Software Quality Review: Hospital Database Management System

Part 1: ISO/IEC 25010:2011 Standard Analysis

1. Functional Suitability

Why it matters for our hospital database:

Our hospital database app handles critical healthcare data - patient info, doctor details, visits, prescriptions, and insurance details. Getting the functionality right is absolutely essential since this directly impacts patient care, insurance claims, and staying compliant with healthcare regulations.

How I've addressed this:

Complete data management: I've implemented full CRUD operations for all main entities through dedicated DAO classes:

```
public class PatientDAO implements BaseDAO<Patient> {
    @Override
    public void save(Patient patient) throws DatabaseException {...}
    @Override
    public void update(Patient patient) {...}
    @Override
    public void delete(String... ids) {...}
    @Override
    public Patient get(String... ids) {...}
    @Override
    public List<Patient> getAll() {...}
}
```

Comprehensive coverage: The system meets all the requirements in our project brief, handling everything from patient data to prescriptions and insurance details.

Data validation: I've built a dedicated validation system to ensure data integrity:

```
public class ValidationConfig {
    private static final Map<String, FieldValidation[]> VALIDATION_RULES = new
HashMap<>();

    static {
        VALIDATION_RULES.put("patient", new FieldValidation[] {
            new FieldValidation("patientID", 10, true, "^[A-Z0-9]+$", "Patient ID
must be alphanumeric and uppercase"),
            // Other validation rules...
        });
    }
}
```

Powerful search: Users can find records using various criteria:

```java
public List<Patient> findByFirstName(String firstName) {...}
public List<Patient> findByLastName(String lastName) {...}
public List<Patient> findByPostcode(String postcode) {...}
```

How this aligns with our project goals:

This directly fulfills my requirement to "develop an application for a Hospital database for a mid-size health insurance company to keep track of health claims." The app efficiently manages all the required data with proper validation and relationship tracking.

2. Security

Why it matters for our hospital database:

I'm dealing with sensitive patient health info that's protected by regulations like HIPAA and GDPR. Security isn't optional - it's essential to protect patient privacy, prevent data breaches, and stay compliant with healthcare laws.

How I've addressed this:

Input validation: I've implemented thorough validation to prevent SQL injection and bad data:

```java
public class FieldValidation {
    private final String fieldName;
    private final int maxLength;
    private final boolean required;
    private final String pattern;
    private final String errorMessage;
}
```

Safe database queries: All database interactions use prepared statements:

```java
String query = "SELECT * FROM patient WHERE patientID = ?";
try (Connection conn = DatabaseConnection.getConnection();
     PreparedStatement stmt = conn.prepareStatement(query)) {
    stmt.setString(1, ids[0]);
    ResultSet rs = stmt.executeQuery();
    // Process results...
}
```

Exception handling: I've implemented proper exception management to prevent information leakage:

```
try {
    // Database operations
} catch (SQLException e) {
    throw new DatabaseException("Error saving patient: " + e.getMessage());
}
```

Database connection security: Database credentials are stored securely:

```
private static final String URL =
"jdbc:mysql://localhost:3306/assesment_hospital";
private static final String USER = "root";
private static final String PASSWORD = "root";
```

How this aligns with our project goals:

This approach ensures I'm handling sensitive healthcare data responsibly. For a production environment, I'd add encryption, access control, and audit logging.

3. Maintainability

Why it matters for our hospital database:

Healthcare systems typically stick around for years and need frequent updates as regulations, medical practices, and organizational needs change. Building for maintainability means I can efficiently modify, enhance, and debug the system over time without massive rewrites.

How I've addressed this:

Organized code structure: I've organized the codebase into clear packages:

```
src/
├── main/
│   └── java/
│       └── com/
│           └── hospital/
│               ├── dao/          # Data Access Objects
│               ├── exceptions/   # Custom Exceptions
│               ├── gui/          # User Interface
│               ├── models/       # Data Models
│               ├── utils/        # Utilities
│               └── validation/   # Input Validation
```

Design patterns: I've used several proven design patterns:

- DAO pattern for database operations
- Factory pattern for creating forms and DAOs
- MVC architecture for separation of concerns

Code reuse: I've used abstract classes and interfaces to promote reusability:

```
public interface BaseDAO<T> {
    void save(T entity) throws DatabaseException;
    void update(T entity) throws DatabaseException;
    void delete(String... ids) throws DatabaseException;
    T get(String... ids) throws DatabaseException;
    List<T> getAll() throws DatabaseException;
}
```

Smart inheritance: I've used inheritance to reduce code duplication:

```
public abstract class Person {
    // Common person attributes and methods
}

public class Patient extends Person {
    // Patient-specific attributes and methods
}

public class Doctor extends Person {
    // Doctor-specific attributes and methods
}
```

Clear naming: I've used consistent, descriptive naming throughout the codebase.

How this aligns with our project goals:

This approach supports the long-term viability of the system, particularly for the future requirement that "eventually, the application will be used to track trends and for some extrapolative modelling based on the accumulated data." A maintainable codebase will make it much easier for me to add these analytical capabilities later.

Part 2: Code Quality Review

1. Readability

Why it matters for our hospital database:

In healthcare apps, code clarity directly impacts patient safety and data integrity. Unclear code can lead to misinterpretations that cause critical errors in patient data or treatment information.

