COMP3820 Group Project - Semester Two 2021

ISBAR Care Handover

By

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Visit us: https://solving-isbarriers.github.io/COMP3820-ISBAR/#/

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Requirements

Problem space

In the clinical environment, ineffective communication has been recognized as a major factor that contributes to the degradation of healthcare quality and accidents. Over the years, studies have identified that communication problems often occur during clinical handover processes. For example, a recent large project of the European Commission found that 25% to 40% of adverse events are caused by the handover process (S. Eggins and D. Slade, 2015). Possible reasons for this result include lack of standardisation for handover processes, misreading clinicians' handwriting and memory deviation.

Solution

To ensure the safety of health care and to reduce unnecessary human errors in clinical environments, handover protocols have been standardized and electronic medical records (EMR) have been used to manage patient information. ISBAR handover form was developed to standardize the handover process, which stands for Introduction, Situation, Background, Assessment, Recommendation. The ISBAR form is used to ensure the clinicians and nurses record all clinical information relevant for a handover process by dividing them into relevant sections and suggesting contents for each section. As electrical medical records are now commonly used to increase workflow efficiency, electronic ISBAR handover forms were suggested as the solution to further increase handover efficiency and reduce errors during the handover process.

Team project

Our team's project is to develop an ISBAR handover form in the form of SMART on FHIR application. The purpose of this application is to enable healthcare students to adapt to electronic healthcare systems in advance by providing an online learning tool to simulate clinical handovers using ISBAR forms. By doing so, the students are allowed to improve the work efficiency and quality of the clinical handover process.

Research

Prior to the application design process, our group conducted extensive research of relevant literature related to the clinical handover. The research suggested in e-medical delivery training, teachers and students believe that "through simulated training, self-directed learning is better than direct guidance, and students/practitioners can get equal opportunities to participate in training" (M. L. Braunstein, 2019). In addition, the literature points out that, "Students often forget their location on the application", and they "Do not want the application to be too 'fragmented'. Furthermore, the application should "Allow effective input of handover information

(ideally, just click the mouse)" and "avoid duplicate data input "(L. Cheah et al., 2005). In a student-centred clinical education literature, it was mentioned that students wanted "to be able to review their own cases effectively."(Elliott, K)

Client requirements:

1. It needs to record ISBAR notes and store them as fhir resources.
2. It needs to be started in the CBL of FHIR teaching EMR.
3. It needs to extract key data from fhir resources in clinical cases to fill in annotations.
4. It needs to store the completed ISBAR in the FHIR resource.
5. It needs to generate PDF and/or word documents of ISBAR notes to allow distribution.
6. It supports two input modes or views, one is the basic text annotation of each element of ISBAR, and the other is a structured form filled with detailed patient data extracted from patient records. (such as observation, vital signs, drugs, condition, etc.)

User requirements:

1. Be able to review the case more effectively.
2. Able to participate in self-directed learning.
3. Equal participation in learning and training.
4. Simple, time-saving and practical.
5. Clear system navigation.
6. Avoid duplicate data entry and ensure that the information viewed is accurate and up-to-date.

System requirements:

Based on the insights gained from the research and the customer's requirements, we have identified several system requirements to guide our design process.

1. Efficient input scheme for handover information
The application should allow practitioners to enter and search for the relevant data they need, and the steps required to select and enter the relevant data should be minimised to improve usability and efficiency.

2. Avoid duplicate data entry
The application should not have any duplicate entries to avoid wasting time.

3. Allow efficient tracking and navigation
In order to identify the person responsible for the information, the electronic form is required to clarify the author, recipient and the time of handover. Moreover, the system should allow the user to easily map their location within the application.

4. Time-saving
The application should have a minimal and simple interface to minimise cognitive load in processing the information, saving the user's time.

5. Avoid process fragmentation
While the electronic form should maintain the five specific sections of the referral protocol - introduction, situation, background, assessment and recommendations - it should present the information in one screen following the traditional use of the referral form, allowing the users to see all the information at a glance.

Functional requirements

Two versions:

- Simple version: simulates a verbal handover process, allowing clinicians to get a quick overview of all aspects of a patient at a glance. This version should meet the need for efficient input, saving time in conveying information.
- Complex version: Presents the five sections of clinical information with more detail and constraints, and pre-fill the fields that contain known information. The presentation should be easy to understand by utilising forms and cards.

Information input function:
The system allows the practitioner to enter information about the patient, including personally identifiable information, clinical data and diagnostic statements.

Save function:
The system should allow the user to save information about the current form.

History function:
The application should allow the user to review and edit the ISBAR forms previously entered by different practitioners.

Print function:
The application should be able to print the ISBAR form in the form of pdf documents to allow distribution.

Design

The concept was designed using two different versions, simple and complex, based on the template of the original handover form provided in the message, combined with all the data obtained. This allows the user to practice different levels of use depending on the version. The prototype has been designed in three parts. Low, Medium and High fidelity. Changes and improvements are made to varying degrees depending on the needs of the user and the results of the tests.

Initial Version： Wireframe + Low Fidelity Prototype

Simple: In the initial design, the simple version took the form of a one-page form only, based on the client's requirements and the user's need for a handover form. This design choice provides the user with an intuitive platform similar to existing online text-filled forms.

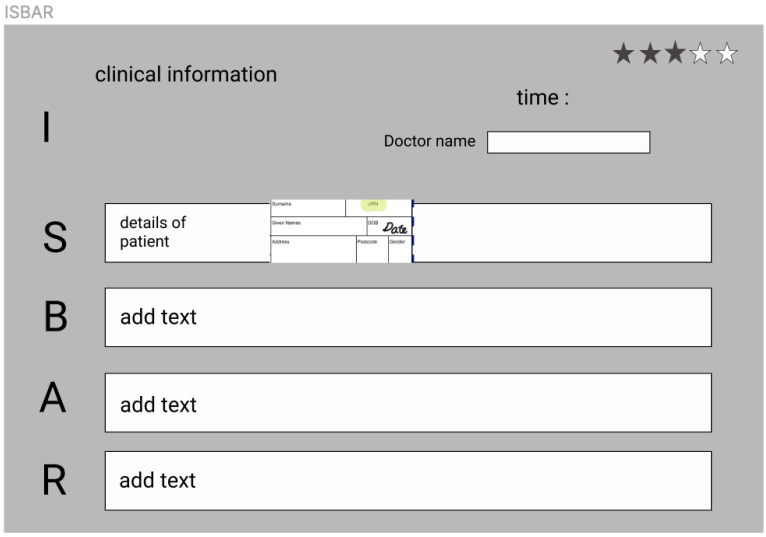

Figure 1: (Simple page)

The simple version is divided into five text areas according to their corresponding ISBAR sections. This design allows the user to fill in the patient's condition according to the different requirements for content in each section while allowing the recipient to get a quick overview of the patient's condition. A user rating mechanism has been designed on the page to prioritise patients according to the overall severity of their condition (e.g. the most serious condition needs to be prioritised by the receiving doctor). A real-time time display is also designed to ensure that user input is always up to date.

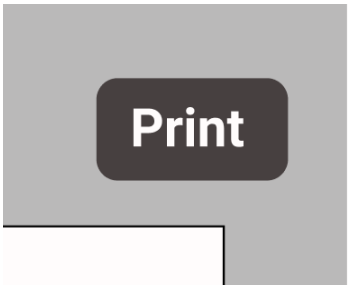

Figure 2: (Print Button)

In addition, a print function has been added as per customer and system requirements to allow users to print out the contents of the paper after filling in the information online for distribution to other recipients. Access to these functions is fixed in the navigation bar at the top of the page to ensure that users always have access to this function.

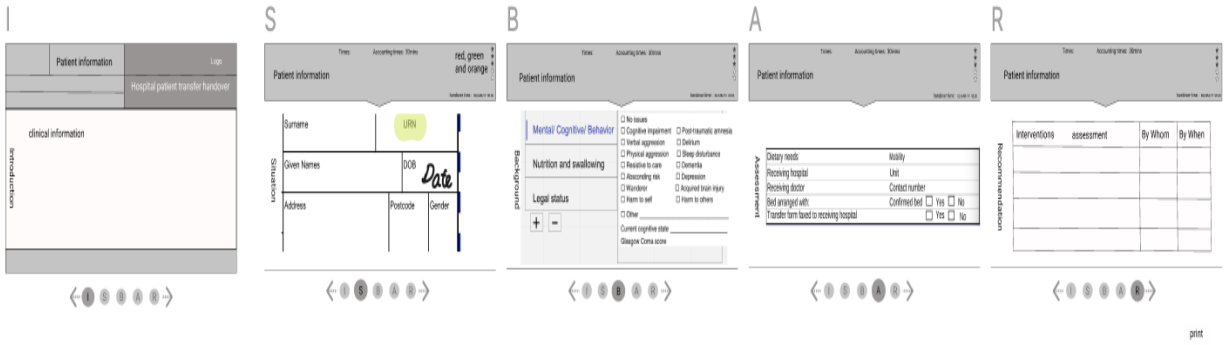

Figure 3: (Complex Version Pages)

Complex: In order to reduce the burden of information intake on the user, the traditional ISBAR form has been divided into five separate pages - Introduction, Situation, Background, Assessment and Presentation - in the complex version of the wireframe. The basic patient information is always kept at the top of the page to make it clear to the doctor which patient the clinical data comes from. The logo and name of the practitioner's hospital are also included at the top. At the bottom of the page is navigation to each page, for users to know where they are at all times and to jump to other pages.

Second Iteration： Medium Fidelity Prototype

After we showed the primary version to the client, the page design and corresponding functionality were determined based on the feedback. The page and function design was refined in the intermediate model.

Figure 4: (Home Screen - Second Iteration)

Two versions have been added to the main page. It would be easier for the user to choose between the simple and the complex version according to the needs of the exercise.

Simple Version：

Figure 5: (Save button - Second Iteration)

A save function has been added and the button has been placed next to the print button. The user can save the completed content at any time.

Figure 6: (Simple ISBAR - Second Iteration)

In the new simple version, the rating function has been optimised. The previous appearance of five stars has been replaced by three circles. Three colours have been used to represent the different information statuses (red, yellow, and green). Each colour represents a different patient-level information status. Red means urgent care, yellow means moderate condition and green means good status. In addition, patient information is set to always be displayed at the top of the page.

Complex Version：

Figure 7: (Complex ISBAR - Second Iteration)

In the complex version, the same saving function and scoring function as in the simple version has been added along with some minor changes. The first is that the information on each page is presented through a table, which restores the original handover table format and is not unfamiliar to the user when using it. Secondly, a large heading has been added to the navigation bar section of each page so that users can easily understand the content of the current page during the exercise.

Final Version： High Fidelity Prototype

Based on feedback from user testing, we have made some improvements.

The overall background colour has been changed from dark blue to white. This improves the overall readability and professionalism of the application.

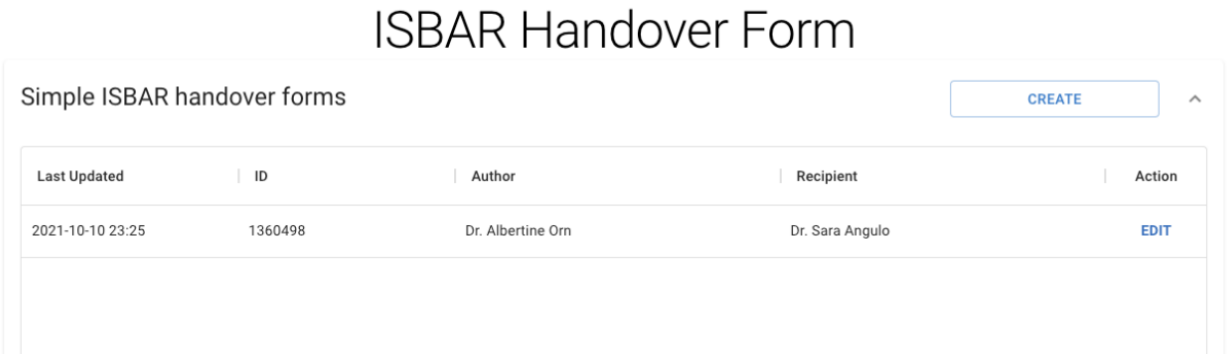

Figure 8: (Home screen - Past encounters)

Functional and detailed improvements were made throughout the application. A post-save history function has been added, which allows users to easily view the results of previous input records after finishing patient encounters. This was a highly desired feature from our client and improves the reusability of the application substantially.

Figure 9: (Home Screen - High Fidelity)

The main page also changed to a cleaner style, leaving only a selection section for simple and complex versions.

