# EIM 319: Hospitals of the Future – Improving Post-Discharge Information Management

EG 3301R Final Report

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# Acknowledgement

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We are also thankful for the patience and support of our interviewees, who provided us with insights into the problem at various stages of this project.

Lastly, we would like to express our heartfelt gratitude to the staff at Alexandra Hospital for taking time out of their busy schedule to meet us. It is only with their support that we could get a better understanding of the problem and get the most relevant feedback for our product prototype.

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# Introduction

This project aims to alleviate patient anxiety during post-discharge care, as a solution to target the partner stakeholder, Alexandra Hospital's focus to *closing-the-loop.* It entails 3 main points on:

1) How might we alleviate anxiety pre-appointment/arrival and post-discharge?

2) How might we enable clear follow-up with patients and caregivers?

3) How might we solve the problem of "broken telephone".

This report will provide a thorough insight into the design journey of the proposed product, which includes the identification of the problem, clarification of the product, derivation of the initial prototype, and the current product prototype. Later parts of the report will include how the team worked with nurses from Alexandra Hospital, as multiple rounds of testing were conducted to improve on the product prototypes. The report will also consider the limitations of the current product prototype and future work that can be pursued.

# Understanding the Challenge of Closing-The-Loop

The first stage involved identifying stakeholders in the problem. Through secondary research and communication with Alexandra Hospital, two key stakeholders were identified: 1) the medical staff such as doctors and nurses at a hospital who are involved in a patient's journey, and 2) the patients and their caregivers who need to carry out the necessary care instructions. Caregivers may include family members or helpers who are primarily responsible for the wellbeing of the patient, but not necessarily living with them.

To understand the problem more, interviews were conducted with hospital staff from Alexandra Hospital, which represents the first category of stakeholders, as well as over 20 family members and friends who had recent experiences being admitted to the hospital, representing the second category of stakeholders. Furthermore, literature reviews were carried out to find problems faced by other hospitals in terms of communication, as well as existing solutions used by both the medical industry and other industries. The following three main points were identified that constituted the key problem.

First, patients are left with unclear instructions when they start their post-discharge care. In most cases, directions for post-discharge are given verbally, which often leads to medical discrepancies that interfere with their recovery.

Second, it is not uncommon for patients to be the ones conveying these details to their caregivers, which could lead to miscommunication. Caregivers are often in need of clarification of the information and instructions as a result.

Lastly, there is often a gap between what doctors think their patients understand and what the patients truly understand. As a result, patients may not be able to comprehend what doctors share.

With these points, it has been identified that post-discharge anxiety stems from communication gaps and fragmented information made available to the patients. Hence, the project aims to tackle the problem of delayed, incomplete, and complex information dissemination, by providing patients with the right amount of information in an easily accessible manner.

## Functional Requirements

To ensure effective communication, the information communicated must be concise and patient centric. This will be achieved through four main functional requirements, where the proposed product must:

1) Act as a recorded reference for all post-discharge information, personalized to each patient's care regimen,

2) Provide easily accessible information at anytime from anywhere in full accuracy by both the patients and their caregivers,

3) Offer outreach options to provide support for the patients in case of further doubts,

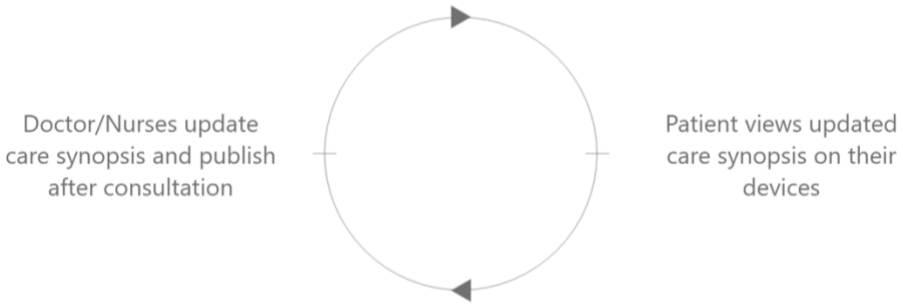
4) Guide the medical staff to format the information in a manner that is suitable to each patient.

In addition to these functional requirements, the product scope targets users who own and use a smartphone, regardless of their age group. Any patients who do not own a smartphone will be excluded from the target group to focus on bringing greater convenience to users who own one. This is accepted as a limitation of the solution.

## Proposed Product Concept

With these requirements in mind, the conceptualized product comprises two components. The first is the Care Synopsis, which allows the patients and caregivers to access their post-discharge care information on a day-to-day basis. It would also provide a way for patients to contact the medical staff in case of further queries.

The second is the Creation Tool, which allows the hospital medical staff to create the synopsis for each patient with the relevant post-discharge information. The tool also guides the medical staff with the organization of information by splitting it into sections. See Appendix A for more details on the concepts generated.

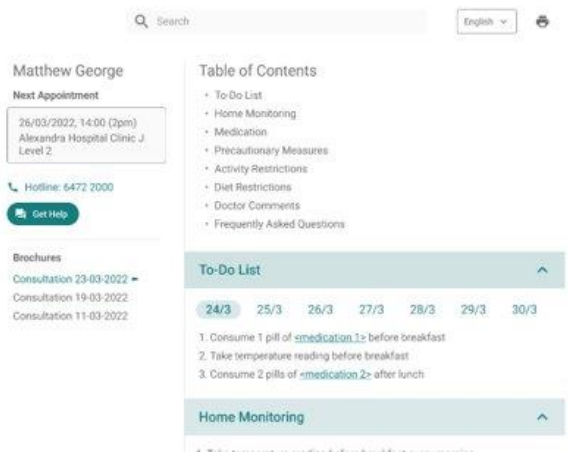



Together, these platforms establish a method of two-way communication between patients and the hospital. By allowing important information to be exchanged between the patients and medical staff without any discrepancies, the product addresses the problem of "broken telephone". It further reduces the need for patients or caregivers to remember all the information, hence serving to alleviate patient anxiety that stems from current communication gaps.

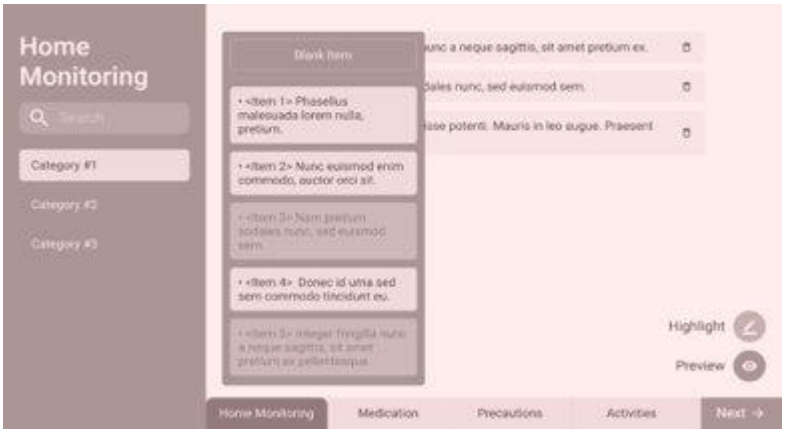
# Clarifying the User's Pain Points

## Figma Prototype User Testing

A set of low-fidelity prototypes were created on Figma for both the care synopsis and creation tool. These prototypes were then shown to the same family and friends interviewed earlier, as well as nurses and staff from Alexandra Hospital. By allowing them to navigate across the various screens, feedback was gathered on the prototypes, which were repeated for multiple iterations. See Appendix B for details on their feedback.




*Care Synopsis*




*Creation Tool*

Based on the feedback obtained, the care synopsis was simplified to only show the to-do list on the home screen. This would reduce the amount of information presented to the patient, prioritizing only what is most frequently used, thus making it easier for them to find what they really need.

## Hospital Observations

To deepen the understanding of the challenges that the patients and hospitals are facing, the team visited Alexandra Hospital on two occasions to make observations. The first visit was to an in-patient ward for elderly patients and patients requiring palliative care. The second was an observation of outpatient appointments at Clinic J, which deals with all kinds of chronic diseases. The observations made from both visits are summarized below. See Appendix C for a detailed list of observations.

### *In-Patient Observation*

One of the issues observed was the lack of communication about what to expect on discharge day. A daughter of a patient discharged on the day had shared that she felt clueless about what was going on. She thought that she was waiting for some paperwork before her mother could be discharged. But according to the nurses, there was no paperwork needed to be done for discharge. Following up on this, it was also revealed that a patient's family would only be notified about the timing to fetch the patient, and not what to expect on discharge day. Such an information gap regarding the discharge process is a problem that will be addressed in the product below.

The patient's daughter also mentioned that she was there every day while her mother was hospitalized. During those days she would occasionally receive training on how to care for her mother, which she found useful. However, not all caregivers would be able to attend the training sessions. The proposed product would address this with the articles in the care synopsis.

Another important observation made was that some patients had to collect their medication from the pharmacy, while for other patients, the medications were brought to them by the pharmacists. Additionally, if the patient has a history of not observing their medication schedule, the pharmacist may sort out the medications and instruct the caregivers regarding the regimen. From this, it was recognized that different patients would have different discharge arrangements. It also reaffirms the importance of the to-do list feature included in the proposed product.

### *Out-Patient Observation*

It was observed that when the doctor was reviewing the patient's report, some patients were able to interpret some of the data on their own, while others had slightly more difficulties comprehending the information or were even uninterested in it. As such, there is a need for the information provided to the patient to be simplified in a manner that most patients and caregivers would be able to understand.

Additionally, phone call inquiries currently go through a long process before they reach the doctor. As such, the doctor took the initiative to provide his email address to patients who were more tech-savvy, so that these patients could contact him directly. But as not all doctors or nurses would do so, this issue would be addressed in the care synopsis.

# Creating Our Product

Feedback and observations from the earlier section were incorporated to generate the high-fidelity prototype using React for frontend, and firebase for the database. Throughout this process, medical staff at Alexandra Hospital staff were also consulted. See Appendix D for more details.

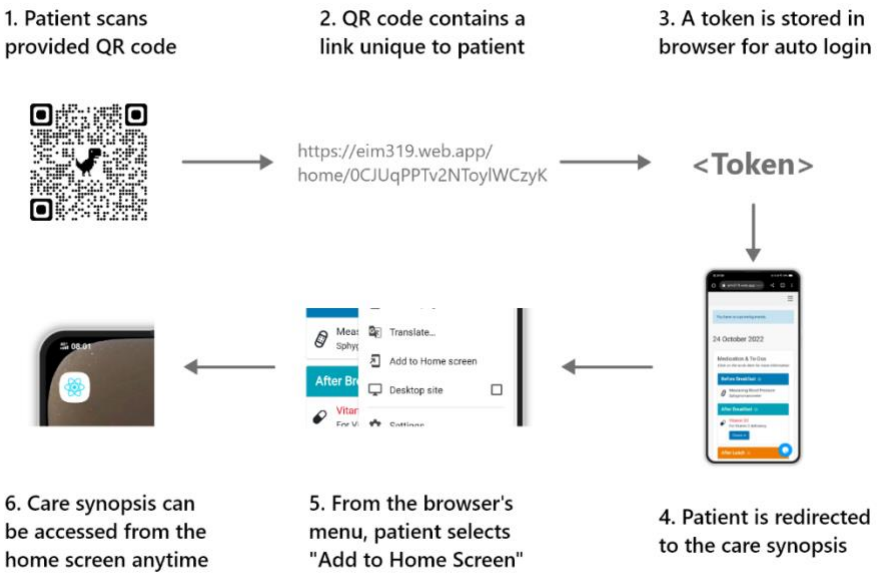
The proposed product comprises of two parts: The first is a care synopsis for patients and their caregivers, providing them with care information that they may require. The other part is a tool for doctors, nurses, and other care staff to add or modify the contents of the care synopsis. The following sections highlight the key features of the product prototype. See Appendix E for detailed descriptions.

## Care Synopsis for Patients

Considering the convenience of mobile devices over desktops, the care synopsis is designed to be optimized for mobile devices and is implemented through a web app for cross-platform support.

