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Rapid Development Tools ICA

The Electronic Medical Records Application

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Rapid Development Tools (**COM1075-N**)

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Executive Summery

This document contains the information regarding the Electronic Medical Records System, including its specifications, testing plans and evaluation. Current medical records are segmented between different clinics and hospitals, making the process of getting a medical treatment very costly and inefficient as the patient must repeat the same information every time they go to a new clinic or get the same tests done unnecessarily at different hospitals to retrieve the same information that other clinics already have.

The system outlined is designed to act as a unified database of patient data accessible for all health care institutions involved for making the process of diagnosis and treatment much more simple and efficient.

Following this objective, the requirement of the application can be summarised to provide a web application that provides the General Practitioners(GPs) and Health Care Professionals(HCPs) with a database and a user interface application that allows them to consolidate and view the medical records of the patients they treat. Another requirement is to allow the use of the application for the patients themselves to see part of their medical records and to be able to change their preferences on how their information available on the database is accessible to the care givers.

Mendix Scrum is chosen as the development methodology for a few reasons. It was already built-in to the Mendix modeller platform that is being used to develop this application, which makes it convenient to tightly integrate the requirements to the development process. The application is also being developed by a very small team, which Scrum is very well suited for in managing the team and keeping track of progress being made.

The application, *Aceso*, is being developed using the Mendix development platform as mentioned earlier. It provides the tools for rapidly developing the application without involving much manual coding of systems. The access credentials for the prototype of the web application are included in section 5.1 of this document.

The resulting application is tested with cases to check if the application developed meets the requirements of the users identified. It is tested using black box testing, where the output of the application is the main criteria of the test cases.

Mendix is a very useful tool for quickly developing applications for various platforms. It removes the requirement for manually coding the entire application and presents relatively easy to use. However, this ease of use also introduces many limitations as many pre-coded blocks can not be repurposed for the developers' own use. The resulting application met most of the objectives that it was set out to fulfil but it also had many compromises due to the limitations of Mendix and development time.

1. Introduction

The following document contains the requirements gathering, planning, development and testing of the application, *Aceso,* and the critical evaluation of the outcome of the application and the Mendix development platform that was used to create the application.

Firstly, the Requirements section contains the documentation for requirements gathering for the application. This includes coming up with user stories as Scrum is being used as a development methodology. They generally outline the requirements the users that are expected to be using the application, which are GPs, HCPs, and patients.

It is followed up by Application Model section, which contains a use case diagram and related use case specifications and the data model of the application. The use case diagram illustrates the different functions of the system and the interactions of the users with said functions, along with use case specifications for each of the use cases. Only the core use case descriptions are included in this section of the document while the remaining use case specifications can be found in Appendix A of this document. The data model contains the structure and association of the entities implemented in the application, which uses the object-oriented database.

The application section provides the log-in credentials to the web application to accounts with different user roles and the link to access the web application from the browser. It also contains the assumptions made in planning and development of the application, along with screenshots of the running application for reference.

The testing section outlines the test plan for the application and the specific test cases to check the functions of the application

Lastly, the critical evaluation discusses the Mendix platform and its effectiveness in development of the application, the methodology used in the development process and the evaluation of the application developed.

2. Requirements

The following are the requirements identified for the application in the form of user stories to indicate the possible uses of the system that the user might require in the form of user stories, use case diagrams and specifications.

2.1 User Stories

2.1.1 Patients

1. As a patient, I want to be able to view my medical records so that I can review information that I discussed with the GP previously.
2. As a patient, I want to be able to consent for my medical history to be entered into the system so that it is available for all clinics and hospitals.
3. As a patient, I want to be able to consent for my medical history to be able to be used for research purposes so that I can contribute to the advancement of medical research.

4. As a patient, I want to be able to deny my medical history from being entered into the system as I do not want to disclose my information to those involved electronically.
5. As a patient, I want to be able to see what consenting to data sharing involves so that I can make a more informed decision about sharing my medical history on the system.

2.1.2 Health Care Professionals (HCP)

1. As an HCP, I want to be able to look up a patient's medical history so that I can quickly learn of the issues previously discussed with the GP and make more informed decisions regarding the patient's treatment.
2. As an HCP, I want to be able to look up the previous tests and scans the patient has gone through prior so that unnecessary tests can be reduced to save cost of treatment for the patient.
3. As an HCP, I want to be able to add my findings to a centralised system so that when the patient goes to a clinic or a secondary care institution, they are able to retrieve the relevant records without having them sent manually.
4. As an HCP working in a lab, I want to be able to enter the results for lab tests from patients into the system so that they are accessible by the GPs consulting the patients.
5. As an HCP in a hospital, I want to be able to access the patients' medical history in an emergency in case of the patient requiring immediate treatment is not in a state to be able to give explicit consent to access their medical records.
6. As an HCP responding to an emergency, I want to be able to access the patients' medical history so that I can quickly plan and prepare for emergency procedures and treatments before arriving on location and onboard the ambulance so that I can save the patient as quickly as possible.

2.1.3 General Practitioner (GP)

1. As a GP, I want to be able to add patient data to the database so that the information is available in the system.
2. As a GP, I want to be able to approve changes to the patients' data so that the added information from HCPs are permanently added to the system.
3. As a GP, I want to be able to edit changes to the patients' data before approving to ensure that the information added is clear and correct.
4. As a GP, I want to be able to access the patients' data from the database so that I can quickly learn of the patients' medical history.
5. As a GP, I want to be able to access the patients' medical history in an emergency in case of the patient requiring immediate treatment is not in a state to be able to give explicit consent to access their medical records.
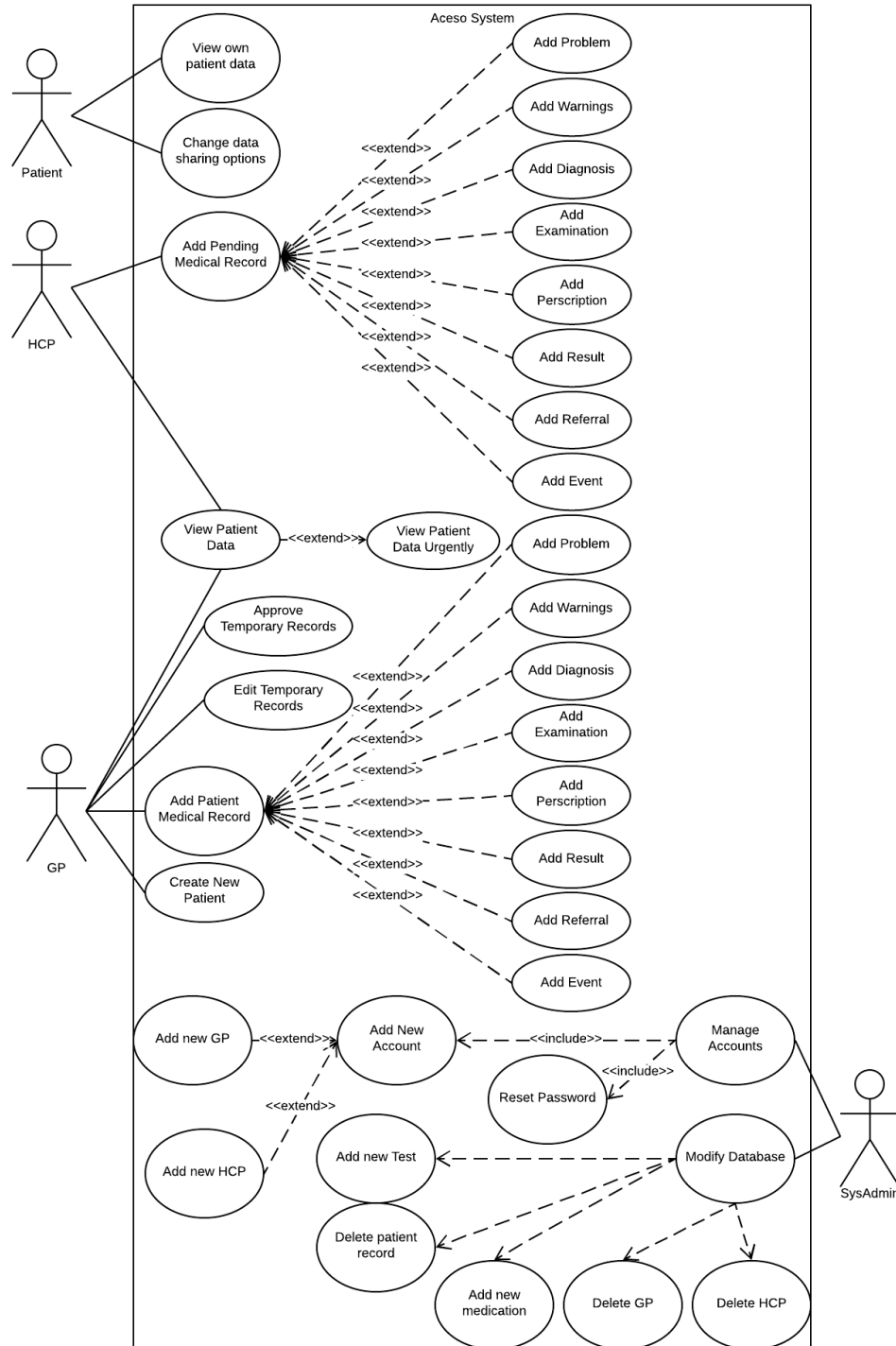
3.0 Application Model

3.1 Use Case Diagram

Figure 1: Use Cases identified

3.2 Use Case Specifications

Use Case Name	View Own Patient Data	
Overview	The Patient views their own medical information in the EMR system.	
Pre-Conditions	The Patient must be logged into an account with "Patient" role.	
Post-Conditions	The Patient must have had access to their own medical information in the system.	
	Event	Response
1	*Patient* clicks "Medical Records"	Patient's relevant "Medical Records" page displayed.

Use Case Name	Change Data Sharing Options	
Overview	The Patient changes their choices on how their data is being shared and used in the EMR system.	
Pre-Conditions	The Patient must be logged in with their account.	
Post-Conditions	The Patient's data sharing consent choices must have changed in the EMR system.	
	Event	Response
1	*Patient* clicks "Change Your Data Sharing Choice"	"Patient Consent Form" displayed.
2	*Patient* chooses an option (Opt-In, Opt-Out or Opt-In + Research)	-
3	*Patient* clicks "Save"	Option saved, patient consent form closed.
	Alternate Cases:	
4	*Patient* clicks "Cancel"	"Patient Consent Form" closed.

Use Case Name	Create New Patient	
Overview	Adds a new patient profile to the GP database.	
Pre-Conditions	The patient must not already exist in the database.	
Post-Conditions	The new patient profile must be added to the database.	
	Event	Response
1	*GP* clicks "New Patient".	New Patient Form displayed.
2.0	Patient NRIC entered.	-
2.1	Patient Name entered.	-
2.2	Patient date of birth entered.	-
2.3	Patient sex entered.	-
2.4	Patient race selected.	-
2.5	Patient contact number entered.	-
2.6	Patient contact number entered.	-
2.7	Patient email entered (optional).	-
3	"Patient" user role selected.	-
4.1	Default password entered	-
4.2	Confirmation password entered	-
3	*GP* clicks Submit.	Patient entry saved, New Patient Form closes.

	Extension Points:	
3.1	GP clicks submit with incorrect data type.	Validation error message displayed.
	Alternate Cases:	
5	GP clicks "Cancel".	New Patient Form closes, no new patient data is added to the database.

Use Case Name	View Patient Data	
Overview	The GP or HCP looks up a patient's medical information.	
Pre-Conditions	The user must be logged into an account with GP or HCP role.	
Post-Conditions	The user must have had access to the medical information of the patient they were looking for.	
	Event	**Response**
1	GP clicks "Patients"	Patient table displayed.
2	GP clicks "Search"	Search forms displayed.
2	GP enters NRIC of patient	Matching entries displayed.
3	GP selects entry and clicks "Open Records"	Access confirmation page displayed.
4	GP clicks "Yes" on access confirmation	Access Confirmation Page closed, Patient's medical records page opens. Access logged in the "AccessHistory" entity.
	Extension Points:	
5	GP clicks "Emergency Access"	Access Confirmation Page closed, Patient's medical records page opens. Warning message "This emergency access has been logged in your access history. "shown. Access logged in the "AccessHistory" entity.
	Alternate Cases:	
	GP clicks "No"	Access Confirmation Page closes, Patient List page shown.