Simple Version：

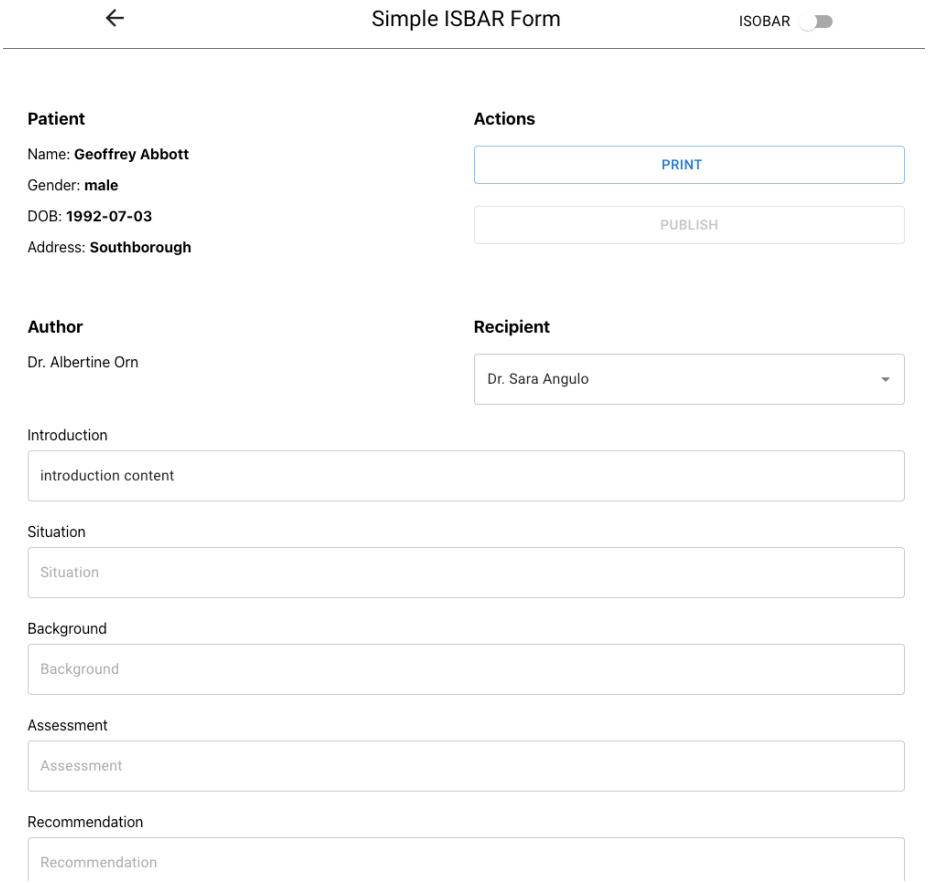

Figure 10: (Simple ISBAR - High Fidelity)

The overall style of the final simple version follows the layout of the previous version. The save button has been converted over to a publish button. Functionally they work the same, but by swapping over to a publish button the user is more inclined to understand that this is writing their input to the server.

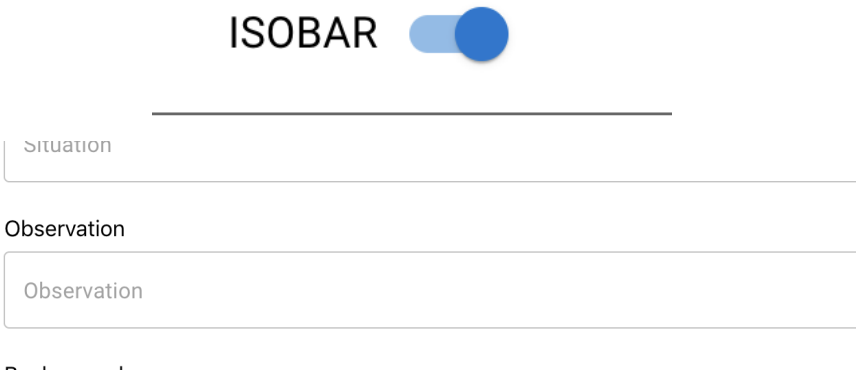

Figure 11: (ISOBAR Switch)

An ISOBAR switch has been added to the top right-hand corner of the page. When the switch is switched on, an observation table will be added to the information table below.

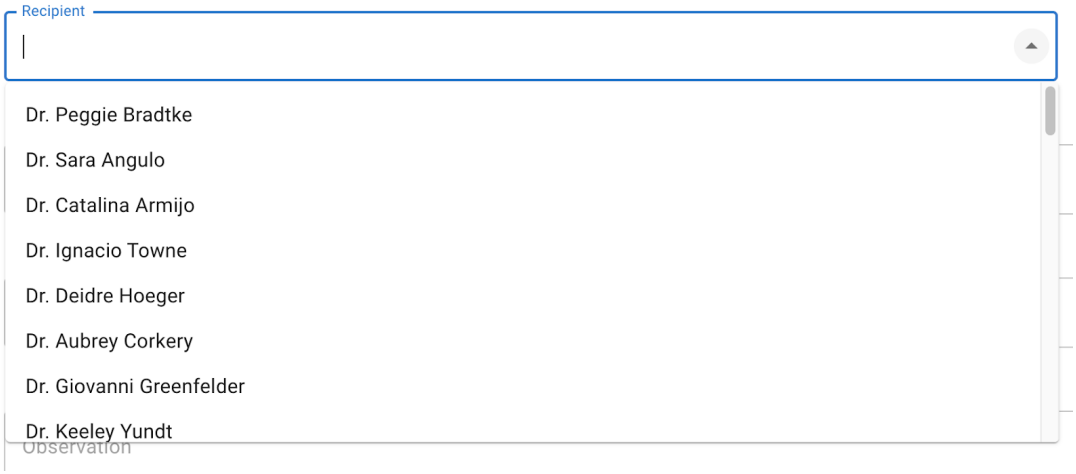

Figure 12: (Recipient Select)

In regards to the user's name, this section has been changed from the individual filling in their details manually to importing the user's name information from the database. They only need to find their name in the information field in the onboarding process.

Complex Version：
After conferring with the client, he expressed the wish to put all five pages of information into one page, which would improve the user's visual experience. In the final complex version, the page will display the basic patient information pre-filled in. At the request of the client, it was desired that the App contain the sending and receiving practitioner. This provides the user more flexibility in facilitating a patient handover.

The client requested that all five sections of the ISBAR be placed on one page, which would reduce the number of clicks during use and improve the user experience. In addition, considering the actual usage scenario, it is easy for clinicians to browse all the information at a glance and improve efficiency.

Based on user requests and research of the ISBAR specification, it was found that information about the sending doctor and the recipient should be clearly displayed in the Introduction section. Therefore, in this section the name of the sending doctor is read directly, in order to save time for the user. We have added the name of the receiving doctor and the relevant information to the right. In addition, the user can select the name of the receiving doctor from the drop down field.

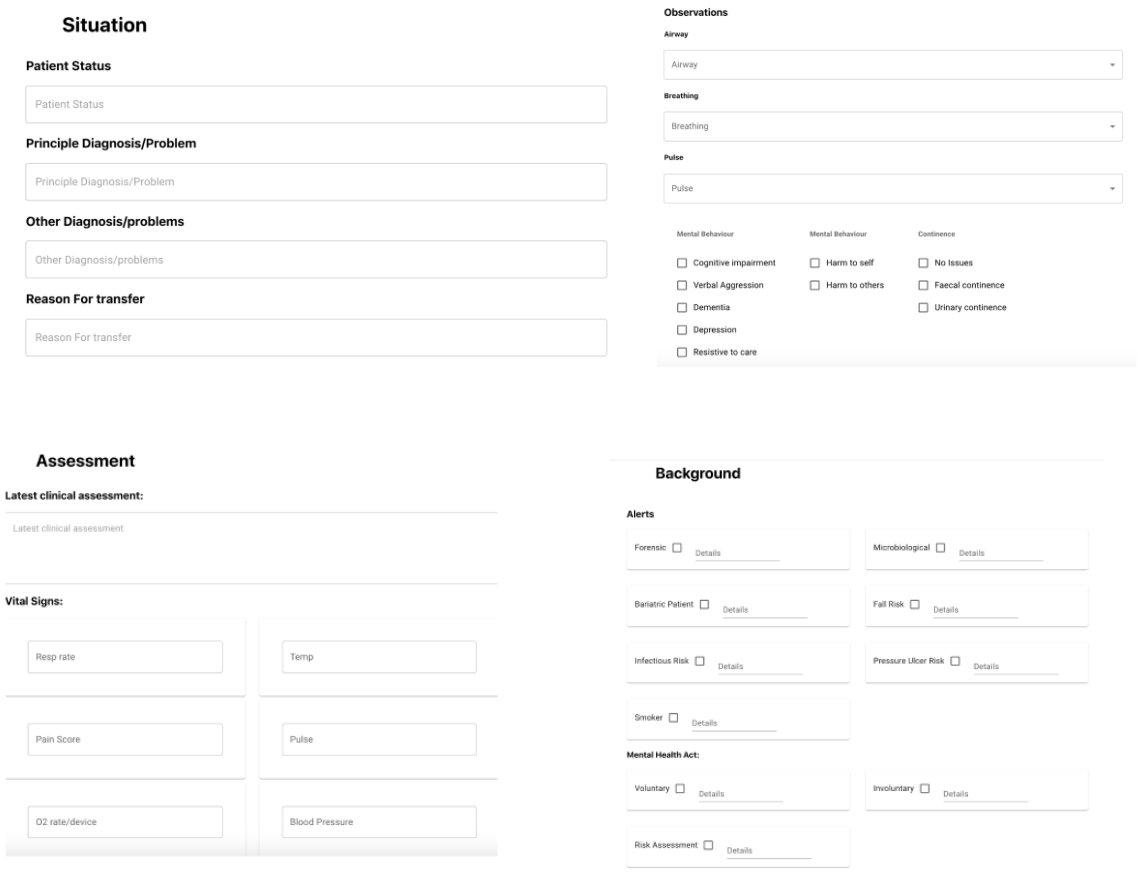

Figure 13: (Complex ISBAR - High Fidelity)

The content of each information section has been changed to the appearance of a card format. The Observation section has been separated from the Situation to create a separate information area.

In the introduction section is the basic handover transfer information. The user needs to fill in their name and the name of the next person to be handed over. The situation section is mainly the current status of the patient. Therefore an observation data is added to the original information in this section. The user can select the severity of the symptoms based on the data provided, as well as check some of the patient's behavioural interactions. In the background section, the main purpose is to give the user an overview of the patient's current status and the patient's previous medical history. Basically it is all checked checkboxes and the text box below can also be filled in with information about the patient that needs special attention. In the assessment section, it requires the results of the clinical observation. Because the client says this clinical assessment is important, it is placed in front of the other information boxes. The following information is similar to the observation and is about the patient's vital characteristics. The user needs to fill in the detailed information. In the final advice section, it needs the user's medical advice to the next user about the patient, such as medication advice and treatment advice.

Testing

A total of two rounds of testing were conducted during the development process. The first round was a usability test using a medium-fidelity prototype, which was focused on evaluating the layout of the application. Three medical students participated in this round of testing, and they were asked if they perceived the layout as efficient and intuitive. The second round was a functionality test of the application, which had core functionalities implemented. During this round of testing the functionality of the application was demonstrated to the client, and feedback about the application was received.

1. First: Usability Test

We set several tasks for the users to complete and used the think-aloud method during the testing. Observation and interviews were also utilised to gain further insights relevant for design evaluation.

User Tasks：
(1)Create a simple version of the ISBAR convert form
Watch： Observe if the user can quickly find the button to create the form
(2)This patient is an emergency patient, please mark it out.
Watch： Observe if the user knows which part is used to mark the patient's priority
(3)Create a form to fill out a detailed patient profile
Watch： Observe whether the user can create the appropriate version to suit the needs of the scenario
(4)Find a section where you can fill in the patient's past medical history
Watch： Observe if the user can quickly find the right place to fill in without experience
(5)Print this form

Watch： Observe that the button is positioned appropriately and that the user can see it among the many messages

Interview questions:
(1)If the user has a problem somewhere in the testing process, follow up on that part, why they think so and if there is a better way
(2)Any further comments on this app

Results：
For the first task, all three users quickly found the button and created a simple version of the ISBAR form. For the second task, none of the users could find the priority label easily, with only one participant finding it while still being unsure of its functionality. For the third task, two users clicked on the create complex version straight away, while the other user thought a little before clicking the button. For the fourth task, only one user could find the relevant section effectively, and the other two opened each page to find the page containing medical history. The last task was completed very quickly by all participants.

During the interview, the users stated the second and fourth tasks were challenging due to various reasons. For the second task, users reported that they were unfamiliar with the patient prioritisation system as they had not used this feature before. For the fourth task, users reported that they were not familiar with ISBAR, and having the contents scattered in different pages did not allow them to easily identify the location of a patient's medical history; they had to click on each page to check whether it contained medical history or not. Users also suggested that the blue background colour of the application makes it look a little chaotic, negatively affecting the user's ability to concentrate.

Reflection：
We have made some changes to the interface based on user feedback and considered putting all five sections of complex ISBAR form into one page to prevent user confusion. We also removed the patient rating system as this section was confusing for users to use and was not often used during the handover process. We removed the blue background to keep the user focused when using the app.

2. Second: Functionality Test

The second user test was mainly to test the functionality of our working application, and our client, Ben, was invited to do the testing.

