

Verification and Validation Report: SFWRENG 4G06A

Team #25, RapidCare

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1 Revision History

| Date | Version | Notes |
|------------|---------|----------------|
| 2025-03-10 | 1.0 | Initial Report |

2 Symbols, Abbreviations and Acronyms

| symbol | description |
|--------|-------------------------------------|
| T | Test |
| SRS | Software Requirements Specification |
| MG | Module Guide |
| MIS | Module Interface Specification |
| FR | Functional Requirements |
| NFR | Non-Functional Requirements |
| UI | User Interface |
| MFA | Multi-Factor Authentication |
| MG | Module Guide |
| M | Module |
| MIS | Module Interface Specification |
| API | Application Programming Interface |
| MFA | Multi-Factor Authentication |
| IR | Integrity Requirement |
| AR | Access Requirement |

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This document summarizes the results of the series of tests as outlined in the VnV Plan, demonstrating the system's compliance with the specified requirements and highlighting areas of success as well as any identified issues.

3 Functional Requirements Evaluation

3.1 Add a document to the database

This subsection covers FR1, FR4, and FR8 from of the [SRS document](#) by testing that the system is able to add a document to the database only when a valid input is provided.

1. test-FR1,4,8-1

Initial State: The system is set up, open to the following sections: Patient Records, Healthcare Professional Records and Healthcare Network Records. The system is ready to take the user input.

Input: Correct and complete input data for all required fields.

Expected Output: A confirmation message and a new entry is added to the appropriate database.

Actual Output: A confirmation message and a new entry is added to the appropriate database.

Result: Pass

2. test-FR1,4,8-2

Initial State: The system is set up, open to the following sections: Patient Records, Healthcare Professional Records and Healthcare Network Records. The system is ready to take the user input.

Input: Invalid input data.

Expected Output: An error message outlining the invalid fields along with a possible steps to guide the users to recover from the error state.

Actual Output: An error message outlining the invalid fields along with a possible steps to guide the users to recover from the error state.

Result: Pass

3.2 Remove a document to the database

This subsection covers FR2, FR5, and FR9 from of the [SRS document](#) by testing that the system is able to remove a document to the database only when a valid input identifier is provided.

1. test-FR2,5,9-1

Initial State: The system is set up, open to the following sections: Patient Records, Healthcare Professional Records and Healthcare Network Records. The system is ready to take the user input. A document exists in the appropriate database.

Input: A correct identifier for the document to be deleted.

Expected Output: A confirmation message and relevant entry no longer exist in the database.

Actual Output: A confirmation message and relevant entry no longer exist in the database.

Result: Pass

2. test-FR2,5,9-2

Initial State: The system is set up, open to the following sections: Patient Records, Healthcare Professional Records and Healthcare Network Records. The system is ready to take the user input. A document exists in the appropriate database.

Input: An invalid identifier for the document to be deleted.

Expected Output: An error message outlining the invalid input along with a possible steps to guide the users to recover from the error state.

Actual Output: An error message outlining the invalid input along with a possible steps to guide the users to recover from the error state.

Result: Pass

3.3 Update a document to the database

This subsection covers FR3, FR6, FR10, and FR11 from of the [SRS document](#) by testing that the system is able to update a document to the database only when a valid input identifier is provided.

1. test-FR3,6,10,11-1

Initial State: The system is set up, open to the following sections: Patient Records, Healthcare Professional Records and Healthcare Network Records. The system is ready to take the user input.

Input: A correct identifier for the document to be updated.

Expected Output: A confirmation message and relevant entry shows the updated data in the database.

Actual Output: A confirmation message and relevant entry shows the updated data in the database.

Result: Pass

2. test-FR3,6,10,11-2

Initial State: The system is set up, open to the following sections: Patient Records, Healthcare Professional Records and Healthcare Network Records. The system is ready to take the user input.

Input: Invalid input data.

Expected Output: An error message outlining the invalid fields along with a possible steps to guide the users to recover from the error state.

Actual Output: An error message outlining the invalid fields along with a possible steps to guide the users to recover from the error state.

Result: Pass

3.4 Login for valid/invalid credentials

This subsection covers FR7 from of the [SRS document](#) by testing that the system is able to allow to access the database only when a valid input credentials is provided.