Use Case Name	Add Patient Medical Record; Problem	
Overview	A GP adds new problem to the patient's medical record in the EMR system.	
Pre-Conditions	The user must be logged into an account with GP role.	
Post-Conditions	New problem medical information entry must be entered into the records of the patient in the EMR system.	
	Event	**Response**
1	*GP* clicks "Patients"	Patient search form displayed
2	*GP* enters NRIC of patient	Matching entries displayed
3	*GP* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*GP* clicks "Problem" tab	Problem tab of Patient Record Page displayed
5	*GP* clicks "New" button under "Problem List"	New Problem form displayed
6.0	Date of entry entered	-
6.1	Description of problem entered	-
7	*GP* clicks "Save"	Problem entry saved. New Problem form closes.
	Extension Points:	
6.2	*GP* does not enter "Date" or "Description"	Required validation message shown.
	Alternate Cases:	
8	*GP* clicks "Cancel".	New Problem Form closes, no new patient medical record is added to the database.

Use Case Name	Add Temporary Patient Data; Problem	
Overview	A HCP adds new medical information to be approved into a patient's medical record in the EMR system.	
Pre-Conditions	The user must be logged into an account with HCP role.	
Post-Conditions	New pending medical information entry must be entered into the records of the patient in the EMR system.	
	Event	**Response**
1	*HCP* clicks "Patients"	Patient search form displayed
2	*HCP* enters NRIC of patient	Matching entries displayed
3	*HCP* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*HCP* clicks "Problem" tab	Problem tab of Patient Record Page displayed
5	*HCP* clicks "New" button under "Problem List (Approval Pending)"	New Temporary Problem form displayed
6.0	Date of entry entered	-
6.1	Description of problem entered	-
7	*HCP* clicks "Save"	Temporary Problem entry saved. New Temporary Problem form closes.

	Extension Points:	
6.2	*HCP* does not enter "Date" or "Description"	Required validation message shown.
	Alternate Cases:	
8	*HCP* clicks "Cancel".	New Problem Form closes, no new temporary patient medical record is added to the database.

Use Case Name	Edit Temporary Patient Medical Record; Problem	
Overview	A GP edits an entry added by a HCP in the temporary problem table	
Pre-Conditions	The user must be logged into an account with GP role.	
Post-Conditions	The resulting Temporary Problem entry must be edited with the information the GP specified.	
	Event	**Response**
1	*GP* clicks "Patients"	Patient list displayed
2	*GP* clicks "Search"	Search form displayed
3	*GP* enters NRIC of patient	Matching entries displayed
4	*GP* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
5	*GP* clicks "Problem" tab	Problem tab of Patient Record Page displayed
6	*GP* selects the problem they wish to edit	-
7	*GP* clicks "Edit" button under "Problem List (Approval Pending)"	Edit Problem form displayed
8.0	Date of entry changed	-
8.1	Description of problem changed	-
9	*GP* clicks "Save"	Problem entry saved. Edit Problem form closes.
	Extension Points:	
8.2	*GP* does not enter "Date" or "Description"	Required validation message shown.
	Alternate Cases:	
10	*GP* clicks "Cancel".	New Problem Form closes, no new patient medical record is added to the database.

Use Case Name	Approve Temporary Patient Medical Record; Problem	
Overview	A GP approves a problem entry added by an HCP.	
Pre-Conditions	The user must be logged into an account with GP role.	
Post-Conditions	Specified problem entry must be transferred to the main Problem List from the approval pending Problem List.	
	Event	Response
1	*GP* clicks "Patients"	Patient search form displayed
2	*GP* enters NRIC of patient	Matching entries displayed
3	*GP* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*GP* clicks "Problem" tab	Problem tab of Patient Record Page displayed
5	*GP* selects the problem they wish to approve	-
6	*GP* clicks "Approve" button under "Problem List (Approval Pending)"	Temporary problem entry is saved to the main problem list. Confirmation message window is shown.
7	*GP* clicks "OK"	Confirmation message window closes.

Use Case Name	Change Own Details	
Overview	A user changes their details.	
Pre-Conditions	The user must be logged into an account with Patient, GP or HCP role.	
Post-Conditions	The details of the user must be updated to what the user specified.	
	Event	Response
1	*User* clicks "Manage Account Details"	Edit User Details form displayed
2	*User* makes changes to fields in form	-
3	*User* clicks "Save"	Changes saved. Edit User Details form closes
	Extension Points:	
4	*User* enters the wrong data type	Validation message shown.
	Alternate Cases:	
5	*User* clicks "Cancel".	Edit User Details form closes, no user detail changes made to the database.

Use Case Name	Change Own Password	
Overview	A user changes their password.	
Pre-Conditions	The user must be logged into an account with Patient, GP or HCP role.	
Post-Conditions	The password of the user must be updated to what the user specified.	
	Event	**Response**
1	*User* clicks "Manage Account Details"	Account window displayed
2	*User* clicks "Change Password"	Change Password form displayed
3.1	*User* enters the old password	-
3.2	*User* enters the new password	-
3.3	*User* enters the new password confirmation	-
4	*User* clicks "Change"	Password changes saved. "The password has been updated" message shown. Edit Change Password form closes.
	Extension Points:	
5	*User* enters the wrong old password	"Password is not correct" message shown
6	*User enters non-matching new passwords*	"The new password do not match" message shown
	Alternate Cases:	
6	*User* clicks "Cancel".	Change Password form closes, no changes made to the user's password.

Use Case Name	Add New Institution	
Overview	Admin adds a new institution to the system.	
Pre-Conditions	The User must be logged into an account with Admin role. The Institution must not already exist.	
Post-Conditions	A new institution must be added to the system.	
	Event	**Response**
1	*Admin* clicks "Institutions"	Institutions list displayed
2	*Admin* clicks "New"	New Institution form displayed
3	*Admin* enters Institution name	-
4	*Admin* enters Institution address	-
5	*Admin* clicks "Save"	Institution added, New Institution form closes
	Extension Points:	
4	*Admin* does not enter name or address	Required validation messages shown.
	Alternate Cases:	
5	*Admin* clicks "Cancel".	New Institution form closes, no changes made to the list of Institutions

Use Case Name	Create New GP	
Overview	Adds a new GP profile to the GP database.	
Pre-Conditions	The GP must not already exist in the database. The user must be logged into an account with Admin role.	
Post-Conditions	The new GP profile must be added to the database.	
	Event	Response
1	*Admin* clicks "GP List"	GP list displayed
2	*Admin* clicks "New".	New GP Form displayed.
3.0	GP NRIC entered.	-
3.1	GP Name entered.	-
3.2	GP date of birth entered.	-
3.3	GP sex entered.	-
3.4	GP contact number entered.	-
3.5	GP contact number entered.	-
3.6	GP email entered (optional).	-
4	"GP" user role selected.	-
5.1	Default password entered	-
5.2	Confirmation password entered	-
6	*Admin* clicks Submit.	GP entry saved, New GP Form closes.
	Extension Points:	
6.1	*Admin* clicks submit with incorrect data type.	Validation error message displayed.
	Alternate Cases:	
7	*Admin* clicks "Cancel".	New GP Form closes, no new GP data is added to the database.

Use Case Name	Create New HCP	
Overview	Adds a new HCP profile to the HCP database.	
Pre-Conditions	The HCP must not already exist in the database. The user must be logged into an account with Admin role.	
Post-Conditions	The new HCP profile must be added to the database.	
	Event	Response
1	*Admin* clicks "HCP List"	HCP list displayed
2	*Admin* clicks "New".	New HCP Form displayed.
3.0	HCP NRIC entered.	-
3.1	HCP Name entered.	-
3.2	HCP date of birth entered.	-
3.3	HCP sex entered.	-
3.4	HCP contact number entered.	-
3.5	HCP contact number entered.	-
3.6	HCP email entered (optional).	-
4	"HCP" user role selected.	-

5.1	Default password entered	-
5.2	Confirmation password entered	-
6	*Admin* clicks Submit.	HCP entry saved, New HCP Form closes.
	Extension Points:	
6.1	*Admin* clicks submit with incorrect data type.	Validation error message displayed.
	Alternate Cases:	
7	*Admin* clicks "Cancel".	New HCP Form closes, no new HCP data is added to the database.

Use Case Name	Reset Password	
Overview	An admin changes the password of a user.	
Pre-Conditions	The user must be logged into an account with Admin role.	
Post-Conditions	The password of the specific user must be changed.	
	Event	**Response**
1	*Admin* clicks "Account Overview"	Account Overview page displayed
2	*Admin* clicks "Search"	Search form displayed
3	*Admin* enters ID of user	Corresponding search results displayed
4	*Admin* clicks on desired user	User entry highlighted
5	*Admin* clicks "Edit"	Edit Account form displayed
6	*Admin clicks "Change Password"*	Change Password form displayed
7	New Password entered	-
8	New Password confirmation entered	-
9	*Admin* clicks "Change"	Password changes saved. Confirmation message "The Password has been updated."
10	*Admin* clicks "OK"	Confirmation message closes
	Extension Points:	
11	Entered passwords do not match	Error message shown
	Alternate Cases:	
12	*Admin* clicks "Cancel".	Change Password form closed. No changes made to the password of user

Use Case Name	Delete User; Patient	
Overview	An Admin deletes a patient medical record	
Pre-Conditions	The user must with logged-in to an account with the admin user role.	
Post-Conditions	The specified Patient's medical record must be deleted from the database.	
	Event	**Response**

1	*Admin* clicks "Patients "	Account Overview page displayed
2	*Admin* clicks "Search"	Search form displayed
3	*Admin* enters ID of patient	Corresponding search results displayed
4	*Admin* clicks on desired patient	Patient entry highlighted
5	*Admin* clicks "Delete"	Confirmation window displayed
5	*Admin* clicks "Yes"	Confirmation window closes. Patient medical record is deleted from the database.
	Alternate Cases:	
6	*Admin* clicks "Cancel".	Confirmation window closes. Patient medical record is not deleted.

Use Case Name	Add New Medication	
Overview	Admin adds a new medication to the system.	
Pre-Conditions	The User must be logged into an account with Admin role. The medication must not already exist.	
Post-Conditions	A new medication must be added to the system.	
	Event	Response
1	*Admin* clicks "Medications"	Medications list displayed
2	*Admin* clicks "New"	New Medication form displayed
3	*Admin* enters Medication name	-
4	*Admin* enters Medication description	-
5	*Admin* clicks "Save"	Medication added, New Medication form closes
	Extension Points:	
4	*Admin* does not enter name or description	Required validation messages shown.
	Alternate Cases:	
5	*Admin* clicks "Cancel".	New Medication form closes, no changes made to the list of Medications

Additional similar use case specifications are located in Appendix A of this document.

3.3 Data Model

The data model is implemented using the embedded object-oriented database in Mendix, which does not specifically require primary or foreign keys unlike in relational databases.
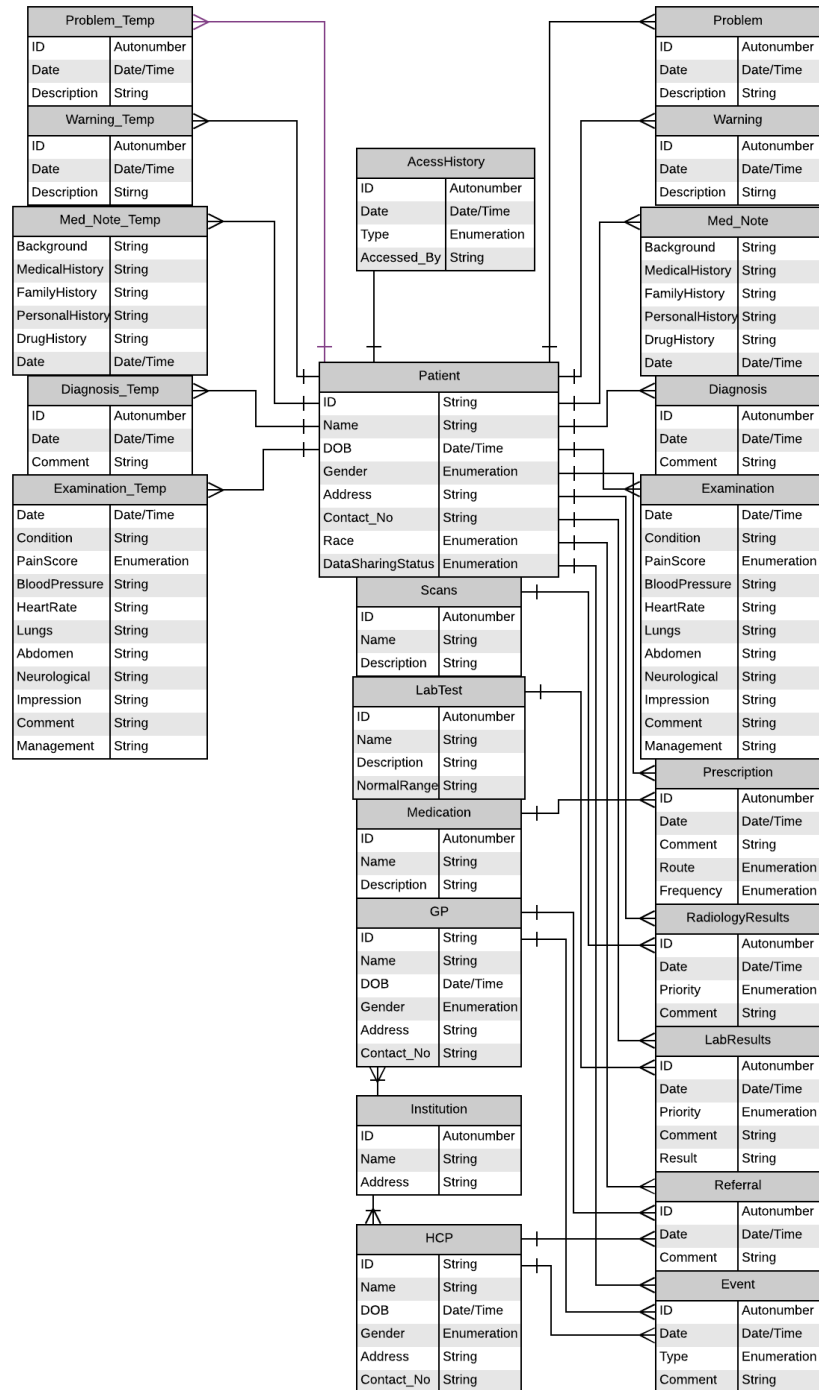