Originally we planned to let Ben experience our app on his own and gather data from observing his behaviours as well as interviewing him after the session. However, because our application

could only be launched in the local environment at the time of testing, the functionalities were demonstrated using the screen sharing functionality of Zoom.

Feedback (Appendix Meeting Logs 29/10) :
(1)Need to be able to see a list of previous forms on the main page, and the application should allow the user to view the contents of these forms.
(2)The application should prefill all sections that could be prefilled by gathering data from the FHIR server, such as vital signs and conditions.
(3)The pre-filled content should be formatted so that it is clearly distinguishable from the user-filled content.
(4)The form should display the role of the practitioner as well
(5)Combine five separate pages into one page to reduce the click required and allow easier browsing.

Reflection :
Based on the feedback received, we have made changes to the interface. The main page contains previously submitted ISBAR forms, which is loaded from the server when the application is loaded. The user can view these forms and modify them if they want to, which updates the form on the server. In both the simple and complex versions, the patient and doctor information is prefilled, which saves the doctor's time and ensures that he/she does not have to waste energy on such repetitive tasks. The complex version would try to extract relevant information from the FHIR server and prefill its contents, reducing the amount of information that has to be entered by the user. Also, pre-filled content would not use input UI elements, allowing a clear distinction between pre-filled and user-entered content. The five sections of complex ISBAR form were positioned on one page, which not only reduces the number of clicks the doctor has to make but also makes it easy for the doctor to find a specific field they are looking for. We investigated Ontoserver(A. Metke-Jimenez,2018) and found the implementation challenges, hence we decided to implement it if there is enough time to do so.

Implementation

Base framework

The application was implemented using React.js as the base framework because it simplified the implementation of application functionalities and modularisation. For FHIR server communication and EHR launch, SMART on FHIR javascript library was used. This library simplified the authorisation sequence for both standalone and EHR launch, allowing easier access to the patient and user information. This library also supplied a wrapper function for sending requests to connected FHIR servers, further simplifying the implementation.

The app was tested using an open FHIR server hosted by SMART Health IT, which contained different resources for the development purpose. The EHR launch was also simulated by using the App Launcher from SMART Health IT, which is a publically available launcher for development purposes. The launcher allowed several launch options for different use contexts, hence it was also used for the development of a standalone version of the application. To test the application in a deployment environment, the application was later deployed using GitHub pages.

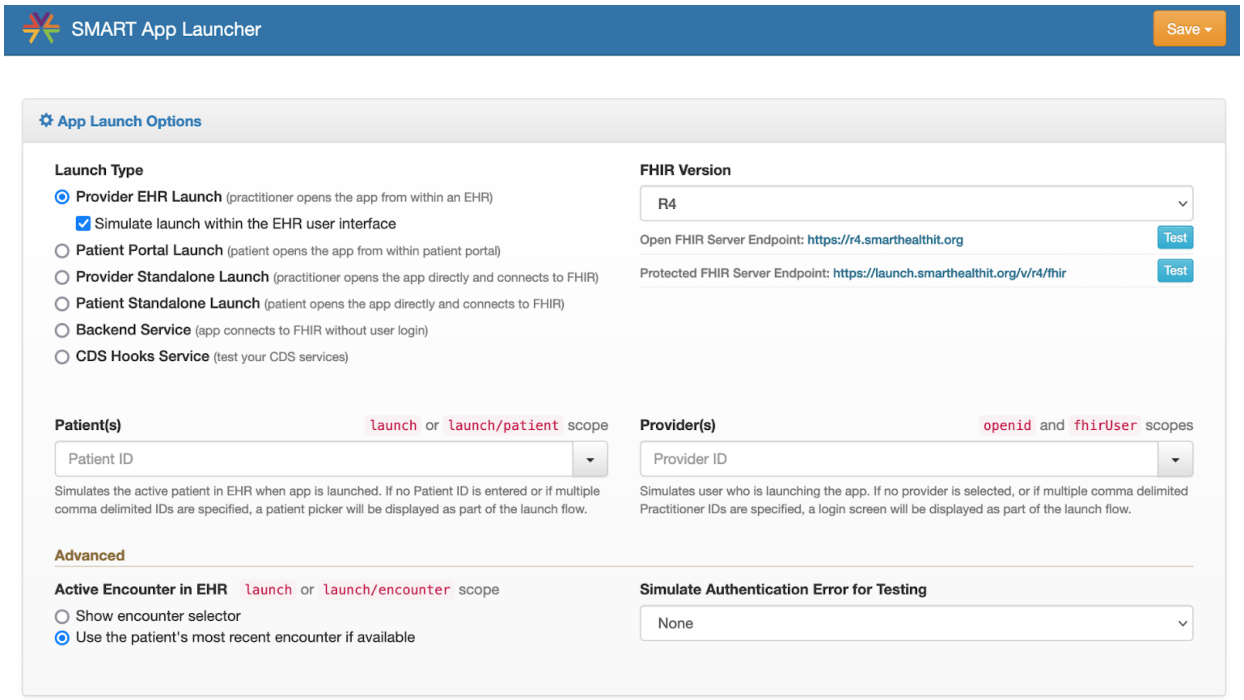

Figure 14: (SMART App Launcher)

For UI elements of the application Material UI (MUI) was used. MUI allowed visual consistency throughout the application, which was one of the key criteria related to the usability of our application; minimising cognitive load. Furthermore, MUI is a library designed to be used in

React applications, hence its UI elements contained many useful functionalities and were fully customisable.

One of the requirements for the application was printing the ISBAR form in .docx or .pdf format. To meet this requirement the React-PDF library was used, which allowed pdf generation directly from a React application. While they had their syntaxes, the content of pdf files was positioned in a way similar to generating an HTML document with custom styling.

Launch configuration

The application was designed for UQ's EHR system, hence it was assumed that it will launch inside an EHR iframe. The launch sequence of the EHR launch is initiated by the EHR session, which supplies the FHIR base URL and redirects the URL to the application. The application then communicates with the EHR FHIR server to get an authorization token, which is then used to communicate with the FHIR server.

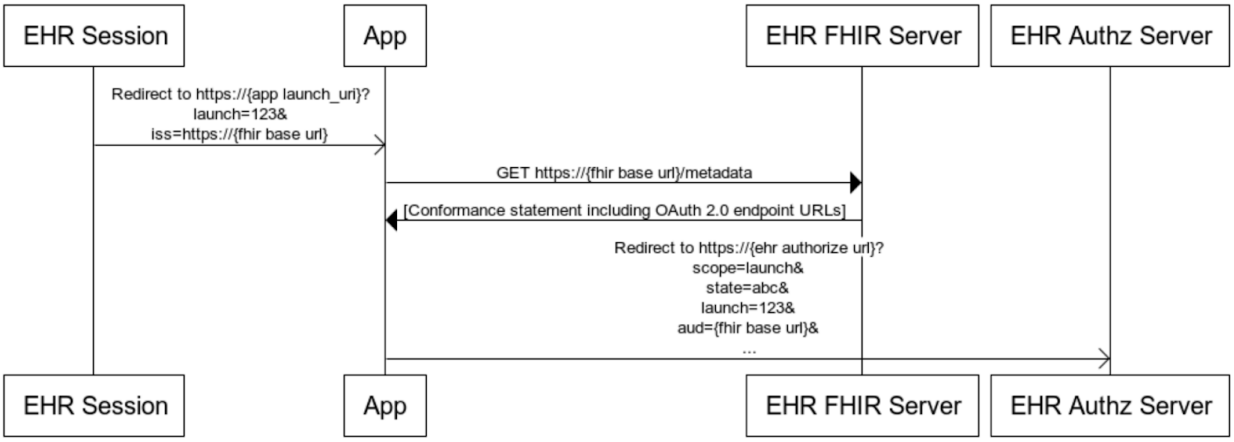

Figure15: (EHR launch sequence)(http://www.hl7.org/fhir/smart-app-launch/)

The application is launched by firstly running the 'launcher.js' file in the project main directory. This launcher file contains the authorisation process from SMART on FHIR javascript library, which takes in a number of launcher settings. The launcher settings include launch settings, which are permission requests for different operations on the FHIR server. Once the server access was granted and the SMART client was retrieved from the server, the application was redirected to the application page and the client object was stored in a React context. Note React contexts could be thought of as a global object that could be accessed by any child components, and this client object was used to make the HTTP calls to the FHIR server throughout the application. The launch sequence could take some time to load, hence relevant loading messages were displayed to ensure the user is aware of the application state.

```
SMART.authorize({
    clientId: "my-client-id",
    scope: "launch launch/patient openid fhirUser patient/*.read patient/*.write",
    // redirectURL for github deployment
    // redirectUri: "https://solving-isbarriers.github.io/COMP3820-ISBAR/#/isbar-app",
    // RedirectURL for the development version
    redirectUri: "#/isbar-app",
    iss: 'https://launch.smarthealthit.org/v/r4/sim/eyJoIjoiMSIsImoiOiIxIn0/fhir',
    // Redirect to main screen.

    completeInTarget: true
});
```

Figure 16: (Launch configuration)

As the launcher redirects the application to its content, routing was necessary. Initially, the application was implemented using browser routing, which functioned well in the development environment. However, the browser routing required the server to record browsing history, which made it incompatible for deployment in Github Pages. Therefore the final version of the application utilises hash routing, which does not rely on servers retaining browser history.

Application structure

The application consists of three main screens; home, simple ISBAR form, and complex ISBAR form. It was implemented this way because simple and complex ISBAR forms are separate - they use completely different sets of resources, and each version is complete by itself. Moreover, the purpose of the simple and complex version is completely different: the simple version was to simulate verbal handover, while the complex version was a representation of the physical ISBAR handover form.

Home page

The home page consists of two accordions, one for the simple version and another for the complex version. Each accordion displays the previous ISBAR forms of that specific patient along with additional information such as author, receiver and time last modified. Each entry in the accordion can be edited by clicking the edit button, which loads the corresponding form. The accordions also contain ‘create’ buttons, which are used to create a new form. When this button is pressed, the user is taken to an empty form of the corresponding version. Note the new form is created locally, and it is published on the server once the user decides to publish it.

To enable existing form editing, the home page had to contain the existing form resources in its state so it could send it to child components. As the contents of accordions were also required to be updated every time the homepage was re-rendered (when the user came back to the homepage), the data updating function was positioned inside the componentDidMount() call of the home page. This data is then passed to the accordion data table as a prop, which automatically updates the data table content upon re-loading. The callback function attached to

the edit button is also passed to the data table, as the edit button is inside the data table as an entry. This callback function opens the existing ISBAR form by telling the form component that it's an existing form, as well as the id for that specific form. While this data could also be passed directly to the handover forms, only the form id was passed to the forms. This was due to performance optimization, as modification of the parent component state re-renders all of its child components. In other words, if the handover form page modifies the form on the home page, it re-renders the whole application every time there is a change in content.

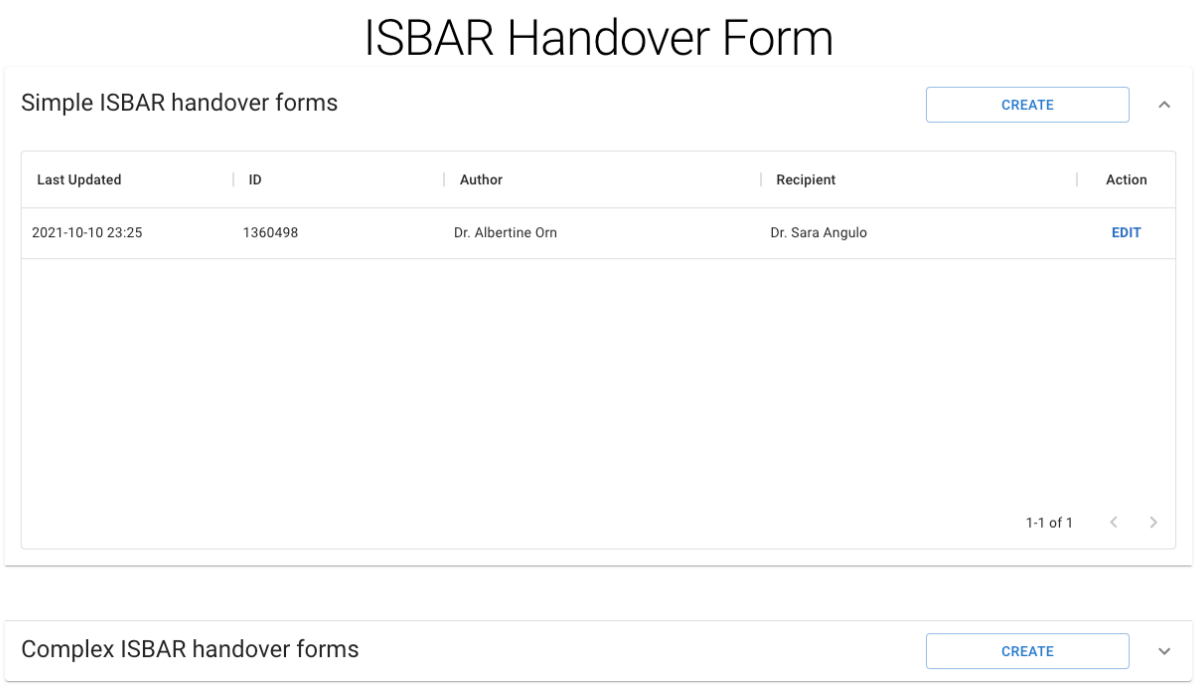

Figure 17: (Home Screen with one simple form)

The accordion is a UI element from MUI, and the content table is a data table element from MUI. As the MUI data table specialises in displaying data, it has some built-in functions such as sorting of table content, automatic pagination and navigation. It was also made to be responsive to screen size, to ensure it is functional with different screen sizes. The data displayed in the data table is given by the home page component, which is the parent component of the data table. The texts on the home page were Typography elements from MUI, which allowed easier visual consistency.

