Requirement & Design Specification
HIV Clinic Appointment Booking System

Version: 1.0

January 2025

Record of Changes

Version	Date	A*M, D	In charge	Change Description
V1.0	07/01/2025	A	Development Team	Initial HIV Clinic System RDS document based on implemented codebase

A - Added M - Modified D - Deleted

Contents

1 Overview

1.1 User Requirements

1.1.1 Actors

The HIV Clinic Appointment Booking System involves four main actors who interact with the system to perform various healthcare-related tasks:

#	Actor	Description
1	Patient	Registered HIV patients who book appointments, manage their medical records, view treatment information, and receive medication reminders
2	Doctor	HIV/AIDS specialists and healthcare providers who manage patient appointments, update medical records, prescribe ARV treatments, and access patient information during consultations
3	Admin	System administrators who manage user accounts, system settings, and have full access to all system functionalities for maintenance and oversight
4	Manager	Healthcare facility managers who oversee operations, generate reports, and manage clinic resources and staff schedules

1.1.2 Use Cases

a. Diagram(s) The system provides comprehensive use cases covering patient care, appointment management, and administrative functions for an HIV clinic environment.

b. Descriptions

ID	Feature	Use Case	Use Case Description
UC-001	User Management	User Registration	New users (patients/doctors) create accounts with role-based access to the HIV clinic system
UC-002	Authentication	User Login	Existing users authenticate using username/password with JWT token-based security
UC-003	Profile Management	Update Profile	Users update personal information, contact details, and profile images
UC-004	Appointment Management	Book Appointment	Patients schedule appointments with available doctors based on doctor availability slots
UC-005	Doctor Operations	Manage Availability	Doctors create, update, and manage their availability time slots for patient appointments
UC-006	Appointment Management	Cancel Appointment	Patients or doctors cancel scheduled appointments with cancellation reasons

UC-007	Patient Care	Manage Patient Records	Doctors access and update patient medical records including history, allergies, and current medications
UC-008	HIV Treatment	ARV Treatment Management	Doctors manage HIV antiretroviral treatment regimens, monitor adherence, and track side effects
UC-009	Medication Management	Medication Routine Management	Doctors create medication schedules and patients receive automated reminders for ARV adherence
UC-010	Notification System	Appointment Reminders	System sends automated reminders to patients for upcoming appointments (24-hour, 1-hour, 30-minute)
UC-011	Notification System	Medication Reminders	System sends daily medication reminders to patients based on their prescribed ARV routine
UC-012	Patient Privacy	Privacy Settings	Patients control the visibility of their medical information and set privacy preferences

1.2 Overall Functionalities

1.2.1 Screens Flow

The HIV Clinic system provides role-based screen flows ensuring appropriate access to sensitive medical information:

- **Patient Flow**: Login → Patient Dashboard → Book Appointment → View Medical Records → Medication Reminders

- **Doctor Flow**: Login → Doctor Dashboard → Manage Availability → View Patient Records → Update Treatment Plans

- **Admin Flow**: Login → Admin Dashboard → User Management → System Settings → Reports

- **Manager Flow**: Login → Manager Dashboard → Clinic Operations → Staff Management → Analytics

1.2.2 Screen Descriptions

#	Feature	Screen	Description
1	Authentication	Login Screen	Secure login with username/password authentication and JWT token generation
2	Authentication	Registration Screen	User registration with role selection, profile information, and email verification

3	Patient Dashboard	Patient Home	Overview of upcoming appointments, medication reminders, and treatment status
4	Appointment Management	Book Appointment	Search available doctors, view time slots, and schedule appointments
5	Appointment Management	My Appointments	View scheduled, completed, and cancelled appointments with details
6	Doctor Dashboard	Doctor Home	Overview of daily appointments, patient notifications, and availability management
7	Doctor Operations	Availability Management	Create, update, and manage doctor availability time slots
8	Patient Records	Medical Records	Comprehensive patient medical history, allergies, current medications, and emergency contacts
9	ARV Treatment	Treatment Management	HIV treatment regimens, adherence tracking, and side effect monitoring
10	Medication Management	Medication Routine	Daily medication schedules, dosage information, and reminder settings
11	Notification System	Notification Center	View and manage appointment reminders and medication alerts
12	Admin Panel	User Management	Manage user accounts, roles, and system permissions