Figure 2: Data Model of Aceso

4. Methodology: Scrum

Medix Scrum is chosen for this project as it is suitable for relatively small projects and can be executed by small teams. This makes it an obvious choice for the project as the EMR system is a small project and is being developed by a single person. It allows for quick delivery of features in small iterations with easy ability to accommodate changes during the project, which is very beneficial for this project where not all requirements and parameters are explicitly defined. This allows for production of higher quality products in my opinion over using other methodology such as the waterfall model, which would require all requirements to be locked in before production of the software starts. Mendix Scrum is also built-in into the Mendix application itself, so the development process can be tightly integrated with the development schedule (Field, 2017).

4.1 Initial Development Plan

Sprint	ID	Function
1: Patients	1.1	Create Home Page
	1.2	Create Patient table and associated pages for handling patients' records
	1.3	Implement detailed tables for patients' records
	1.4	Ensure consistency and continuity in access of records
	1.5	Setup Patient user role and permissions
2: GPs	2.1	Implement GP table and access pages
	2.2	Implement Key Events and Referrals
	2.3	Setup Referral page
	2.4	Setup GP user role and permissions
3: HCPs	3.1	Implement HCP tables and access pages
	3.2	Implement temporary versions of patient records
	3.3	Implement HCP into referral systems
	3.4	Implement HCP user roles and permissions
4: Mechanics	4.1.1	Implement temporary changes mechanics
	4.1.2	Add edit temporary changes function
	4.2	Add patient data sharing status markers
	4.3	Add patent data sharing acknowledgement page
5: Security and Roles	5.1	Enable Patient consent check page and audit entries
	5.2	Implement patient user role and data read access
	5.3	Implement data read and write access across all roles
	5.	Turn on production level security, implement all read/write access to tables for all roles
6: Polish and Bug Fixes	6.1	Check all validation and constraint rules
	6.2	Enter sample data
	6.3	UI theme improvements
	6.4	General polishing, bug fixes and preparation for submission

Sprint duration: 1 week

5.0 The Application

5.1 Access Instructions

The application can be accessed on the Mendix servers via the link,

https://sgwdp.mxapps.io

For access as Patient:

USERNAME: S1234567A

PASSWORD: PatientA

For access as GP:

USERNAME: G1234567P

PASSWORD: GPA

For access as HCP:

USERNAME: H1234567P

PASSWORD: HCPA

For access as Administrator:

USERNAME: Admin

PASSWORD: AdminA

5.2 Assumptions

- Outpatient only, application specifications do not fit hospital needs so it is assumed that hospitals have separate internal systems.
- Patient's data sharing consent is set to Opt-In by default as per the GNCR system given in the ICA specification.
- An administrator needs to add the institution and the GPs and HCPs associated with the institution to the system. User sign-ups to the application are not permitted.
- The application is more localised for Singapore use.

5.3 Screenshots of Running Application

This is the home page of *Aceso*. Different user roles will see different buttons depending on their permissions on the system.
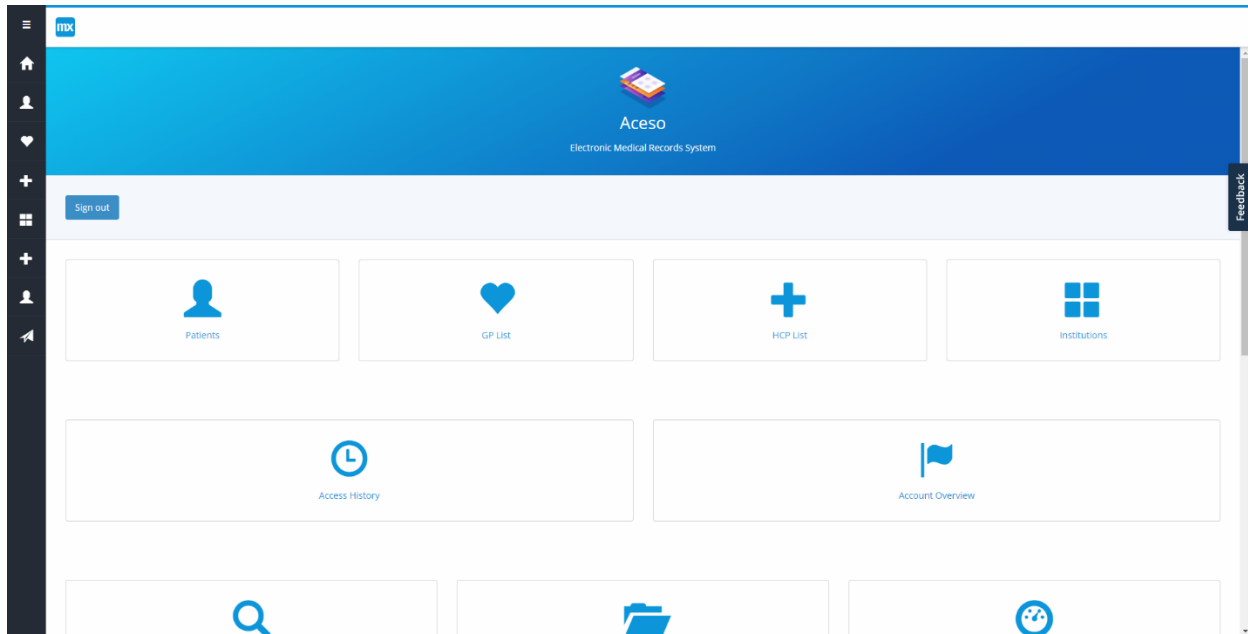
Figure 3: Home Page

The patient list screen shows the list of patients to access their medical records. It also allows for search by different columns and provide buttons for creating and deleting (for Admin) patient records.
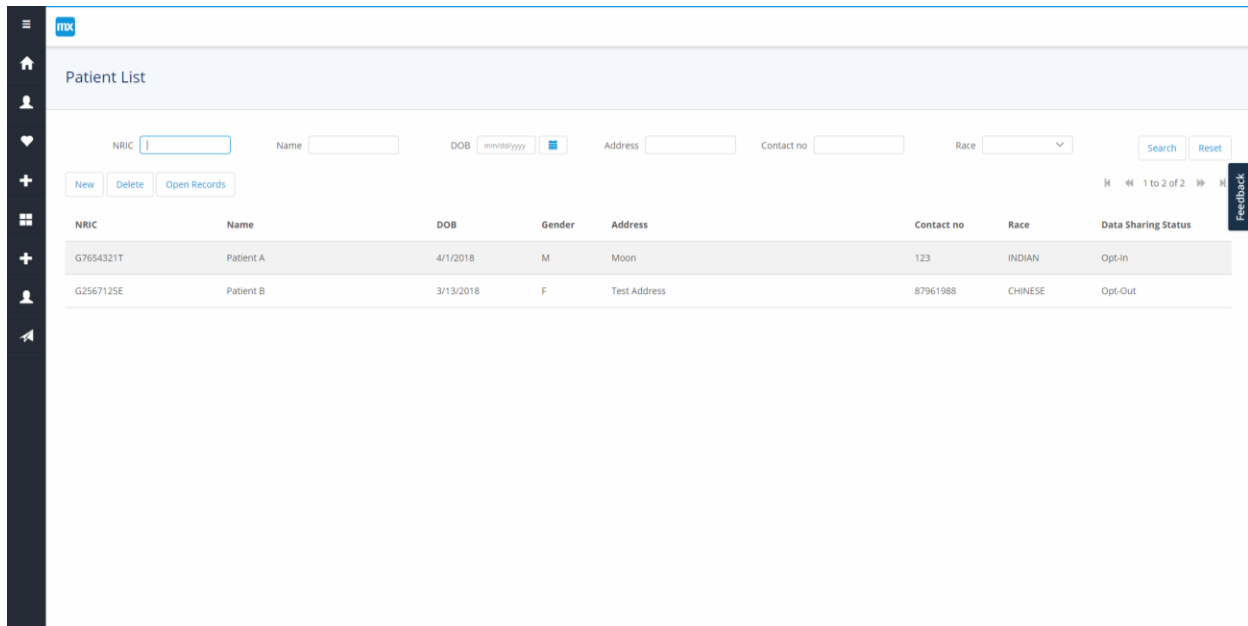

Figure 4: Patient List Page

This window pops up when attempting to open a patient record as a GP or HCP. They have to confirm whether they have the permission of the patient before the record is shown.
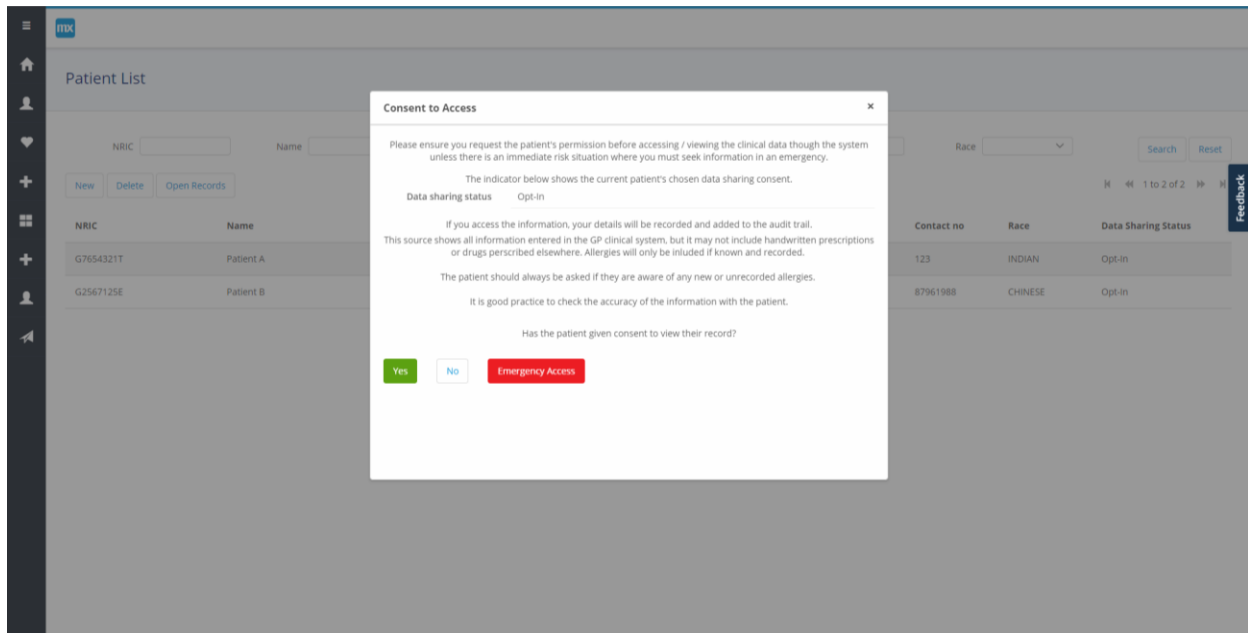
Figure 5: Consent to Access screen