Simple ISBAR form

Resource structure

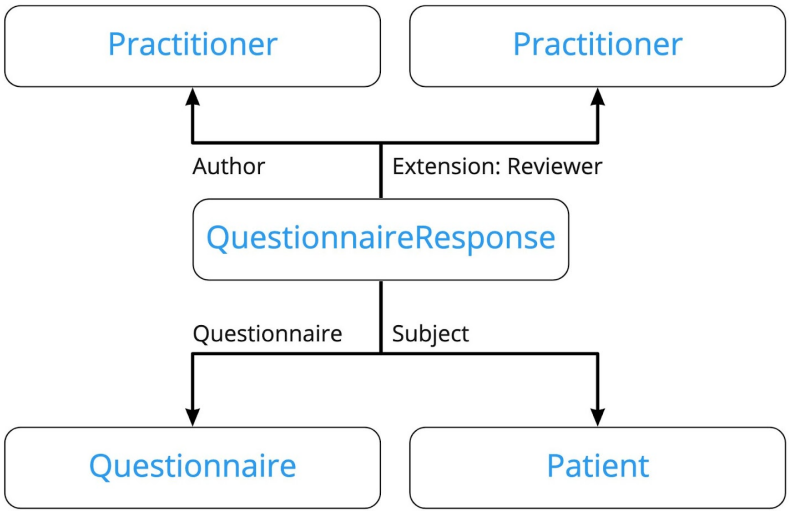

Figure 18: (Resource structure of the simple application)

The simple ISBAR form application was implemented using four different FHIR resources; practitioner, patient, questionnaire and questionnaireResponse. The questionnaireResponse resource is the core resource of the application, which stores different fields of simple ISBAR form in its 'items' field. The questionnaireResponse resource contains a total of 6 items so it can be used for ISOBAR forms as well. The questionnaireResponse resource also contains references to the subject, author, recipient and questionnaire of the ISBAR form. The questionnaire resource referenced by the questionnaireResponse resource is a hard-coded ISBAR questionnaire that contains a unique identifier in its title field. The primary purpose of this questionnaire resource is filtering of the questionnaireResponse resource for simple ISBAR forms, hence the content of the questionnaire was actually unused. The questionnaireResponse object did not contain a field for the recipient by default, hence a reviewer extension was used to contain this additional information. Both the author field and reviewer extension contain a reference to the corresponding practitioner resource, which is in the form of Practitioner/{practitioner id}.

The application

The simple ISBAR form loads when the user presses the create button or edit button on the home page. For creating a new form, a new, empty form is generated locally, which is published later when the user presses the publish button. For editing a new form, the id of the existing ISBAR form (questionnaireResponse) is passed to the simple ISBAR form as an input. The

simple form then loads the existing form from the server, including referenced resources relevant for the form.

The form loading is initiated inside the componentDidMount() call of the simple form class, as this is called only when the component is newly mounted. The loading process starts with asynchronous calls to the current patient and practitioner, which is later used to print the form and display additional information about the subject and the author of the form. For creating a new form, the new form is initiated with the ids of the questionnaire, current patient and practitioner (user). For editing a new form, the existing form is loaded from the FHIR database using the form id passed by the home page, and references to practitioners are resolved and stored locally. As the IDs of relevant FHIR resources were known at this point, client.request() call of SMART on the FHIR library was used to fetch the resources from the server using resource IDs. The content of the form is stored locally as the form utilises controlled components; the states and contents of UI elements are controlled by the React class, rather than each UI element managing its state.

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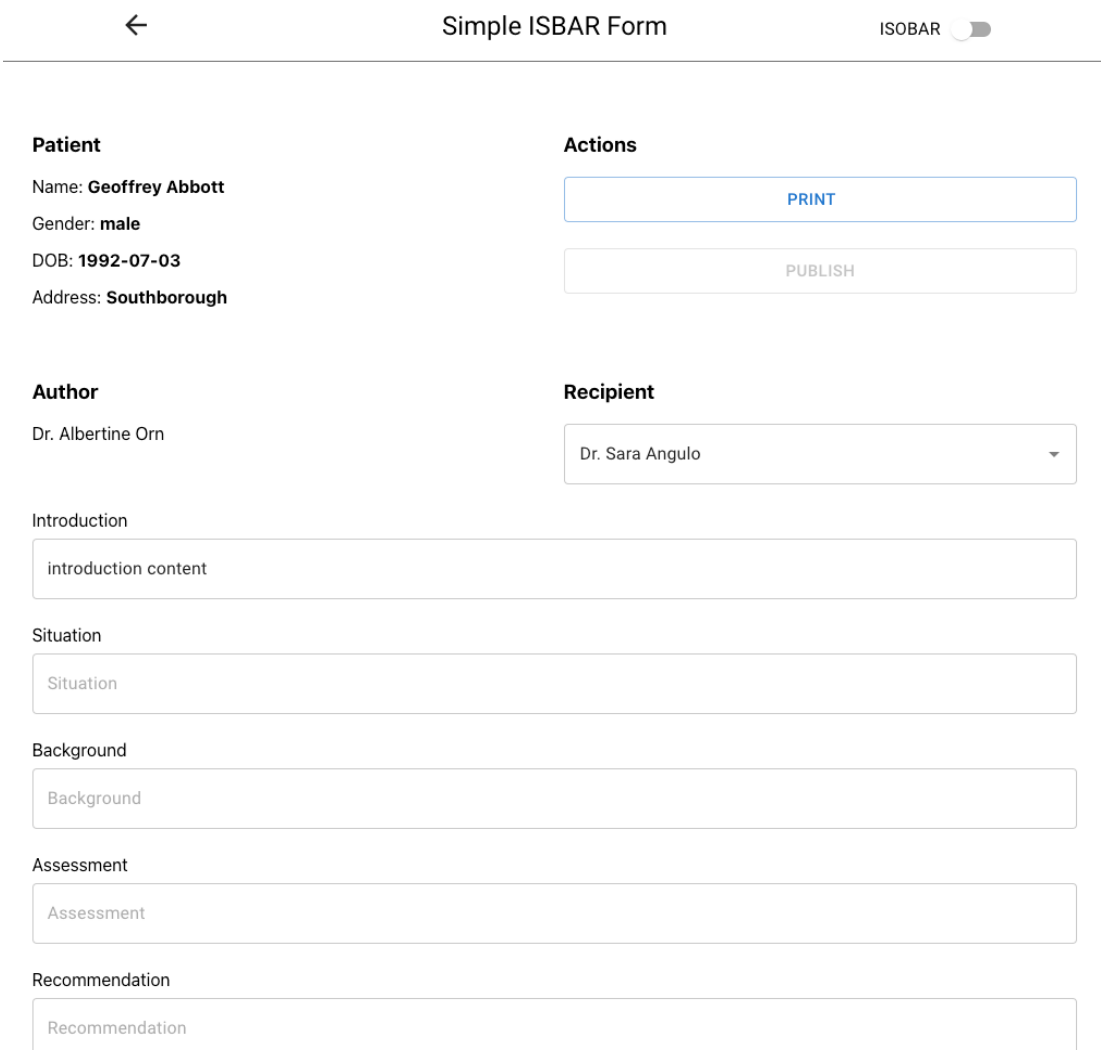

Figure 19: (Simple application for published form)

The header of the simple version consists of the application title, back button to the main menu and toggle to toggle between ISBAR and ISOBAR. As both simple and complex forms are child components of the home page component, the onclick event attached to the back button simply toggles the display state from simple form to the home page. On the other hand, the ISOBAR toggle button displays and hides the observation text field, which is positioned between situation and background. The initial state of the toggle is off unless the loaded form is an existing form with some content in the observation field.

The first part of the simple form contains basic form information and UI. The subject (patient) information is loaded by searching the database using patient id and parsing the relevant fields into a string form. As the patient ID is given by the launch context and the patient section is static, the patient loading process is handled independently by a patient section component. The fields used from the patient resource are name, gender, DOB and address.
The actions section contains buttons for printing the form in PDF form and publishing the form on the server. The publish button is only active for new forms that haven't been published and stays deactivated once the form is on the server. Once the user clicks the publish button, the form is published to the server using the client.create() function call of SMART on FHIR Javascript library. Once the resource is created successfully this function call returns the created resource, which is stored and used to update the form. On the other hand, the print button allows the user to download a pdf version of the simple ISBAR form. This pdf contains all the information that is in the simple form, including the author, subject and recipient information. As the recipient field of the form could be empty, the form content is generated only when the recipient is specified for error prevention. As previously mentioned, the form is generated using the React-PDF plugin.

The author field of the form is fixed to be the practitioner who created the ISBAR form, and it is prefilled using the client context. However, the recipient of the ISBAR form cannot be derived from the client context, and it has to allow the user to select the recipient conveniently. Thus, the recipient field of the application was implemented using the autocomplete element of MUI. The autocomplete component takes in a list of possible entries and has autocompleted and searching functionality, allowing the user to search the practitioner within the entries. Since the application was intended to be used in UQ learning EMR, the number of practitioners in the system could be excessive to be loaded at once. Therefore, the autocomplete uses the user entry as a search query and updates the entries every time the user enters content in the autocomplete. By doing so, the autocomplete effectively searches the database for possible entries, allowing the user to fully explore the possible entries on the server. The entries for practitioner autocomplete include practitioner name and ID, where the name is used to display the practitioner in human-readable format and ID is used to reference the receiving practitioner.

The text fields of the simple version are text area UI elements from MUI, which automatically resizes to fit the entered text. The simple version contains 5 or 6 text areas for each section of ISBAR or ISOBAR form, with a corresponding header on top of it. These text areas are controlled components; the state and content of text areas are managed by the React

component, rather than managed by the UI component itself. To minimise the cost of re-rendering, the text area components kept their state individually, which is updated every time the user presses the key. By doing so, only the corresponding text area is re-rendered when the user is modifying the content. This individual state is pushed to the main application (simple form) when there is no input for a set duration of 2 seconds, which is implemented using a timeout function.

```
handleChange(event) {

    // set the value of this field
    this.setState({ value: event.target.value });
    // clear the timeout
    clearTimeout(this.state.timeout)
    // set the timeout
    this.setState({
        timeout: setTimeout(() => { this.props.updateField(this.state.value) },
            this.state.delay)
    })
}
```

Figure 20: (on change callback of text area)

Once the main application receives an update from the text areas, the application updates the server-side resource with the updated content. Since the main application is updated when there is no input on the text area, this also prevents excessive update requests. This automatic update is handled by the componentDidUpdate() lifecycle method of react, and the client.update() function of SMART on FHIR is used to update the resource on the server. The update process is initiated only if the form is already published.

Complex ISBAR form

The application

The complex ISBAR form utilises a variety of resources organised using a Careplan resource at the top of the hierarchy. Due to its diversity, the implementation details of the application are broken down into sections of the ISBAR form. Note all the sections are displayed in the application, so the user can scroll through the whole form without additional navigation. Due to time constraints, the functionality of the complex ISBAR form was not implemented. However, UI elements for the form were positioned and relevant FHIR resources were researched. For the full content of the complex form, refer to appendix A.