1. test-FR7-1

Initial State: The system is set up, open to the following sections: Patient Records, Healthcare Professional Records and Healthcare Network Records. The system is ready to take the user input.

Input: The correct credentials for login.

Expected Output: A confirmation message and user is logged into the system.

Actual Output: A confirmation message and user is logged into the system.

Result: Pass

2. test-FR7-2

Initial State: The system is set up, open to the following sections: Patient Records, Healthcare Professional Records and Healthcare Network Records. The system is ready to take the user input.

Input: Invalid credentials for login.

Expected Output: An error message outlining the invalid fields.

Actual Output: An error message outlining the invalid fields.

Result: Pass

3.5 Voice-to-text-transcription check

This subsection covers FR7 from of the [SRS document](#) by testing that the system is able to transcribe audio data to the written text.

1. test-FR11-1

Initial State: The system is set up, open to the following sections: Patient Records, Healthcare Professional Records and Healthcare Network Records. The system is ready to take the user input.

Input: A valid audio chunk from the conversation between the healthcare professional and the patient.

Expected Output: A confirmation message indicating successful transcription and the screen shows the transcribed text.

Actual Output: A confirmation message indicating successful transcription and the screen shows the transcribed text.

Result: Pass

2. test-FR11-2

Initial State: The system is set up, open to the following sections: Patient Records, Healthcare Professional Records and Healthcare Network Records. The system is ready to take the user input.

Input: An invalid data format for transcription.

Expected Output: An error message saying that the file or data format is not valid.

Actual Output: An error message saying that the file or data format is not valid.

Result: Pass

3.6 Validate output of correct diagnosis and medication

This subsection covers FR12 and FR13 from of the [SRS document](#) by testing that the system is able to create predictions on the diagnosis and medicines with a high accuracy and confidence.

1. test-FR12,13-1

Initial State: The user has uploaded the blank chart, and the chart has been populated with the patients symptoms.

Input: Correct and complete input data where all the symptoms fields of the chart are filled out.

Expected Output: A suggestion on what the diagnosis should be based on the symptoms, then based on the diagnosis provide possible medicine.

Actual Output: A suggestion on what the diagnosis should be based on the symptoms, then based on the diagnosis provide possible medicine.

Result: Pass

3.7 Validate input data for models

This subsection covers FR12, FR13, and IR5 from of the [SRS document](#) by testing that the system is able to validate the input data in the charts such that it may be inputted into the prediction module.

1. test-FR12,13,IR5-1

Initial State: The user has uploaded a blank chart.

Input: Correct and complete input data where all the symptoms fields of the chart are filled out.

Expected Output: A suggestion on what the diagnosis should be based on the symptoms, then based on the diagnosis provide possible medicine.

Actual Output: A suggestion on what the diagnosis should be based on the symptoms, then based on the diagnosis provide possible medicine.

Result: Pass

2. test-FR12,13,IR5-2

Initial State: The user has uploaded the blank chart a blank chart.

Input: Incorrect and incomplete input data where all the symptoms fields of the chart are filled out.

Expected Output: An error message asking to fix the respective fields.

Actual Output: An error message asking to fix the respective fields.

Result: Pass

4 Nonfunctional Requirements Evaluation

4.1 Aesthetic and Design

1. test-AD1

Initial State: UI is designed and implemented.

Input: Team members and peers view the UI under normal operating conditions.

Output: Feedback collected on UI's aesthetic appeal and simplicity.

Result: Pass

2. test-AD2

Initial State: UI is operational and accessible to users.

Input: Users interact with the UI during routine tasks and provide feedback.

Output: Team members and peers report satisfaction with the UI design.

Result: Pass

4.2 Usability

1. test-UR1

Initial State: System is deployed and accessible.

Input: Users navigate and explore system features independently.

Output: Majority of users can locate core functions without additional guidance.

Result: Pass

4.3 Performance

1. test-PR1

Initial State: Transcription interface open and ready.

Input: Real-time voice input provided by healthcare professionals.

Output: Real-time transcription displayed within a 2-second delay.

Result: Pass

4.4 Operational

1. test-OR1

Initial State: System is live and connected to monitoring software.

Input: 7-day operational period with intermittent load testing.

Output: Team members and peers monitored uptime consistently maintained at 99.9% or above.