1.2.3 Screen Authorization

Screen	Patient	Doctor	Admin	Manager
Login Screen	X	X	X	X
Registration Screen	X	X	X	X
Patient Dashboard	X			
View Own Records	X			
Update Own Profile	X			
Book Appointments	X			
Doctor Dashboard		X		
Manage Availability		X		
View Patient Records		X	X	
Update Treatment Plans		X		
Admin Dashboard			X	
User Management			X	
System Settings			X	
Manager Dashboard				X
Generate Reports			X	X
View Analytics			X	X

Appointment Management	X	X	X	X
Cancel Appointments	X	X	X	
Notification System	X	X	X	X

1.2.4   Non-UI Functions

#	Feature	System Function	Description
1	Notification Scheduling	Automated Reminder Service	Background service that schedules and sends appointment and medication reminders based on configured templates
2	Security	JWT Token Management	Automatic token generation, validation, and refresh for secure API access
3	Data Validation	Input Sanitization	Server-side validation and sanitization of all user inputs to prevent SQL injection and XSS attacks
4	Audit Logging	Activity Tracking	Automatic logging of user actions, login attempts, and data modifications for security and compliance
5	Database Management	Automated Backups	Scheduled database backups and maintenance operations
6	Email Service	SMTP Integration	Email delivery service for notifications and system communications

1.3   System High Level Design

1.3.1   Database Design

a. Database Schema   The HIV Clinic system uses Microsoft SQL Server with the following core tables:

- **Users**: Central user management with role-based access

- **Roles**: System roles (Patient, Doctor, Admin, Manager)

- **PatientProfiles**: Extended patient information

- **DoctorProfiles**: Extended doctor information with specialties

- **Appointments**: Appointment scheduling and management

- **DoctorAvailabilitySlots**: Doctor availability management

- **PatientRecords**: Medical records and patient history

- **ARVTreatments**: HIV antiretroviral treatment tracking

- **MedicationRoutines**: Daily medication schedules

- **Notifications**: System notification management

- **NotificationTemplates**: Reusable notification templates

b. Table Descriptions

No	Table	Description
01	Users	Central user authentication and profile management table storing username, password hash, email, and role associations - Primary keys: UserID - Foreign keys: RoleID (references Roles)
02	Roles	System role definitions for access control - Primary keys: RoleID - Contains: Patient, Doctor, Admin, Manager roles
03	PatientProfiles	Extended patient information including demographics and privacy settings - Primary keys: PatientProfileID - Foreign keys: UserID (references Users)
04	DoctorProfiles	Doctor professional information including specialties and qualifications - Primary keys: DoctorProfileID - Foreign keys: UserID (references Users), SpecialtyID (references Specialties)
05	Appointments	Appointment scheduling between patients and doctors - Primary keys: AppointmentID - Foreign keys: PatientUserID, DoctorUserID (references Users), AvailabilitySlotID
06	DoctorAvailabilitySlots	Doctor availability time slot management - Primary keys: AvailabilitySlotID - Foreign keys: DoctorUserID (references Users)
07	PatientRecords	Comprehensive medical records including history, allergies, medications - Primary keys: RecordID - Foreign keys: PatientUserID (references Users)
08	ARVTreatments	HIV antiretroviral treatment regimens and monitoring - Primary keys: ARVTreatmentID - Foreign keys: PatientUserID, DoctorUserID (references Users), AppointmentID
09	MedicationRoutines	Daily medication schedules and reminder configurations - Primary keys: RoutineID

		- Foreign keys: PatientUserID, DoctorUserID (references Users), ARVTreatmentID
10	Notifications	System notifications for appointments and medication reminders - Primary keys: NotificationID - Foreign keys: UserID (references Users), templateId (references NotificationTemplates)
11	NotificationTemplates	Reusable notification message templates - Primary keys: templateId - Contains: appointment reminder, medication reminder, and system notification templates

1.3.2 Code Packages

The HIV Clinic system follows a layered Spring Boot architecture:

No	Package	Description
01	com.hivclinic.controller	REST API controllers handling HTTP requests for appointments, authentication, patient records, doctor operations, and notifications
02	com.hivclinic.service	Business logic layer containing services for appointment management, user authentication, patient care, ARV treatment, and notification scheduling
03	com.hivclinic.repository	Data access layer with JPA repositories for database operations
04	com.hivclinic.model	Entity classes representing database tables including User, Appointment, PatientRecord, ARVTreatment, and Notification models
05	com.hivclinic.dto	Data Transfer Objects for request/response handling and API communication
06	com.hivclinic.config	Configuration classes for security (JWT), database, and application settings
07	com.hivclinic.exception	Custom exception handling for application-specific errors
08	com.hivclinic.validation	Input validation and sanitization utilities

2 Requirement Specifications

2.1 Authentication & User Management

2.1.1 UC-001_User Registration

a. Functionalities UC ID and Name: UC-001 User Registration
Created By: Development Team
Date Created: January 2025
Primary Actor: Guest User (future Patient/Doctor)
Secondary Actors: System Administrator

Trigger: New user accesses registration page and submits registration form

Description: New users register for accounts in the HIV clinic system with role-based access. The system validates user information, creates secure accounts, and establishes appropriate permissions.

Preconditions:

- User has valid email address

- Username is unique in the system

- Password meets security requirements

Postconditions:

- User account created with encrypted password

- Role assigned based on registration type

- User profile initialized

- Account activation email sent

Normal Flow:

1. User accesses registration screen

2. User enters username, email, password, and confirms password

3. User selects role (Patient/Doctor)

4. User provides additional profile information

5. System validates input data

6. System checks username and email uniqueness

7. System creates user account with encrypted password

8. System assigns appropriate role

9. System creates corresponding profile record

10. System sends confirmation response

Alternative Flows:

- **1.1 Doctor Registration:** Additional validation for medical credentials and specialty selection

Exceptions:

- **1.0.E1:** Username already exists - System displays error message

- **1.0.E2:** Email already registered - System displays error message

- **1.0.E3:** Password confirmation mismatch - System requests password re-entry

- **1.0.E4:** Invalid email format - System displays validation error

Priority: Must Have

Frequency of Use: Low frequency, primarily during initial system rollout

Business Rules: BR-001, BR-002, BR-003

b. Business Rules

ID	Business Rule	Business Rule Description
BR-001	Password Security	User passwords must be hashed using BCrypt with minimum 8 characters, including uppercase, lowercase, and numbers
BR-002	Unique Credentials	Username and email must be unique across the entire system
BR-003	Role Validation	Doctor registrations require additional verification of medical credentials

2.1.2   UC-002_User Login

a. Functional Description   UC ID and Name: UC-002 User Login
Created By: Development Team
Date Created: January 2025
Primary Actor: Registered User (Patient/Doctor/Admin/Manager)
Secondary Actors: Authentication Service
Trigger: User attempts to access the system or protected resources
Description: Registered users authenticate using username/password credentials to access role-appropriate system features. The system validates credentials and provides JWT tokens for secure session management.
Preconditions:

- User account exists and is active

- User has valid credentials

Postconditions:

- User session established with JWT token

- User redirected to role-appropriate dashboard

- Login activity logged for security audit

Normal Flow:

1. User accesses login screen

2. User enters username and password

3. System validates credentials against database

4. System generates JWT token with role information

5. System returns authentication response with token

6. User redirected to appropriate dashboard

7. System logs successful login activity

Alternative Flows: None
Exceptions:

- **2.0.E1:** Invalid credentials - System displays error message and logs failed attempt

- **2.0.E2:** Account inactive - System displays account status message

- **2.0.E3:** Multiple failed attempts - System temporarily locks account

Priority: Must Have
Frequency of Use: High - Daily usage by all system users
Business Rules: BR-004, BR-005, BR-006

b. Business Rules

ID	Business Rule	Business Rule Description
BR-004	Session Management	JWT tokens expire after 24 hours and must be refreshed for continued access
BR-005	Account Lockout	Account locked for 30 minutes after 5 consecutive failed login attempts
BR-006	Audit Logging	All login attempts (successful and failed) are logged with timestamp, IP address, and user agent

2.2   Appointment Management

2.2.1   UC-004_Book Appointment

a. Functional Description   UC ID and Name: UC-004 Book Appointment
Created By: Development Team
Date Created: January 2025
Primary Actor: Patient
Secondary Actors: Doctor (availability provider)
Trigger: Patient initiates appointment booking process
Description: Patients book appointments with available doctors by selecting from available time slots. The system ensures no double-booking and automatically updates doctor availability.
Preconditions:

- Patient is logged into the system

- Doctor has available time slots

- Patient has no conflicting appointments

Postconditions:

- Appointment created with "Scheduled" status

- Doctor availability slot marked as booked

- Appointment confirmation sent to patient

- Automatic reminders scheduled

Normal Flow:

1. Patient accesses appointment booking screen

2. System displays list of available doctors

3. Patient selects preferred doctor

4. System displays available time slots for selected doctor

5. Patient selects desired appointment time

6. Patient provides appointment notes (optional)

7. System validates appointment availability

8. System creates appointment record

9. System updates doctor availability slot

10. System schedules automatic reminders

11. System sends confirmation to patient

   Alternative Flows:

   - **4.1 Emergency Appointment:** Priority booking for urgent medical needs

   Exceptions:

   - **4.0.E1:** Time slot no longer available - System refreshes available slots

   - **4.0.E2:** Patient has conflicting appointment - System displays conflict warning

   - **4.0.E3:** Maximum appointments per day exceeded - System enforces daily limit

   Priority: Must Have
   Frequency of Use: High - Multiple daily bookings expected
   Business Rules: BR-007, BR-008, BR-009

b. Business Rules

ID	Business Rule	Business Rule Description
BR-007	Appointment Limits	Patients limited to 3 active appointments at any time
BR-008	Advance Booking	Appointments can be booked up to 30 days in advance
BR-009	Default Duration	All appointments default to 30 minutes unless specified otherwise

2.3   Patient Care Management

2.3.1   UC-007_Manage Patient Records

a. Functional Description   UC ID and Name: UC-007 Manage Patient Records
   Created By: Development Team
   Date Created: January 2025
   Primary Actor: Doctor
   Secondary Actors: Patient, Admin
   Trigger: Doctor accesses patient record during appointment or review
   Description: Doctors access and update comprehensive patient medical records including medical history, allergies, current medications, and treatment notes. The system maintains complete audit trails of all record modifications.
   Preconditions:

- Doctor is authenticated with appropriate permissions

- Patient record exists in the system

- Doctor has legitimate medical reason for access

Postconditions:

- Patient record updated with new information

- Modification audit trail created

- Patient notified of record updates (if enabled)

Normal Flow:

1. Doctor searches for patient record

2. System displays patient medical information

3. Doctor reviews current medical history

4. Doctor updates relevant medical information

5. Doctor adds appointment notes

6. System validates input data

7. System saves record updates

8. System creates audit log entry

9. System confirms successful update

Alternative Flows:

- **7.1 Emergency Access:** Override access for emergency medical situations

- **7.2 Patient Self-Update:** Patients update non-clinical information

Exceptions:

- **7.0.E1:** Access denied - Patient privacy settings prevent access

- **7.0.E2:** Record locked - Another doctor currently editing

- **7.0.E3:** Invalid data - System validates medical information format

Priority: Must Have
Frequency of Use: High - Used during every patient consultation
Business Rules: BR-010, BR-011, BR-012

b. Business Rules

ID	Business Rule	Business Rule Description
BR-010	Privacy Protection	Patient records can only be accessed by treating doctors or with explicit patient consent
BR-011	Audit Requirements	All record access and modifications must be logged with doctor ID, timestamp, and reason
BR-012	Data Retention	Patient records must be retained for minimum 7 years as per medical regulations

2.4   Notification System

2.4.1   UC-010_Appointment Reminders

a. Functional Description   UC ID and Name: UC-010 Appointment Reminders
Created By: Development Team
Date Created: January 2025
Primary Actor: System (Automated Service)
Secondary Actors: Patient, Notification Service
Trigger: Scheduled reminder time reached for upcoming appointment
Description: System automatically sends appointment reminders to patients at configured intervals (24 hours, 1 hour, 30 minutes) before scheduled appointments using notification templates.
Preconditions:

- Appointment exists with scheduled date/time

- Patient has active notification preferences

- Notification templates configured

Postconditions:

- Reminder notification sent to patient

- Notification status updated in database

- Delivery confirmation logged

Normal Flow:

1. System scheduler identifies upcoming appointments

2. System checks reminder intervals (24h, 1h, 30min)

3. System selects appropriate notification template

4. System personalizes message with patient/doctor details

5. System sends notification via configured channels

6. System logs notification delivery

7. System updates reminder status

Alternative Flows:

- **10.1 SMS Reminder:** Send reminder via SMS for urgent notifications

- **10.2 Email Reminder:** Send detailed reminder via email

Exceptions:

- **10.0.E1:** Delivery failure - System retries notification delivery

- **10.0.E2:** Patient opted out - System skips notification

- **10.0.E3:** Appointment cancelled - System cancels pending reminders

Priority: Should Have
Frequency of Use: High - Automated daily operations
Business Rules: BR-013, BR-014, BR-015

b. Business Rules

ID	Business Rule	Business Rule Description
BR-013	Reminder Schedule	Appointment reminders sent at 24 hours, 1 hour, and 30 minutes before appointment
BR-014	Template Usage	All notifications must use predefined templates for consistency
BR-015	Opt-out Respect	System must respect patient notification preferences and opt-out requests

3   Design Specifications

3.1   Authentication System

3.1.1   User Login

This screen allows users to authenticate into the system with role-based access to appropriate functionalities.
   Related use cases: UC-002 User Login

UI Design

Field Name	Field Type	Description
Username*	Text Box	User enters registered username or email address for authentication
Password*	Password Box	User enters password (masked input for security)
Login	Button	Submits authentication request to server
Register	Hyperlink	Redirects to user registration page for new users
Forgot Password?	Hyperlink	Initiates password reset process

Database Access

Table	CRUD	Description
Users	R	Verify username/email and password hash for authentication
Roles	R	Retrieve user role information for authorization
LoginActivity	C	Log login attempt for security audit

```
-- 1. Authenticate user credentials
SELECT u.UserID, u.Username, u.Email, u.IsActive, r.RoleName
FROM Users u
INNER JOIN Roles r ON u.RoleID = r.RoleID
WHERE (u.Username = ? OR u.Email = ?) AND u.IsActive = 1

-- 2. Log login activity
INSERT INTO LoginActivity
(UserID, UsernameAttempted, AttemptTime, IsSuccess, IPAddress, UserAgent)
VALUES (?, ?, GETDATE(), ?, ?, ?)
```

3.2 Appointment Management

3.2.1 Appointment Booking

This screen enables patients to book appointments with available doctors by selecting from available time slots.

Related use cases: UC-004 Book Appointment

UI Design

Field Name	Field Type	Description
Doctor Selection*	Dropdown	List of available doctors with specialties

Appointment Date*	Date Picker	Calendar widget for selecting appointment date
Available Time Slots*	Radio Buttons	Dynamic list of available time slots for selected doctor/date
Appointment Notes	Text Area	Optional notes about appointment purpose or concerns
Book Appointment	Button	Submit appointment booking request
Cancel	Button	Return to previous screen without booking

Database Access

Table	CRUD	Description
Users	R	Retrieve available doctors with their specialties
DoctorAvailabilitySlots	R, U	Query available slots and mark as booked
Appointments	C	Create new appointment record
Notifications	C	Schedule appointment reminder notifications

```
-- 1. Get available doctors
SELECT u.UserID, u.FirstName, u.LastName, dp.Bio, s.SpecialtyName
FROM Users u
INNER JOIN DoctorProfiles dp ON u.UserID = dp.UserID
LEFT JOIN Specialties s ON dp.SpecialtyID = s.SpecialtyID
WHERE u.RoleID = (SELECT RoleID FROM Roles WHERE RoleName = 'Doctor')
AND u.IsActive = 1

-- 2. Get available time slots
SELECT AvailabilitySlotID, SlotDate, StartTime, EndTime
FROM DoctorAvailabilitySlots
WHERE DoctorUserID = ? AND SlotDate = ? AND IsBooked = 0
ORDER BY StartTime

-- 3. Create appointment
INSERT INTO Appointments
(PatientUserID, DoctorUserID, AvailabilitySlotID, AppointmentDateTime,
 Status, AppointmentNotes, CreatedAt, UpdatedAt)
VALUES (?, ?, ?, ?, 'Scheduled', ?, GETDATE(), GETDATE())

-- 4. Update availability slot
UPDATE DoctorAvailabilitySlots
SET IsBooked = 1, UpdatedAt = GETDATE()
WHERE AvailabilitySlotID = ?
```

3.3 Patient Care System

3.3.1 Patient Records Management

This screen provides comprehensive medical record management for HIV patients including treatment history and current medications.