Introduction

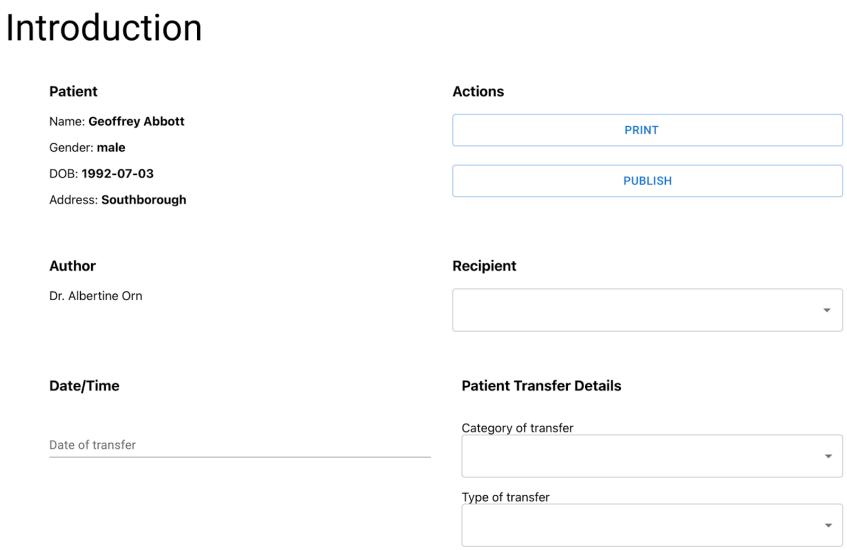

Figure 21: (Introduction)

The introduction part of the application contains basic information about the ISBAR form, such as author, subject, recipient, time of transfer and transfer details. For the base information part, the component that was used for the simple version was reused, which contains the patient, author, recipient information and actions that could be performed with the form. Text field was used for time of transfer, which takes a free text as an input. For the category and type of transfer, autocomplete is used. Similar to the simple version, the patient and practitioner resources were used in the introduction section, which is referenced by the CarePlan resource. The resources used in the introduction section are:

Field	Resource and field	Code
Patient	Patient	
Author	Practitioner	
Recipient	Practitioner	
Role of author	PractitionerRole	SNOMED code is used
Role of recipient	PractitionerRole	SNOMED code is used

(Table 1: Introduction FHIR resources)

Situation

Figure: Situation section

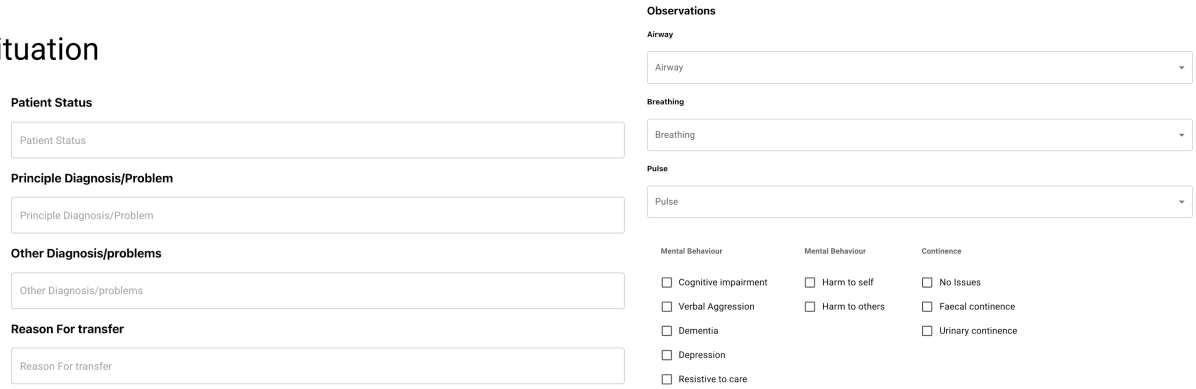

Figure 22: (Situation)

The situation part of the complex application contains patient status, diagnosis, the reason for transfer and various observations. For patient status, diagnosis and reason for transfer, a free text entry was used for input. For observations, dropdowns were used for observations that could only contain one reading, and checkboxes were used for fields that should allow multiple selections. The resources used for the situation section are listed below:

Field	Resource and field	Additional information
Patient status	Encounter. priority	
Principal Diagnosis	Condition	Referenced by ClinicalImpression.findings field.
Other Diagnosis	ClinicalImpression.note	

Reason for transfer	EpisodeOfCare.referralRequest	
Airway	Observation	LOINC code: 60955-2
Breathing	Observation	Snomed Code: 719983008
Pulse	Observation	Snomed Codes Abnormal: 67683007 Bounding: 271640005 Fast: 86651002 Slow: 42177007
Mental Behaviour	Observation	ICD-O-3 codes are used (http://build.fhir.org/ig/ahdis/ch-crl/StructureDefinition-ch-crl-observation-icdo3behaviour.html)
Physical Behaviour	Observation	ICD-O-3 codes are used (http://build.fhir.org/ig/ahdis/ch-crl/StructureDefinition-ch-crl-observation-icdo3behaviour.html)

(Table 2:Situation FHIR resources)

Background

The background section of the application contains background information about the subject (patient) such as various alerts, mental health acts, Allergies and current medications. The input for alerts, mental health acts and drug allergies consists of a checkbox and text field to enter further detail, and other background information is stored in a free text form. The resources used for the background sections are:

Field	**Resource and field**	**Additional information**
Alerts	Condition.evidence	SNOMED codes where concept : is-a 404684003 (Clinical finding) Is-a 71388002 (Procedure) Clinical findings and procedure reason value sets were used Code: 24484000 (Severe) Code: 6736007 (Moderate) Code: 255604002 (Mild)
Allergy	AllergyIntolerance	SNOMED codes where concept : is-a 418038007 (Propensity to adverse reactions to substance)

		is-a 267425008 (Lactose intolerance) is-a 29736007 (Syndrome of carbohydrate intolerance) is-a 340519003 (Lysine intolerance) is-a 190753003 (Sucrose intolerance) is-a 413427002 (Acquired fructose intolerance) is-a 716186003 (No known allergy) Allergy intolerance code value set (https://www.hl7.org/fhir/valueset-allergyintolerance-code.html) : Code: low (Low Risk) Code: high (High Risk) Code: unable-to-assess (Unable to Assess Risk)
Medication	Medication	SNOMED CT Drug Therapy Status codes from http://snomed.info/sct where concept is-a 266710000 (Drugs not taken/completed) is-a 410684002 (Drug therapy status) Medication status code value set (https://www.hl7.org/fhir/valueset-reason-medication-status-codes.html) Code : active (Active) Code: on-hold (On Hold) Code: cancelled (Cancelled) Code: completed (Completed) Code: entered-in-error (Entered in Error) Code: stopped (Stopped) Code: draft (Draft) Code: unknown (Unknown)

(Table 3: Background FHIR resources)

Assessment

The assessment section takes in the latest clinical assessment and various vital signs using free text entry. The vital signs taken by the assessment section are respiratory rate, body temperature, pain score, pulse, blood oxygen level, blood pressure, urine output, oxygen saturation (SpO2), patient anxiety and hemoglobin level (Hb). The resources used for the assessment section are listed below:

Field	Resource	Additional information
Resp. rate	Observation	LOINC Code: 9279-1
Temperature	Observation	LOINC Code: 8310-5
SpO2	Observation	LOINC Code: 59408-5
Blood pressure	Observation	LOINC Codes: Systolic blood pressure -8480-6 Diastolic blood pressure-8462-4
Patient anxiety	Observation	LOINC Code: 95878-5
Pain Score	Observation	LOINC Code: 72102-7
O2 rate	Observation	LOINC Code: 60842–2
Pulse	Observation	LOINC Code: 80346–0
Urine output	Observation	LOINC Code: 9187–6
Hemoglobin	Observation	LOINC Code: 718–7
Narrative diagnostic report	DiagnosticReport	LOINC Code: 50398–7

(Table 4: Assessment FHIR resources)

Recommendation

Recommendation section consists of a free text entry that the user can use to enter the recommendation for the patient. This free text entry is stored using a goal resource. The resources used in the recommendation section are:

Field	Resource	Additional information
Recommendation	Task.description	
Medication	MedicationRequest	Referenced by Task resource of recommendation field
Service	ServiceRequest	Referenced by Task resource of recommendation field

(Table 5: Recommendation FHIR resources)

Future Work

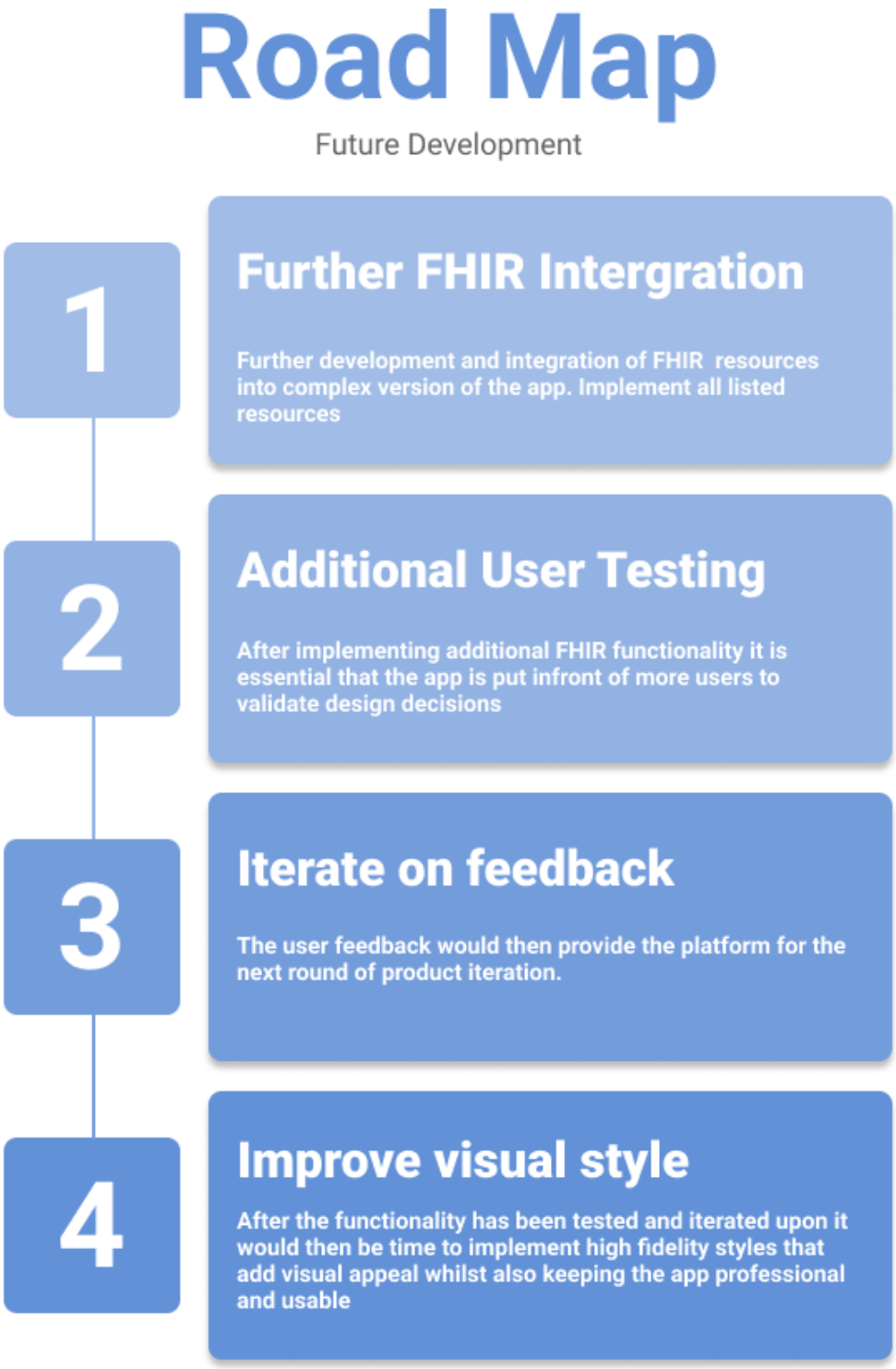

Figure 23: (Road Map)

Further FHIR Integration

The current implementation of the complex version incorporates MUI elements to facilitate the base desired workflow of the user. Due to time constraints, the full functionality has not been implemented. For future iterations of the application, the complex version would incorporate full FHIR functionality (as seen in Table: 1,2,3,4,5).

Additional User Testing

After achieving the first milestone of increased FHIR functionality it is vital that the app is vigorously tested by the client and real-world users. Our initial testing sessions were limited to virtual walkthroughs of features due to the current stage of development. This testing session would put the tester at the helm and allow them to use the app as if they were using it in a clinical setting. The first iteration of these user tests would see our client Ben using the app and providing his initial thoughts on the implementation. These points would be recorded and actioned before we collaborated with the client to create a set of user tasks that would take the user through the full app functionality and also represent a traditional user workflow. The team would observe the user completing these tasks and not any bugs or pain points the tester experiences.

Iterate

These user testing sessions would then be leveraged to iterate on our product. It is essential that the team addresses pain points identified in the previous testing sessions. As the team aren't the intended users of the product or experts in the domain we must take our users to feedback on board to ensure an intuitive experience.

Implement Styles

After achieving the expected level of functionality it is also desirable that the team updates the visual style of the application. Leveraging base level MUI elements has ensured that the team has consistent, responsive styling throughout the application, however, these elements have minimal visual intrigue. The team aims to iterate on these styles in a way that preserves the functionality and responsiveness of the app but also enhances the visual experience of the application. In updating the visual style of the application it is imperative that the team keeps the application professional, clean and usable.

Retest and iterate

As the team completes the next phase of development we would continue our strong design process by consistently reiterating and testing with our target audience. This ensures usability as the functionality increases.

