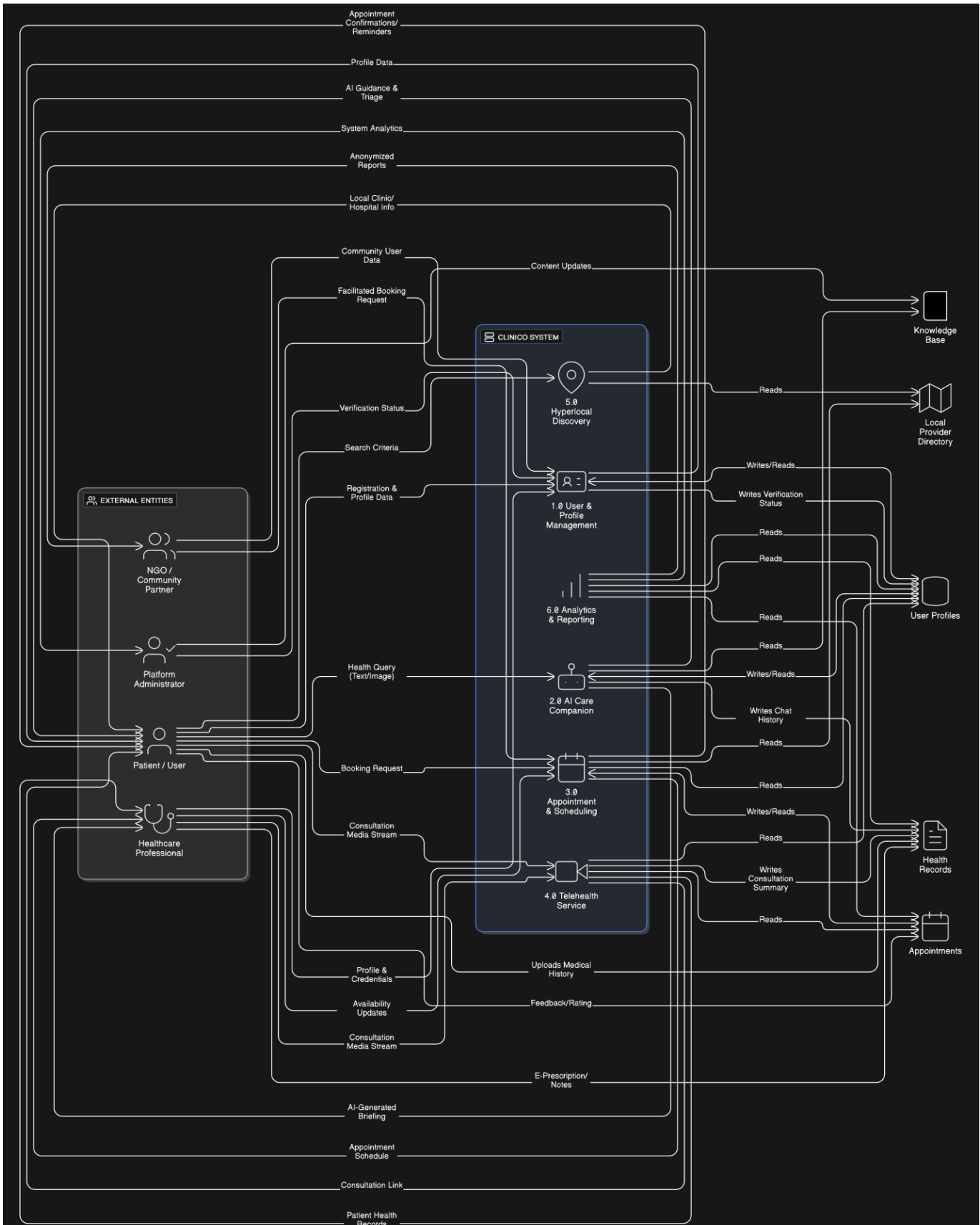


Figure 6.2: Data Flow Diagram – Level 1

Use Case Group 1: Identity, Registration & Consent Management

- **Actors:** Patient, Admin
- **Key Use Cases:**
 - Register/Login (via OTP)
 - Consent Management (give/withdraw consent)
 - Role-based Access

Use Case Group 2: Intake, Triage & Risk Management

- **Actors:** Patient, CHW, Doctor, Counsellor, Triage Engine
- **Key Use Cases:**
 - Symptom Intake (physical/mental)
 - AI-Assisted Triage (Human approval required)
 - Crisis Workflow (suicidal/self-harm escalation)