This is the patient records screen. It displays the summery tab on arrival by default, which displays some basic information at a glance.
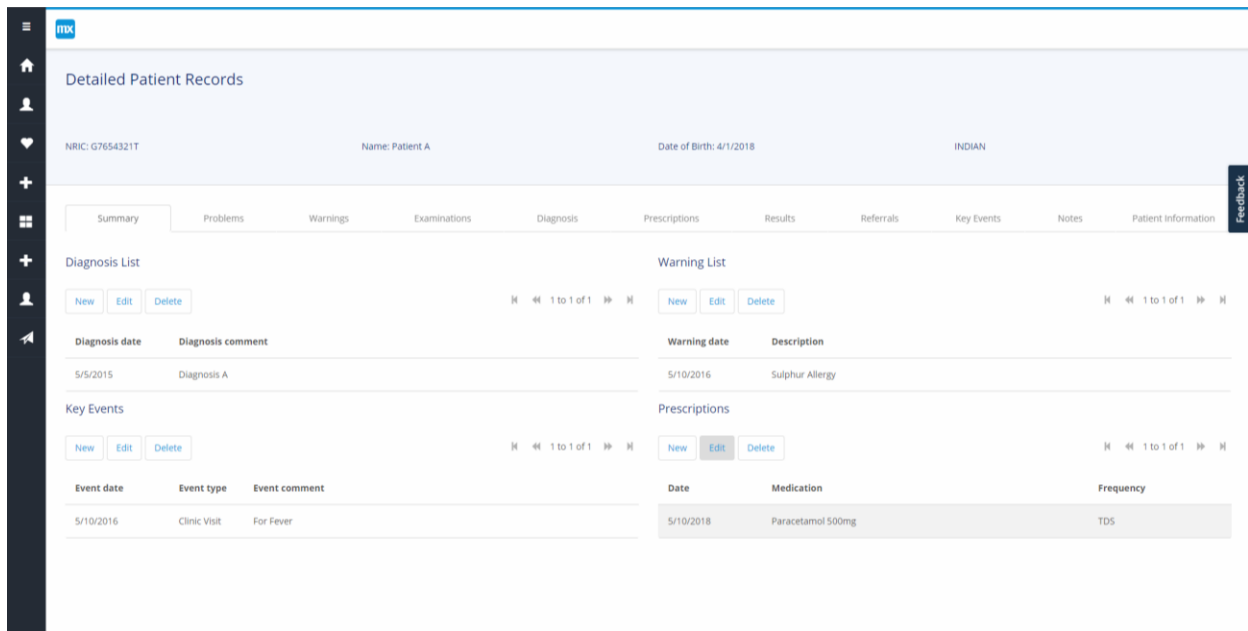
Figure 6: Patient Records page

This is an example of the other tabs in the patient record page. They have a main list and an approval-pending list.

Figure 7: Patient Record Page; Problem Tab

The GP list screen shows the list of GPs on the system. It also allows for search by different columns and provide buttons for adding and deleting GPs for Admins.

Figure 8: GP List Page

The HCP list screen shows the list of HCPs on the system. It also allows for search by different columns and provide buttons for adding and deleting HCPs for Admins.
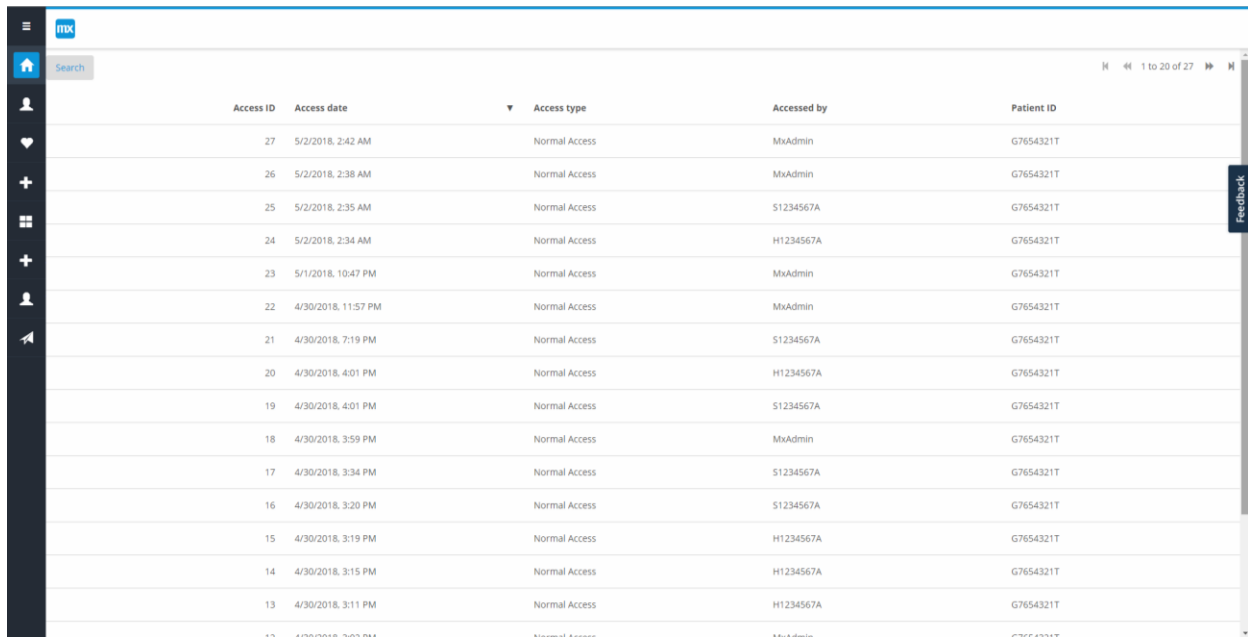

Figure 9: HCP List Page

The Institutions screen shows the list of institutions the GPs and HCPs on the system are working at. It also allows for search by different columns and provide buttons for adding and deleting institutions for Admins.
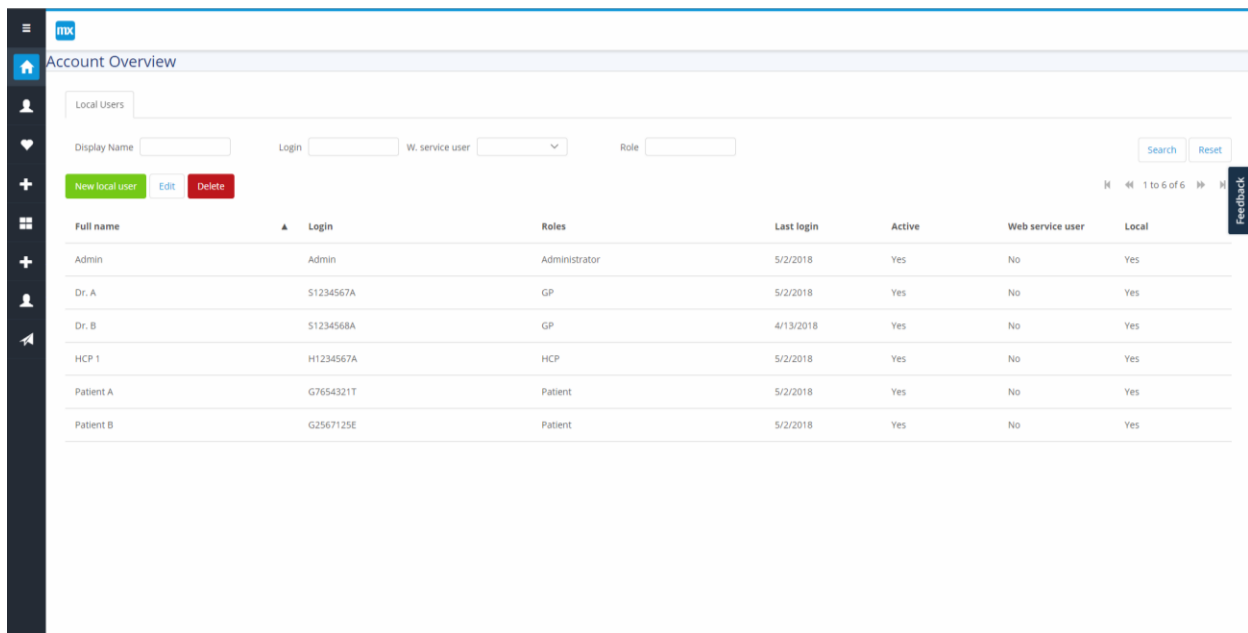

Figure 10: Institutions List Page

This is the access history page that is only visible to the admin. It logs the normal and emergency accesses of patient records by users.

Figure 11: Patient Record Access History Page
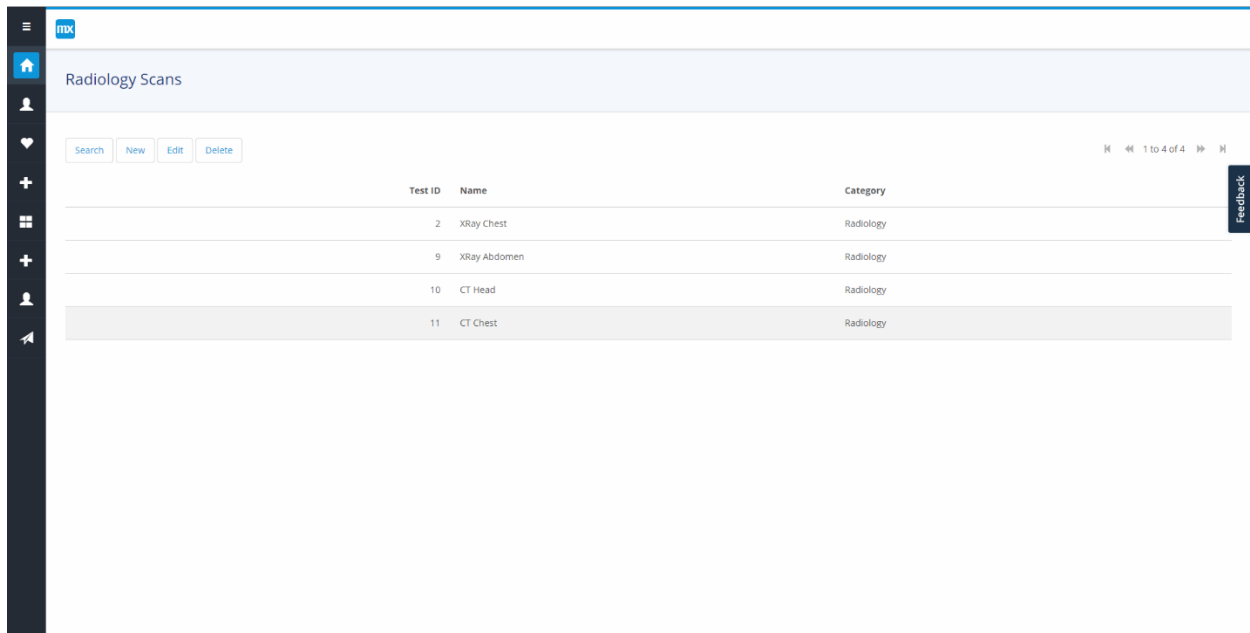
The account overview page provides the admin a list of all users on the system and provides menus for account management functions such as resetting passwords, for example.

Figure 12: Admin's Account Overview Page
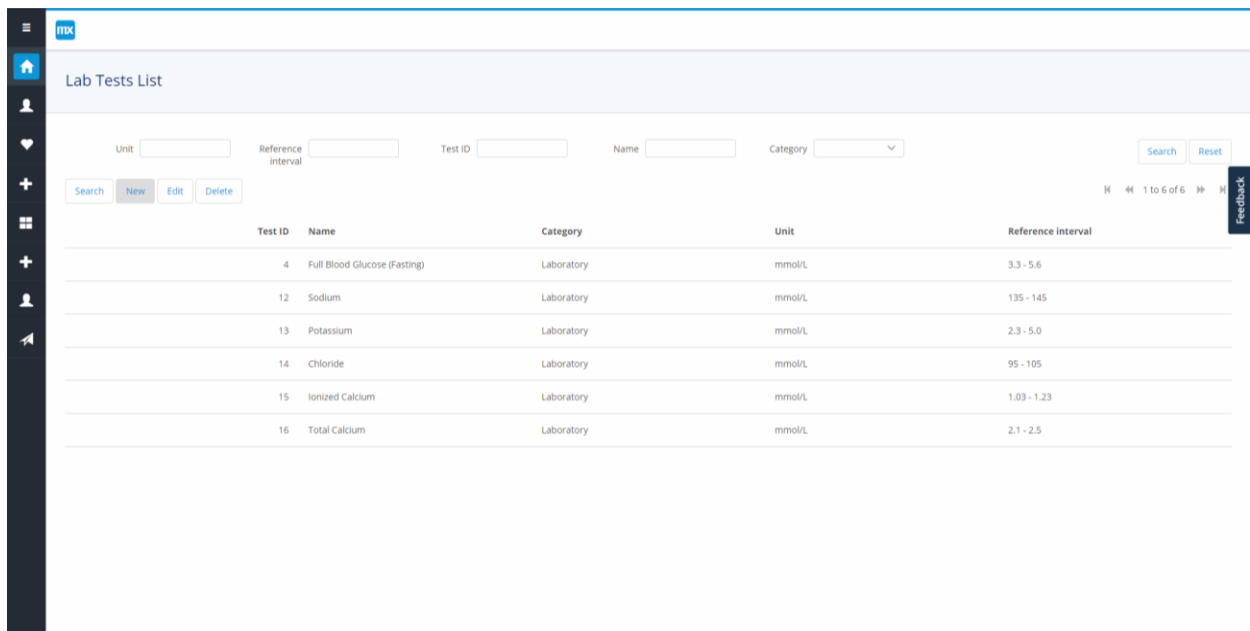
This is the page that shows the list of scans that can be used for adding radiology results. It also allows the admin to add new scans to the list.