References

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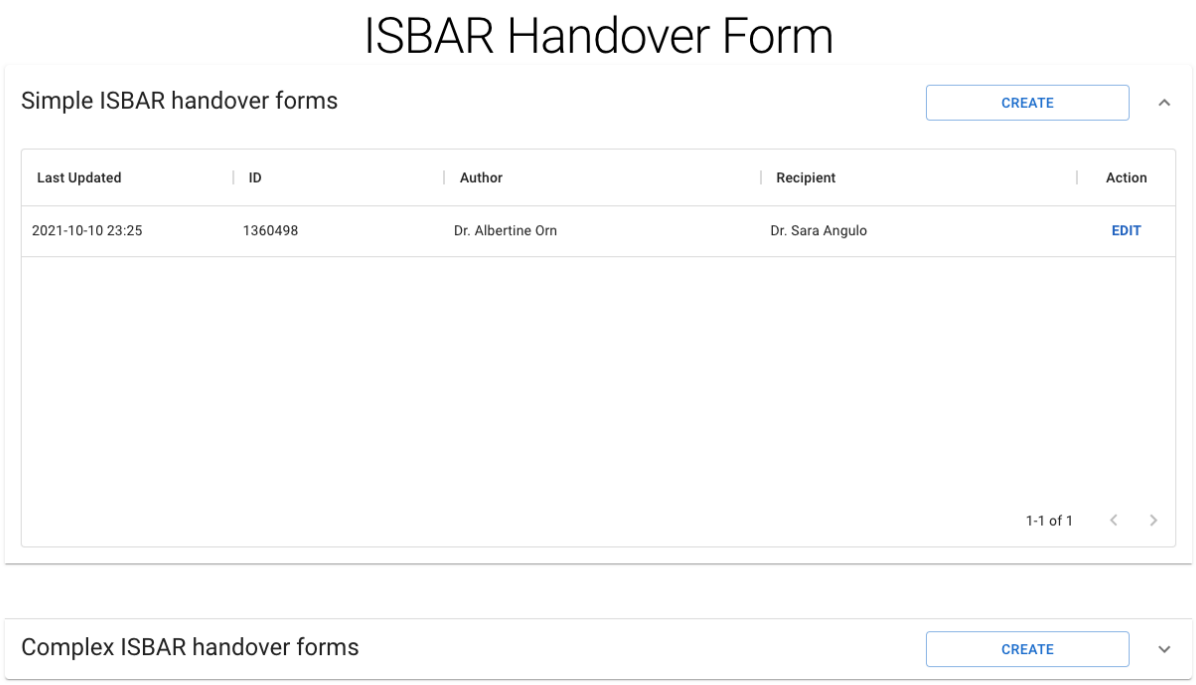
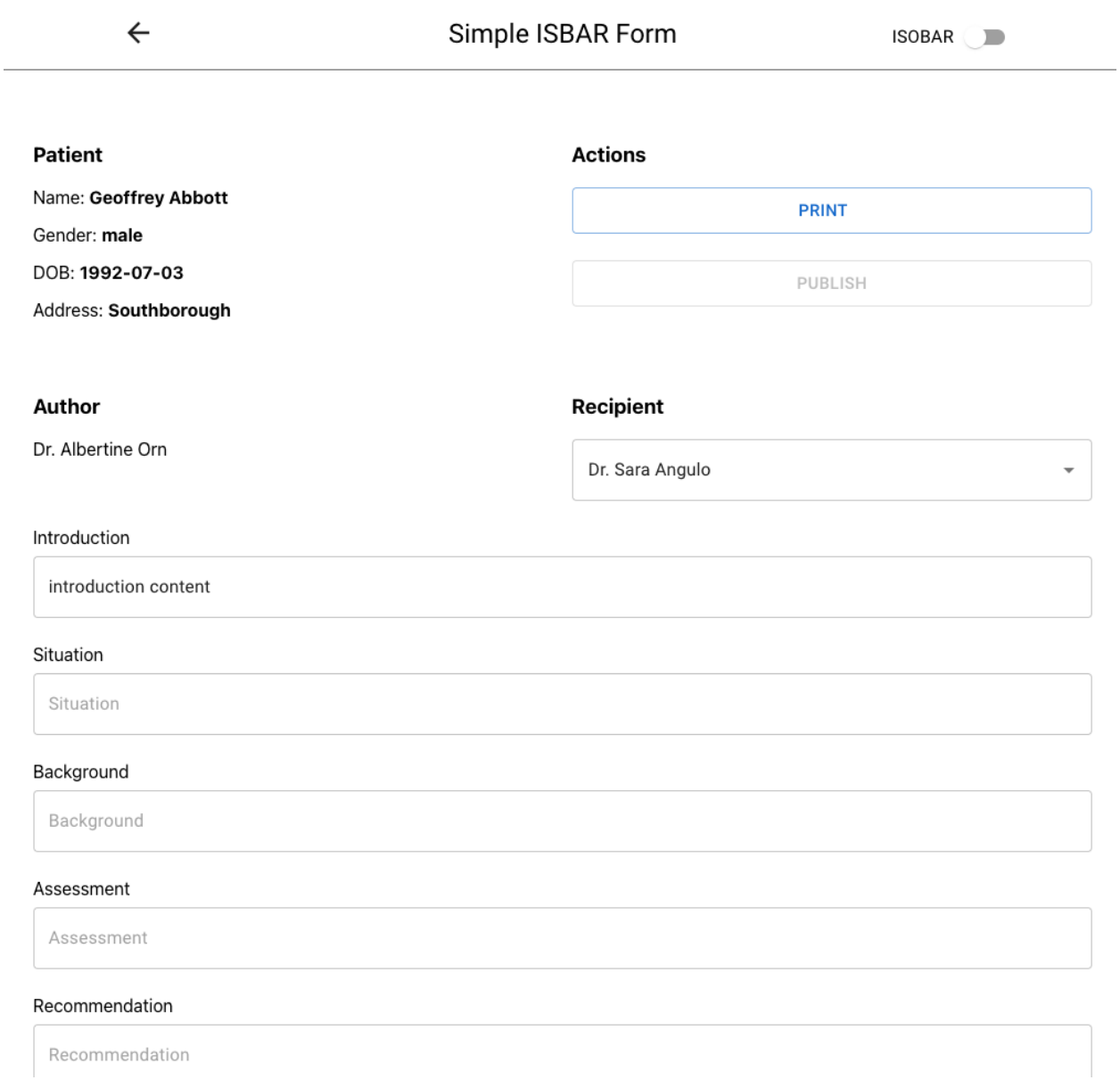
Appendix

A. Application screenshots

Home screen



Simple ISBAR form



Complex ISBAR form

Introduction

Patient

Name: **Geoffrey Abbott**

Gender: **male**

DOB: **1992-07-03**

Address: **Southborough**

Actions

PRINT

PUBLISH

Author

Dr. Albertine Orn

Recipient

Date/Time

Date of transfer

Patient Transfer Details

Category of transfer

Type of transfer

Situation

Patient Status

Patient Status

Principle Diagnosis/Problem

Principle Diagnosis/Problem

Other Diagnosis/problems

Other Diagnosis/problems

Reason For transfer

Reason For transfer

Observations

Airway

Airway

Breathing

Breathing

Pulse

Pulse

Mental Behaviour

- [ ] Cognitive impairment
- [ ] Verbal Aggression
- [ ] Dementia
- [ ] Depression
- [ ] Resistive to care

Mental Behaviour

- [ ] Harm to self
- [ ] Harm to others

Continence

- [ ] No Issues
- [ ] Faecal continence
- [ ] Urinary continence

Background

Alerts

Forensic ☐ Details

Microbiological ☐ Details

Bariatric Patient ☐ Details

Fall Risk ☐ Details

Infectious Risk ☐ Details

Pressure Ulcer Risk ☐ Details

Smoker ☐ Details

Mental Health Act:

Voluntary ☐ Details

Involuntary ☐ Details

Risk Assessment ☐ Details

Drug Allergy

State Drug/Reaction ☐ Details

Other ☐ Details

Current Episode Medications:

Details

Investigations:

Details

Specialty-Specific Information:

Details

Assessment

Latest clinical assessment:

Latest clinical assessment

Vital Signs:

Resp rate

Temp

Pain Score

Pulse

O2 rate/device

Blood Pressure

Urine Output

SpO2

Patient Anxiety

Hb

Recommendation

Recommendation

Recommendation

Medication Request

Medication

Service Request

Service

B. Individual Reflections

Tong Jia：

Overall this semester, I have learned a lot about healthcare through this course, and I was able to find data on electronic healthcare systems, but I still don't know how to write code to call data.

At first, I was curious about this course because I had not been exposed to medical content before all the content was new to me. Throughout the study this semester, I gained an initial understanding of the eHealth system. Know how healthcare workers use EMRs. Through reading the literature, I learnt about the current problems faced by the eHealth system when used in an actual healthcare environment, such as increased click pressure on doctors and no absolute advantage over traditional paper-based medical records. I reflect on the fact that the current use of technology should not be designed just for the sake of using, but should consider the user experience and design from the user's perspective.

For the group project: In the research phase, through reviewing online materials and video materials, I learnt what ISBAR is, how it worked and how doctors apply it in real-life situations. In the design phase, the app was designed to ensure usability and enable use in a real working environment. The interface should be designed in such a way as to avoid committing the problems that have already been criticised by doctors in electronic medical systems.

During the implementation phase, I learnt how to read user information from the FHIR system, retrieve patient information using postman and make changes. It was rather basic, but it was an improvement for me.

Through online study and exams, I learned that each piece of information in the FHIR system has a corresponding storage location and I know how to find the unique ID of a column.

Although I have made some progress, there are still shortcomings. I was not able to help my teammates in the code part, except for the code for the page layout part, but the code for calling data was not written in the format used by my teammates.

Although looking at the tutorial, we have found the code we can use to read and fill in the data, but because we need the code in a different format than the tutorial, we know how it should be written.

According to the client's requirements, we were to use OntoServer [5] for our doctor's occupation field, and I checked out the articles to understand how this system works. Although it was already known that a multi-prefix read method was used for the lookup, the code section would not call an existing search system for our use.

Shuying Wang：

At the very beginning of the course, I wasn't really sure what exactly the course was going to be about. I just followed my friends because they all took it. After the first introductory class, I felt that the class seemed interesting, as I needed to use my previous knowledge of UI interaction to design a simple healthcare system in the healthcare field that could be done through online data. However, I found out afterwards when I split up into groups that apart from writing a paper and writing a front-end website, the assignment also required me to be able to connect to a database using FHIR. This made me spend a lot of time and effort this semester trying to learn how this code should be implemented.

In terms of personal assignments, I think it's also a huge challenge for me. This is because the content of the three essays required a strong understanding of digital health and a detailed use of FHIR. The first and third essays were relatively less difficult, and I was able to get a general idea about the importance of digital health and future trends etc. based on some relevant papers I found. I learnt that digital healthcare is becoming a mainstream trend today and that it facilitates the process of work and treatment for both healthcare professionals and patients. However, when writing my second paper, I did have a bit of trouble finding a large number of papers on the subject, but I was unable to understand the operation of FHIR and the relevant code data. I had to rely on my own understanding to complete the thesis.

Regarding the group assignment, this is a long-term project from the start of the group until the end of the semester. There were 5 of us in the group. As my coding skills were really bad, I volunteered to take on the pre-research, analysis and design of the prototypes at various stages. We had a few meetings with Ben, the client, so that he could give us some advice when it came to designing the UI and interactions. The design of the UI and interaction part was not that difficult, the hard part was the content of the medical information to be presented in the app. Because the theme of our group was the handover form for nurses. So we looked up a lot of information and words before designing the interface. Many of the medical words in it were really difficult for me as a foreigner.

I also tried my hand at writing part of the code for the subsequent complex versions that were completed. In the beginning I wrote a version first using HTML and CSS first. But the group and I said that this was not the code we were using for our app, so I asked Jerry who wrote the code to use and tried to write the code for the Background section in ISBAR. I am grateful for Jerry's teaching. In regards to the import of the FHIR data in it, this was really super duper hard. I found the data to be used in the app and the code they represented, based on the information and the client's requirements.

Through this project, I learnt where my coding skills were short and where I didn't understand some of the areas that needed to be understood in depth. In the future I will try to learn some coding skills and read more papers and case studies when I don't know enough.

Myoungseok Jeong：

I was exposed to many different health and digital health concepts throughout the semester, which were quite interesting because I had no previous knowledge about them. I've also contributed to the project throughout the semester, and mainly worked with the implementation of the application. I was also responsible for writing the meeting logs throughout the semester, keeping the record of our team's progress and discussions. During the design phase of the application, I participated in design iterations and requirement identification by actively participating in the team discussion and client meetings. While doing so, I learned React and FHIR as we decided to use them as our base framework for our project.

In terms of implementation, I set up the development and deployment launch sequence, client context setting and managed application routing for both development and deployment. I've also implemented the initial iteration of the simple ISBAR form, which contained headers, toggle checkbox and save status indicator. This implementation includes all the functionalities of the simple version, such as creating and updating the questionnaire and questionnaireResponse, printing the ISBAR form and all the codes required to achieve its functionality. I've also implemented all UI elements and functionalities of the final version's homepage. This includes the state machine for the application, loading necessary resources, and all the codes required for functionality. Every UI element and functionalities of the simple version except the patient information field, which was implemented by Oscar, were also implemented by me. Note this implementation of the simple version includes researching the required resources and extensions. For the complex version, I reused the basic information field from the simple version, repositioned some UI elements for consistency over different screen sizes, researched the resources and positioned UI elements for the recommendation section.