Related use cases: UC-007 Manage Patient Records

UI Design

Field Name	Field Type	Description
Medical History	Text Area	Comprehensive medical history including HIV diagnosis details
Current Allergies	Text Area	Known allergies and adverse reactions
Current Medications	Text Area	List of current medications including ARV regimens
Blood Type	Dropdown	ABO blood type classification
Emergency Contact	Text Box	Emergency contact person name
Emergency Phone	Text Box	Emergency contact phone number
Clinical Notes	Text Area	Doctor's clinical observations and notes
Save Record	Button	Save medical record updates
View ARV Treatments	Button	Access HIV treatment management screen

Database Access

Table	CRUD	Description
PatientRecords	R,U	Retrieve and update patient medical records
ARVTreatments	R	Access HIV treatment history
MedicationRoutines	R	View current medication schedules
Users	R	Verify doctor access permissions

```
-- 1. Retrieve patient record
SELECT RecordID, PatientUserID, MedicalHistory, Allergies,
       CurrentMedications, BloodType, EmergencyContact,
       EmergencyPhone, Notes, UpdatedAt
FROM PatientRecords
WHERE PatientUserID = ?

-- 2. Update patient record
UPDATE PatientRecords
SET MedicalHistory = ?, Allergies = ?, CurrentMedications = ?,
    BloodType = ?, EmergencyContact = ?, EmergencyPhone = ?,
    Notes = ?, UpdatedAt = GETDATE()
WHERE PatientUserID = ?
```

```
-- 3. Get ARV treatment history
SELECT ARVTreatmentID, Regimen, StartDate, EndDate,
       Adherence, SideEffects, IsActive
FROM ARVTreatments
WHERE PatientUserID = ?
ORDER BY StartDate DESC
```

4 Appendix

4.1 Assumptions & Dependencies

- **AS-1:** Microsoft SQL Server database is available and properly configured for healthcare data storage

- **AS-2:** SMTP email service is configured for sending appointment and medication reminders

- **AS-3:** System users have basic computer literacy and internet access

- **AS-4:** Clinic staff will receive training on HIV patient management workflows

- **DE-1:** Integration with existing hospital information systems may be required

- **DE-2:** HIPAA compliance requirements must be met for patient data protection

- **DE-3:** System depends on reliable internet connectivity for real-time operations

4.2 Limitations & Exclusions

- System does not include billing or insurance processing capabilities

- Laboratory result integration is not included in current scope

- Telemedicine or video consultation features are excluded

- Mobile application development is not part of initial release

- Integration with pharmacy systems for prescription management is excluded

- Advanced analytics and reporting dashboards are limited in scope

4.3   Business Rules

ID	Category	Rule Definition
BR-016	Data Security	All patient data must be encrypted at rest and in transit using AES-256 encryption
BR-017	Access Control	Role-based access ensures patients can only view their own records unless explicitly shared
BR-018	Appointment Scheduling	No overlapping appointments allowed for any doctor or patient
BR-019	Medication Adherence	ARV medication reminders are mandatory for all HIV patients unless opted out
BR-020	Record Retention	Patient medical records must be retained for minimum 7 years per healthcare regulations
BR-021	Emergency Access	Emergency override allows authorized medical staff to access any patient record
BR-022	Notification Preferences	Patients must be able to opt-out of non-critical notifications
BR-023	Data Backup	Daily automated backups of all patient data with 30-day retention

4.4   Technical Specifications

- **Backend Technology:** Spring Boot 3.x with Java 17

- **Frontend Technology:** React 18 with modern JavaScript (ES6+)

- **Database:** Microsoft SQL Server with T-SQL stored procedures

- **Authentication:** JWT (JSON Web Tokens) with BCrypt password hashing

- **API Architecture:** RESTful APIs with JSON data exchange

- **Security:** HTTPS/TLS encryption, CORS configuration, input validation

- **Deployment:** Containerized deployment ready (Docker compatible)