### *Onboarding a New Patient*

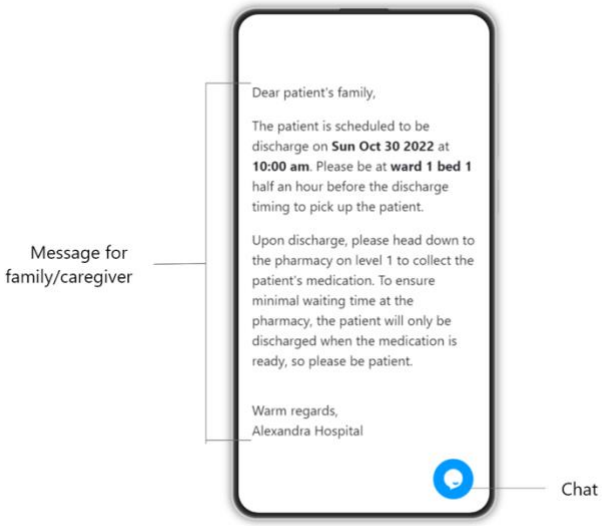
To onboard patients, various methods from SMS to passwords were considered. While the target audience includes elderly people with smartphones, many of them are still less tech-savvy compared to typical younger users. As such, factors such as convenience, speed of onboarding, and accessibility were considered to derive the solution as shown below.




*Flow for Onboarding Patients*

## *Inpatient Discharge Guide*

The care synopsis addresses some concerns that a caregiver may have during the patients' hospitalization. For example, to address the information gap regarding discharge process and better prepare caregivers for it, the care synopsis is updated with discharge instructions specific to the patient one day prior to the patient's discharge day.



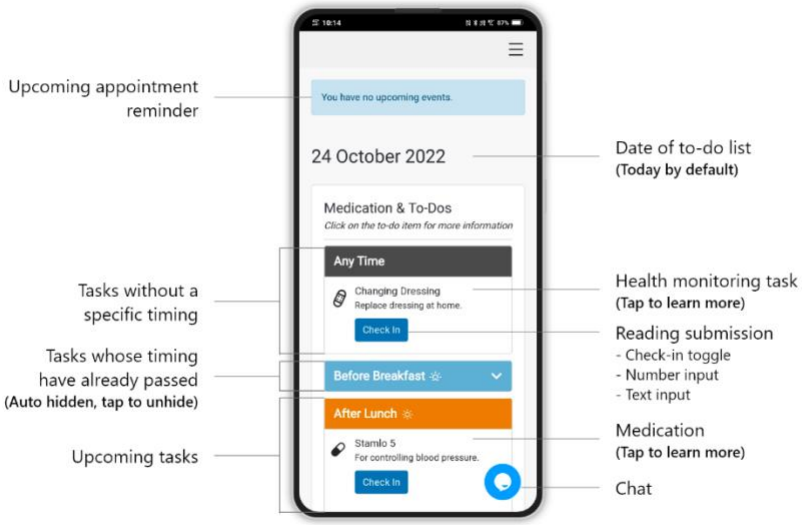

*Discharge Message for Patient's Family/Caregiver*

## *Outpatient Care Information*

For outpatients, the platform aids the patients and caregivers to recap on what needs to be done when they are back at home. When a patient is discharged, they can access their at-home care synopsis, where they will be able to find information relating to medication, health monitoring and appointments. With this objective in mind, the following features were included:

1. **To-Do List: Quick References**

A significant challenge is to minimize the need to search for key information, so that patients will have a more seamless experience with the care synopsis. As identified by the hospital visits, most patients often prioritize information such as medication consumption and health monitoring timings, so that they can be reminded to them at the right time. As such, a to-do list is added to the home screen to summarize this set of key information. Whenever a patient forgets what they need to do, they can simply open the app and check the tasks they need to carry out.

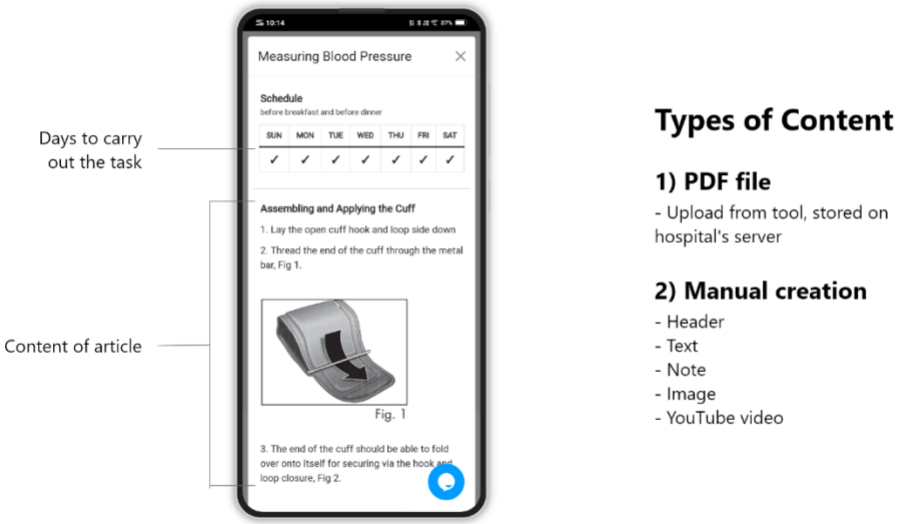



*To-Do List*

Based on the observation of out-patient consultations and further confirmation from Alexandra Hospital, it would be helpful to allow patients to record down health monitoring readings they may be required to measure frequently, such as weight monitoring or blood pressure. Hence, this platform allows patients to submit these readings from the to-do list, which can then be viewed by the medical staff for monitoring purposes prior to consultation.

**2. Articles: Providing Training Anywhere**

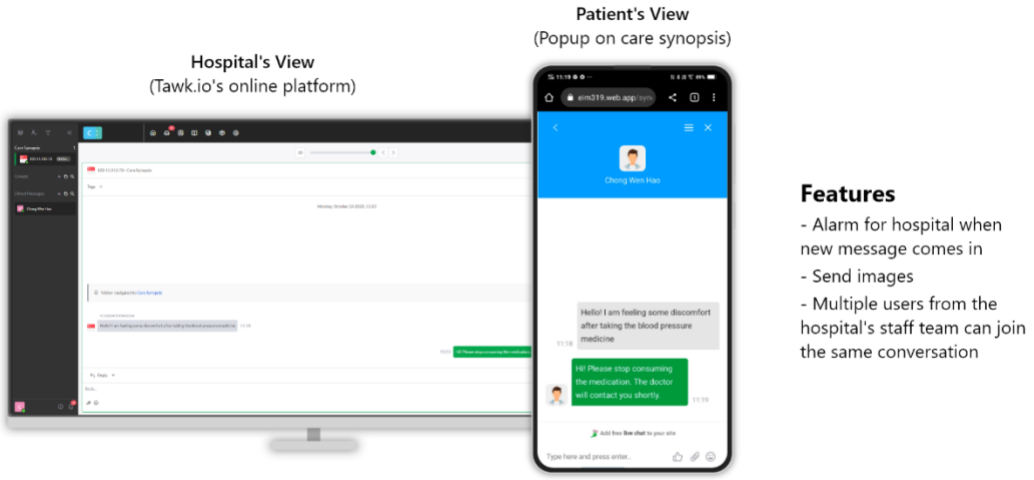
At times, caregivers may be unable to visit the hospital for the necessary training to care for the patient. To address this, articles containing instructions on how to care for the patient may be added to the care synopsis.




*Article*

## *Outpatient & Inpatient: 2-Way Communication*

The observations earlier highlighted the tedious process that patients need to go through to contact doctors and nurses. Hence, to allow patients to communicate directly with them, a chat feature is added to the care synopsis using Tawk.to, where patients can initiate a new conversation. Depending on the type of query, the call center, doctors and nurses can all join in the conversation as necessary to address the patient's query.



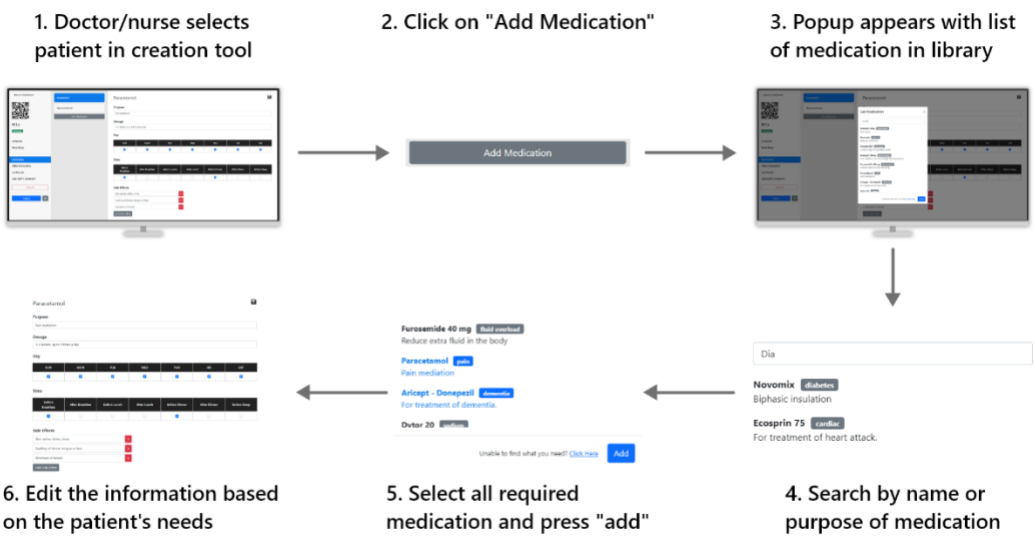

*Chat Feature*

## Creation Tool

The creation tool will be used on the hospital's computers, by nurses and doctors assigned to the patient to create their care synopsis.

### *Adding Medications & Articles*

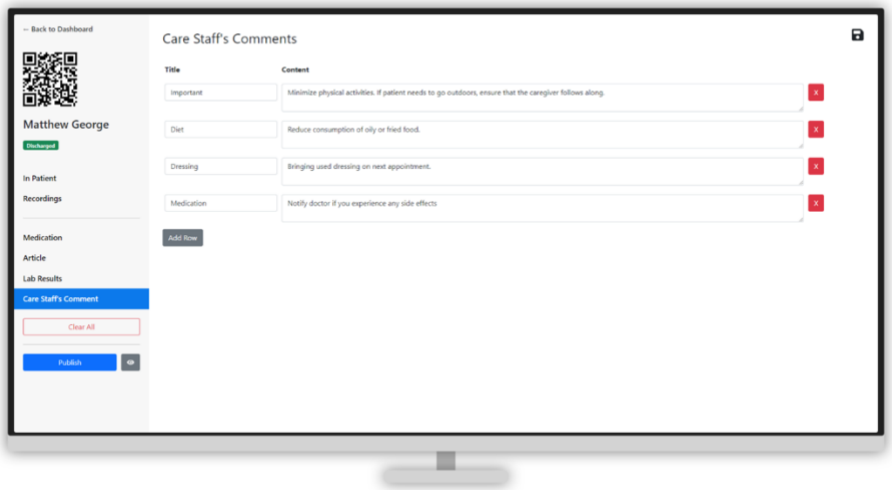
Due to the busy schedule of doctors and nurses, a key focus of the creation tool is to simplify the process of populating the synopsis content to avoid overwhelming them. For this, the medication and articles content are stored in a library that can be imported with just a click. The process is similar for both medication and articles, allowing doctors/nurses to fill in the care synopsis rapidly as summarized below:




*Flow of Adding Content from Library*

With potentially thousands of items in the library, the search process is further eased by adding tags to each of the items. This allows doctors to search for a medication/article by name or its purpose. For example, searching “diabetes” would bring up all the medication related to diabetes.

If there are any additional comments that the doctors or nurses would like to add that are not covered by the medication and articles, it can be added to the “Care Staff’s Comments” section.



### *Populating the To-Do List*

Doctors and nurses are not required to populate the to-do list as all medications and articles with specified timings are automatically added into the patient's to-do list.

# Testing With Alexandra Hospital

To test whether the proposed product achieves its purpose, two rounds of testing were performed at Alexandra Hospital. Due to the strict approval requirements, the team was unable to conduct the testing with patients. As such, the next best option was to test it with nurses, who have an accurate understanding of the patient's perspective with their years of experience.

## First Round of Testing: Evaluation

A total of 11 nurses participated in the first round of testing. The main objective was to observe their initial reactions to the product.


### *Round 1 Testing*

The following paragraphs discuss the nurses' feedback and the changes subsequently made to address their concerns. See Appendix F for a detailed list of feedback.