Result: Pass

2. test-OR2

Initial State: System in operational use.

Input: Users access the system over a 7-day period under normal and peak loads.

Output: Team members and peers confirm that uptime meets standards without significant interruptions.

Result: Pass

4.5 Maintainability

1. test-MR1

Initial State: System running on the latest version with recent update logs.

Input: Regular software update applied for bug fixes and improvements.

Output: System successfully applies updates without impacting stability.

Result: Pass

2. test-MR2

Initial State: Previous version of the system with identified bugs or issues.

Input: Apply updates addressing known issues.

Output: System functions as expected with resolved issues and no new errors introduced.

Result: Pass

4.6 Security

1. test-SR1

Initial State: System fully operational with access logs enabled.

Input: Simulate unauthorized access attempts.

Output: Unauthorized attempts are blocked; access logs capture details.

Result: Pass

4.7 Cultural

1. test-CR1

Initial State: System operational with default settings.

Input: User interacts with the system in a culturally diverse context, including input that may contain sensitive language.

Output: System processes the input and responds appropriately, ensuring cultural sensitivity and avoiding any inappropriate language in its output.

Result: Pass

4.8 Legal

1. test-LR1

Initial State: System is fully functional and contains patient records.

Input: Conduct a compliance audit with PIPEDA and other relevant data protection standards.

Output: System passes all compliance checks with no exceptions.

Result: Pass

2. test-LR2

Initial State: System storing and transmitting patient data over a network.

Input: Monitor data handling and transfer processes during operation.

Output: All patient data is handled in compliance with regulations, without any unauthorized access or data breaches.

Result: Pass

4.9 Scalability

1. test-S1

Initial State: System deployed on a test server environment capable of scaling horizontally.

Input: Simulate an increasing number of concurrent users.

Output: System maintains consistent performance and response times without degradation.

Result: Pass

4.10 Tests for Safety and Security Requirements

4.10.1 Access Requirements Tests (AC1)

1. test-AC1-1

Initial State: System deployed with authentication module enabled and test user accounts configured.

Input: Attempt to access protected resources with invalid credentials.

Output:

- System logs each failed attempt.
- User receives failed to login notification.

Result: Pass

2. test-AC1-2

Initial State: System operational with authentication logs enabled.

Input: Attempt to access system resources without authentication.

Output:

- All unauthorized access attempts are blocked.
- Each attempt is logged with timestamp, IP address, and attempted resource.

Result: Pass

3. test-AC2-1

Initial State: System operational with standard user and admin accounts configured.

Input: Attempt to create, update, and delete user accounts using non-admin credentials.

Output:

- All unauthorized actions are blocked.
- Actions are logged with user details.
- Security team can review blocked attempts.

Result: Pass

4.10.2 Integrity Requirements Tests (IR1)

1. test-IR1-1

Initial State: System operational with test user accounts and authentication database.

Input: Simulate multiple concurrent failed login attempts while monitoring credential storage.

Output: User credentials remain unchanged, and system maintains stability.

Result: Pass

2. test-IR2-1

Initial State: System is set up, open to the relevant section, and ready to take user input.

Input: Submit an invalid data input.

Output: An error message is displayed to the user. No data is added to any database.

Result: Pass

3. test-IR3-1

Initial State: The prediction model is ready to predict medication and diagnosis.

Input: A test set of various patient medical charts.

Output: The prediction includes a diagnosis and medication prediction, each with a confidence score exceeding 85%.

Result: Pass

4. test-IR4-1

Initial State: System is set up, open to the relevant section, and ready to take user input. A document already exists in the relevant database.

Input: A new input with the same data as an existing document.

Output: An error message is displayed. No new document is added to the database.

Result: Pass

5. test-IR5-1 Initial State: System is set up, open to the relevant section, and ready to take user input. A document already exists in the relevant database.

Input: Written text transcribed from the audio data.

Output: The data is correctly classified in the generated report with no diagnosis errors.

Result: Pass

6. test-IR6-1

Initial State: System is set up, open to the relevant section, and ready to take user input.

Input: Audio conversation between the patient and healthcare professional.

Output: The written text transcribed from the input data matches the conversation with minimal to no interference.

Result: Pass

5 Comparison to Existing Implementation

This section will not be appropriate for the project.