Use Case Group 3: Scheduling & Teleconsultation Management

- **Actors:** Patient, Doctor, Counsellor
- **Key Use Cases:**
 - Appointment Booking (book, reschedule, cancel)
 - Virtual Consult (video/audio/IVR fallback)
 - E-Prescription & Care Plan

Use Case Group 4: Records, Messaging & Follow-ups Management

- **Actors:** Patient, Doctor, Counsellor, CHW
- **Key Use Cases:**
 - EHR-lite Records (timeline of visits, screenings, prescriptions)
 - Secure Messaging (encrypted chat)
 - Reminders & Adherence (medication/therapy reminders)

Use Case Group 5: Volunteer & Workforce Management

- **Actors:** Admin, Volunteer Doctor, Counsellor
- **Key Use Cases:**

- Volunteer Onboarding (license verification, availability)
- Quality & Supervision (case review, feedback, escalation)

Use Case Group 6: Admin, Audit & Analytics Management

- **Actors:** Admin, Partner (read-only)
- **Key Use Cases:**
 - Admin Console (manage users, roles, content)
 - Metrics & Dashboards (utilization, referral outcomes)
 - Audit Trails (tamper-proof logs, compliance reporting)

7.2 Use Case Traceability Matrix

Use Case ID	Use Case Name	Related Functional Requirements	Priority
UC-1	Patient Registration	FR-1.1, FR-1.2, FR-1.3	High
UC-2	AI Health Consultation	FR-2.1, FR-2.2, FR-2.3, FR-2.4	High
UC-3	Professional Appointment Booking	FR-3.1, FR-3.2, FR-3.3	High
UC-4	Teleconsultation Session	FR-3.2, FR-4.1, FR-5.2	High
UC-5	Health Record Management	FR-5.1, FR-5.3	Medium
UC-6	Local Provider Discovery	FR-6.1, FR-6.2, FR-6.3	Medium

7.2 Use Case Traceability Matrix

Use Case ID	Use Case Name	Related Functional Requirements	Priority	Status
UC-1.1	Patient Registration via OTP	FR-1.1, FR-1.2	High	Defined
UC-1.2	Consent Management	FR-1.3	High	Defined
UC-1.3	Role-based System Access	FR-1.2, FR-7.1	High	Defined
UC-2.1	Symptom Intake Processing	FR-2.3, FR-2.4	High	Defined
UC-2.2	AI-Assisted Triage	FR-2.1, FR-2.2	High	Defined
UC-2.3	Crisis Intervention Workflow	FR-2.3	Critical	Defined
UC-3.1	Appointment Booking System	FR-3.1, FR-3.3	High	Defined
UC-3.2	Virtual Consultation Platform	FR-3.2	High	Defined
UC-3.3	E-Prescription Generation	FR-4.1	High	Defined
UC-4.1	EHR-lite Records Management	FR-5.1	Medium	Defined
UC-4.2	Secure Messaging System	FR-5.2	High	Defined
UC-4.3	Medication Adherence Tracking	FR-4.2, FR-5.3	Medium	Defined

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UseCase Diagram

Actors

- Patient
- Doctor
- Counsellor
- Admin

Primary Use Cases

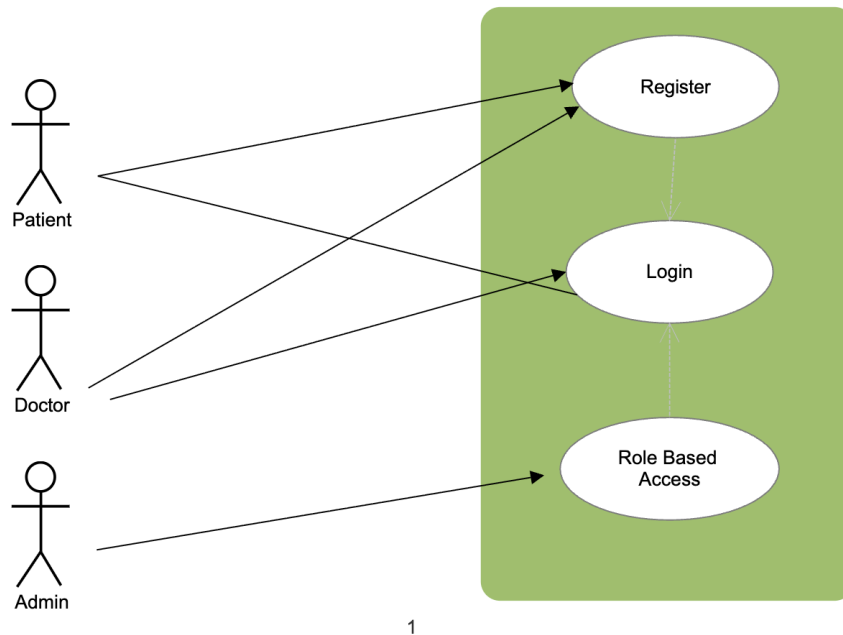
1. Identity, Registration & Consent Management