### *Creation Tool*

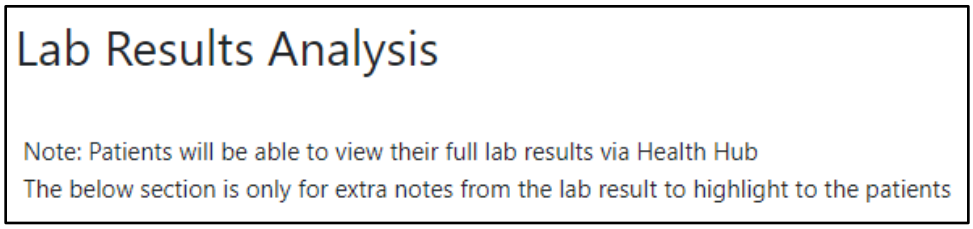
**Appreciated points**

Generally, the nurses found the creation tool to be well-organized, containing the right amount of information for the staff to populate. They also believe that it would be helpful to ensure medical adherence. They liked the straightforwardness of the organization and layout of the sections, as well as the flexibility of personalizing the information for every patient. A nurse even mentioned that they have always hoped for such a tool when working with patients.

They also felt that the ability to collect patient recordings and view them through a graph is useful to monitor their patients and ensure they are taking their readings regularly.

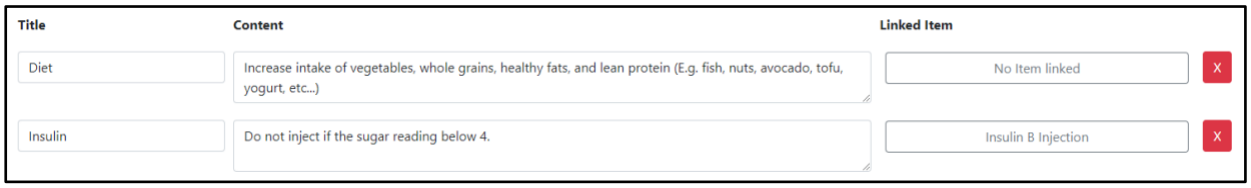
**Improvements made**

Some nurses were unclear of the purpose of some sections, such as the "Lab Results" section. This was addressed by adding a description of the section.

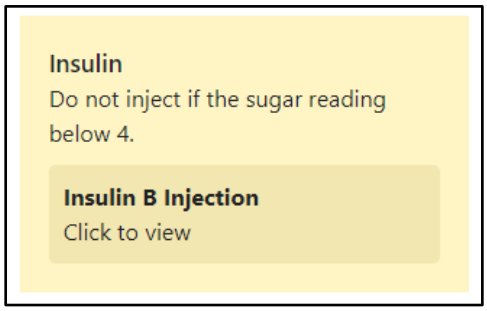



*Instructions for Lab Results in Creation Tool*

Additionally, when creating a care synopsis, the nurses hesitated on deciding whether certain information should be placed under the "Articles" or the "Care Staff's Comments" section as their comments may be pertain to a particular medication or article. As such, we added the ability to cite articles or medication in "Care Staff's Comments" section.




*Linking Medication/Article to a Comment in Creation Tool*




*Comment With Linked Medication/Article in Care Synopsis*

## *Care Synopsis*

### Appreciated points

The nurses found the onboarding process convenient and hassle-free. They also mentioned that the amount of information was just right, not too overwhelming, yet not leaving out any details. They also felt that the "To-do List" would help patients to feel less anxious when searching for the information they need. Furthermore, they liked the idea of regular updates after every appointment, with information that alleviates the challenge of remembering information.

The nurses felt that the chat function would aid in faster communication for minor queries, which could be easily addressed without the need for an appointment. Furthermore, the ability to send over images and documents also serves to better achieve the two-way communication that Alexandra Hospital hopes for.

### Improvements made

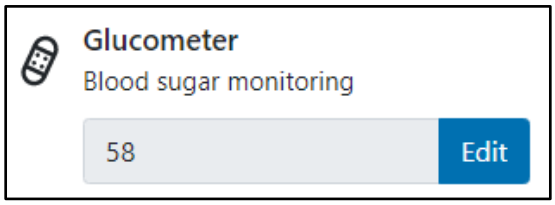
As some nurses were not aware that they could tap on a medicine or monitoring activity on the "To-do List" to learn more about it, an instruction was added to clarify this feature.


*Instructions for To-Do List*

Some nurses were ambiguous about the purpose of the "Articles" section. Based on their recommendation, the section was renamed to "Patient Education".

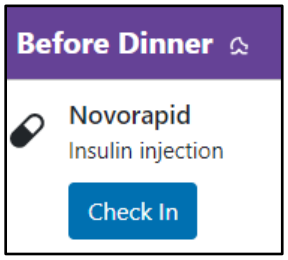
*Patient Education Screen in Care Synopsis*

In this iteration of the product prototype, the patients could not edit the recordings once submitted. The nurses raised the concern that patients may key in the wrong value, hence requiring a need for the modification of the readings.



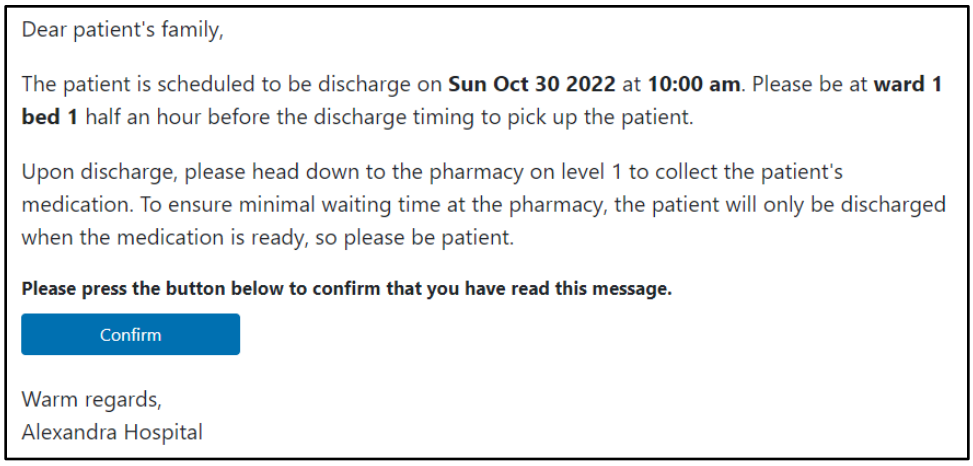

*Edit Toggle That Appears After Submission*

Nurses also brought up that it would be helpful for patients to check-in when they consume their medication, to allow the hospital to better monitor the patients' adherence to their schedule. As such, this feature was added to medications in the to-do list.




*Check In for Medication*

For the information provided when a patient is ready to be discharged, the nurses requested for an acknowledgement toggle to check whether the patient's caregiver/family has read it. This is to ensure that the caregiver/family really received the message, reducing the chance of miscommunication. This toggle was added to the care synopsis, as well as an indicator on the creation tool to let the hospital know that the patient has acknowledged the message.




*Acknowledgement Toggle for Discharge Message*

## Second Round of Testing: Confirmation

Following the changes made to the platform and creation tool, a second round of testing was conducted to check if the changes made were successful in addressing the concerns raised in the first round. The second round was carried out with 5 nurses, of which the majority were from the previous round of testing.


*Round 2 Testing*

**Appreciated points**

The nurses had a much more positive response in the second round of testing and were more confident while using the platform as well. They found the ability to link care staff comments with medicines and patient education articles very helpful.

**Possible Improvements**

One of the nurses suggested images for medication would help patients distinguish their medications. This was a feature considered earlier. However, considering that medications could be produced by different manufacturers and hence have different packaging, it was concluded that this feature

could lead to confusion. As a work in progress, the creation tool could allow patients or nurses to upload the images themselves to ensure that it is always the correct one that is being shown.

# Limitations

The second round of testing generally yielded positive feedback regarding the proposed product. However, there are some limitations to this project. First, the testing of the prototypes could not be conducted on real patients due to the strict restrictions. Secondly, the proposed product could not be integrated into the Epic system used by the hospital, which would have allowed the product to automate some of the steps involved in the population and generation of the care synopsis.

# Future Work

For future development, the security aspects of the product such as the implementation of access controls could be considered. The potential of implementing the care synopsis as a native app may also be further explored, as it may open the doors to even more possibilities, such as having alarms at different times of the day to remind the user to consume their medication.

Beyond the scope of this project, there are a few challenging areas that could take things even further with the care synopsis. For example, having a translation feature to automatically translate the articles could make the care synopsis more accessible to users who are not fluent in English. An option to have the articles to be read by AI may also be incorporated.

# Appendix

## Appendix A: Concepts

Upon establishing our functional requirements, the following morphological chart was created to generate four different concepts as shown in the table.

Concept 1: Concept 3:

Concept 2: Concept 4:

Hospital's Platform

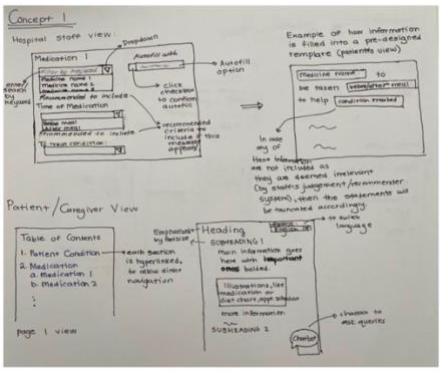
| Functions | Solution Principles | | | |
|---|---|---|---|---|
| ***Interacting with the platform*** | Drag and drop  | Dropdown selection  | Radio Buttons & Checkbox | |
| ***Determining similarity of content*** | Only what applies to all patients | Only what applies to patients with the same illness  | What applies to most patient of the same illness  | What applies to most patients of the same illness with similar factors (E.g., age, education level)  |
| ***Getting Patient's Preferences*** | Survey patients to find out what information they need | Use patient's factors to guess patient's preference  | No optimization based on patient's preferences  | |
| ***Adding additional Information*** | Modify existing component's information  | Additional comments section  | | |
| ***Determining how much information and details to include*** | Recommender system using machine learning  | Own (doctor's) judgement based on experience  | Assessment of patient (human judgement)  | |

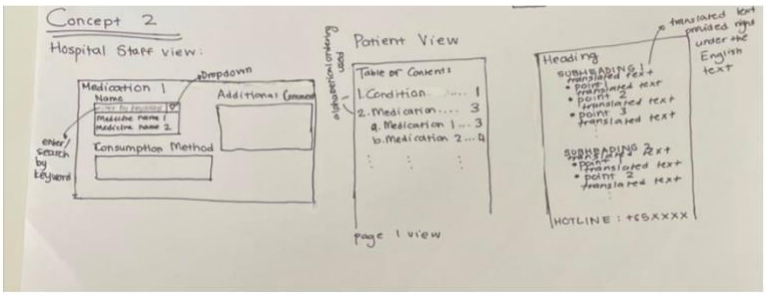
Patient's Platform

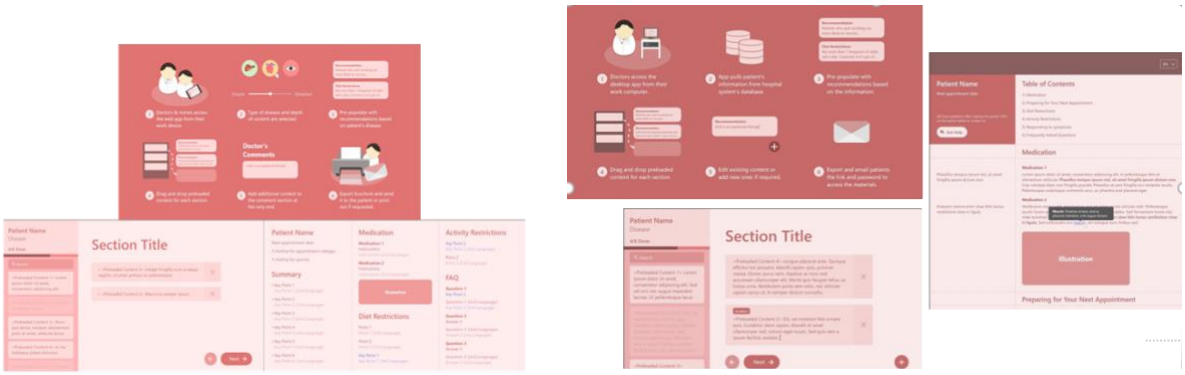
| Functions | Solution Principles | | | |
|---|---|---|---|---|
| ***Exporting and sharing the brochure*** | Password protected link  | Physical | Printable PDF  | |

| | | | | |
|---|---|---|---|---|
| ***Emphasizing important points*** | Font size/weight<br>🔴🔵🟢🟡 | Color | Underline | |
| ***Supporting various languages*** | Only one language of patient's choice | English + patient's mother tongue<br>🔴🔵🟢🟡 | One language of patient's choice, one language of caretaker's choice | |
| ***Presenting the information*** | Paragraph | Point form<br>🔵🟢 | Pictogram with accompanying text<br>🔴 | Cornell layout<br>🟡 |
| ***Getting an overview of the contents*** | Summary of key information<br>🟢 | Table of contents<br>🔴🔵🟡 | | |
| ***Ordering the content*** | Sort by order of importance<br>🟢🟡 | Sort by order of most likely asked | Put relevant sections together<br>🔴 | Alphabetical ordering<br>🔵 |
| ***Getting answers to uncovered questions*** | Automated chat bot<br>🔴🟡 | Contact hotline<br>🔵 🟢 | Online messaging service | |

The 4 concepts are displayed below via sketches and diagrams.