6 Unit Testing

6.1 Behaviour-Hiding Module

6.1.1 User Authentication Module

Control: Manual

Initial State: The default email and password are initialized as variables and given a default value.

Test Case Derivation: The expected behavior is derived from the correct registration and login functionality of Firebase Authentication, ensuring valid user creation and authentication processes, as well as error handling for invalid credentials.

Test Procedure: The tests are performed as follows:

1. Sign up using valid credentials:
 - **Input:** The input for this test are the valid credentials of email and password.
 - **Output:** The user object is returned by the signup function.
 - **Test Derivation:** Verifies that the signup function correctly works and creates a new user account when the valid credentials are provided.
 - **Result:** Pass
2. Sign up throwing errors with invalid credentials:
 - **Input:** The input for this test are the invalid credentials of email and password.
 - **Output:** An error thrown up by the signup function.
 - **Test Derivation:** Verifies that the signup function correctly throws error when the invalid credentials are provided.
 - **Result:** Pass
3. Sign in using valid credentials:
 - **Input:** The input for this test are the valid credentials of email and password.
 - **Output:** The user object is returned by the signin function.
 - **Test Derivation:** Verifies that the signin function correctly authenticates the user when valid credentials are provided.
 - **Result:** Pass
4. Sign in throwing errors with invalid credentials:
 - **Input:** The input for this test are the invalid credentials of email and password.
 - **Output:** An error thrown up by the signin function.

- **Test Derivation:** Verifies that the signin function correctly throws error when the invalid credentials are provided.
- **Result:** Pass

6.1.2 Administrator Account Management Module and Patient Account Management Module

Control: Manual

Initial State: Provides mock data of healthcare professionals, healthcare networks and patients.

Test Case Derivation: The expected behavior is derived from the correct functionality of onboarding, updating, and removing the healthcare networks, healthcare professionals and patient records.

Test Procedure: The tests are performed as follows:

1. Adding valid documents to the database:

- **Input:** Mock data of the healthcare professionals, healthcare networks and patients are given as input.
- **Output:** Successful addition of valid information of healthcare networks, healthcare professionals and patients in the database.
- **Test Derivation:** Verifies that addHealthcareProfessional, addHospital and addPatient functions work correctly ensuring proper document creation. The functions addHealthcareProfessional and addHospital add the documents if they don't exist in the database. However, if they do, then these functions update the data in those documents. The function addPatient is only used to add a new patient record in the database.
- **Result:** Pass

2. No duplicate addition of patient document in the system:

- **Input:** Mock data of the patients are given as input.
- **Output:** No specific output is returned by the test function itself. However, the test asserts a specific state in the database.
- **Test Derivation:** Verifies that the addPatient function correctly handles attempts to add duplicate patient records. It ensures that only one patient record is created even if the addPatient function is called multiple times.
- **Result:** Pass

Note: Test for invalid document format:

Since, we have implemented validate input function in the UI module, this ensures

that no invalid output is taken by the system. In addition to this, TypeScript has type checking on the parameters therefore invalid objects cannot be passed.

3. Deleting existing documents from the database:

- **Input:** Mock data of the healthcare professionals, healthcare networks and patients are given as input.
- **Output:** Successful deletion of valid information of healthcare networks, healthcare professionals and patients in the database.
- **Test Derivation:** Verifies that deleteHealthCareProfessional, deleteHospital and deletePatient functions work correctly ensuring proper document deletion. item
Result: Pass

4. Updating existing patient documents in the database:

- **Input:** Mock data of the patients are given as input.
- **Output:** Successful update of valid information of the patients in the database.
- **Test Derivation:** Verifies that updatePatient function works correctly ensuring proper patient record update.
- **Result:** Pass

5. Retrieve correct existing document:

- **Input:** Mock id of the patients are given as input.
- **Output:** Retrieval of the correct patient object from the database.
- **Test Derivation:** Verifies that the getPatient function correctly retrieves an existing patient document from the database after providing patient id.
- **Result:** Pass

6. Retrieve non-existing document:

- **Input:** Non-existent mock id of the patients are given as input.
- **Output:** Returns null.
- **Test Derivation:** Verifies that the getPatient function correctly handles situations when a non-existing patient document from the database is requested to retrieve after providing a non-existing patient id.
- **Result:** Pass

6.1.3 Administrator View Module and Patient View Module

Control: Manual

Initial State: No specific initialization is required as tests solely focus on validating fields.