Outside the implementation, I assisted other team members with setting up the development environment, participated in group meetings throughout the semester, researched and decided the frameworks we used in the project, and troubleshooted the issues we encountered when we tried to host our application on Github pages.

Getting my head around the FHIR was very challenging though, because I was not familiar with the medical field. Our team struggled with implementation because using the FHIR database was much harder than I imagined, and the project itself wasn't really motivating. Also, I think we should've sat together and learned the FHIR documentation and sorted out the resource structure early during the semester, which we ended up doing at the end of the semester. We also tried to distribute some technical work between team members as we were struggling with the implementation, however that was too late for the non-technical team members to learn much applicable knowledge. I would also enforce some strict deadlines and detailed task allocation between all members, because sometimes the responsibility was not clear and the job wouldn't get done in time. Lastly, I would try to find stronger motivation to work with the project.

Ying Zhou：

Individual contributions and specific explanations:

1. Identification of problems in clinical handover and problems in electronic delivery of case-based learning. The research was conducted primarily through a literature survey and the problems and recommendations encountered in these literature cases were collated (to the extent that they were relevant to our project).

2. Analyse and highlight some useful insights for our project and establish system requirements and functional requirements in relation to customer requirements and traditional ISBAR protocols.

3. Identify existing medical websites and applications for design inspiration. The relevant resources were shared on Miro, a group poll was launched, and the most popular design styles were voted on by the group members.

4. I was inspired to combine the traditional handover form with the generalised design requirements to create a wireframe diagram, a high fidelity prototype of the simple version and finally a high fidelity prototype of the Assessment in the complex version.

5. I used HTML and CSS to complete the Assessment part of the complex version (web version)

6. Using the Material UI example, I implemented the complex version of the rough Assessment page via Javascript. This was later refined with the help of Jeong and Oscar.

7. Find the data code and resources related to human signs and diagnostic reports in Fhir and Loinc.

What I would do differently:

In the future, I would like to make up for the lack of coding skills that have hindered my work to some extent. For example, I need the help of my team members for code other than html and css. If I acquire more knowledge of code in the future, it will help me to gain a deeper understanding of how projects should be implemented, facilitate communication with programmers and most importantly, this skill will help me to explore the gaps between project design and implementation.

Teamwork strategies:

In teamwork, everyone takes an active part and creates a team atmosphere of mutual help. Goal-orientation and active communication are essential. On the basis of early mutual discussion and clear division of labor, keeping each of us consistent is the part with room for progress in the future. Fortunately, our teamwork skills have been improving throughout the semester.

Oscar Dunstan :

Entering the world of health informatics I found myself both daunted and highly intrigued. Healthcare products have always struck me as a unique design challenge that I always wanted to tackle. Building solutions that have the potential to tangibly improve the lives of users is the basis of my decision to major in User Experience design and I haven't had a better opportunity to do just that in my studies. Being one of my last courses in my degree I wanted to focus on designing an innovative product whilst following a strong user-centred design process that I have developed in my time at university. I initially volunteered to become the ‘leader‘ of the group, this wasn't a highly structured role but was still one I was assigned. My hopes to have a strong design role in this project quickly evaporated as I realised the level of development this project would require and the development background of the team. Development is a weaker area of my skill set and after realising that my role would be development heavy - I recalibrated my goals for this course to see it more as an opportunity to work on an area that I was weaker in. I have never formally been taught how to work with react and APIs so I was quite anxious.

I started the project off by listing the early requirements that the team needed to complete. Our initial design phase was to build our knowledge of the requirements for the project. This was a collaboration-heavy process that had the team brainstorm and build upon each other's ideas. As we built our inceptive concept we ran our ideas past our client - Ben. This initial stage was quite collaborative. I assisted our planning by creating a group on GitHub and made a Kanban board of tasks each team member needed to complete. My idea here was to create a simple platform that allows us to see the status of each team member and what they are working on.

As the semester continued I struggled with the team leader role. I wanted to keep technical contributions even across the team but this was quite delayed as there was a steep learning curve with some of the technical requirements. The initial technical deliverable I implemented was the UI elements of the simple form. Jerry did a fantastic job building the skeleton of our project and I built upon that to create the first version of the simple ISBAR form. This design was based on the initial concept prototyped by the other team members in Figma.

I also completed the Situation section in the complex app. This section utilized different Material UI components to build an intuitive and responsive experience for the user. This development took me far longer than a normal webpage would have; this is purely due to the fact I was so inexperienced with React.

Additionally, I took responsibility for making our app launch standalone as this was a key wish from our client. This task was by far the most frustrating part of development for me. After tens of hours rewriting how our app launches and countless online tutorials I finally admitted defeat. This was a problem that persisted right up to our group presentation and was one that I wanted to complete before the semester finished. Fortunately, Jerry looked into the issue for me and fixed the issue which was quite relieving but I was quite disappointed in myself for not figuring out the solution sooner.

Toward the end of the semester, I aided other team members with their development issues. I provided tutorials on how to install npm and fix issues in regards to problems surrounding npm. Git version control was also an area I helped other team members, in doing this I ensured everyone was working on their branch and having minimal conflicts.

In reflection of my semester, there are a few areas that I would address differently. Primarily, I wish I assumed a stronger more consistent leadership role. I felt as though the team got off task and a little disjointed in the middle of the semester. If I had a more active leadership role we would have avoided this development pitfall.

C. Team Charter

Date: 10/8/2021

Team Name: Solving ISBARriers

Team Members

Name: Myoungseok Jeong

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Email: shuying.wang@uqconnect.edu.au

Name: Ying Zhou

Email: y.zhou6@uqconnect.edu.au

Online tools

Messaging or Discussions

Slack (required): COMP3820 -> #team-isbar

Other messaging tools

Facebook group, Slack

Online Meetings

Zoom

Creating documents

Google Drive – Doc, Sheets, etc.

Office 365 – Word, Excel, etc.

Github

Responding to messages and emails

How often should we check messages and emails?

Messages: maximum 12 hrs

Emails: 24hrs

When assessments are due should we check more often? Yes, 3hrs

Communication response time (see 6)

Meetings/time

Whole of team meeting day and time (see 1b)

Tuesday after 4pm

Additional work sessions each week (see 1c)

5hrs outside of meeting and class

Time to fix an issue (see 15a)

72hrs

Privacy

Do we need to record online meetings?

No

Problems or Disagreements

What should we do if we have a problem with another team member's behaviour or work?

Consult with the person as a team and attempt to find a resolution. If the issue persists, let the teaching team know.

Team Roles

Leader (to keep the group motivated or on task): Oscar Dunstan

Note or minute taker: Myoungseok Jeong

Other team role(s):

Will we rotate roles?

No. We'll try to get everyone to try different roles

Signed and Accepted

Myoungseok Jeong

Oscar Dunstan

Tong Jia

Shuying Wang

Ying Zhou

Our Commitment

1. As a team, we commit to:
   a. Use our best endeavours and efforts throughout the project.
   b. Attend all course studio sessions, the whole of team meeting as specified above, and any additional meetings agreed on by the team.
   c. Dedicate necessary time and effort as is required by the team including the additional hours per week specified above.
   d. Contribute to the project equally.

   Work consistently and complete all required tasks on time and at a quality as agreed by the team.

2. We will work together by:
   a. Supporting each other;
   b. Being respectful and inclusive;
   c. Sharing resources;
   d. Listening to each other;
   e. Providing feedback to each other;
   f. Always being constructive and polite; and
   g. Maintaining a high level of communication.

How we will communicate

3. We will use the team communication channel for all our team communication.
4. Where necessary, we will also communicate via email and/or other online tools using the details for each team member provided at the start of this charter.
5. Each of us commits to checking the team communication channel at least daily, except on weekends and public holidays.

6. We will respond to messages on the team communication channel within the communication response time specified above.

How we will make decisions

7. Decisions about the project will be made by consensus (with all team member's agreement).
8. We will work towards reaching agreement by working through pros and cons and assessing what is best for the project.
9. Where we cannot achieve consensus, decisions will be made by majority vote.
10. Where there is a deadlock, the decision will be made by the team leader.
11. Once a decision has been made, we all agree to accept and support that decision.

Managing work

12. We will allocate work equally.
13. When allocating work, we will clearly define:
    a. Who is expected to complete the work;
    b. The task that is expected to be completed;
    c. When the work is to be completed; and,
    d. The expected standard of the work.
14. If a team member is not able to complete the work allocated to them, they must advise the team of this as soon as possible.
15. If a team member has not completed the work allocated to them within the set timeframe or not to the specified standard:
    a. The issue must be raised with that team member directly and agree what that team member must do to complete or fix the work. The team member must complete or fix the work within the time to fix an issue as specified above.
    b. If the team member fails to complete or fix the issue within this time, the team leader must send an email to that team member asking them to complete or fix the work within a further 24 hours. That email should be copied as a 'cc' to the tutor.
    c. If the work is not completed within that time further extended time, the team leader shall email their tutor advising them of this and ensure that a copy of this email is sent to the team member.

D. Meeting Logs

Date: 10 /8/2021
Team Name: Solving ISBARriers

Items Discussed/Worked On
Team charter was completed.

Oscar's girlfriend works as a nurse, and the handover usually is only done verbally. Often 4 patients per nurse.
The sample chart seems to have too much irrelevant information, and it could be why they often do handover verbally. Some nurses push around a computer for data input, which is also used for handover.
Some things were derived from the discussions:
Questions:
Q. What is the role of the computer, and how much data is stored there?
Q. Their process of handover, and what information is actually relevant during handover.
Q. What caused the handover to take verbal form for those who do it verbally?
System requirements:
UI with better usability (minimum cognitive load); sample chart contained huge amount of information and didn't seem to have great usability.
Optimised input method; the sample chart seemed to contain many irrelevant fields or fields that could be pre-filled.
Ideas:
Represent time-related information of each patient – medication, treatments etc. - in a form of timeline for individual patients. This way, staffs could easily import the timeline of patients they have to take care of, and generate the timeline for their shift and efficiently manage their time.

Questions for Ben
Who are our target audience > should we refine the target audience? Or is it for general hospital staffs.
What is the role of the computer, and how much data is stored there?
- What equipment they use (to connect to database)

The handover process (what are they doing now), and what information is handed over

Actions Required
Put together questions for our client, then later discuss it via slack or verbally by meeting.
More background research by each team member to better understand the project

Start on project documentation

Deliverables/Plan To Be Completed By The Next Week
Put together questions for our client – By Thursday

Signed and Accepted
Myoungseok Jeong
Oscar Dunstan
Tong Jia
Ying Zhou
Shuying wang

Date:17/8/21

Team Name: Solving ISBARriers

Items Discussed/Worked On
First meeting with our client, Ben, has been done this week, and our answers were clarified. Based on the discussion, system requirements were derived.
System requirements
The system have two ways to input the data: simple one with text input for each field of ISBAR, and complex one with many specific fields. For the complex form, we have flexibility to improve its usability compared to the example forms.
The system should load and prefill the patient information if it could.
The system should store current state of the form upon exit, so students can come back and work from where they left.
We also divided the work between team members for this week.
Wendy, Sophia, Tong: Wireframes
Jerry, Oscar: FHIR authentication.

Deliverables/Plan To Be Completed By The Next Week
Setup Github and Figma for the project.
Design a wireframe for simple and complex interface
FHIR resource relevant for our application should be researched
Get FHIR authentication working

Consultation Activities With The Client
NOTE: The meeting is recorded.
Questions and answers

Can we modify the ISBAR form? Because if it's for teaching environment then we might not be able to modify the form.
It is for the teaching environment, but it doesn't have to strictly follow the structure of paper form – we can improve usability of the form. Also, there is no specific structure for the form.
How can we access the development environment?
There are some public FHIR servers that could be used for testing, such as FHIR sandbox.
How is ISBAR used in teaching? How exactly will our system be used in teaching environment?
Ben showed us a demo of the system, and it will take the form of separate SMART app in the teaching system in independent section.

Signed and Accepted
Myoungseok Jeong
Oscar Dunstan
Tong Jia
Ying Zhou
Shuying wang

Date: 25/8/2021

Team Name: Solving ISBARriers

Items Discussed/Worked On
Wireframe of the app was generated in Figma, for simple and complicated version.
Some things about wireframe were required discussion with the client, as the team could not determine the effectiveness and relevant of those features. The features were:
- Having patient star rating for priority of treatment
- Using same information section (related to patient and clinician detail) for both modes.

Resources suitable for our project was researched:
- Questionnaire and questionnaire resource for simple version (text input only) of the app.
- Using care plan resource as the base resource, storing observation and other relevant resources related to ISBAR form

Deliverables/Plan To Be Completed By The Next Week
Additional research about resources that could be used for the project.
Wireframe for next iteration of the design.

Consultation Activities With The Client

A meeting with the client was arranged to discuss the progress and requirement of the project.