Actors: Patient, Admin

Use Cases:

- Register/Login (via OTP)
- Consent Management (give/withdraw consent)
- Role-based Access

Identity, Registration & Consent Management



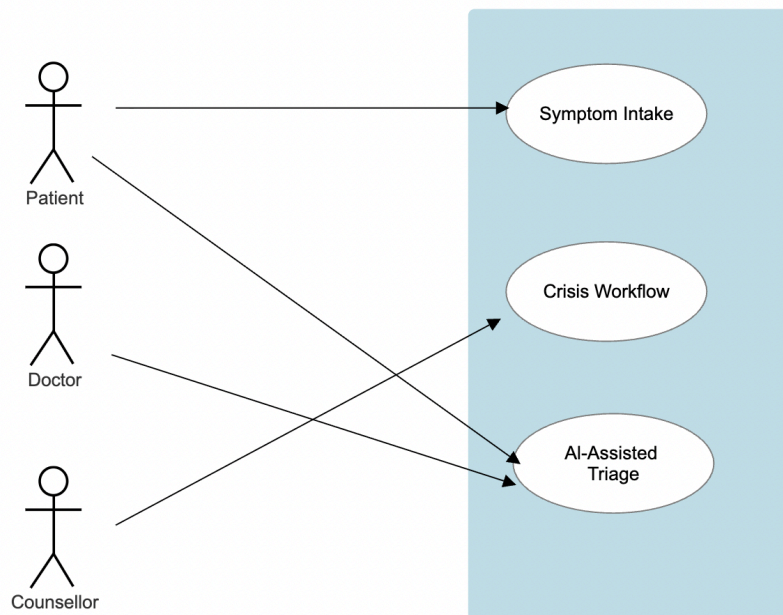
2. Intake, Triage & Risk Management

Actors: Patient, CHW, Doctor, Counsellor, Triage Engine

Use Cases:

- Symptom Intake (physical/mental)
- AI-Assisted Triage (Human approval required)
- Crisis Workflow (suicidal/self-harm escalation)

Intake, Triage & Risk Management



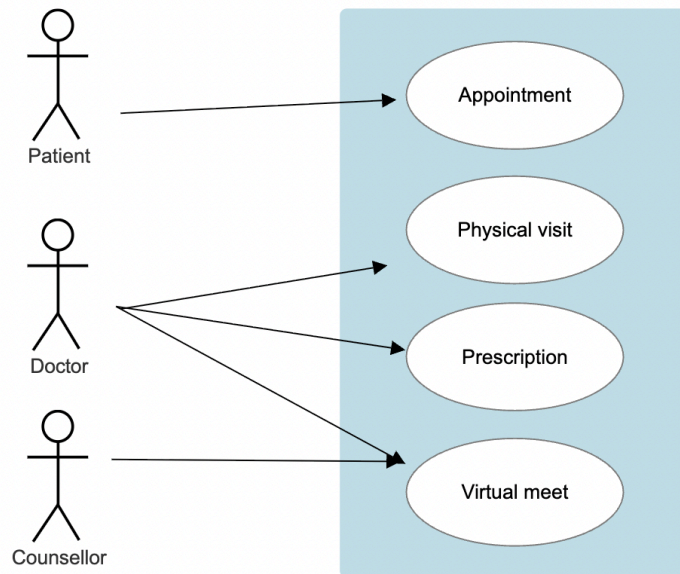
3. Scheduling & Teleconsultation Management

Actors: Patient, Doctor, Counsellor

Use Cases:

- Appointment Booking (book, reschedule, cancel)
- Virtual Consult (video/audio/IVR fallback)
- E-Prescription & Care Plan