These concepts were compared with one another and evaluated based on how well the various features met our functional requirements: 1) Act as a recorded reference for all post-discharge information, personalized to each patient's care regimen, 2) Provide easily accessible information at anytime from anywhere in full accuracy by both the patients and their caregivers, 3) Offer outreach options to provide support for the patients in case of further doubts, 4) Guide the medical staff to format the information in a manner that is suitable to each patient. Utilizing this set of criteria in our evaluation, below are some of the key points that were observed.

Firstly, the usage of recommender systems in the creation tools of concepts 1 and 4 to pre-populate certain content based on patient condition were found to speed up the process of populating the patient's synopsis. It was further found that this feature could be further enhanced by including an "additional comments" section as seen in concepts 2 and 4 to provide the flexibility to the hospital staff to fill out any other information and hence provide a more personalized care plan to each of the patients. Furthermore, the drag and drop form in the creation tools proposed in concept 3 was more efficient to search the database and reduce chances of human error.

For the care synopsis, the layout presented in concept 4 was found to be the most organized and readable without compromising on the details or important information. Additionally, the feature of the to-do list was found to be a helpful tool to provide patients with a summary of their care information. Furthermore, features such as the chat function, language selection, and tooltips were also helpful to improve the accessibility and understandability of the information presented.

Finally, considering that the patients in user interview included both who had mobile devices and familiar were familiar with how to use them as well as patients who did not own a mobile device or were not as familiar with how to use them, both forms of media, hardcopy and softcopy, were considered for our care synopsis. However, it was found that since using web app surpasses the extent to which it provides

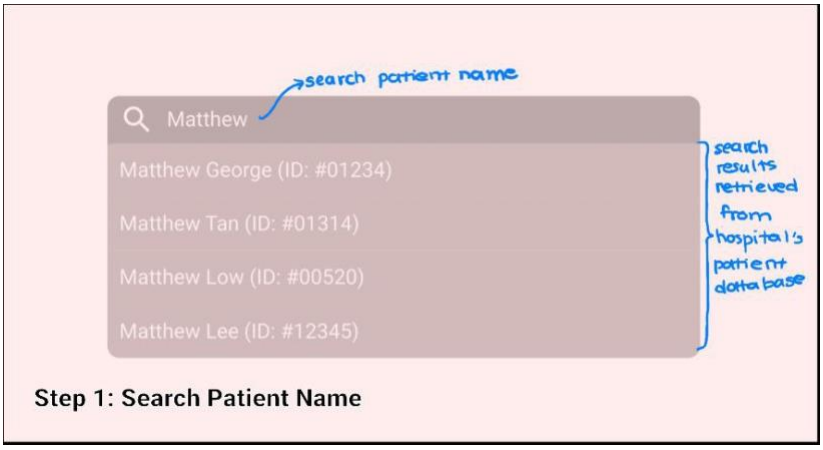
accessibility, reliability, and functionality. As a result, our project at this stage only targets users across all age groups and demographics who own and know how to use a mobile device.

# Appendix B: Figma Concept User Testing

## *B.1 Prototype 1*

**Creation Tool**

The tool opens up with a dashboard to search a patient's name.

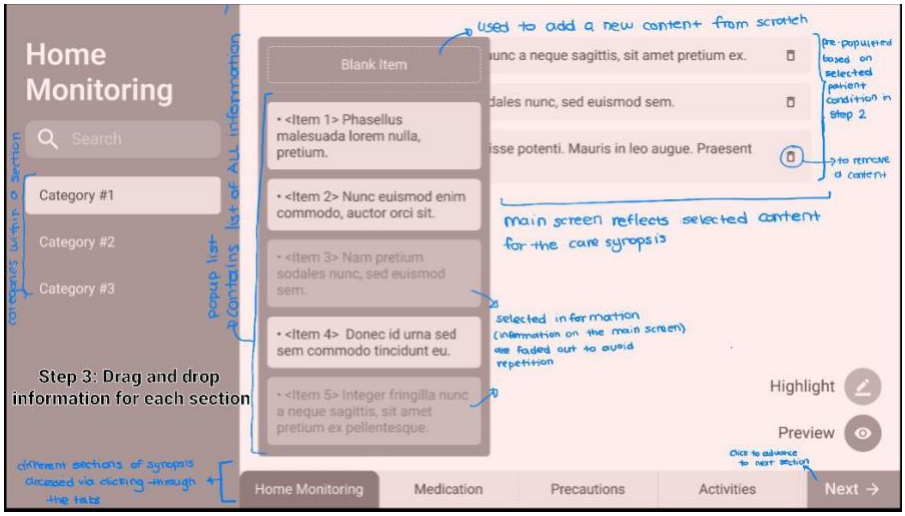



*Figma Prototype 1: Searching for Patient Name*

Once the patient is selected, patient condition is to be selected from a list of all the patient's conditions retrieved from the hospital's database. This selection determines how the content for each of the sections of the care synopsis in the later step are pre-populated

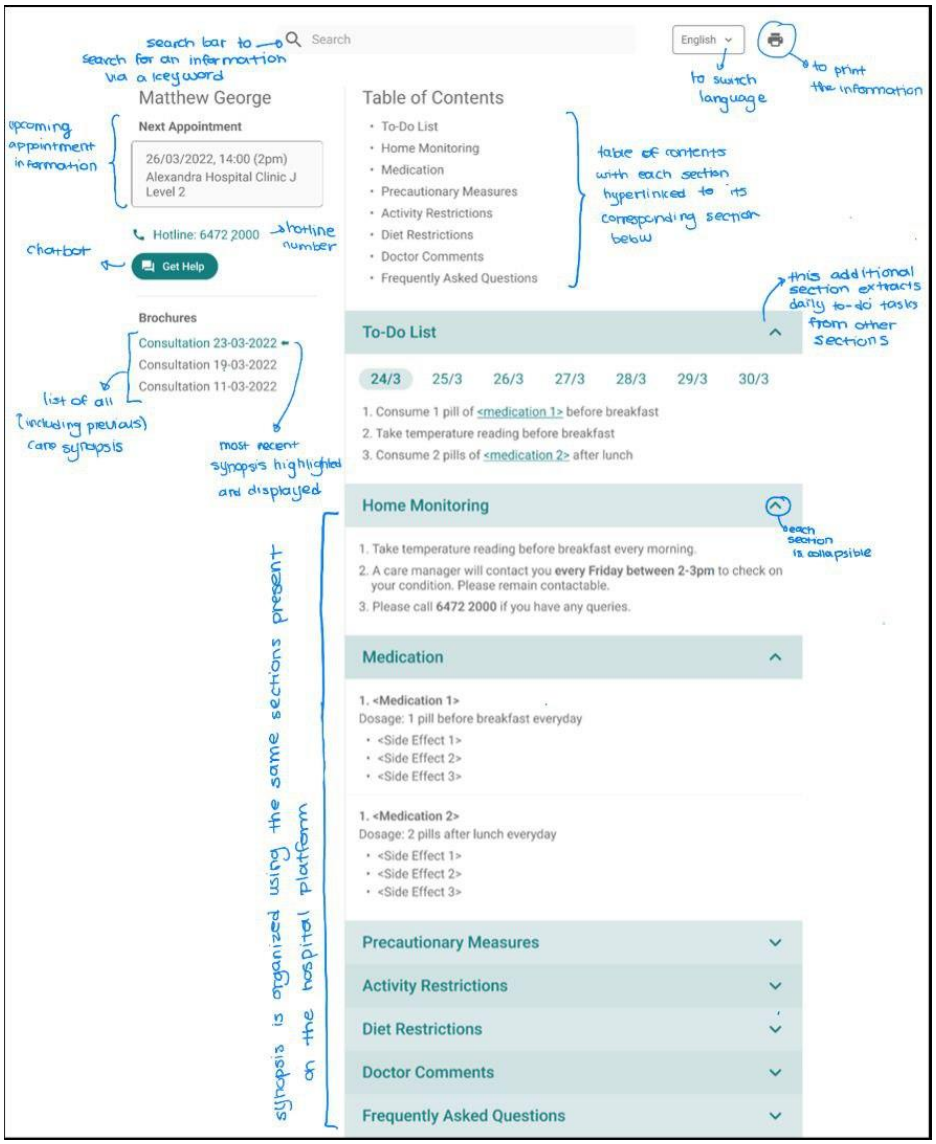

*Figma Prototype 1: Selecting Patient Condition*

Next, the hospital user is lead to the creation page. Each section is filled with default content based on the selected patient's condition. This content may be removed, or new content may be added from library of items. After all sections have been completed, the synopsis is exported and disseminated to the users.




*Figma Prototype 1: Dragging and Dropping Information*

**Care Synopsis**




*Figma Prototype 1: Care Synopsis*

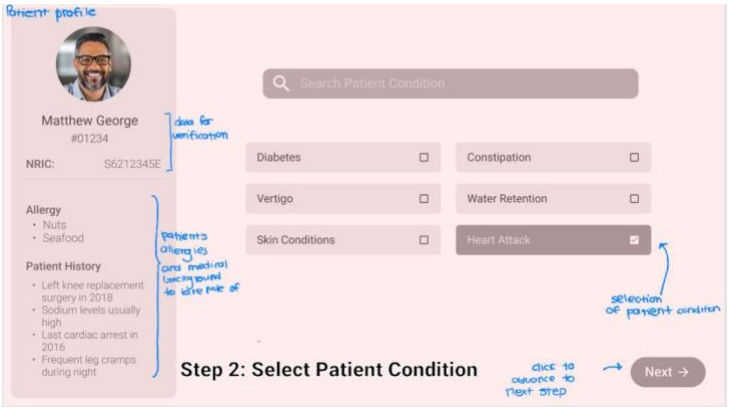
The layout of the synopsis has 2 columns to provide greater accessibility in a less overwhelming manner (see Fig. 10). The left column is fixed in position while the right column is scrollable with the information from the various sections. An additional “to-do list" section organizes all the daily care instructions from other sections, allowing users to view a day-to-day summary of care instructions.

## *B.2 Prototype 2*

**Creation Tool**

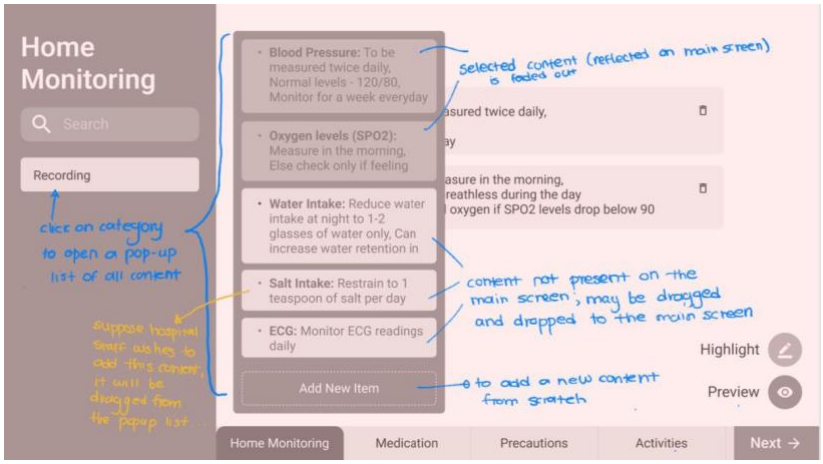
The following images highlights the changes that were made from prototype 1.

Firstly, the patient profile page is simplified, where patient's background and verification information is placed on the left, while the select of patient condition is placed on the main screen on the right.