Test Case Derivation: The expected behavior is derived from the correct implementation of data validation rules and age calculation logic, ensuring accurate identification of invalid input, acceptance of valid input, and precise calculation of age based on provided dates.

Test Procedure: The tests are performed as follows:

1. Should return appropriate error for invalid field input:
 - **Input:** The inputs for this test are the actual value of the field and a string representing the field type.
 - **Output:** Returns appropriate error messages on receiving invalid input.
 - **Test Derivation:** Verifies that the validateField function correctly identifies invalid input values for different field types. It ensures that the function returns appropriate error messages for invalid email formats, phone numbers, dates, and numerical values for age, weight, and height.
 - **Result:** Pass
2. Should return an empty string for valid field input:
 - **Input:** The inputs for this test are the actual value of the field and a string representing the field type.
 - **Output:** Returns an empty string on receiving invalid input.
 - **Test Derivation:** Verifies that the validateField function correctly identifies valid input values for different field types. It ensures that the function returns an empty string for valid email formats, phone numbers, dates, and numerical values for age, weight, and height.
 - **Result:** Pass
3. Correct calculation of age:
 - **Input:** The input for this test is the date of birth.
 - **Output:** Returns a number representing the calculated age.
 - **Test Derivation:** Verifies that the calculateAge function correctly calculates the age for a given date of birth.
 - **Result:** Pass
4. Calculation of age for future dates:
 - **Input:** The input for this test is the date of birth in the future.

- **Output:** Returns 0.
- **Test Derivation:** Verifies that the calculateAge function correctly handles the age for a given date of birth in the future.
- **Result:** Pass

5. Calculation of age for the present date:

- **Input:** The input for this test is the date of birth representing today's date.
- **Output:** Returns 0.
- **Test Derivation:** Verifies that the calculateAge function correctly handles the age for a given date of birth with today's date.
- **Result:** Pass

6.2 Software Decision Module

6.2.1 Diagnosis Prediction Module and Medicine Prediction Module

Control: Manual

Initial State: A predefined set of conversation is used for testing. It also assumes that Open API Key is configured correctly.

Test Case Derivation: The expected behavior is derived from the correct functioning of an API endpoint that processes patient inputs and provides relevant responses, ensuring accurate handling of valid and invalid input data, as well as a high confidence level in generating appropriate responses.

Test Procedure: The tests are performed as follows:

1. Confidence score test:

- **Input:** The input for this test is the list of strings which represent patient conversation.
- **Output:** There is no direct output. This test asserts a condition based on the number of successful evaluations.
- **Test Derivation:** Verifies that the testConfidence function correctly sends each conversation to the API endpoint. The test calculates the success rate based on the number of relevant responses and asserts that the success rate is above a certain threshold (0.85). Due to the output of this test not being the deterministic, we have used a strategy that involves using a third independent AI agent to evaluate the confidence. This allows for an initial benchmark of the confidence on the service's performance.
- **Result:** Pass

2. Valid data input test:

- **Input:** A dictionary that contains a valid transcription of a patient conversation.
- **Output:** Returns a response object from API endpoint.
- **Test Derivation:** Verifies that the API endpoint correctly handles and processes valid input data. It sends POST request with valid transcription to the API endpoint and asserts that the response status code is 200, indicating successful processing of the input.
- **Result:** Pass

3. Invalid data input test:

- **Input:** A dictionary that contains an empty string of invalid transcription of a patient conversation.
- **Output:** Returns a response object from API endpoint.
- **Test Derivation:** Verifies that the API endpoint correctly handles and processes invalid input data. It sends POST request with invalid and missing transcription to the API endpoint and asserts that the response status code is 400, successful identification of invalid input.
- **Result:** Pass

7 Changes Due to Testing

Based on the feedback received during the Rev 0 demo, we focused on ensuring that we prioritize critical and necessary requirements in the final implementation. We incorporated user feedback messages in accordance with the functional tests. Additionally, we updated the functions responsible for validating input data to cover the edge cases discovered during testing, ensuring that the system can handle unexpected or invalid inputs gracefully. Furthermore, we placed a strong emphasis on UI and usability testing. This involved gathering feedback on the aesthetic appeal and functionality of the user interface, ensuring that users could navigate the system intuitively and efficiently. Iterative testing process allowed us to refine the system significantly and make several design adjustments leading to a more user-friendly application.

