

PROJECT SPECIFICATION DOCUMENT

Advanced U.S. Dental Insurance System

1. Introduction

The *Advanced U.S. Dental Insurance System* is a role-based web application designed to simulate real-world dental insurance workflows in the United States.

The system manages:

- Dental insurance plan creation
- Patient enrollment
- Dentist procedure submissions
- Claim calculation (deductible, coverage %, annual max)
- Claim tracking and reporting

The project is built using **Spring Boot**, **JPA**, **Spring Security (JWT)**, **MySQL**, and follows a layered architecture.

2. Project Objectives

1. Provide a **realistic insurance management platform** involving patients, dentists, and administrators.
 2. Implement **role-based authentication** using Spring Security.
 3. Automate **claim calculation** using actual dental billing logic.
 4. Offer interactive **dashboards** for each user role.
 5. Maintain accurate records of plans, treatments, claims, and insurance payouts.
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3. System Architecture

The application uses a **standard three-layer architecture**:

3.1 Presentation Layer

- REST Controllers
- Endpoints for patient, dentist, admin modules
- JWT authentication

3.2 Service Layer

- Business logic
- Claim calculation engine
- Deductible and annual max management
- Plan rule processing

3.3 Data Access Layer

- JPA Repositories
- CRUD operations for all entities
- MySQL relational schema

3.4 Security Layer

- Spring Security + JWT
- Role-based URL authorization
- Password encryption (BCrypt)

4. User Roles and Functional Specifications

There are **three primary users** in the system.

Each role has distinct features, dashboards, and permissions.

4.1 PATIENT (End User of Insurance)

4.1.1 Responsibilities

The patient is the insured individual who selects a plan, undergoes treatments, and views insurance benefits.

4.1.2 Functionalities

1. Register Account

- Enter personal details
- System validates and stores patient profile
- Default role: PATIENT

2. Login & Authentication

- Login using email + password
- Receives JWT token for all protected operations

3. View Available Dental Plans

- List all plans created by admin
- View coverage percentages, deductible, annual max, premium

4. Enroll in a Plan

- Choose one plan
- System creates `Enrollment` record with:
 - benefitYear
 - deductibleUsed = 0
 - annualMaxUsed = 0

5. View Benefit Summary

- Shows remaining deductible
- Shows annual max remaining
- Shows plan coverage details

6. Submit Claim (optional if dentist does not submit)

- Upload invoice or treatment details

7. View Claims and Status

- For each claim:
 - Total fee
 - Insurance paid
 - Patient responsibility
 - Claim processing date

8. View Treatment History

- Claims grouped by date or dentist
 - Procedure names and codes displayed
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4.2 DENTIST (Healthcare Provider)

4.2.1 Responsibilities

The dentist or clinic submits treatments performed on patients.

4.2.2 Functionalities

1. Login

- Access dentist dashboard
- JWT-based authentication

2. Add Dental Procedures

- Enter CDT code, description, category, and fee
- Stored in `DentalProcedure` table

3. Submit Treatment Claim

- Select patient
- Select procedure performed
- Add treatment notes
- System creates a `Claim` + `ClaimLine`

4. View Past Claims Submitted

- List of claim submissions
- Status: Calculated / Pending / Completed

5. View Calculation Results

- Insurance vs patient share
 - Deductible calculations applied
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4.3 ADMIN (Insurance Company Staff)

4.3.1 Responsibilities

Admin manages the entire insurance ecosystem.

4.3.2 Functionalities

1. Login

- Secure access with ADMIN role

2. Create Dental Plans

- Name
- Deductible
- Annual Maximum
- Coverage by category (Preventive, Basic, Major)
- Monthly premium

3. Edit Existing Plans

- Modify coverage percentages
- Update annual max or deductible

4. Manage Fee Schedules

- Add/update procedure categories (coverage types)
- Link coverage % to CDT categories

5. User Management

- Approve dentists (optional)
- View list of patients enrolled

6. Claims Administration (Advanced)

- View claim queue
- Approve or reject claims (if manual processing enabled)

7. Analytics Dashboard

- Total claims
- Total payouts

- Plan performance
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5. System Workflow

This section describes **how the complete system behaves end-to-end**.

STEP 1 – Admin Creates Dental Insurance Plans

Admin logs into dashboard → Creates a new plan:

Plan: Delta Dental Gold

Deductible: \$50

Annual Max: \$1500

Coverage:

- Preventive: 100%
- Basic: 80%
- Major: 50%

Premium: \$40/month

Plan stored in `DentalPlan` table.

STEP 2 – Patient Enrolls in a Plan

Patient logs in → Views available plans → Chooses one.

System creates `Enrollment`:

`benefitYear = 2025`

`deductibleUsed = 0`

`annualMaxUsed = 0`

STEP 3 – Dentist Performs Treatment and Submits Claim

Dentist selects patient and procedure (e.g., CDT D2740: Crown).

Claim is created in:

- `Claim`
 - `ClaimLine`
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STEP 4 – Claim Calculation Engine

The system automatically applies U.S. dental billing logic:

4.1 Deductible Application

- If deductible remaining > 0 → patient pays first

4.2 Coverage Percentage

Based on category:

Category	Coverage %
Preventive	100%
Basic	80%
Major	50%

4.3 Annual Maximum Enforcement

Insurance stops paying once annual max is reached.

Example Result:

Total Fee: 1200

Deductible Applied: 50

Insurance Pays: 575

Patient Pays: 625

Annual Max Remaining: 925

Enrollment table updated accordingly.

STEP 5 – Patient Views Final Claim Result

Displayed on dashboard:

Claim #1024

Insurance Paid: \$575

You Pay: \$625

Deductible Remaining: \$0

Annual Max Remaining: \$925

6. Role-Based Dashboards

Each user sees different modules.

6.1 Patient Dashboard

- Plan Enrollment
 - Benefit Summary
 - Claims List
 - Submit Claim
 - Treatment history
 - Profile settings
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6.2 Dentist Dashboard

- Add Procedures
 - Submit Claim
 - View Submitted Claims
 - Patient lookup
 - Edit notes
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6.3 Admin Dashboard

- Create / Edit Plans
- Manage Coverage Rules
- User Management
- Claims Monitoring
- Reports & Analytics

7. Database Design (High-Level)

Key Entities:

- User
- Role
- Patient
- Dentist
- DentalPlan
- Enrollment
- Claim
- ClaimLine
- DentalProcedure

(If you want, I can produce a **full ER diagram PDF.**)

8. Security Module

Features:

- JWT Authentication
- Role-based authorization
- Endpoints access control:

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/admin/** → ADMIN only  
/dentist/** → DENTIST only  
/patient/** → PATIENT only
```

- Password encryption using BCrypt

9. Technology Stack

Layer	Technology
Backend	Spring Boot (Java 21)

Layer	Technology
ORM	JPA / Hibernate
Security	Spring Security + JWT
Database	MySQL
View Layer	JSP / React (your choice)
Tools	STS, Postman