Figure 13: List of Radiology Scans page

This is the page that shows the list of lab tests that can be used for adding lab results. It also allows the admin to add new lab tests to the list.

Figure 14: List of Lab Tests page

This is the page that shows the list of medication that can be used for prescriptions. It also allows the admin to add new medication to the list.
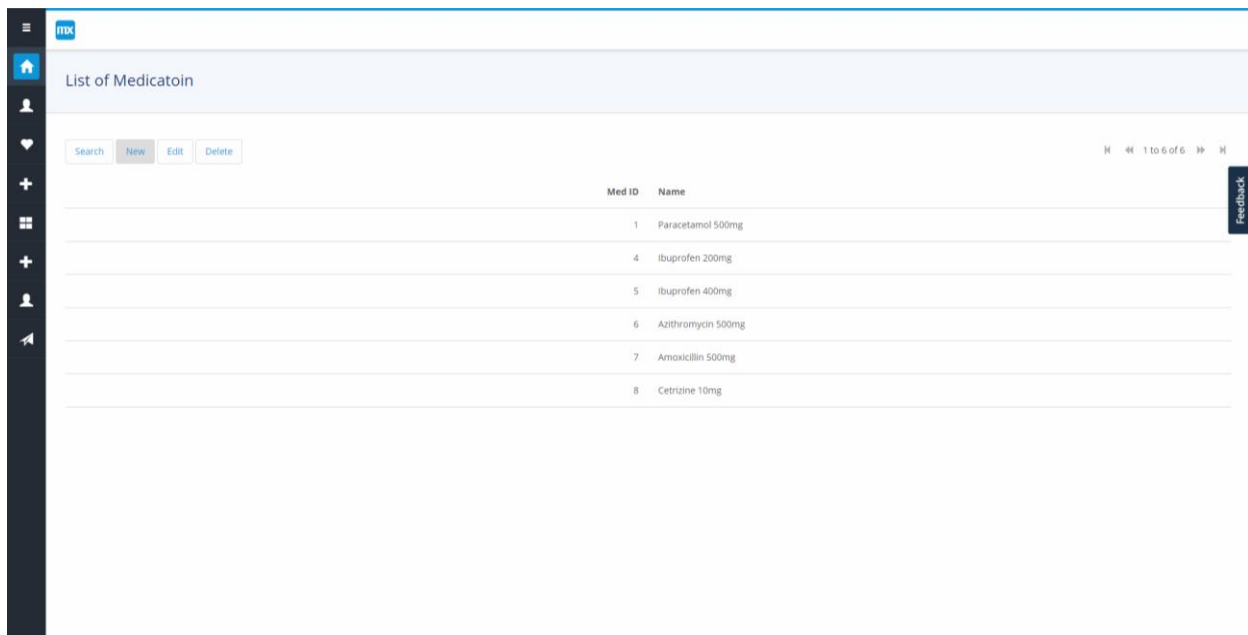
Figure 15: List of Medication page

The data sharing consent page can be only seen by the patient. It allows the patient to choose how their data on the system can be used.
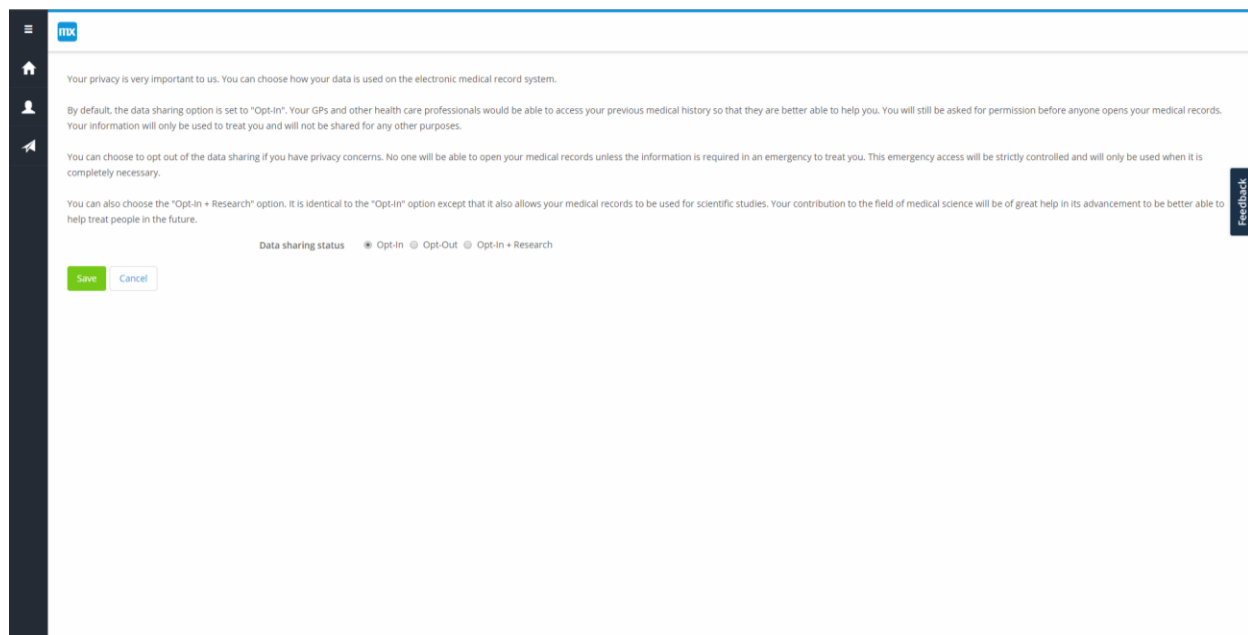
Figure 16: Data Sharing Consent Change page

6.0 Application Testing

6.1 Test Plan

The application will be tested to ensure effective, error-free performance of the application and that it fulfils the requirement of the end users. It will be tested in similar cases to how the end user would use the application. The test cases will closely follow the use cases and user stories identified in the early planning of the application to check if the application fulfils the requirements of the intended users.

6.1.1 Testing Assumptions

1. The system will be treated as a black box; if the information shows correctly online and, in the reports, it will be assumed that the database is working properly.
2. All test cases start from the login screen of the application.

6.2 Testing Platform Information

Device:	Desktop PC
Operating System:	Windows 10 Home 64-Bit Version 1709
Browser Used:	Google Chrome 64-Bit Version 65.0.3325.181
	Microsoft Edge 41.16299.371.0
Screen Information:	24' 16:9 1920x1080 Resolution IPS Display

6.3 Test Cases

ID	Test Cases
1.	Accessing Own Medical Records – Patient Test Procedure: - Login with the patient account credentials. - Click on "View My Own Records". Expected Outcome: The application should show the Patient Records page of the correct patient ID.
2.	Changing Data Sharing Preferences -Patient Test Procedure: - Login with the patient account credentials. - Click on "Change Your Data Sharing Choice". - Choose a different option on the radio buttons from default "Opt-In". - Click "Save". Expected Outcome: When clicked on "Change Your Data Sharing Choice" again, the marked option should be the option chosen in the previous step. The change should also be reflected on the patient list in the GP and HCP views and should affect access rights to a patient's records.
3.	Accessing a Patient's Medical Records - GP Test Procedure: - Login with the GP account credentials. - Click on "Patients". - Select a patient and click "Open Records". - Click "Yes" on the consent to view screen.

	Expected Outcome: The medical records page of the correct patient selected in the list should be shown on screen. All expected tabs and tables should be present and accessible.

4.	Accessing a Patient's Medical Records - HCP
	Test Procedure:
	    - Login with the HCP account credentials.
	    - Click on "Patients".
	    - Select a patient and click "Open Records".
	    - Click "Yes" on the consent to view screen.
	Expected Outcome:
	The medical records page of the correct patient selected in the list should be shown on screen.
	All expected tabs and tables should be present and accessible.

5.	Using Emergency Access of a Patient's Medical Records – HCP
	Test Procedure:
	    - Login with the HCP account credentials.
	    - Click on "Patients"
	    - Select a patient and click "Open Records"
	    - Click "Emergency Access" on the consent to view screen.
	    - Click "OK" on the popup information screen.
	Expected Outcome:
	The medical records page of the correct patient selected in the list should be shown on screen.
	All expected tabs and tables should be present and accessible. An entry to the Access History table should be made with correct information (Date/Time, patient accessed, accessed by which user, etc)

6.	Adding Patient Medical Record (Problem) – GP
	Test Procedure:
	    - Login with the GP account credentials.
	    - Click on "Patients"
	    - Select a patient and click "Open Records"
	    - Click "Yes" on the consent to view screen.
	    - Click on "Problem" tab.
	    - Click "New" in Problem List.
	    - Enter Date.
	    - Enter Description.
	    - Click "Save".
	Expected Outcome:
	A new problem should be added to the Problem List of the patient's medical record.

7.	Adding Patient Medical Record (Problem) – HCP
	Test Procedure:
	    - Login with the HCP account credentials.
	    - Click on "Patients"
	    - Select a patient and click "Open Records"
	    - Click "Yes" on the consent to view screen.
	    - Click on "Problem" tab.
	    - Click "New" in Problem List (Approval Pending).
	    - Enter Date.

	- Enter Description. - Click "Save". Expected Outcome: A new temporary problem should be added to the Problem List (Approval Pending) of the patient's medical record.
8.	Edit Temporary Patient Medical Record (Problem) – GP Test Procedure: - Login with the GP account credentials. - Click on "Patients" - Select a patient and click "Open Records" - Click "Yes" on the consent to view screen. - Click on "Problem" tab. - Select a temporary entry to edit. - Click "Edit" in Problem List (Approval Pending) - Change the contents of the entry. - Click "Save". Expected Outcome: The edited entry should reflect the updated content.
9.	Approve Temporary Patient Medical Record (Problem) – GP Test Procedure: - Login with the GP account credentials. - Click on "Patients" - Select a patient and click "Open Records" - Click "Yes" on the consent to view screen. - Click on "Problem" tab. - Select a temporary entry to approve. - Click "Save to Main List" Expected Outcome: The temporary medical record entry should be moved up to the main Problem List.
10.	Creating a New Patient – GP Test Procedure: - Login with the GP account credentials. - Click on "Patients". - Click "New". - Enter the fields in the form, NRIC, Name, Date of Birth, Gender, Race, Address, Contact Number, Email, Patient User Role and Passwords. - Click "Save". Expected Outcome: A new patient record is added to the list of patients.
11.	Adding a New Institution – Admin Test Procedure: - Login with the Admin account credentials. - Click on "Institutions". - Click "New". - Enter the fields on the form, Institution Name and Address.

	- Click "Save" Expected Outcome: A new institution entry is added to the institution list.

12.	Creating a New GP – Admin
	Test Procedure:
	    - Login with the Admin account credentials.
	    - Click on "GP List".
	    - Click "New".
	    - Enter the fields in the form, NRIC, Name, Date of Birth, Gender, Address, Contact Number, Institution, Email, GP User Role and Passwords.
	    - Click "Save".
	Expected Outcome:
	A new GP record is added to the GP list.

13.	Creating a New HCP – Admin
	Test Procedure:
	    - Login with the Admin account credentials.
	    - Click on "HCP List".
	    - Click "New".
	    - Enter the fields in the form, NRIC, Name, Date of Birth, Gender, Address, Contact Number, Institution, Email, GP User Role and Passwords.
	    - Click "Save".
	Expected Outcome:
	A new HCP record is added to the HCP list.

14.	Adding New Test (Radiology) – Admin
	Test Procedure:
	    - Login with the Admin account credentials.
	    - Click on "Radiology Scans".
	    - Click "New".
	    - Enter "Test Name" and choose "Radiology".
	    - Click "Save"
	Expected Outcome:
	A new scan entry is added to the Radiology Scans list.

15.	Adding New Test (Laboratory) – Admin
	Test Procedure:
	    - Login with the Admin account credentials.
	    - Click on "Laboratory Tests".
	    - Click "New".
	    - Enter the form fields, test name, unit of test, reference interval and test type.
	    - Click "Save"
	Expected Outcome:
	A new test entry is added to the Laboratory Tests list.