Scheduling & Teleconsultation Management



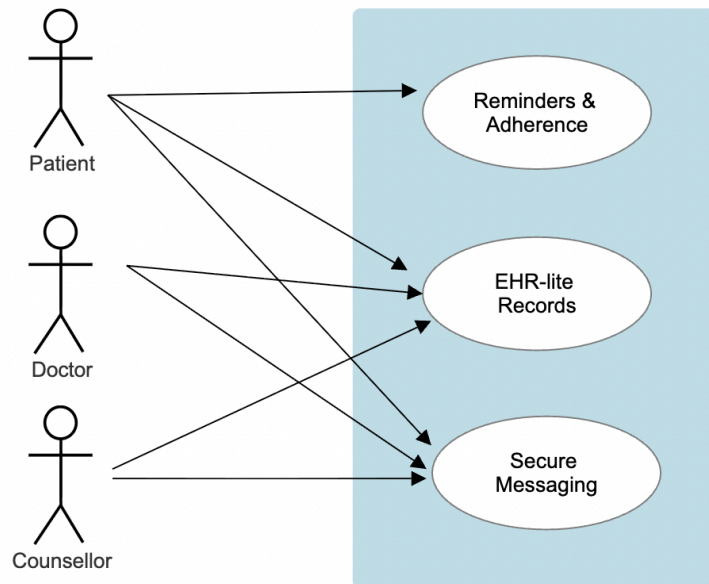
4. Records, Messaging & Follow-ups Management

Actors: Patient, Doctor, Counsellor, CHW

Use Cases:

- EHR-lite Records (timeline of visits, screenings, prescriptions)
- Secure Messaging (encrypted chat)
- Reminders & Adherence (medication/therapy reminders)

Records, Messaging & Follow-ups Management



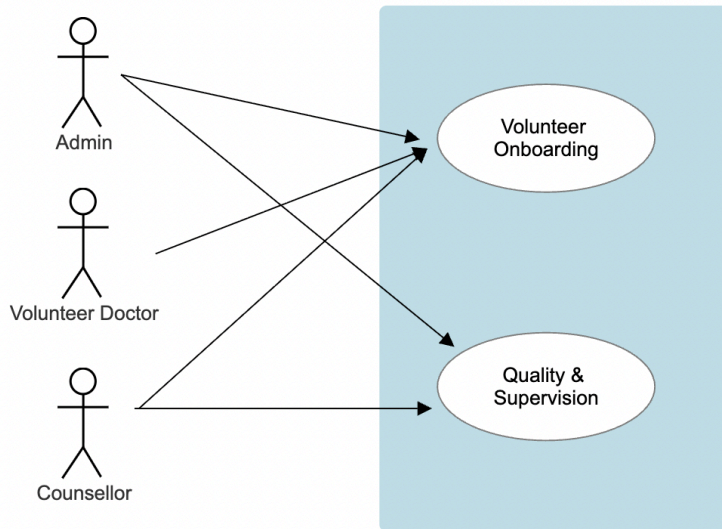
5. Volunteer & Workforce Management

Actors: Admin, Volunteer Doctor, Counsellor

Use Cases:

- Volunteer Onboarding (license verification, availability)
- Quality & Supervision (case review, feedback, escalation)

Volunteer & Workforce Management



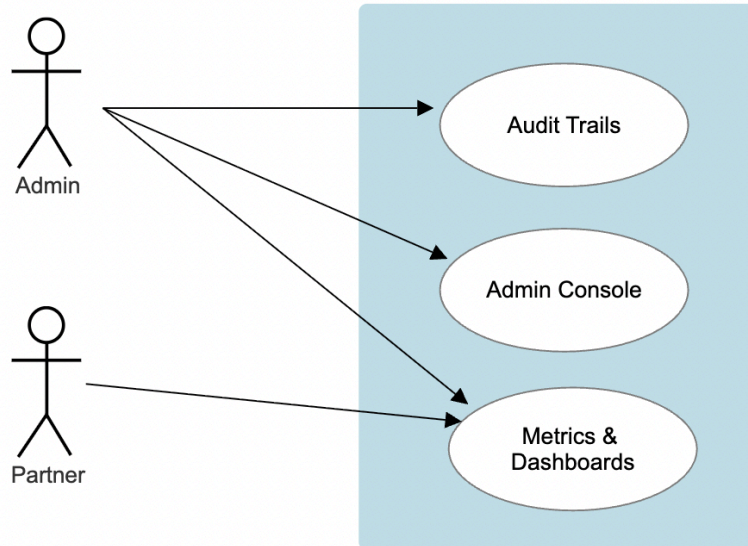
6. Admin, Audit & Analytics Management

Actors: Admin, Partner (read-only)

Use Cases:

- Admin Console (manage users, roles, content)
- Metrics & Dashboards (utilization, referral outcomes)
- Audit Trails (tamper-proof logs, compliance reporting)

Admin, Audit & Analytics Management



UC-5.1	Volunteer Professional Onboarding	FR-7.1	High	Defined
UC-5.2	Quality Assurance & Supervision	FR-7.2	High	Defined
UC-6.1	Administrative Console	FR-8.1	Medium	Defined
UC-6.2	Analytics Dashboard	FR-8.2	Medium	Defined
UC-6.3	Audit Trail Management	FR-8.3	High	Defined

7.3 Risk Assessment Matrix

Risk Category	Risk Description	Impact	Probability	Mitigation Strategy
Technical	AI model accuracy issues	High	Medium	RAG implementation, human oversight, regular model updates
Technical	Third-party service dependencies	Medium	High	Multi-vendor strategy, fallback mechanisms, SLA agreements
Regulatory	Healthcare compliance violations	High	Low	Legal consultation, compliance audits, regulatory monitoring
Business	Volunteer professional retention	High	Medium	Engagement programs, recognition systems, impact tracking
Security	Healthcare data breach	Critical	Low	Multi-layer security, encryption, regular security audits
Operational	Scalability bottlenecks	Medium	Medium	Load testing, auto-scaling, performance monitoring

7.3 Technology Stack Specifications

7.3.1 Frontend Technologies

- **Mobile Development:** React Native 0.72+ with TypeScript
- **Web Application:** React 18+ with Next.js framework
- **State Management:** Redux Toolkit with RTK Query
- **UI Components:** Material-UI / React Native Elements
- **Testing:** Jest, React Testing Library, Detox for mobile

7.3.2 Backend Technologies

- **API Services:** Node.js 18+ with Express.js framework
- **AI Services:** Python 3.9+ with FastAPI framework
- **Authentication:** Auth0 or custom JWT implementation
- **API Documentation:** OpenAPI 3.0 with Swagger UI
- **Testing:** Jest, Supertest, pytest for Python services

7.3.3 Data & Infrastructure

- **Primary Database:** PostgreSQL 13+ with TimescaleDB extension
- **Vector Database:** Pinecone or Weaviate for AI embeddings
- **Cache:** Redis 6+ for session management and caching
- **Message Queue:** Apache Kafka for event streaming
- **Cloud Platform:** AWS or Google Cloud Platform
- **Container Platform:** Docker with Kubernetes orchestration

7.4 Compliance & Regulatory Considerations

7.4.1 Healthcare Regulations

- **Telemedicine Licensing:** Compliance with regional telemedicine laws
- **Medical Device Regulations:** Software as Medical Device (SaMD) considerations
- **Professional Standards:** Healthcare professional licensing verification
- **Clinical Guidelines:** Evidence-based medical content standards

7.4.2 Data Protection Compliance

- **GDPR Compliance:** European data protection regulation adherence
 - **HIPAA Equivalent:** Regional healthcare data protection standards
 - **Data Localization:** Regional data residency requirements
 - **Cross-Border Transfer:** Privacy shield and adequacy decisions
-

8. References

8.1 Primary Source Documents

8.1.1 Problem Statement Documentation

- **Document:** Problem Statement.pdf
- **Content Summary:** Comprehensive analysis of healthcare accessibility challenges
- **Key Insights:**
 - Fragmented healthcare systems creating access barriers
 - Financial constraints in underprivileged communities
 - Mental health stigma and professional shortage
 - Technology gap between automated and human-centered care
- **Impact on Requirements:** Informed scope definition and feature prioritization

8.1.2 Business Model Analysis

- **Document:** Business Model Canvas (lean-canvas.jpg)
- **Framework:** Lean Canvas methodology for healthcare solution validation
- **Strategic Components:**
 - **Customer Segments:** Multi-tier user base including underserved communities
 - **Value Propositions:** AI-human hybrid approach for comprehensive care
 - **Revenue Streams:** Freemium model with sustainable funding mechanisms
 - **Cost Structure:** Volunteer-driven network with technology infrastructure costs
- **Competitive Analysis:** Differentiation from existing platforms (Doctors for Seva, K Health, Woebot)

8.2 Technical Design Documentation

8.2.1 Use Case Specifications

- **Document:** Usecase.pdf
- **Methodology:** Actor-centric use case modeling with scenario analysis
- **Coverage Areas:**
 - Identity and consent management workflows
 - AI-assisted triage and risk assessment procedures
 - Teleconsultation and appointment management processes
 - Health records and communication management
 - Administrative and quality assurance frameworks
- **Traceability:** Direct mapping to functional requirements in Section 3