8 Automated Testing

In our repository, we use GitHub Actions to automate critical aspects of our development workflow, primarily focusing on testing and code quality. This automation ensures that every code change undergoes a rigorous validation process before being integrated into the main branch. The execution of our suite of unit and integration tests forms the basis of our

continuous integration approach. This makes sure that any new code modifications don't cause regressions or interfere with already-existing functionality. These tests are automatically executed on each pull request, allowing us to promptly detect and fix any possible problems early in the development cycle. Our team has been continuously running into linting problems on all pull requests lately. Even though our tests pass GitHub Actions CI / Explore-GitHub-Actions (push) test, it fails the Lint code base (push) test. The screenshot below show an example of lint-codebase error.

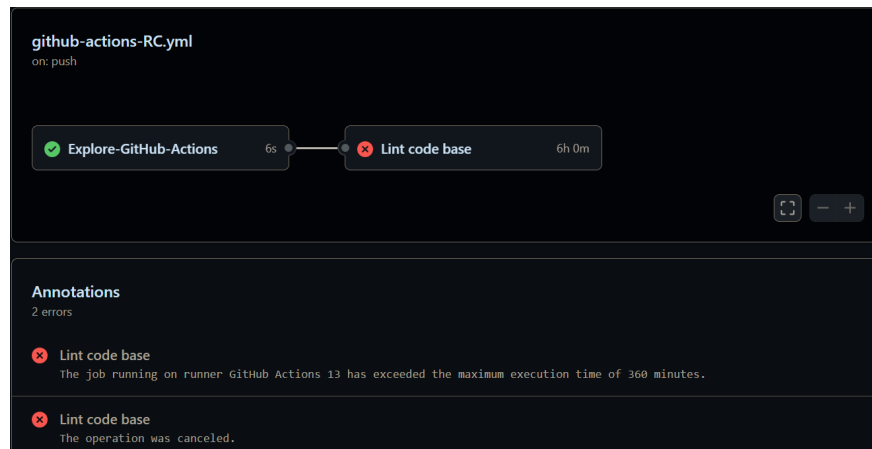


Figure 1: Lint codebase error

9 Trace to Requirements

See SRS Documentation at [SRS document](#) for detailed Information.

| Test ID | FR1 | FR2 | FR3 | FR4 | FR5 | FR6 | FR7 | FR8 | FR9 | FR10 | FR11 | FR12 | FR13 |
|--------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| test-FR1,4,8-1 | × | | | × | | | | × | | | | | |
| test-FR1,4,8-2 | × | | | × | | | | × | | | | | |
| test-FR2,5,9-1 | | × | | | × | | | | × | | | | |
| test-FR2,5,9-2 | | × | | | × | | | | × | | | | |
| test-FR3,6,10,11-1 | | | × | | | × | | | | × | × | | |
| test-FR3,6,10,11-2 | | | × | | | × | | | | × | × | | |
| test-FR7-1 | | | | | | | × | | | | | | |
| test-FR7-2 | | | | | | | × | | | | | | |
| test-FR11-1 | | | | | | | | | | | × | | |
| test-FR11-2 | | | | | | | | | | | × | | |
| test-FR12,13-1 | | | | | | | | | | | | × | × |
| test-FR12,13,IR5-1 | | | | | | | | | | | | × | × |
| test-FR12,13,IR5-2 | | | | | | | | | | | | × | × |

Table 1: **Functional Requirements Tests Requirement Traceability**

| TestID | NFR1 | NFR2 | NFR3 | NFR4 | NFR5 | NFR6 | NFR7 | NFR8 | NFR9 |
|----------|------|------|------|------|------|------|------|------|------|
| test-AD1 | × | | | | | | | | |
| test-AD2 | × | | | | | | | | |
| test-UR1 | | × | | | | | | | |
| test-PR1 | | | × | | | | | | |
| test-OR1 | | | | × | | | | | |
| test-OR2 | | | | × | | | | | |
| test-MR1 | | | | | × | | | | |
| test-MR2 | | | | | × | | | | |
| test-SR1 | | | | | | × | | | |
| test-CR1 | | | | | | | × | | |
| test-LR1 | | | | | | | | × | |
| test-LR2 | | | | | | | | × | |
| test-S1 | | | | | | | | | × |