16.	Adding New Medication – Admin
	Test Procedure:
	    - Login with the Admin account credentials.
	    - Click on "Medication".
	    - Click "New".

	- Enter "Medication Name". - Click "Save" Expected Outcome: A new medication entry is added to the medication list.
17.	Deleting a Patient Record – Admin Test Procedure: - Login with the Admin account credentials. - Click on "Patients". - Select an entry to delete. - Click "Delete" Expected Outcome: The selected patient record should be removed from the list of patients.
18.	Deleting a GP Record – Admin Test Procedure: - Login with the Admin account credentials. - Click on "GP List". - Select an entry to delete. - Click "Delete" Expected Outcome: The selected GP record should be removed from the GP List.
19.	Deleting a HCP Record – Admin Test Procedure: - Login with the Admin account credentials. - Click on "HCP List". - Select an entry to delete. - Click "Delete" Expected Outcome: The selected HCP record should be removed from the HCP List.

6.3 Test Results

ID	Test Case	User Role	Expected Outcome	Pass/Fail	Mitigation Action
1.	Accessing Own Medical Records	Patient	The application should show the Patient Records page of the correct patient ID.	Pass	-
2.	Changing Data Sharing Preferences	Patient	When clicked on "Change Your Data Sharing Choice" again, the marked option should be the option chosen in the previous step. The change should also be reflected on the patient list in the GP and HCP views and	Pass	-

			should affect access rights to a patient's records.		
3.	Accessing a Patient's Medical Records	GP	The medical records page of the correct patient selected in the list should be shown on screen. All expected tabs and tables should be present and accessible.	Pass	-
4.	Accessing a Patient's Medical Records	HCP	The medical records page of the correct patient selected in the list should be shown on screen. All expected tabs and tables should be present and accessible.	Pass	-
5.	Using Emergency Access of a Patient's Medical	HCP	The medical records page of the correct patient selected in the list should be shown on screen. All expected tabs and tables should be present and accessible. An entry to the Access History table should be made with correct information (Date/Time, patient accessed, accessed by which user, etc)	Pass	-
6.	Adding Patient Medical Record (Problem)	GP	A new problem should be added to the Problem List of the patient's medical record.	Pass	-
7.	Adding Temporary Patient Medical Record (Problem)	HCP	A new temporary problem should be added to the Problem List (Approval Pending) of the patient's medical record..	Pass	-
8.	Edit Temporary Patient Medical Record (Problem)	GP	The edited entry should reflect the updated content.	Pass	-
9.	Approve Temporary Patient Medical Record (Problem)	GP	The temporary medical record entry should be moved up to the main Problem List.	Pass	-
10.	Creating a New Patient	GP	A new patient record is added to the list of patients.	Pass	-
11.	Adding a New Institution	Admin	A new institution entry is added to the institution list.	Pass	-
12.	Creating a New GP	Admin	A new GP record is added to the GP list.	Pass	-

13.	Creating a New HCP	Admin	A new HCP record is added to the HCP list.	Pass	-
14.	Adding New Test (Radiology	Admin	A new scan entry is added to the Radiology Scans list.	Pass	-
15.	Adding New Test (Laboratory)	Admin	A new test entry is added to the Laboratory Tests list.	Pass	-
16.	Adding New Medication	Admin	A new medication entry is added to the medication list.	Pass	-
17.	Deleting a Patient Record	Admin	The selected patient record should be removed from the list of patients.	Pass	-
18.	Deleting a GP Record	Admin	The selected GP record should be removed from the GP List.	Pass	-
19.	Deleting a HCP Record	Admin	The selected HCP record should be removed from the HCP List.	Pass	-

Additional test cases and their results are in Appendix C of this document.

7.0 Critical Evaluation

Mendix as a platform for rapid development of applications is very useful and mostly achieves its aims. It provides a method to quickly assemble applications, especially with its built-in pre-configured widgets and building blocks, without much manual coding involved. Using these built-in components was simple and Mendix makes putting them in a desired layout easy with the use of Cascading Style Sheets (CSS) throughout the platform. I was able to quickly design and configure the user interface of the Aceso application such as the pages, the data display grids buttons, for example. The tool to implement the data model of the application also contributes to the ease of use of the platform. It uses object-oriented databases to store data for the applications developed in Mendix and makes setting up extremely simple with a relative user-friendly user interface, removing the need to write my own SQL queries to manage the database. However, some of the advantages mentioned also create the flaws of the platform.

While the pre-coded blocks make development very quick, they also act to hinder it when one wants to use the blocks in more creative ways than what the original programmer intended. There is a way to program in custom behaviours for the application called "Microflows", which does mitigate the issue mentioned earlier but not completely. There are only a few premade actions to use in the logic flow and anything more imaginative requires knowledge of ANTLR (Mendix, 2013), which nullifies the speed advantage of Mendix to a certain degree.

The error checking tools in Mendix can also be finicky. They mostly do a great job of exactly identifying and directing the developers to the exact elements in the application with the error. It greatly contributes to the speed at which applications can be developed in Mendix. However, it also just as easily hinders it when the error checker fails to identify the error or even presence of one at all, making the application run with unexplained unintentional behaviours.

As a rapid development tool, Mendix achieves its goals to a large degree for developing small applications in my opinion. Its mostly graphics-based tools for application development allow for even those who are not familiar with application development to start working on their own web app without as much confusion as direct coding. In spite of all its advantages, Mendix still has a few flaws that make it frustrating to use at times as mentioned before.

The application, *Aceso*¸ achieved most of its aims that I set out to create from the planning phase. It can provide the facilities for GPs to share the medical records of patients for a more consistent care from various institutions which will allow patients' experience of healthcare to be more seamless. I based the application off the existing medical record systems in Singapore as far as possible with the limitations of my knowledge of Mendix, time and Mendix itself. Due to these limitations, some compromises were made in the application such as a more simplified data model than I would have preferred, lack of document attachment capabilities, etc. Nevertheless, I think the application sufficiently meets the requirements.

Mendix Scrum, the methodology used, was effective for this application. Being able to set up Scrum related planning in Mendix itself made sure that the plan and the execution was tightly integrated. However, it is not the most effective when only one person is working on the project as many of the Scrum procedures were designed to manage small teams.

References

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Appendices

Appendix A: Additional Use Case Descriptions

Use Case Name	Add Patient Medical Record; Warning	
Overview	A GP adds new Warning to the patient's medical record in the EMR system.	
Pre-Conditions	The user must be logged into an account with GP role.	
Post-Conditions	New Warning medical information entry must be entered into the records of the patient in the EMR system.	
	Event	**Response**
1	*GP* clicks "Patients"	Patient search form displayed
2	*GP* enters NRIC of patient	Matching entries displayed
3	*GP* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*GP* clicks "Warning" tab	Warning tab of Patient Record Page displayed
5	*GP* clicks "New" button under "Warning List"	New Warning form displayed
6.0	Date of entry entered	-
6.1	Description of Warning entered	-
7	*GP* clicks "Save"	Warning entry saved. New Warning form closes.
	Extension Points:	
6.2	*GP* does not enter "Date" or "Description"	Required validation message shown.
	Alternate Cases:	
8	*GP* clicks "Cancel".	New Warning Form closes, no new patient medical record is added to the database.

Use Case Name	Add Patient Medical Record; Examination	
Overview	A GP adds new Examination to the patient's medical record in the EMR system.	
Pre-Conditions	The user must be logged into an account with GP role.	
Post-Conditions	New Examination medical information entry must be entered into the records of the patient in the EMR system.	
	Event	**Response**
1	*GP* clicks "Patients"	Patient search form displayed
2	*GP* enters NRIC of patient	Matching entries displayed
3	*GP* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*GP* clicks "Examination" tab	Examination tab of Patient Record Page displayed
5	*GP* clicks "New" button under "Examination List"	New Examination form displayed
6.0	Date of entry entered	-

6.1	Condition entered	-
6.2	Pain Score chosen from dropdown list	-
6.3	Blood Pressure entered	-
6.4	Heart rate entered	-
6.5	Heart Sounds note entered	-
6.6	Lungs note entered	-
6.7	Abdomen note entered	-
6.8	Neurological Examination note entered	-
6.9	Other comments entered	-
6.10	Impression entered	-
6.11	Management Plan entered	-
7	*GP* clicks "Save"	Examination entry saved. New Examination form closes.
	Extension Points:	
6.2	*GP* does not enter "Date", "Description" or "Examination to"	Required validation message shown.
	Alternate Cases:	
8	*GP* clicks "Cancel".	New Examination Form closes, no new patient medical record is added to the database.

Use Case Name	Add Patient Medical Record; Diagnosis	
Overview	A GP adds new Diagnosis to the patient's medical record in the EMR system.	
Pre-Conditions	The user must be logged into an account with GP role.	
Post-Conditions	New Diagnosis medical information entry must be entered into the records of the patient in the EMR system.	
	Event	**Response**
1	*GP* clicks "Patients"	Patient search form displayed
2	*GP* enters NRIC of patient	Matching entries displayed
3	*GP* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*GP* clicks "Diagnosis" tab	Diagnosis tab of Patient Record Page displayed
5	*GP* clicks "New" button under "Diagnosis List"	New Diagnosis form displayed
6.0	Date of entry entered	-
6.1	Description of Diagnosis entered	-
7	*GP* clicks "Save"	Diagnosis entry saved. New Diagnosis form closes.
	Extension Points:	
6.2	*GP* does not enter "Date" or "Description"	Required validation message shown.
	Alternate Cases:	
8	*GP* clicks "Cancel".	New Diagnosis Form closes, no new patient medical record is added to the database.

Use Case Name	Add Patient Medical Record; Prescriptions	
Overview	A USER adds new Prescriptions to the patient's medical record in the EMR system.	
Pre-Conditions	The user must be logged into an account with GP or HCP role.	
Post-Conditions	New Prescriptions medical information entry must be entered into the records of the patient in the EMR system.	
	Event	**Response**
1	*USER* clicks "Patients"	Patient search form displayed
2	*USER* enters NRIC of patient	Matching entries displayed
3	*USER* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*USER* clicks "Prescriptions" tab	Prescriptions tab of Patient Record Page displayed
5	*USER* clicks "New" button under "Prescriptions List"	New Prescriptions form displayed
6.0	Date of entry entered	-
6.1	Description of Prescriptions entered	-
6.2	Medication chosen from dropdown list	-
6.3	Comment entered	-
6.4	Route entered	-
6.5	Frequency entered	-
7	*USER* clicks "Save"	Prescriptions entry saved. New Prescriptions form closes.
	Extension Points:	
6.2	*USER* does not enter "Date", "Description" or "Prescriptions to"	Required validation message shown.
	Alternate Cases:	
8	*USER* clicks "Cancel".	New Prescriptions Form closes, no new patient medical record is added to the database.

Use Case Name	Add Patient Medical Record; Lab Result	
Overview	A USER adds new Lab Result to the patient's medical record in the EMR system.	
Pre-Conditions	The user must be logged into an account with GP or HCP role.	
Post-Conditions	New Lab Result medical information entry must be entered into the records of the patient in the EMR system.	
	Event	**Response**
1	*USER* clicks "Patients"	Patient search form displayed
2	*USER* enters NRIC of patient	Matching entries displayed
3	*USER* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*USER* clicks "Lab Result" tab	Lab Result tab of Patient Record Page displayed

5	*USER* clicks "New Lab Result" button under "Lab Result List"	New Lab Result form displayed
6.0	Lab Test chosen from dropdown list	-
6.1	Result entered	-
6.2	Date of entry entered	-
6.3	Priority of result chosen on radio buttons	-
6.4	Comment entered	-
7	*USER* clicks "Save"	Lab Result entry saved. New Lab Result form closes.
	Extension Points:	
6.2	*USER* does not enter "Date", "Description" or "Lab Result to"	Required validation message shown.
	Alternate Cases:	
8	*USER* clicks "Cancel".	New Lab Result Form closes, no new patient medical record is added to the database.

Use Case Name	Add Patient Medical Record; Scan Result	
Overview	A USER adds new Scan Result to the patient's medical record in the EMR system.	
Pre-Conditions	The user must be logged into an account with GP or HCP role.	
Post-Conditions	New Scan Result medical information entry must be entered into the records of the patient in the EMR system.	
	Event	**Response**
1	*USER* clicks "Patients"	Patient search form displayed
2	*USER* enters NRIC of patient	Matching entries displayed
3	*USER* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*USER* clicks "Scan Result" tab	Scan Result tab of Patient Record Page displayed
5	*USER* clicks "New Scan" button under "Scan Result List"	New Scan Result form displayed
6.0	Scan chosen from dropdown list	-
6.1	Date of scan result entered	-
6.2	Priority of result chosen on radio buttons	-
6.3	Comment entered	-
6.4	Click "Browse" in upload image section	File selection window opens
6.5	Select relevant image to upload	File selection window closes, file path entered to form
7	*USER* clicks "Save"	Scan Result entry saved. New Scan Result form closes.
	Extension Points:	
6.2	*USER* does not enter "Date", "Description" or "Scan Result to"	Required validation message shown.
	Alternate Cases:	

8	*USER* clicks "Cancel".	New Scan Result Form closes, no new patient medical record is added to the database.