- It would be helpful to have an indicator for patient priority, however star rating system is not suitable as having more stars has positive meaning from social convention. Therefore, colour coding such as red, orange and green (red for urgent, orange for medium and green for not urgent) as suggested as an alternative.
- Rather than having one app that has two modes of input, having two different apps could be helpful as it makes the app more mobile, allowing selection based on the context. Also, it was suggested to complete the simple version of the app first, then produce complicated version of the app.
- For verbal input method, mobile app was suggested because it is difficult to get authentication to use microphone from web-based app. However, this feature should be considered as an addition rather than essential feature. For mobile app, user can use QR code for authentication rather than entering all the details via text input.
- The app should be responsive to different screen sizes – it is not expected to be used in mobile phones, but some people would access it from screen as small as ipad mini.
- It was suggested that rather than limiting the app to take two input modes, prompting the user to select their preferred input mode would be beneficial.
- Servicerequest resource can potentially be used for our app, hence feasibility research should be conducted.

Signed and Accepted
Myoungseok Jeong
Oscar Dunstan
Tong Jia
Ying Zhou
Shuying wang

Date: 31/8/2021

Team Name: Solving ISBARriers

Items Discussed/Worked On

Wireframe iteration:

- The toggle will be removed, because we don't expect the user to change the type of form during their interaction. Instead, user will be allowed to select the type of form they want to enter when they launch the app and will be given a back button to change the form they're using.
- Simple version will be developed as a standalone app.

- All text fields of the simple version will be opened from the start, then they'll be allowed to collapse them.
- Patient detail will be pinned on top of the app.

Development of a simple version of the app started.

Deliverables/Plan To Be Completed By The Next Week
Additional research about resources that could be used for the project.
Wireframe for the next iteration of the design.

Consultation Activities With The Client
A meeting with the client was arranged to discuss the progress and requirement of the project.
- It would be helpful to have an indicator for patient priority, however, the star rating system is not suitable as having more stars has positive meaning from social convention. Therefore, colour coding such as red, orange and green (red for urgent, orange for medium and green for not urgent) is suggested as an alternative.
- Rather than having one app that has two modes of input, having two different apps could be helpful as it makes the app more mobile, allowing selection based on the context. Also, it was suggested to complete the simple version of the app first, then produce the complicated version of the app.
- For the verbal input method, a mobile app was suggested because it is difficult to get authentication to use a microphone from a web-based app. However, this feature should be considered as an addition rather than an essential feature. For mobile apps, users can use QR code for authentication rather than entering all the details via text input.
- The app should be responsive to different screen sizes – it is not expected to be used in mobile phones, but some people would access it from a screen as small as an iPad mini.
- It was suggested that rather than limiting the app to take two input modes, prompting the user to select their preferred input mode would be beneficial.
- Servicerequest resource can potentially be used for our app, hence feasibility research should be conducted.

Signed and Accepted
Myoungseok Jeong
Oscar Dunstan
Tong Jia
Ying Zhou
Shuying wang

Date: 7/9/2021

Team Name: Solving ISBARriers

Items Discussed/Worked On

Jerry and Oscar have been learning FHIR and React to implement the simple version of the app.

The simple version of the app successfully communicated with development FHIR server, searching, and creating resources. React development was also started, with basic structure defined and pushed into git repository.

Issues That Arose

The implementation of design was progressing at slow pace, as it required more work and knowledge than expected. With two people working on implementation, completion of both simple and complex version of the app by the end didn't seem feasible as both deriving FHIR data structure and development of React application were required. Furthermore, there was nothing much to do in terms of design due to slow progression of implementation, which made three people available.

Actions Required

Team discussed with the work allocation, and made decision:

Jerry: work on implementation, focusing on FHIR side

Oscar: work on implementation, focusing on front end

Tong, Sophia, Wendy:

- Translate the background research for complex form
- Generate CSS file for simple version
- Learn about the FHIR data structure and React development so they can assist with development of complex form.

Signed and Accepted

Myoungseok Jeong

Oscar Dunstan

Tong Jia

Ying Zhou

Shuying wang

Date: 14/9/2021

Team Name: Solving ISBARriers

Items Discussed/Worked On
The app successfully launched in the sandbox EHR, and five text fields were implemented. Creation of FHIR questionnaire and questionnaire resource were implemented. Program logic and updating UI with data to be done.

Deliverables/Plan To Be Completed By The Next Week
Work on implementation

Signed and Accepted
Myoungseok Jeong
Oscar Dunstan
Tong Jia
Ying Zhou
Shuying wang

Date: 5/10/2021
Present: Oscar, Jerry (Myoungseok)
Team Name: Solving ISBARriers

Items Discussed/Worked On
We had a catch-up meeting and discussed our current progress, as well as future plan and feasibility of different options.
Current overall progress:
- Research for design (some requires translation)
- Wireframe and design prototype for simple and complex version
- The basic version of the app that displays five text fields, which can create Questionnaire, QuestionnaireResponse and update QuestionnaireResponse by clicking a button
- The report hasn't been started

For simple version of the prototype, it is near completion with few additional work to be done:
- Connect questionnaire with questionnaireResponse
- Filter questionnaireResponse so that it only loads ISBAR questionnaire
- Creation of duplicate questionnaireResponse when refreshing too quick, although it may be the server issue.
- Styling of the application
- Printing functionality.

The feasibility of complex version of the app is questionable, but it didn't seem impossible to be completed by the end of the semester. From discussion, we thought the best approach would be:
1. Code the static html page and style it to match our design
2. Start application development by implementing that front end in react, transferring completed html and css
3. Start implementing back end by implementing core functionalities, and what is easiest to implement. Try re-use as much code as possible from previous version.

Issues That Arose
Not all members met up, and we haven't had a meeting for 2 weeks, so we don't the progress of work allocated to individual member. Therefore, a meeting is necessary to discuss the progress to catch up, and plan towards the completion of the assessment.

Actions Required
Arrange a meeting as soon as possible and communicate with each other to adjust the work. From now on we need more detailed plan about who's doing what for individuals.

Deliverables/Plan To Be Completed By The Next Week

Make the html and css for our application on separate file – By Oscar, By the end of 5/10/2021
Update the application based on the html and css from Oscar – By Jerry, By the end of 6/10/2021
Complete the backend, including the print functionality – By Jerry, By the end of 12/10/2021

Signed and Accepted
Myoungseok Jeong
Oscar Dunstan

Date: 8/10/2021
Present: Oscar, Jerry (Myoungseok) Tong, Shuying, Ying
Team Name: Solving ISBARriers

Items Discussed/Worked On
We had a catch-up meeting and discussed our current progress, as well as future plan and feasibility of different options.
Things has been done:
- Sophia, Wendy and Tong had a look at FHIR, React and Javascript. Tong gained basic understanding of FHIR operations and resource structure.
- Jerry implemented filtering functionality for questionnaire response using canonical URL of loaded questionnaire
- Jerry implemented Printing to pdf functionality
- Oscar generated application stylesheet and html, which was then converted to React by Jerry.
- Oscar iterated through the application, modified the sizes, and the size of text area

Things to be done:
- High fidelity prototype – Sophia and Tong
o Until next meeting, the data in the paper ISBAR form will be analyzed and arranged in a way suitable for FHIR to be used. This data will be discussed with Ben
o After data discussion, will continue work to produce high fidelity prototype.
- Start working on report – Wendy
o Start working on the group software development report on Google docs.
- Finish off the simple version (functionality) – Jerry
o Major addition:
§ Conversion between ISBAR and ISOBAR
o Minor addition:
§ Status indicator for save status
§ Basic formatting of generated pdf.
- Finish off the simple version (visuals) - Oscar
- Talk to Ben and arrange a meeting – Oscar

Actions Required
Work on the jobs assigned.

Deliverables/Plan To Be Completed By The Next Week
Sophia and Tong: Analyse the data structure for complex version of ISBAR, and start designing high fidelity prototype
Wendy: Start working on Report

Jerry: Finish off the simple version functionality
Oscar: Finish off the simple version functionality, arrange a meeting time with Ben

Signed and Accepted
Myoungseok Jeong
Oscar Dunstan
Tong Jia
Ying Zhou
Shuying wang

Date: 12/10/2021
Present: Oscar, Jerry (Myoungseok) Tong, Ying
Team Name: Solving ISBARriers

Items Discussed/Worked On
Wendy wasn't present, hence the progress with report writing was not updated
What have been done:
- Ying translated the background research into English
- Tong and Ying analyzed physical ISBAR form and retrieved the information fields.
- Jerry implemented button converting between ISBAR and ISOBAR, and prompt for save/editing state
- Oscar modified styling of simple version

After some discussion and talking to teaching team, we thought dividing each section (I,S,B,A,R) of the complex version will divide some workload and allow every member to look at the technical side of the project. So, we decided to divide each section of complex version to each team members. It was divided as such:
- Tong: Introduction
- Oscar: Situation
- Wendy: Background
- Sophia: Assessment
- Jerry: Recommendation and assist overall progress

Jerry took recommendation and overall progress, because recommendation would likely to be a text field that could be imported from simple version.
Other things to do:
- Contact client
- Work on the report

Deliverables/Plan To Be Completed By The Next Week
Everyone: Find out FHIR resources for their section, and learn FHIR.
Oscar: arrange meeting with client
Jerry: upload meeting logs to Google drive.

Signed and Accepted
Myoungseok Jeong
Oscar Dunstan
Tong Jia
Ying Zhou

Date: 26/10/2021
Present: Oscar, Jerry (Myoungseok) Tong, Ying
Team Name: Solving ISBARriers

Items Discussed/Worked On

- Oscar gave a detailed rundown/tutorial on how to install and run NPM.
- Looked into the possibility of using Medblox UI as a framework
- Discussed how to work around CSS and layout differences between sections

Issues That Arose

- Each section has vastly different CSS and there are major layout issues in some sections
- NPM not installed

Actions Required

- Find a CSS framework that looks good and is easy to follow
- Follow NPM install tutorial if there are any problems after the workshop

Deliverables/Plan To Be Completed By The Next Week
Get a bulk of each section done to show the client

Consultation Activities With The Client

- The client contacted us wanting to meet. Our progress has been minimal so wanted to get more progress before the meeting. Meeting set for tomorrow via Zoom.

Other Comments

Signed and Accepted
Myoungseok Jeong
Oscar Dunstan
Tong Jia
Ying Zhou
Shuying wang

Date: 29/10/2021
Present: Oscar, Jerry (Myoungseok) Tong, Ying, shuying
Team Name: Solving ISBARriers

Items Discussed/Worked On
The team gathered in the library, to work on the project.
There were some compatibility issues with the shoelace and medblocks-ui library that we attempted to use, so a new library called material-ui was found.

Ying: worked on putting UI elements for Assessment part of the app
Tong: worked on putting UI elements for Introduction part of the app
Wendy: worked on putting UI elements for background part of the app
Oscar: worked on putting UI elements for Situation part of the app, and setting up the app to launch standalone.
Jerry: modified the simple version of the app and the home page, so it responds to the feedback from client:

Issues That Arose
There were some difficulty with hosting via github pages
Actions Required
Further investigation with hosting options for the app

Deliverables/Plan To Be Completed By The Next Week
Sophia: Place UI elements and research FHIR resources for assessment section, prepare background and research process part of presentation
Tong: Place UI elements and research FHIR resources for introduction section, prepare future plan part of presentation
Wendy: Place UI elements and research FHIR resources for background section, prepare complex version part of presentation
Oscar: Plae UI elements and research FHIR resources for situation section, prepare introduction part of presentation, get the app to launch standalone
Jerry: Finish implementation of simple version based on the feedback including functionalities, place UI elements and research FHIR resources for recommendation section, prepare simple version part of presentation

Consultation Activities With The Client
On Thursday this week (28/10), the team had a Zoom meeting with the client to discuss current progress and get some feedback. Following feedbacks were received:
1. demonstration of launch in a SMART context and provision of a link for user beta testing will be invaluable,
2. reading of existing ISBAR notes on re-launching of the app within a case (i.e., same patient record) will be critical,

3. a feature to list and select from prior ISBAR notes (could be multiple versions) will be highly desirable - a small number icon denoting instances of previous notes and permitting selection of these would be suitable and could sit well on the intro screen,
4. display on the form (and the PDF) of the practitioner doing the handover (name, ID, role), and receiving the handover, as well as the patient details will be important. These fields should be read from the record FHIR resources and pre-filled; for the practitioner receiving handover the fields will generally need entry by the user of these details (do note that often a Care Team resource that contains a list of all practitioners supporting a patient and could be good to access as a drop down to select from in addition to free entry. For specification of role, using Ontoserver and the SNOMED CT People in the Healthcare Environment branch would be good.
5. For complex ISBAR, do note that vital signs and conditions would best be read and populated from existing entries in the EMR; where they are entered by the form they should be entered as appropriately coded and termed observation or other suitable resources).

Other Comments

Signed and Accepted
Myoungseok Jeong
Oscar Dunstan
Tong Jia
Ying Zhou
Shuying wang