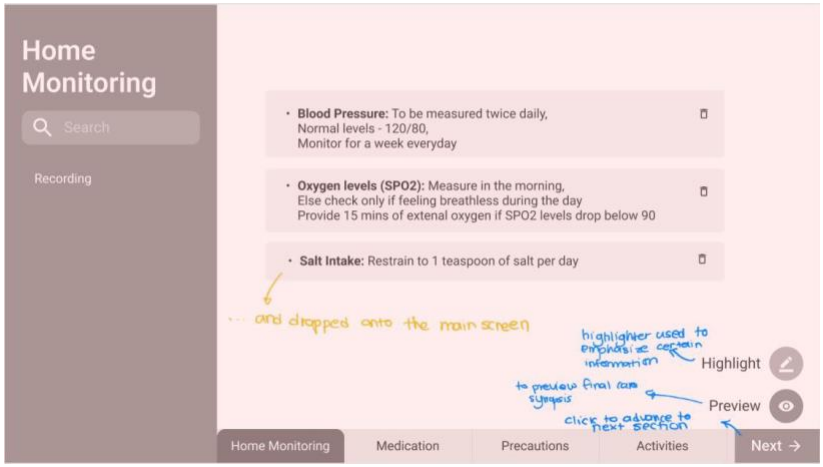



*Figma Prototype 2: Selecting Patient Condition*

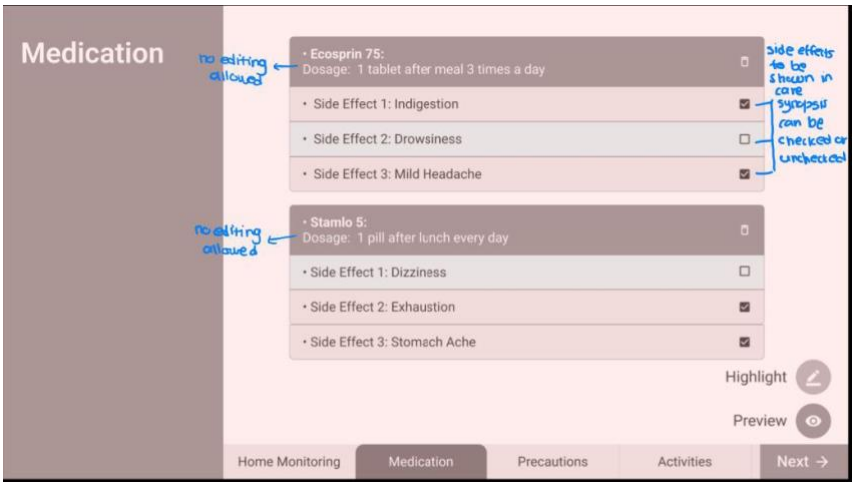
Dummy patient data was also added into the different sections of the creation page to provide a realistic idea of how the synopsis population works.




*Figma Prototype 2: Home Monitoring (Selecting Content)*




*Figma Prototype 2: Home Monitoring (After Content Selection)*

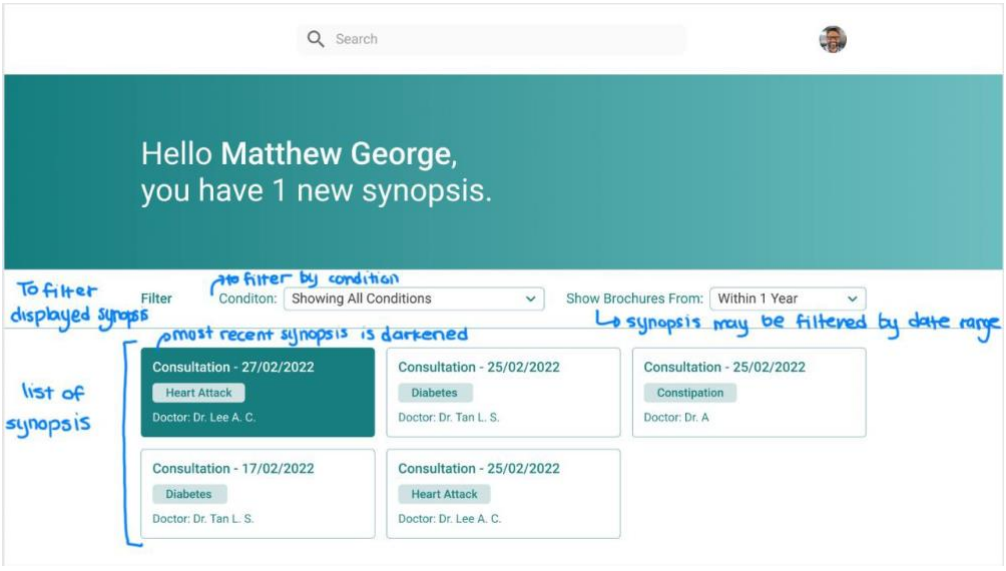



*Figma Prototype 2: Medication Page*

The medication section was also laid out different to allow the edition of specific information, such as side effects, within each medication item.

**Care Synopsis**

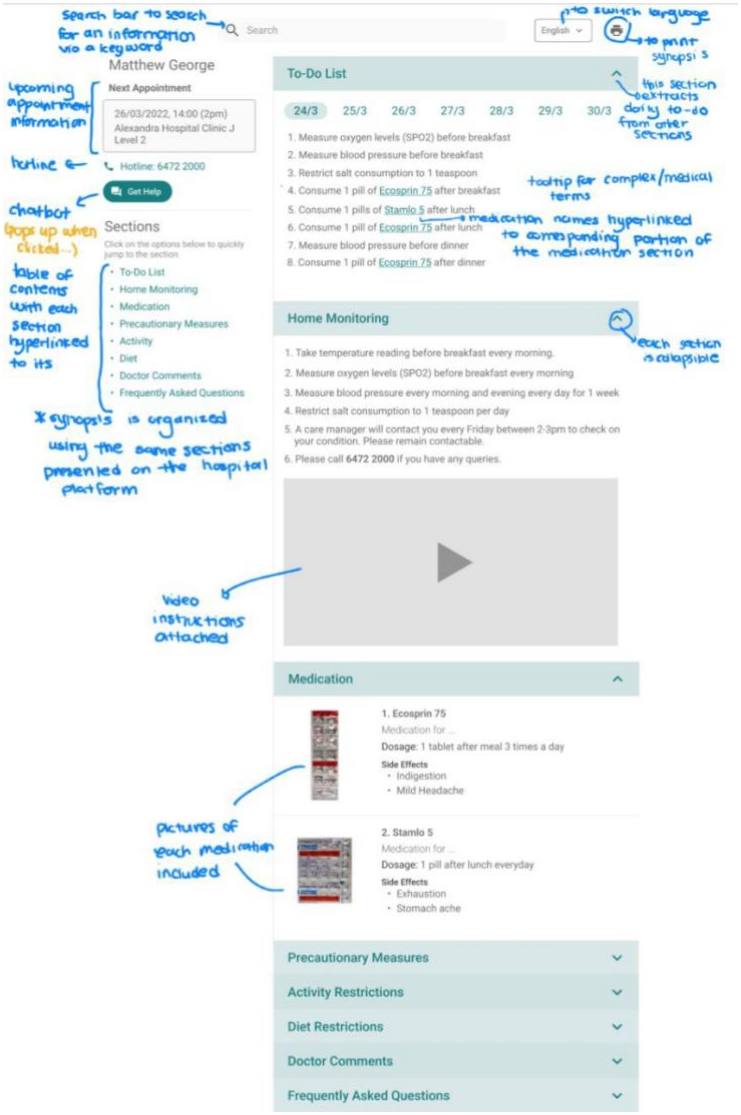
A dashboard was added to the main page of the synopsis, allowing users to select their synopses of different consultation. *Note that this dashboard was removed in our subsequent iterations to avoid confusion for the patients on which synopsis they should select or leading to discrepancies stemming from selecting the wrong synopsis on accident.*




*Figma Prototype 2: Synopsis Dashboard*

The layout of the care synopsis was also changed significantly. The hyperlinked table of contents was shifted to the left to allows patients to jump around the sections more freely regardless of

where they are in the synopsis. Additionally, care instructions are accompanied with pictures and videos to aid patients and caregivers in carrying out the care instructions correctly. The medicine names from the "To-Do List" are hyperlinked to allow navigation to the corresponding portion of the synopsis containing more details about the medication




*Figma Prototype 2: Care Synopsis*

## *B.3 Feedback*

The above prototypes were displayed to doctors, nurses and other medical staff from Alexandra who managed both inpatient and outpatient operations at Clinics J & K at different prototypes. Some of our users from the initial user interviews were also contacted back to receive their feedback on the layout and amount of information in the care synopsis. Below are some of the key points from their feedback:

1) The general idea of the app sounds very useful for both the patients and hospital staff
2) Splitting up the content into various sections is organized, however, it must not be too overwhelming for the patients to navigate through on the care synopsis nor too difficult for the hospital staff to populate on the creation tool
3) FAQs were preferred over chatbots
4) Extend the platform to provide some form of two-day direct communication between the patient and the hospital on a regular basis, to drop by messages such as updates on lab results or allow patients to easily ask a query directly to someone at the hospital help desk.
5) It would be great if the platform could also tackle the issue of caregivers unable to come at the point of patient discharge (from in-patient wards) due to the communication gaps between the hospital and patient's family/caregiver.
6) There were some discussions and concerns on who would be the one populating the care synopsis, especially during out-patient consultation, and
7) Hopes for the platform to provide a way to improve the communication of lab results i.e., whether they are perfectly fine or there's any concern and whether an appointment is needed or not to discuss the lab results. This would serve both stakeholders, for doctors to efficiently manage their consultation times with patients as well as reduce patient anxiety stemming from uncertainty in interpretation of or inability to view the lab results
8) Both the creation tool and care synopsis must be kept as simple as possible since existing solutions (such as the hospital's current information management system, Epic) are already complex and somewhat difficult to navigate around.

# Appendix C: Hospital Observation

## *C.1: In-patient Wards*

The following outlines the observations made based on the patient's in-patient and discharge journey.

| | |
|---|---|
| **During Stay** (In-patient ward) | Hospital keeps an estimate of the days to discharge. *E.g., D-2 = 2 days before discharge* |
| | Patient is briefed and trained on what they need to do by various specialists. (E.g., Dietician) |
| **D – 1** | Hospital informs next-of-kin that patient is ready to be discharged. A timing is arranged, but the next-of-kin is not briefed about what to expect. |

| | |
|---|---|
| | |
| | Pharmacist is informed to prepare medication via Epic (Alexandra hospital's internal information management system) |
| **Discharge Day** | If there any changes to be made to the patient's medication prescription or the requires special attention, the pharmacist assigned to the ward will personally brief to the family and hand the medication to the patient/family.<br><br>Else, the patient must head downstairs to the pharmacy to collect the medication on their own. To ensure that patients do not wait too long, nurses try to ensure that medication is ready at the pharmacy before the patient is discharged.<br><br>*Note: This portion is always the cause of delay in the discharge process.* |
| | Nurses take readings (such as blood pressure, etc.) to ensure that the patient is fit for discharge. Nurses also go through a checklist on Epic to verbally brief patients and their family on their care instructions. |
| | The patient is discharged |

Other observations made upon watching the discharge process of 2 patients:

- If a language barrier exists between the pharmacist and the caregiver and/or patient, another nurse is called to help translate.
- The pharmacist and nurses carefully briefed any changes in the medications
- It seemed like the accompanying caregiver at times did not understand/remember all the instructions
- One of the caregivers was confused about why there was a delay in her patient's discharge process as they heard different things from different nurses. *Lack of communication to the family members about the discharge procedure/what to expect.*

## *C.2: Out-patient Clinics J & K*

| | |
|---|---|
| **During Consultation** | Both doctors and nurse clinicians can carry out consultations. Nurse clinician would, however, only carry out consultation for revisits and would have to ask the doctor to approve certain prescriptions. |
| | A room assistant (not medically trained) is present in the room during the consultations to assist the doctors and nurses in patient-related admin work such as scheduling next appointment, lab tests, etc. |
| **Post Consultation** | Patients would wait right outside the consultation room in the hallway until the room assistant briefs and dismisses them. |
| | After each patient's consultation, the room assistant will provide the patients with a green appointment card which lists the date of the next appointment and necessary lab tests the patient needs to take before their appointment. A text message is also sent to the next-of-kin right after the consultation *(but not prior to their appointment date).*<br><br>*Note: This process often took too long since the room assistant would have to not only update the information on Epic but also manually write out next appointment's information to give it to the patient.* |
| | If patient must collect medication, they will head down to the pharmacy to collect it. |

Observations made upon from out-patient consultations of 13 patients:

- All information, such as changes in medication, potential side-effects of medication, interpretation of lab results, care instructions, etc. were all verbally communicated to the patients and caregivers. At times, some patients tend to forget what was communicated to them and the nurse clinician/doctor had to repeat it to them. The information was only written out on a paper for the patients when one of the patients requested it as she could not remember all the information the doctor told her.
- The patients and caregivers sometimes seemed to have different understandings of the patient's ongoing care regimen or medications.
- Some patients and caregivers were unable to recall technical details, such as the name of past medications, or the name of of their past lab tests, etc. when asked by the nurse clinician or doctor.