Use Case Name	Add Patient Medical Record; Referral	
Overview	A USER adds new Referral to the patient's medical record in the EMR system.	
Pre-Conditions	The user must be logged into an account with GP or HCP role.	
Post-Conditions	New Referral medical information entry must be entered into the records of the patient in the EMR system.	
	Event	**Response**
1	*USER* clicks "Patients"	Patient search form displayed
2	*USER* enters NRIC of patient	Matching entries displayed
3	*USER* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*USER* clicks "Referral" tab	Referral tab of Patient Record Page displayed
5	*USER* clicks "New" button under "Referral List"	New Referral form displayed
6.0	Date of entry entered	-
6.1	Description of Referral entered	-
6.2	USER or HCP to refer to chosen from dropdown list	-
7	*USER* clicks "Save"	Referral entry saved. New Referral form closes.
	Extension Points:	
6.2	*USER* does not enter "Date", "Description" or "Referral to"	Required validation message shown.
	Alternate Cases:	
8	*USER* clicks "Cancel".	New Referral Form closes, no new patient medical record is added to the database.

Use Case Name	Add Patient Medical Record; Event	
Overview	A USER adds new Event to the patient's medical record in the EMR system.	
Pre-Conditions	The user must be logged into an account with GP or HCP role.	
Post-Conditions	New Event medical information entry must be entered into the records of the patient in the EMR system.	
	Event	**Response**
1	*USER* clicks "Patients"	Patient search form displayed
2	*USER* enters NRIC of patient	Matching entries displayed
3	*USER* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*USER* clicks "Event" tab	Event tab of Patient Record Page displayed
5	*USER* clicks "New" button under "Event List"	New Event form displayed
6.0	Date of entry entered	-
6.1	Event Type chosen from radio buttons	-
6.2	Comment of Event entered	-
7	*USER* clicks "Save"	Event entry saved. New Event form closes.
	Extension Points:	
6.2	*USER* does not enter "Date", "Comment" or chose an "Event Type"	Required validation message shown.
	Alternate Cases:	
8	*USER* clicks "Cancel".	New Event Form closes, no new patient medical record is added to the database.

HCP Use Cases

Use Case Name	Add Temporary Patient Medical Record; Warning	
Overview	A HCP adds new Warning to the patient's medical record in the EMR system.	
Pre-Conditions	The user must be logged into an account with HCP role.	
Post-Conditions	New Temporary Warning medical information entry must be entered into the records of the patient in the EMR system.	
	Event	**Response**
1	*HCP* clicks "Patients"	Patient search form displayed
2	*HCP* enters NRIC of patient	Matching entries displayed
3	*HCP* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*HCP* clicks "Warning" tab	Warning tab of Patient Record Page displayed
5	*HCP* clicks "New" button under "Warning List"	New Temporary Warning form displayed
6.0	Date of entry entered	-
6.1	Description of Warning entered	-

7	*HCP* clicks "Save"	Temporary Warning entry saved. New Temporary Warning form closes.
	Extension Points:	
6.2	*HCP* does not enter "Date" or "Description"	Required validation message shown.
	Alternate Cases:	
8	*HCP* clicks "Cancel".	New Temporary Warning Form closes, no new patient medical record is added to the database.

Use Case Name	Add Temporary Patient Medical Record; Examination	
Overview	A HCP adds new Examination to the patient's medical record in the EMR system.	
Pre-Conditions	The user must be logged into an account with HCP role.	
Post-Conditions	New Temporary Examination medical information entry must be entered into the records of the patient in the EMR system.	
	Event	**Response**
1	*HCP* clicks "Patients"	Patient search form displayed
2	*HCP* enters NRIC of patient	Matching entries displayed
3	*HCP* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*HCP* clicks "Examination" tab	Examination tab of Patient Record Page displayed
5	*HCP* clicks "New" button under "Examination List"	New Temporary Examination form displayed
6.0	Date of entry entered	-
6.1	Condition entered	-
6.2	Pain Score chosen from dropdown list	-
6.3	Blood Pressure entered	-
6.4	Heart rate entered	-
6.5	Heart Sounds note entered	-
6.6	Lungs note entered	-
6.7	Abdomen note entered	-
6.8	Neurological Examination note entered	-
6.9	Other comments entered	-
6.10	Impression entered	-
6.11	Management Plan entered	-
7	*HCP* clicks "Save"	Temporary Examination entry saved. New Temporary Examination form closes.
	Extension Points:	
6.2	*HCP* does not enter "Date", "Description" or "Examination to"	Required validation message shown.
	Alternate Cases:	

8	*HCP* clicks "Cancel".	New Temporary Examination Form closes, no new patient medical record is added to the database.

| Use Case Name	Add Temporary Patient Medical Record; Diagnosis	
Overview	A HCP adds new Diagnosis to the patient's medical record in the EMR system.	
Pre-Conditions	The user must be logged into an account with HCP role.	
Post-Conditions	New Temporary Diagnosis medical information entry must be entered into the records of the patient in the EMR system.	
	Event	**Response**
1	*HCP* clicks "Patients"	Patient search form displayed
2	*HCP* enters NRIC of patient	Matching entries displayed
3	*HCP* selects entry and clicks "Open Records"	Patient Record page of relevant entry displayed
4	*HCP* clicks "Diagnosis" tab	Diagnosis tab of Patient Record Page displayed
5	*HCP* clicks "New" button under "Diagnosis List"	New Temporary Diagnosis form displayed
6.0	Date of entry entered	-
6.1	Description of Diagnosis entered	-
7	*HCP* clicks "Save"	Temporary Diagnosis entry saved. New Temporary Diagnosis form closes.
	Extension Points:	
6.2	*HCP* does not enter "Date" or "Description"	Required validation message shown.
	Alternate Cases:	
8	*HCP* clicks "Cancel".	New Temporary Diagnosis Form closes, no new patient medical record is added to the database.

Appendix B: Microflow Documentation

Normal Access Microflow

Purpose: Creates an entry in the AccessHistory table when clicked "Yes" in the patient consent screen.

Components:

1. Opens the Records page of selected patient.
2. Creates an entry in the AccessHistory table with Patient ID, Current User ID, Date/Time and Access Type as "Normal Access"
3. Closes the patient consent screen.
4. Retrieves the ID of selected patient.
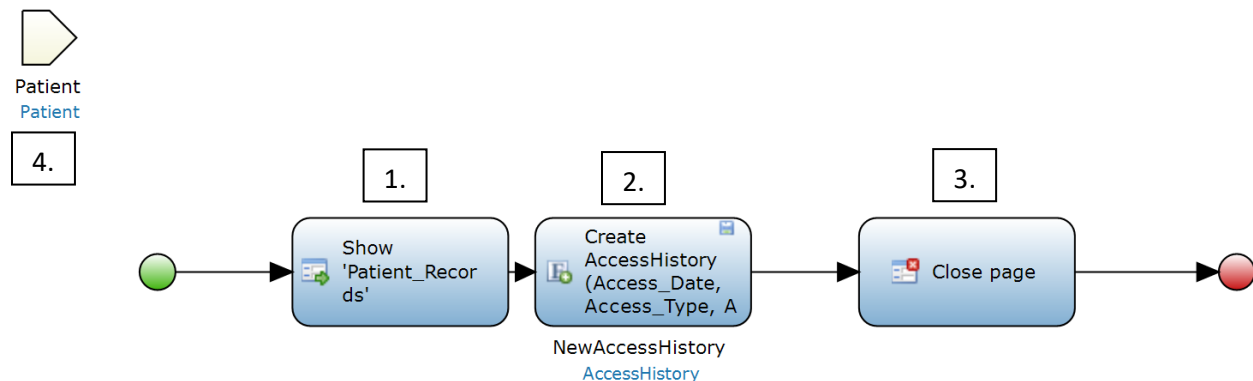
Emergency Access Microflow

Purpose: Creates an entry in the AccessHistory table when clicked "Yes" in the patient consent screen.

Components:

1. Displays an information popup.
2. Opens the Records page of selected patient.
3. Creates an entry in the AccessHistory table with Patient ID, Current User ID, Date/Time and Access Type as "Emergency Access"
4. Closes the patient consent screen.
5. Retrieves the ID of selected patient.
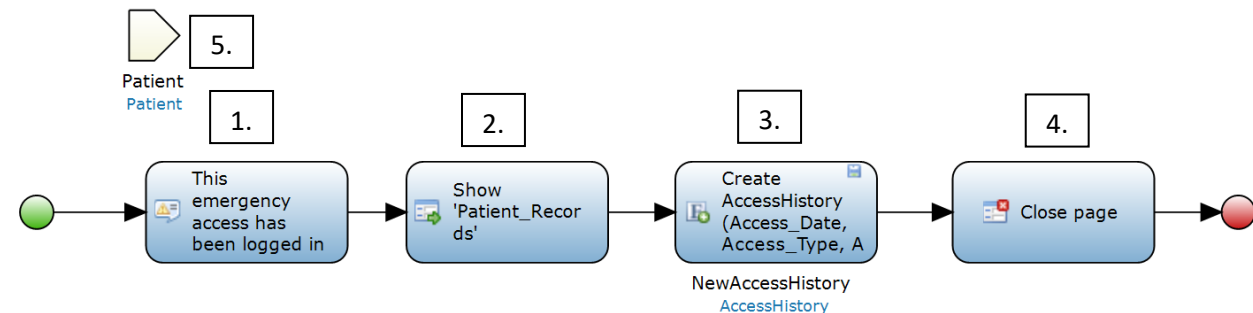
Temporary Entry Approval Microflow Example

Purpose: "Moves" the temporary medical record entered by an HCP to the main list when approved by a GP. This particular microflow is for approving a temporary diagnosis entry.

Components:
1. Retrieves the selected temporary medical record entry.
2. Retrieves the patient belonging to the record.
3. Creates a new object in the main table with variables copied from the temporary entry, assigns the new object to the patient.
4. Deletes the temporary entry.
5. Shows information message.
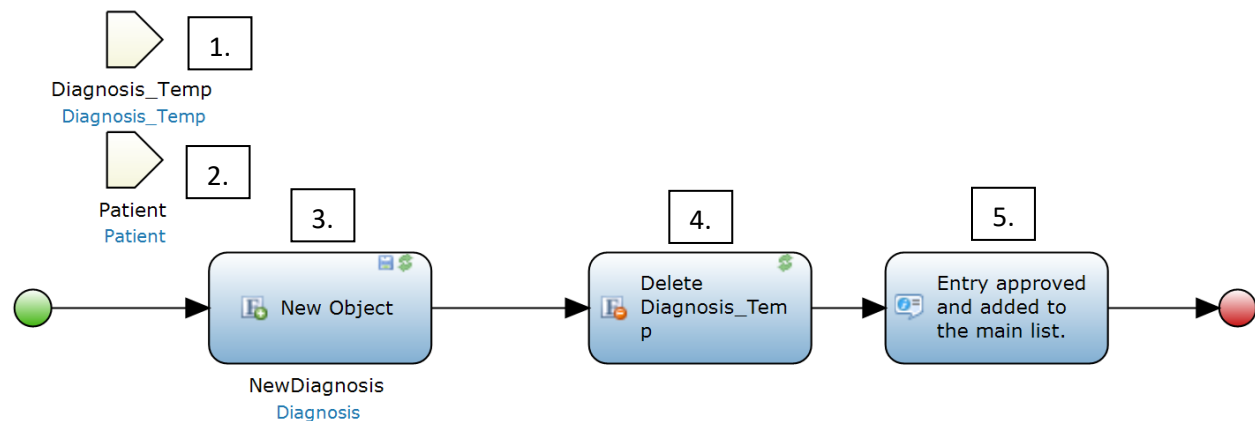
New Account Microflow Example

Purpose: Creates a new user (GP, HCP, Patient) account and password data objects then shows the new account form. This particular microflow is for creating a new patient in the system.