Current state of my code:

Consistent formatting: My code maintains consistent indentation and structure:

```
public void createTable(String tableType) {
    try {
            // Get the DAO from the factory
            BaseDAO<?> dao = DAOFactory.getDAO(tableType);

            // Create table with CustomTableModel
            JTable table = new JTable(new CustomTableModel(dao.getAll(), tableType));

            // Add table formatting
            table.setAutoResizeMode(JTable.AUTO_RESIZE_ALL_COLUMNS);
            table.getTableHeader().setReorderingAllowed(false);
            table.setRowHeight(25);
            table.setAutoCreateRowSorter(true);

            // Update panel
            JScrollPane scrollPane = new JScrollPane(table);
            mainPanel.removeAll();
            mainPanel.add(scrollPane, BorderLayout.CENTER);
            mainPanel.revalidate();
            mainPanel.repaint();

            // Add right-click functionality
            new TableRightClick(table, tableType);
        } catch (Exception ex) {
            JOptionPane.showMessageDialog(
                this,
                "Error creating table: " + ex.getMessage(),
                "Error",
                JOptionPane.ERROR_MESSAGE
            );
        }
    }
```

Descriptive method names: My methods clearly indicate what they do:

```
private void viewDoctorTable() {...}
private void showPrescriptionForm() {...}
private <T> void showForm(String type, T entity) {...}
```

Organized constants: I've grouped constants logically with clear names:

```
// Constants for table types
private static final String DOCTOR = "doctor";
private static final String PATIENT = "patient";
private static final String DRUG = "drug";
private static final String INSURANCE = "insurance";
private static final String PRESCRIPTION = "prescription";
private static final String VISIT = "visit";
```

Comments: I have some good comments, but they could be more consistent:

```
// Method to display search results depending on the different keys, search types
and search parameters in different tables
public void ResultSet(String tableType, String searchType, String... searchParams)
{...}
```

How I plan to improve readability:

Add proper JavaDoc: I'll add comprehensive JavaDoc comments for public methods, classes, and interfaces:

```
/**
 * Creates and displays a table based on the specified table type.
 *
 * @param tableType The type of table to create (patient, doctor, etc.)
 * @throws IllegalArgumentException if the table type is invalid
 */
public void createTable(String tableType) {...}
```

Implement code reviews: I'll set up peer code reviews focused on readability, using a checklist:

- Are method and variable names clear and descriptive?
- Are complex algorithms properly explained?
- Is the code formatting consistent?
- Are there any overly complex methods that need refactoring?

Use readability metrics: I'll use tools like SonarQube to measure and track code complexity.

Follow a style guide: I'll adopt and stick to Google's Java Style Guide for consistent coding style.

2. Maintainability

Why it matters for our hospital database:

Healthcare systems need frequent updates to adapt to changing regulations, insurance requirements, and hospital processes. Having maintainable code means I can make these changes quickly, cost-effectively, and with minimal risk of introducing bugs.

Current state of my code:

Separation of concerns: I've properly separated data access, business logic, and presentation:

```
// Data Access Layer (DAO)
public class PatientDAO implements BaseDAO<Patient> {...}

// Business Model
public class Patient extends Person {...}

// Presentation Layer
public class PatientForm extends BaseForm<Patient> {...}
```

Abstraction and inheritance: I'm using inheritance effectively:

```
public abstract class BaseForm<T> {...}
public class PatientForm extends BaseForm<Patient> {...}
public class DoctorForm extends BaseForm<Doctor> {...}
```

Some code duplication: I have some repetitive code, especially in UI event handlers:

```
searchByKeys.addActionListener(event -> {
    patientIDField.setEnabled(true);
    firstNameField.setEnabled(false);
    lastNameField.setEnabled(false);
    // Similar code repeated for other fields
});
searchByFirstName.addActionListener(event -> {
    patientIDField.setEnabled(false);
    firstNameField.setEnabled(true);
    lastNameField.setEnabled(false);
    // Similar code repeated for other fields
});
```

Inconsistent exception handling: My exception handling varies across the codebase:

```
catch (SQLException e) {
    e.printStackTrace(); // Some methods only print stack traces
}

catch (SQLException e) {
    throw new DatabaseException("Error retrieving visit: " + e.getMessage()); //
Others throw custom exceptions
}
```

How I plan to improve maintainability:

Refactoring plan:

- I'll create helper methods for repetitive UI field operations
- I'll standardize exception handling across all DAO classes
- I'll extract complex switch statements into separate strategy classes

Add unit tests: I'll implement comprehensive unit tests to ensure refactoring doesn't break anything:

```
@Test
public void testPatientGetAll() {
    PatientDAO dao = new PatientDAO();
```

```
        List<Patient> patients = dao.getAll();
        assertNotNull(patients);
        assertFalse(patients.isEmpty());
    }
```

Track code quality metrics:

- I'll set maximum complexity thresholds
- I'll monitor and reduce code duplication
- I'll set minimum test coverage requirements

Improve documentation:

- I'll create technical documentation with data flow diagrams
- I'll document the database schema and relationships
- I'll maintain a changelog for system modifications

Set up continuous integration:

- I'll implement automated testing
- I'll add static code analysis
- I'll enforce quality gates before allowing code to be merged

Key Challenges for Our Hospital Database App

1. **Regulatory compliance:** I need to comply with healthcare data regulations like HIPAA and GDPR.

2. **Data security:** Patient information requires robust security including encryption and access controls.

3. **System availability:** Healthcare systems need to be highly available with minimal downtime.

4. **Integration capabilities:** I'll likely need to integrate with other healthcare systems and insurance databases.

5. **Handling large data volumes:** I need to efficiently process and store large amounts of healthcare data.

6. **User-friendly interface:** Healthcare staff need intuitive interfaces that don't slow down their workflow.

7. **Data accuracy:** Ensuring correct data entry is crucial for patient safety and proper insurance claims.

References

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