- Some patients would show up to the appointment without doing the required lab results as they forgot/did not receive a reminder. As a result, they were sent back with a rescheduled appointment.
- Some patients got too impatient when the conversation got too technical and wanted to "skip" to the important part, while others wanted to know more details and kept asking questions.
- When communicating the lab results, sometimes patients were unable to understand if it was good or bad as the doctor would only describe it in numbers.

## Appendix D: Interim React Prototype Feedback

The following are some of the considerations highlighted by Alexandra Hospital that were considered in developing our first React prototype:

- Various content management templates (e.g., WordPress or Joomla) to get inspiration on the layout we should use to allow edition of the different contents of the creation tool
- Usage of dummy databases for medications and article sections
- The nurses and doctors preferred having as much pre-populated content in the database as possible for all the Medications and Caregiving articles of the creation tool, yet giving them the ability to edit or add minor details on a patient-to-patient basis
- Although pictures for medication section are helpful to allow patients to distinguish them from another, the actual medication dispensed from the pharmacy may not be consistent across different patients.
- Keeping Lab Results and Additional Comments section more open-ended, rather than following a rigid template
- Organizing the information from past consultations in a way that keeps them accessible but does not hinder the flow or understanding of the most updated information.

## Appendix E: Prototype

GitHub Repos

Care Synopsis: https://github.com/EIM319/Synopsis

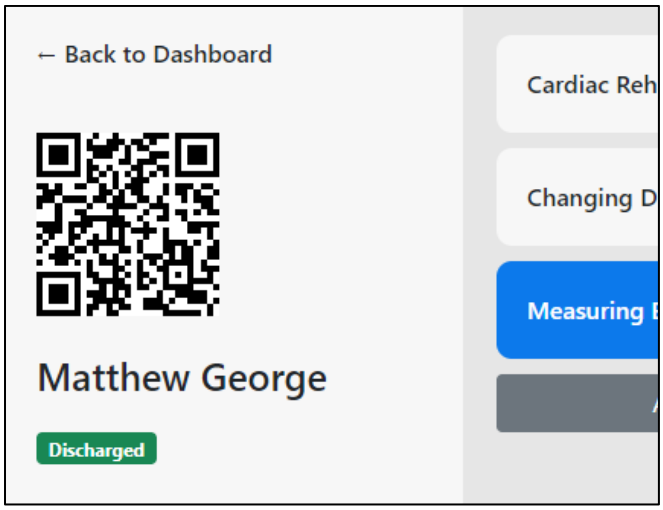
Creation Tool: https://github.com/EIM319/creation_tool

Testing Our Apps

The latest version of the creation tool can be viewed here:

https://eim319-tool.web.app/

To access the care synopsis, select a patient and click on the QR code on the top left of the screen.



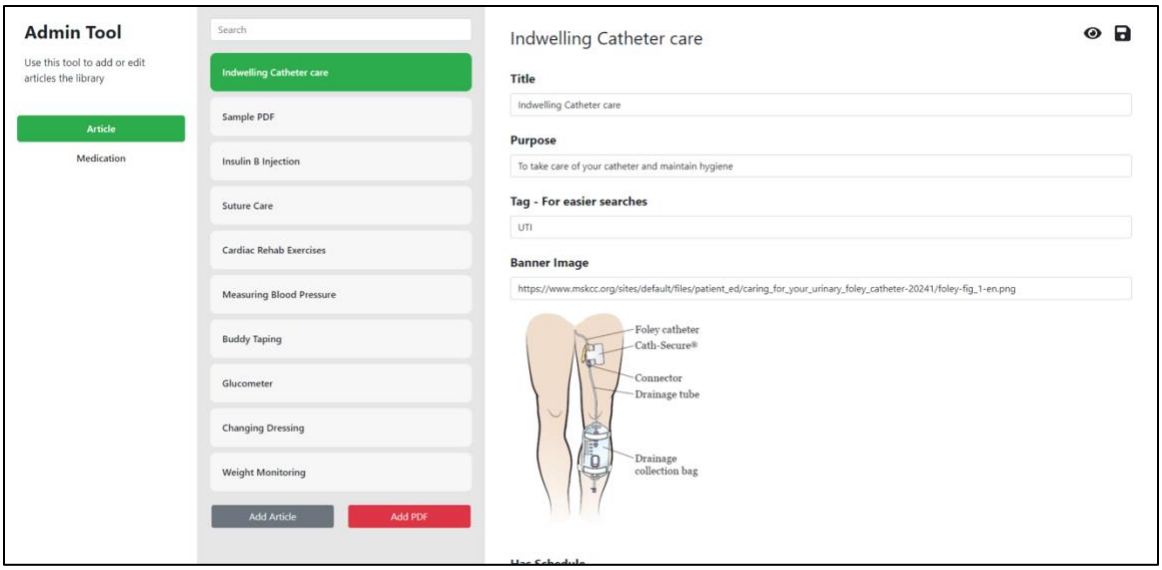

This will log you in to the patient's care synopsis and you will remain logged in until you try to login with another patient's care synopsis.

### *E.1: Tech Stack*

Our prototype is built with React on the front end. To avoid the need for implementing a backend ourselves, we used Firebase Firestore for the database. Hosting for the two web apps and storage for files uploaded are also done with Firebase. For the chat function, we used Tawk.io.

### *E.2: Pre-Rollout*

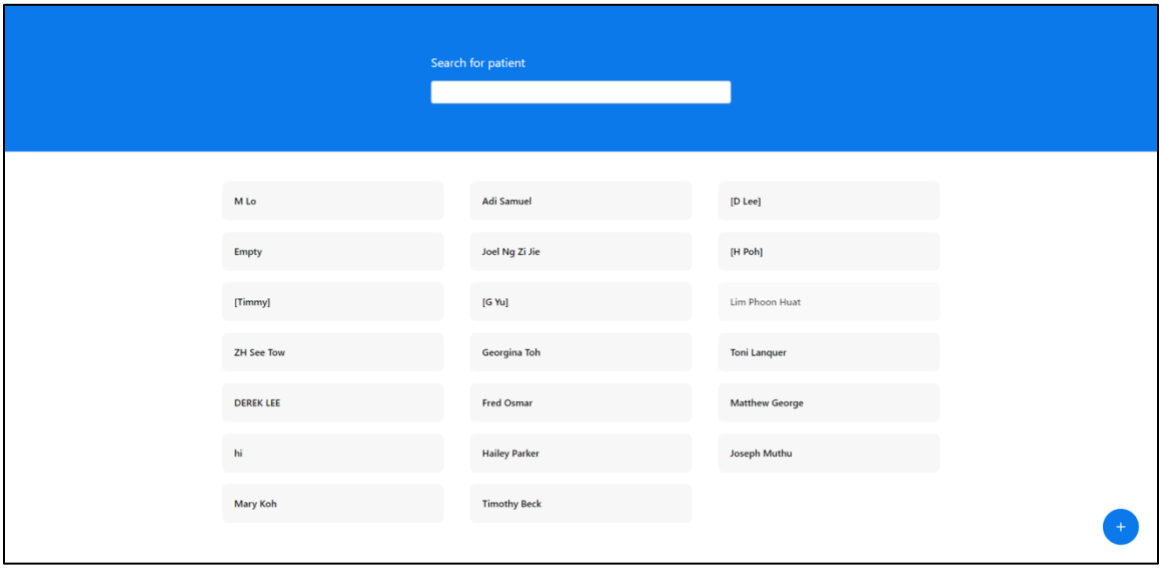
Before the prototype can be rolled out, the library must be populated with medication and patient education materials. To do this, the hospital could arrange a team of doctors and nurses across various specializations to come up with the content. Once all the content has been generated, they can be added to the library with the following admin tool: https://eim319-tool.web.app/tool




## *E.3: Creation Tool*

### Selecting Patient

The creation tool allows doctors and nurses to edit the patient's care synopsis. First, they need to select the patient on the dashboard. The search bar makes it easier to find the right patient. If a patient is not yet on the list, they can be added manually in our prototype. But if we were to integrate our solution with the hospital system, this process can be automated.

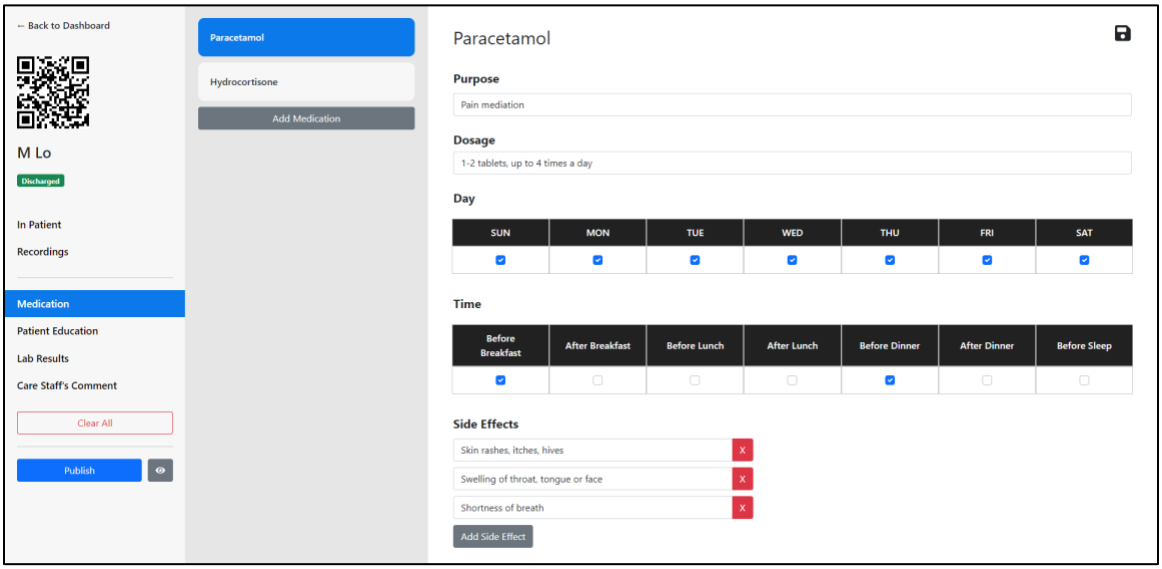



**Onboarding &** Editing Care Synopsis

Upon selecting a patient, doctors will be able to edit the care synopsis for the patient. Note that any changes made here will not be shown on the patient's side until it has been published. There are 4 sections to edit the care synopsis, and they are as follows:

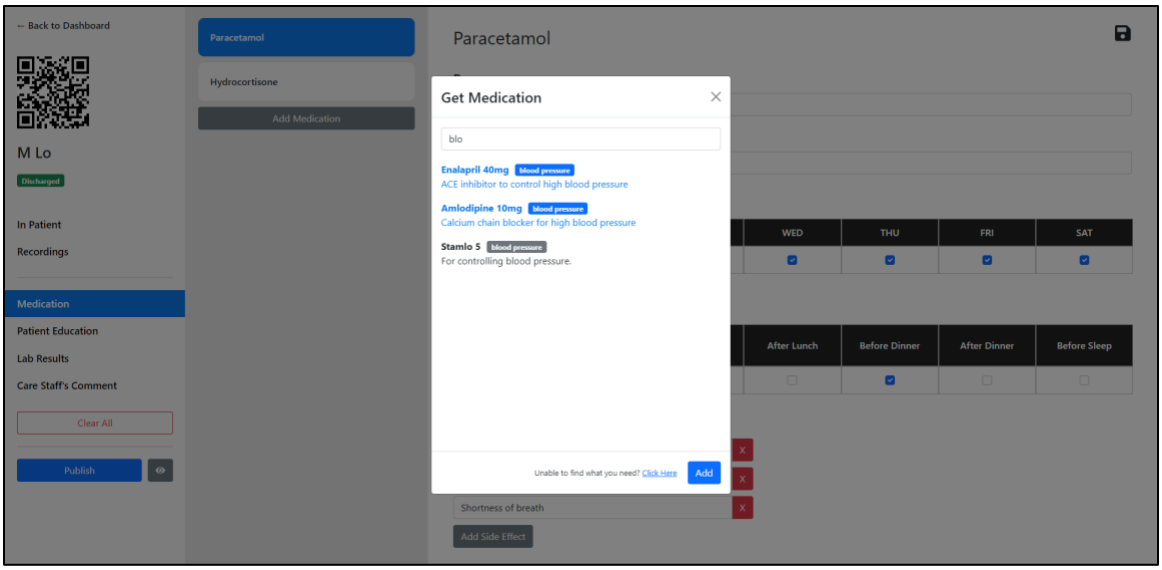
1) Medication
2) Patient education
3) Lab result
4) Care staff's comments

To onboard patients, patients can scan the QR code at the top left. Alternatively, right clicking on the QR code allows the link to be copied and shared with the patient by other means.