Table 2: **Non-Functional Requirements Tests Requirement Traceability**

| Test ID | AC1 | AC2 | IR1 | IR2 | IR3 | IR4 | IR5 | IR6 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|
| test-AC1-1 | × | | | | | | | |
| test-AC1-2 | × | | | | | | | |
| test-AC2-1 | | × | | | | | | |
| test-IR1-1 | | | × | | | | | |
| test-IR2-1 | | | | × | | | | |
| test-IR3-1 | | | | | × | | | |
| test-IR4-1 | | | | | | × | | |
| test-IR5-1 | | | | | | | × | |
| test-IR6-1 | | | | | | | | × |

Table 3: **Safety and Security Requirements Tests Requirement Traceability**

10 Trace to Modules

See MG Documentation at [MG](#) for detailed Information.

| Test ID | M1 | M2 | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 | M11 | M12 |
|--------------------|----|----|----|----|----|----|----|----|----|-----|-----|-----|
| test-FR1,4,8-1 | | × | × | | | | | | | | × | × |
| test-FR1,4,8-2 | | × | × | | | | | | | | × | × |
| test-FR2,5,9-1 | | × | × | | | | | | | | × | × |
| test-FR2,5,9-2 | | × | × | | | | | | | | × | × |
| test-FR3,6,10,11-1 | | × | × | | | | | | | | × | × |
| test-FR3,6,10,11-2 | | × | × | | | | | | | | × | × |
| test-FR7-1 | × | × | × | | | × | | | | | | |
| test-FR7-2 | × | × | × | | | × | | | | | | |
| test-FR11-1 | | | × | | | × | × | × | | | | |
| test-FR11-2 | | | × | | | × | × | × | | | | |
| test-FR12,13-1 | | | × | | | × | | | × | × | | |
| test-FR12,13,IR5-1 | | | × | | | × | | | × | × | | |
| test-FR12,13,IR5-2 | | | × | | | × | | | × | × | | |

Table 4: **Functional Requirements Tests Module Traceability**

| TestID | M1 | M2 | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 | M11 | M12 |
|----------|----|----|----|----|----|----|----|----|----|-----|-----|-----|
| test-AD1 | | × | × | | | | | | | | | |
| test-AD2 | | × | × | | | | | | | | | |
| test-UR1 | × | × | × | × | × | × | × | × | × | × | × | × |
| test-PR1 | | | × | | | × | × | × | | | | |
| test-OR1 | × | × | × | × | × | × | × | × | × | × | × | × |
| test-OR2 | × | × | × | × | × | × | × | × | × | × | × | × |
| test-MR1 | × | × | × | × | × | × | × | × | × | × | × | × |
| test-MR2 | × | × | × | × | × | × | × | × | × | × | × | × |
| test-SR1 | × | × | | | | × | | | | | | |
| test-CR1 | | × | × | | | | | | | | | |
| test-LR1 | | | | | | × | | | | | × | × |
| test-LR2 | | | | | | × | | | | | × | × |
| test-S1 | × | × | × | × | × | × | × | × | × | × | × | × |

Table 5: **Non-Functional Requirements Tests Module Traceability**

| Test ID | M1 | M2 | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 | M11 | M12 |
|------------|----|----|----|----|----|----|----|----|----|-----|-----|-----|
| test-AC1-1 | × | | | | | | | | | | | |
| test-AC1-2 | × | | | | | | | | | | | |
| test-AC2-1 | × | | | | | | | | | | | |
| test-IR1-1 | × | × | × | | | | | | | | × | × |
| test-IR2-1 | | × | × | | | | | | | | × | × |
| test-IR3-1 | | | | | | | | | × | × | | |
| test-IR4-1 | | × | × | | | | | | | | × | × |
| test-IR5-1 | | | | | | | × | × | | | | |
| test-IR6-1 | | | | | | | × | × | | | | |

Table 6: **Safety and Security Requirements Tests Module Traceability**

11 Code Coverage Metrics

The image below displays the code coverage metrix. This includes all the files, includes the files for which the team created unit tests. As can be seen in the figure below, the code coverage for all the files we created the unit tests for is 100%.