8.2.2 System Design Artifacts

- **Document:** clinico.pdf with architectural diagrams
- **Design Components:**
 - **Data Flow Diagrams:** Level 0 context and Level 1 process decomposition
 - **Entity Relationship Model:** Comprehensive database schema design
 - **Feature Specifications:** Detailed functionality descriptions
 - **Integration Architecture:** External service connection points
- **Technical Depth:** Multi-agent AI system specification with RAG implementation

8.3 Feasibility Analysis Framework

8.3.1 Technical Feasibility Assessment

- **AI/ML Capabilities:** Multi-agent system implementation feasibility
- **Integration Complexity:** Third-party service dependency analysis
- **Scalability Requirements:** Infrastructure capacity planning
- **Performance Benchmarks:** Response time and throughput validation
- **Security Implementation:** Healthcare-grade security architecture feasibility

8.3.2 Market & Operational Feasibility

- **Target Market Analysis:** User segment accessibility and adoption potential
- **Volunteer Network Viability:** Healthcare professional recruitment and retention
- **Partnership Development:** NGO and institutional collaboration feasibility
- **Regulatory Compliance:** Healthcare regulation adherence complexity
- **Financial Sustainability:** Revenue model validation and break-even analysis

8.4 Requirements Traceability Documentation

8.4.1 Source-to-Requirement Mapping

SRS Section	Primary Source	Secondary Sources	Validation Method
1.2 Project Scope	Problem Statement.pdf	Business Model Canvas	Stakeholder review
2.2 Business Context	Business Model Canvas	Market research data	Financial modeling
3.1-3.9 System Features	Usecase.pdf	Technical specifications	Use case walkthrough
5.0 Database Design	clinico.pdf ERD	Data flow diagrams	Schema validation
6.0 System Architecture	Technical diagrams	Integration requirements	Architecture review

8.4.2 Change Impact Analysis

- **Requirement Dependencies:** Cross-functional impact assessment
- **Source Document Updates:** Change propagation tracking
- **Version Control:** Document revision management
- **Stakeholder Communication:** Change notification procedures

8.5 Quality Assurance References

8.5.1 Standards Compliance

- **ISO 27001:** Information security management systems
- **ISO 13485:** Medical device quality management
- **NIST Cybersecurity Framework:** Security control implementation

- **WCAG 2.1 AA:** Web accessibility guidelines compliance

8.5.2 Best Practices Documentation

- **Healthcare Software Development:** FDA guidance for medical software
- **Telemedicine Standards:** Clinical practice guidelines for remote care
- **AI Ethics in Healthcare:** Responsible AI implementation principles
- **Data Privacy Engineering:** Privacy-by-design implementation patterns

8.6 Appendix References

8.6.1 Supporting Documentation

- **User Research Reports:** Target audience analysis and requirements validation
- **Competitive Analysis:** Market landscape and feature benchmarking
- **Technical Specifications:** Detailed API documentation and integration guides
- **Compliance Checklists:** Regulatory requirement verification matrices

8.6.2 External Standards and Frameworks

- **HL7 FHIR:** Healthcare data interoperability standards
- **OAuth 2.0 / OpenID Connect:** Authentication and authorization protocols
- **OpenAPI 3.0:** API documentation and specification standards
- **GDPR/HIPAA:** Data protection and privacy regulation compliance

Document Control

Version History:

Version	Date	Author	Changes Summary
1.0	September 2025	Requirements Team	Initial SRS document creation
1.1	[Pending]	[TBD]	Stakeholder feedback incorporation

Review and Approval:

Role	Name	Signature	Date
Project Manager	[TBD]	[Pending]	[Pending]
Technical Lead	[TBD]	[Pending]	[Pending]
Medical Advisor	[TBD]	[Pending]	[Pending]

Legal/Compliance	[TBD]	[Pending]	[Pending]
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Document Classification: Confidential - Internal Use Only
Next Review Date: December 2025
Distribution: Development team, stakeholders, regulatory consultants

Source Documents:

- Problem Statement.pdf
- Usecase.pdf
- clinico.pdf
- Business Model Canvas (lean-canvas.jpg)
- System Architecture Diagrams (Images 2-4)

This document serves as the authoritative specification for Clinico: The Healing Hand Initiative development project. All implementation decisions should reference and comply with the requirements outlined in this SRS.