**Medication**

To add a new medication, one can press on the "Add Medication" toggle to import from the library. A popup will appear showing all the medication that is in the library. To make it easier for doctors to find what they are looking for, they can either search up the name of the medication, or the tag associated with it. Tags help to identify the purpose of the medication, like "blood pressure" for example.




Multiple medication can be selected at once and clicking on "Add" will import all of them into the patient's care synopsis. Once imported, each medication can be edited to the needs of the patient. For example, if the patient needs to take one pill instead of the default two, that can be modified here. All changes made here will only be for this patient.

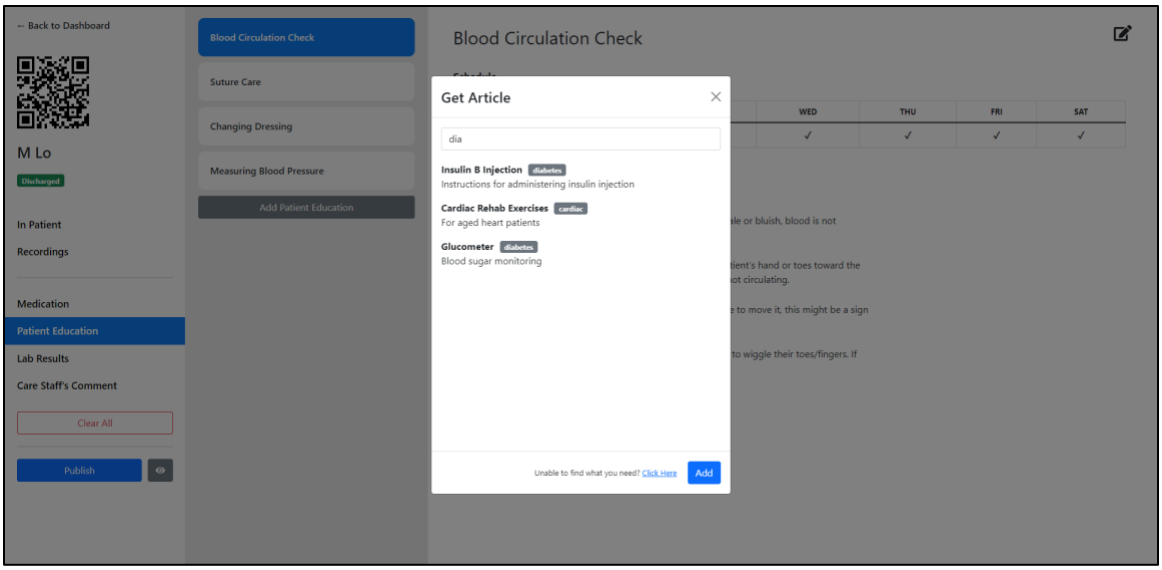
Based on the feedback we received from our research, we added these fields to each medication:

- Purpose
- Dosage
- Schedule
- Side effects
- Extra notes: Anything else that the patient needs to take note of. For example, some medication can be harmful when in contact with the skin, and thus needs extra caution when handling.

*Note: Tag is not editable here as it is no longer relevant after importing.*

**Patient Education**

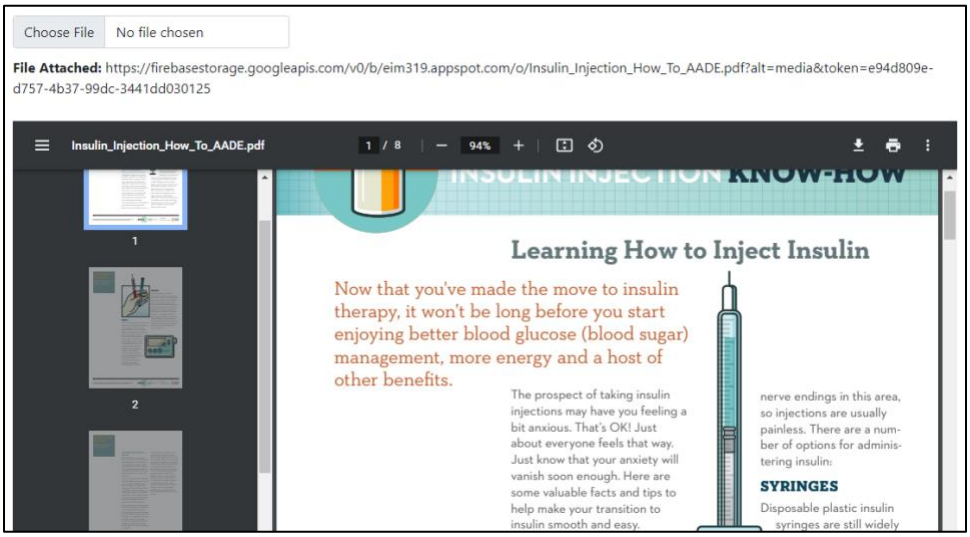
Adding a patient education article is the same process as adding a medication, just that one would press the "Add Patient Education" toggle instead. The same search and tag system is used here.




Each patient education will contain the following:

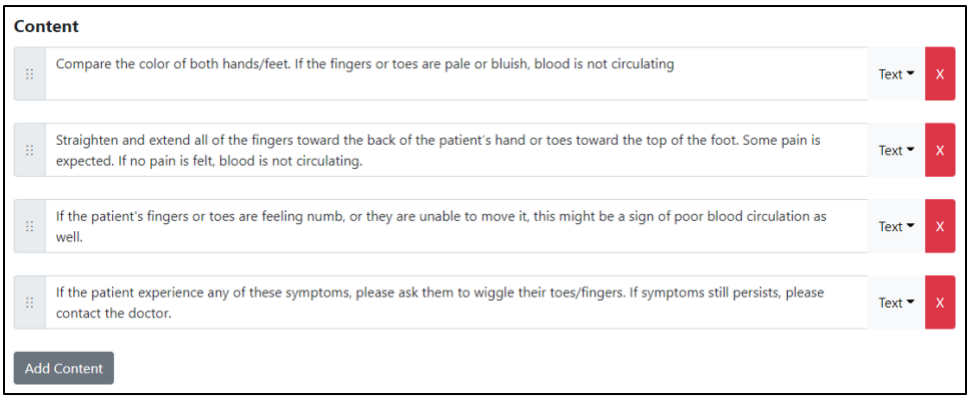
- Purpose
- Banner image
- Schedule: Can be disabled. Setting a schedule will add it to the to-do list.
- Monitoring type: Indicates the type of reading to record. Number, text, check-in or none.
- Content

There are two types of content that can be added. The first is PDF, which can be imported.



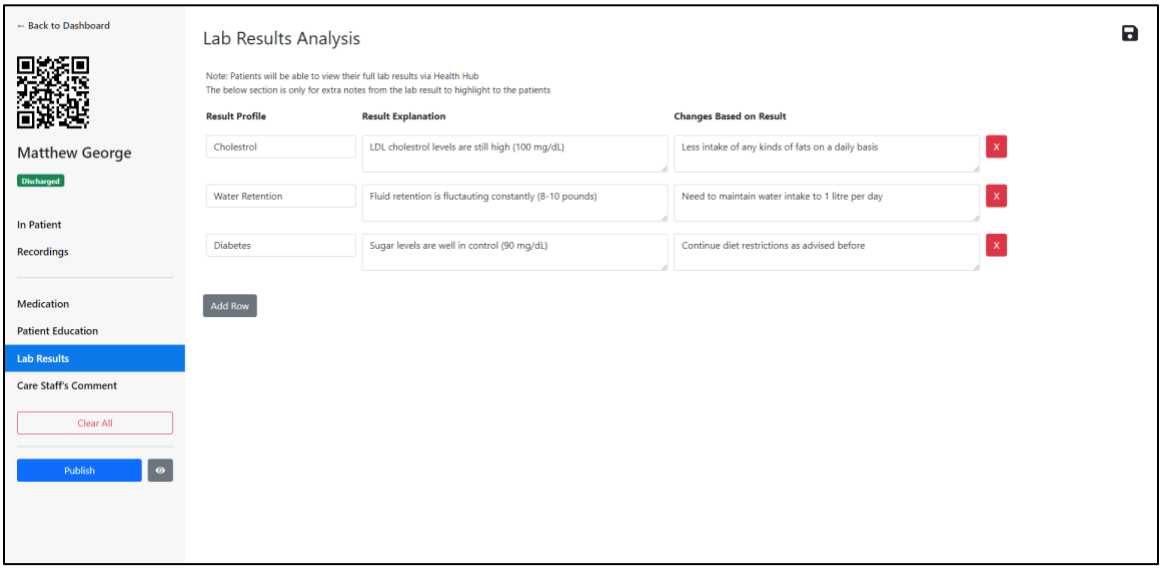

The other is the manual approach, similar to writing a blog on WordPress. It allows for the following types of content:

- Text
- Header
- Note: Italicized text.
- Image: Specify a link to an image.
- Video: Specify the ID of a YouTube video.



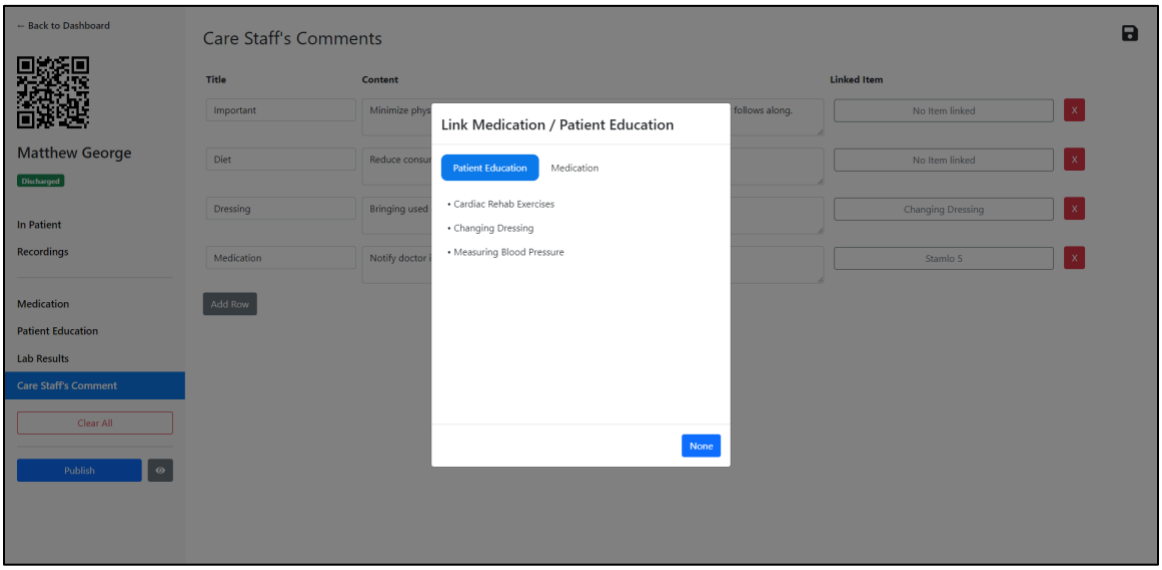

## Lab Results

This is where doctors will list out important points that he/she has identified from a patient's report, specifically those that are abnormal or require more attention. The doctor can explain what the results imply, and what actions are required to address them.