| File | % Stmts | % Branch | % Funcs | % Lines | Uncovered Line #s |
|--------------------------------|---------|----------|---------|---------|-------------------|
| All files | 100 | 100 | 100 | 100 | |
| firebaseControllers | 100 | 100 | 100 | 100 | |
| DatabaseOps.ts | 100 | 100 | 100 | 100 | |
| firebaseAuth.ts | 100 | 100 | 100 | 100 | |
| helpers | 100 | 100 | 100 | 100 | |
| helper.ts | 100 | 100 | 100 | 100 | |
| Test Suites: 3 passed, 3 total | | | | | |
| Tests: 15 passed, 15 total | | | | | |
| Snapshots: 0 total | | | | | |
| Time: 9.928 s | | | | | |
| Ran all test suites. | | | | | |

Figure 2: Code Coverage Metrics

Appendix — Reflection

The information in this section will be used to evaluate the team members on the graduate attribute of Reflection.

The purpose of reflection questions is to give you a chance to assess your own learning and that of your group as a whole, and to find ways to improve in the future. Reflection is an important part of the learning process. Reflection is also an essential component of a successful software development process.

Reflections are most interesting and useful when they're honest, even if the stories they tell are imperfect. You will be marked based on your depth of thought and analysis, and not based on the content of the reflections themselves. Thus, for full marks we encourage you to answer openly and honestly and to avoid simply writing "what you think the evaluator wants to hear."

Please answer the following questions. Some questions can be answered on the team level, but where appropriate, each team member should write their own response:

1. What went well while writing this deliverable?

This document has let us strengthen the understanding about unit testing of all functional requirements as well as verification of all non-functional qualities of the system. While going through the outline of the document, we were able to conduct unit testing and compare it with the existing implementation. It also made us better execute the detailed procedure of system testing along with performing validation and verification of the system.

2. What pain points did you experience during this deliverable, and how did you resolve them?

There are obstacles in any team project that must be overcome for it to proceed successfully. To ensure seamless operations, we had to develop a strategy for contributions. Since we already had the list of tests that were needed to be conducted for both functional and non-functional requirements, we divided them equally among all the team members. We also needed to create a schedule to contribute to the template and review each other's work in the best way possible.

3. Which parts of this document stemmed from speaking to your client(s) or a proxy (e.g. your peers)? Which ones were not, and why?

The client's feedback helped us to understand the changes due to testing the requirements. Before Rev 0 demo, the team gave a demo to the supervisor about the system pretending the supervisor as the healthcare professional using the system. The supervisor then gave us some possible ways that the healthcare professional would like to use the system. This helped us to improve some features of the system such as whether prescription of a patient is being saved or not. If yes, then is it being stored within the system or on local machine. Furthermore, the section such as unit testing of all functional requirements stemmed from the collective ideas of our peers. We discussed different test cases that each requirement could possibly have along with how they will

be implemented. In this way, we got diverse test cases and all team members were able to contribute especially in this critical section of the report.

4. In what ways was the Verification and Validation (VnV) Plan different from the activities that were actually conducted for VnV? If there were differences, what changes required the modification in the plan? Why did these changes occur? Would you be able to anticipate these changes in future projects? If there weren't any differences, how was your team able to clearly predict a feasible amount of effort and the right tasks needed to build the evidence that demonstrates the required quality? (It is expected that most teams will have had to deviate from their original VnV Plan.)

VnV Plan was little bit different from the activities that were actually conducted and recorded in VnV Report. This is because VnV Plan includes one extra functional requirement test which needs to be deleted as the team has decided to not pursue with that functional requirement. Therefore, the team will modify the VnV Plan to remove that requirement. Additionally, as part of the modifications, the team removed some Non-Functional Requirements tests to reduce redundancy, such as test-S2, test-CR2, and test-PR1, and updated the traceability to the requirements for both Non-Functional Requirements tests and Safety and Security tests. These changes were made to streamline the testing process and ensure alignment with the system's goals. This change occurred as we went through every detail of our system and it turns out that functional requirement is not necessary for the system to accomplish its goal. Yes, we will be able to anticipate thus change in the future projects as going through every detail of the project review the necessary and non-necessary features of the product.