Components:
1. Creates a new object in the relevant user table (GP, HCP, Patient).
2. Creates a new object associated with the new user object in the AccountPasswordData table.
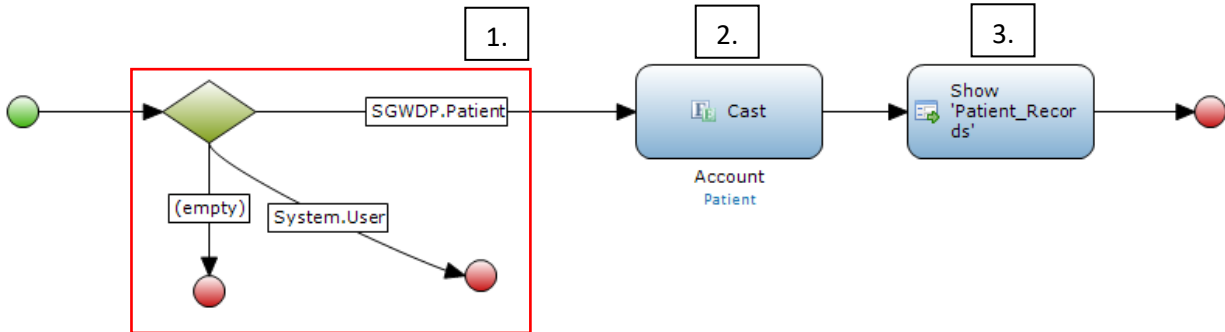3. Passes the newly created objects to the relevant new user form.
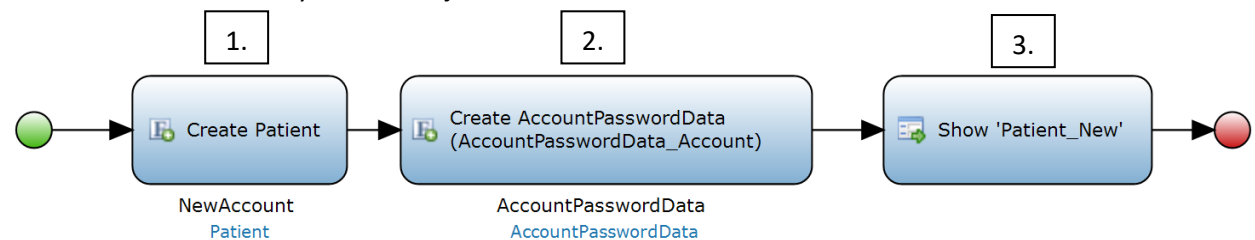
Retrieve Current User Microflow Example

Purpose: Retrieves the current user ID, takes the object associated with the user from the relevant user table (GP, HCP, Patient) and passes it to a page that requires it such as the Patient Records page.

Components:

1. Retrieves the ID of the current user.
2. Retrieves the account associated with the user ID.
3. Takes user ID and passes it to a page that requires it.

Appendix C: Additional Test Cases and Results

ID	Test Case
20.	Adding Patient Medical Record (Warning) – GP Test Procedure: - Login with the GP account credentials. - Click on "Patients" - Select a patient and click "Open Records" - Click "Yes" on the consent to view screen. - Click on "Warning" tab. - Click "New" in Warning List. - Enter Date. - Enter Description. - Click "Save". Expected Outcome: A new Warning should be added to the Problem List of the patient's medical record.
21.	Adding Patient Medical Record (Examination) – GP Test Procedure: - Login with the GP account credentials. - Click on "Patients" - Select a patient and click "Open Records" - Click "Yes" on the consent to view screen. - Click on "Examination" tab. - Click "New" in Examination List. - Enter Date. - Enter Condition. - Select Pain Score. - Enter Blood Pressure. - Enter Heart Rate. - Enter Heart Sounds note. - Enter Lungs note. - Enter Abdomen note. - Enter Neurological Examination note. - Enter Impression. - Enter Management Plan. - Click "Save". Expected Outcome: A new Examination should be added to the Examination List of the patient's medical record.
22.	Adding Patient Medical Record (Diagnosis) – GP Test Procedure: - Login with the GP account credentials. - Click on "Patients" - Select a patient and click "Open Records" - Click "Yes" on the consent to view screen. - Click on "Diagnosis" tab. - Click "New" in Diagnosis List. - Enter Date.

	- Enter Description. - Click "Save". Expected Outcome: A new Diagnosis should be added to the Diagnosis List of the patient's medical record.
23.	Adding Temporary Patient Medical Record (Warning) – HCP Test Procedure: - Login with the HCP account credentials. - Click on "Patients" - Select a patient and click "Open Records" - Click "Yes" on the consent to view screen. - Click on "Warning" tab. - Click "New" in Warning List (Approval Pending). - Enter Date. - Enter Description. - Click "Save". Expected Outcome: A new temporary Warning should be added to the Warning List (Approval Pending) of the patient's medical record.
24.	Adding Temporary Patient Medical Record (Examination) – HCP Test Procedure: - Login with the HCP account credentials. - Click on "Patients" - Select a patient and click "Open Records" - Click "Yes" on the consent to view screen. - Click on "Examination" tab. - Click "New" in Examination List (Approval Pending). - Enter Date. - Enter Condition. - Select Pain Score. - Enter Blood Pressure. - Enter Heart Rate. - Enter Heart Sounds note. - Enter Lungs note. - Enter Abdomen note. - Enter Neurological Examination note. - Enter Impression. - Enter Management Plan. - Click "Save". Expected Outcome: A new temporary Examination should be added to the Examination List (Approval Pending) of the patient's medical record.
25.	Adding Temporary Patient Medical Record (Diagnosis) – HCP Test Procedure: - Login with the HCP account credentials.

	- Click on "Patients" - Select a patient and click "Open Records" - Click "Yes" on the consent to view screen. - Click on "Diagnosis" tab. - Click "New" in Diagnosis List (Approval Pending). - Enter Date. - Enter Description. - Click "Save". Expected Outcome: A new temporary Diagnosis should be added to the Diagnosis List (Approval Pending) of the patient's medical record.
26.	Adding Patient Medical Record (Prescription) – GP/HCP Test Procedure: - Login with the GP account credentials. - Click on "Patients" - Select a patient and click "Open Records" - Click "Yes" on the consent to view screen. - Click on "Prescription" tab. - Click "New" in Prescription List. - Enter date. - Select Medication. - Enter comment. - Select Route. - Select Frequency. - Click "Save". Expected Outcome: A new Prescription should be added to the Prescription List of the patient's medical record.
27.	Adding Patient Medical Record (Lab Result) – GP/HCP Test Procedure: - Login with the GP account credentials. - Click on "Patients" - Select a patient and click "Open Records" - Click "Yes" on the consent to view screen. - Click on "Result" tab. - Click "New Lab Result" in Result List. - Select Lab Test. - Enter Result. - Enter Date. - Select Result Priority. - Enter Comment. - Click "Save". Expected Outcome: A new Lab Result should be added to the Lab Result List of the patient's medical record.
28.	Adding Patient Medical Record (Scan Result) – GP/HCP Test Procedure:

	- Login with the GP account credentials. - Click on "Patients" - Select a patient and click "Open Records" - Click "Yes" on the consent to view screen. - Click on "Result" tab. - Click "New Scan" in Result List. - Select Scan. - Enter Date. - Select Result Priority. - Enter Comment. - Click "Browse" in Upload Image. - Select an image to upload. - Click "Save". Expected Outcome: A new Scan Result should be added to the Scan Result List of the patient's medical record.
29.	Adding Patient Medical Record (Referral) – GP/HCP Test Procedure: - Login with the GP account credentials. - Click on "Patients" - Select a patient and click "Open Records" - Click "Yes" on the consent to view screen. - Click on "Referral" tab. - Click "New" in Referral List. - Enter Date. - Select a GP to refer to. - Enter Comment. - Click "Save". Expected Outcome: A new Referral should be added to the Referral List of the patient's medical record.
30.	Adding Patient Medical Record (Event) – GP/HCP Test Procedure: - Login with the GP account credentials. - Click on "Patients" - Select a patient and click "Open Records" - Click "Yes" on the consent to view screen. - Click on "Event" tab. - Click "New" in Event List. - Enter Date. - Select Event Type. - Select GP involved. - Enter Comment. - Click "Save". Expected Outcome: A new Event should be added to the Event List of the patient's medical record.

| ID	Test Case	User Role	Expected Outcome	Pass/Fail	Mitigation Action
20.	Adding Patient Medical Record (Warning)	GP	A new Warning should be added to the Problem List of the patient's medical record.	Pass	-
21.	Adding Patient Medical Record (Examination)	GP	A new Examination should be added to the Examination List of the patient's medical record.	Pass	-
22.	Adding Patient Medical Record (Diagnosis)	GP	A new Diagnosis should be added to the Diagnosis List of the patient's medical record.	Pass	-
23.	Adding Temporary Patient Medical Record (Warning)	HCP	A new temporary Warning should be added to the Warning List (Approval Pending) of the patient's medical record.	Pass	-
24.	Adding Temporary Patient Medical Record (Examination)	HCP	A new temporary Examination should be added to the Examination List (Approval Pending) of the patient's medical record.	Pass	-
25.	Adding Temporary Patient Medical Record (Diagnosis)	HCP	A new temporary Diagnosis should be added to the Diagnosis List (Approval Pending) of the patient's medical record.	Pass	-
26.	Adding Patient Medical Record (Prescription)	GP/HCP	A new Prescription should be added to the Prescription List of the patient's medical record.	Pass	-
27.	Adding Patient Medical Record (Lab Result)	GP/HCP	A new Lab Result should be added to the Lab Result List of the patient's medical record.	Pass	-
28.	Adding Patient Medical Record (Scan Result)	GP/HCP	A new Scan Result should be added to the Scan Result List of the patient's medical record.	Pass	-
29.	Adding Patient Medical Record (Referral)	GP/HCP	A new Referral should be added to the Referral List of the patient's medical record.	Pass	-
30.	Adding Patient Medical Record (Event)	GP/HCP	A new Event should be added to the Event List of the patient's medical record.	Pass	-

Appendix D: Turnitin Similarity Report
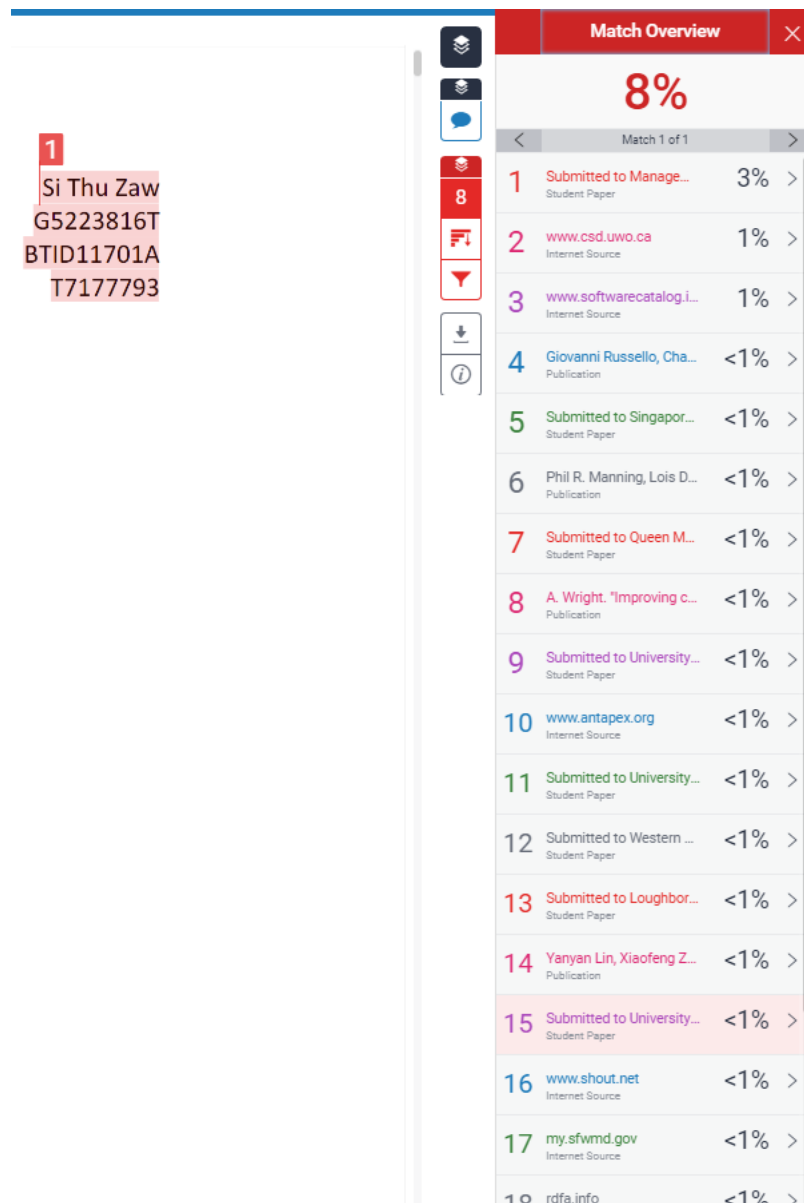
Figure 17: Similarity Report Sources