### Care Staff's Comments

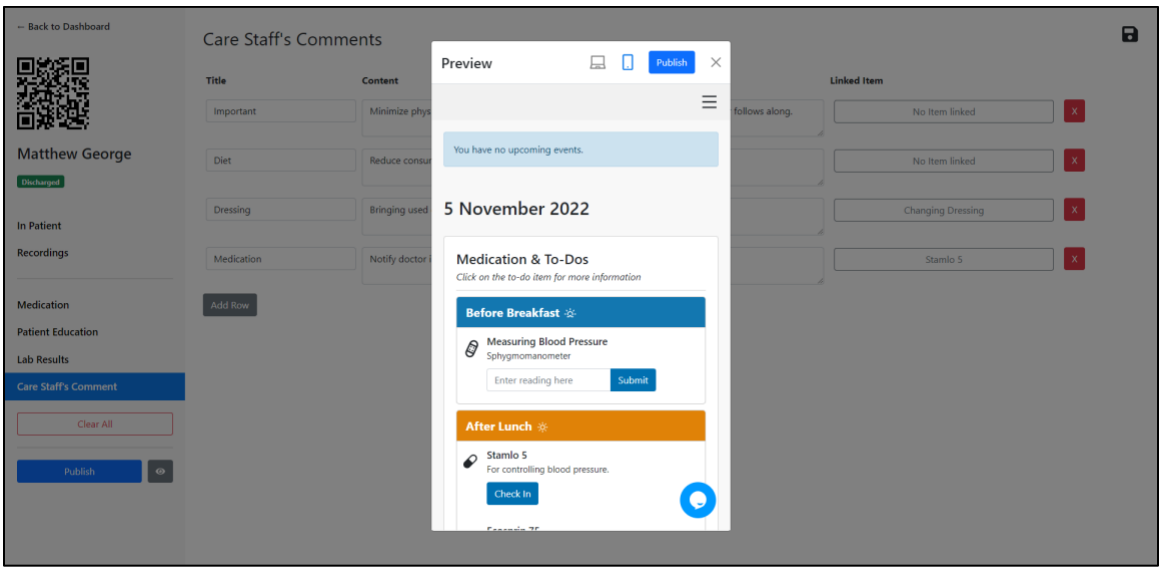
This is where any short comments that are important will go. For example, if a patient needs to adhere to a certain diet, nurses and doctors can type it here. Additionally, if referencing a medication or patient education can help aid the comment, they can be linked to this comment.




### Preview & Publish

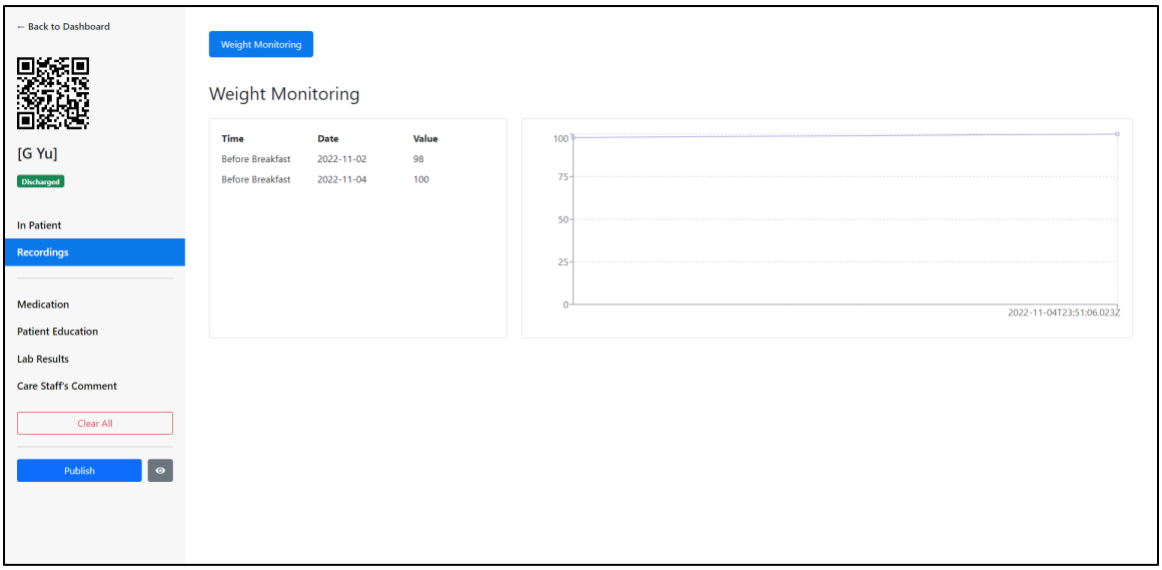
For any changes to take effect, the care synopsis will need to be published, which can be done via the toggle below the menu. Before publishing, they can preview the latest changes to check for errors. The preview will show what the patient would see, both on the phone and desktop.

Upon publishing, a notification is sent to the patient.



## Readings

Our solution allows patients to take down health readings and check in after consuming medication. On the creation tool, doctors will be able to check these readings to ensure that patients adhere to the schedule. For readings that involve numbers, the values are shown on a graph.




## In-Patient Controls

Under the in-patient screen, one can control the hospitalization status of the patient. Each status determines what content is shown on the care synopsis, as follows:

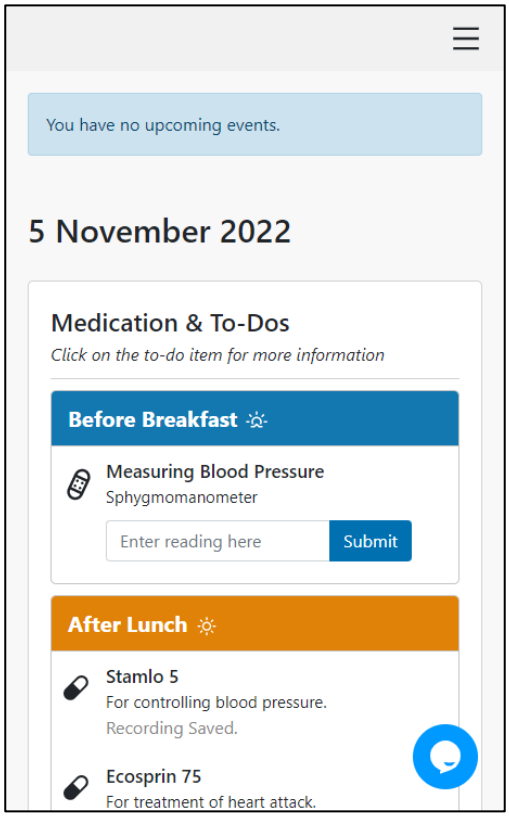
- Discharged: Care synopsis is shown.
- Hospitalized: Patient's bed and ward number is shown.
- To discharge: Message for discharge is shown.

For the message shown for patients who are ready to be discharged, one of 3 messages can be selected, each matching a scenario that we observed at Alexandra Hospital.

## *E*.4: Care Synopsis

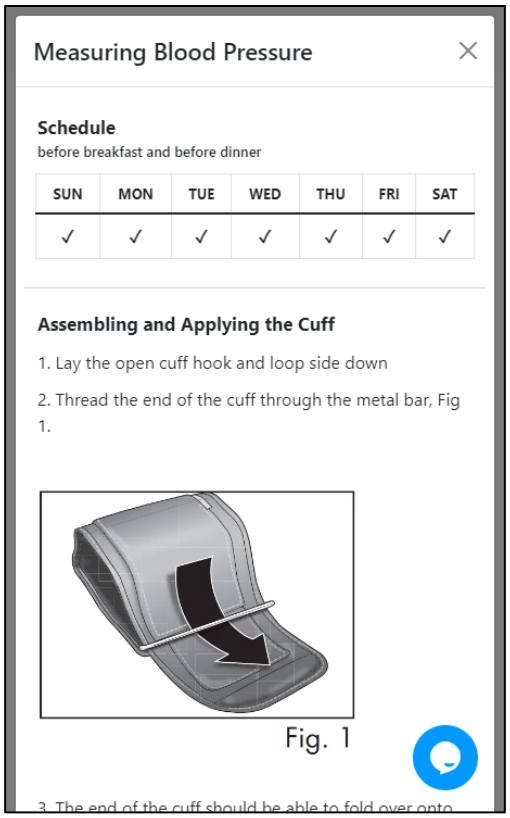
### To-Do List Screen

The to-do list screen is the first thing that users will see when they open the app. Here, patients can learn about their next appointment, and a to-do list indicating all the tasks for the day.

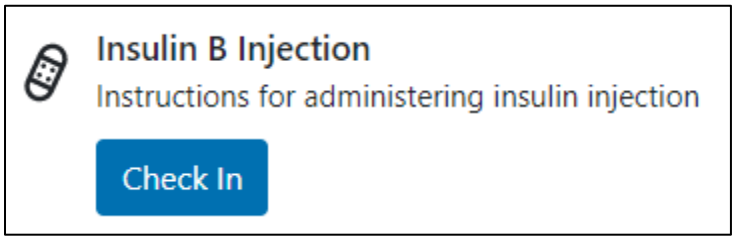


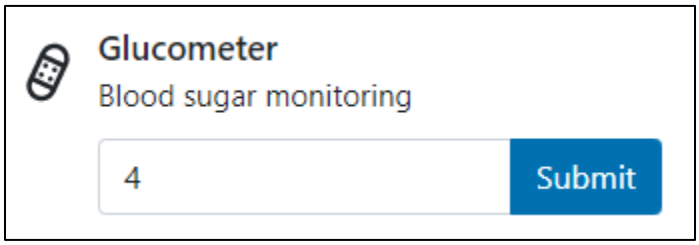

Tasks for the day are sorted into 8 categories, 6 indicating before/after meals for each meal, 1 for before sleep and 1 for any time. Depending on how the schedule is set for the item, it will be added to one of the 8 categories. A pill icon indicates that the item is a medication, while a bandage icon indicates that it is a health monitoring activity, extracted from a patient education.

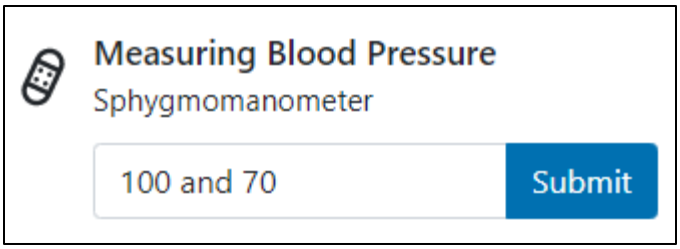
Clicking on one of these tasks will bring up a popup containing all the information for that task. If it is the medication, the details of the medication are shown. If it is a health monitoring activity, its patient education article would be shown instead.



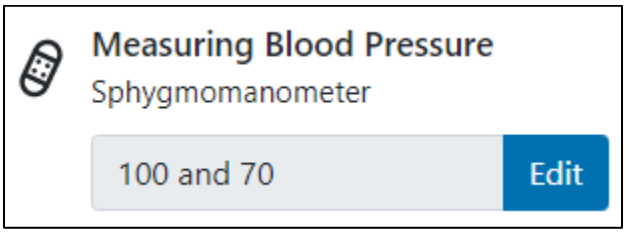

For each task, patients will be able to take a recording if allowed. This is only shown for tasks today. A check-in toggle would allow patients to indicate that they have done it. A text field allows for entering of free-form strings. Lastly, a number field only allows numbers as input, as the name implies.





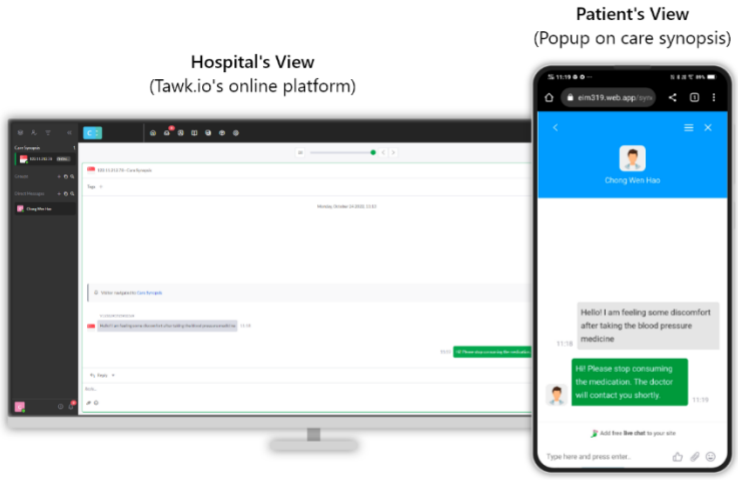

Upon submission, patients will be able to view the values that they submitted. If there is any error, they can edit it if it is a number or text field.




At the bottom of the to-do list screen, patients will also be able to view the care staff comments they have received. With this, all this information summarizes the important information that patients are going to need regularly.

**Chat**

The blue round toggle at the bottom right is to bring up the chat. With this chat, implemented with Tawk.io, patients can start a conversation with the hospital. It allows for the sending of text, as well as images and files. The hospital will reply to any queries the patient may have on the platform provided by Tawk.io on their website.

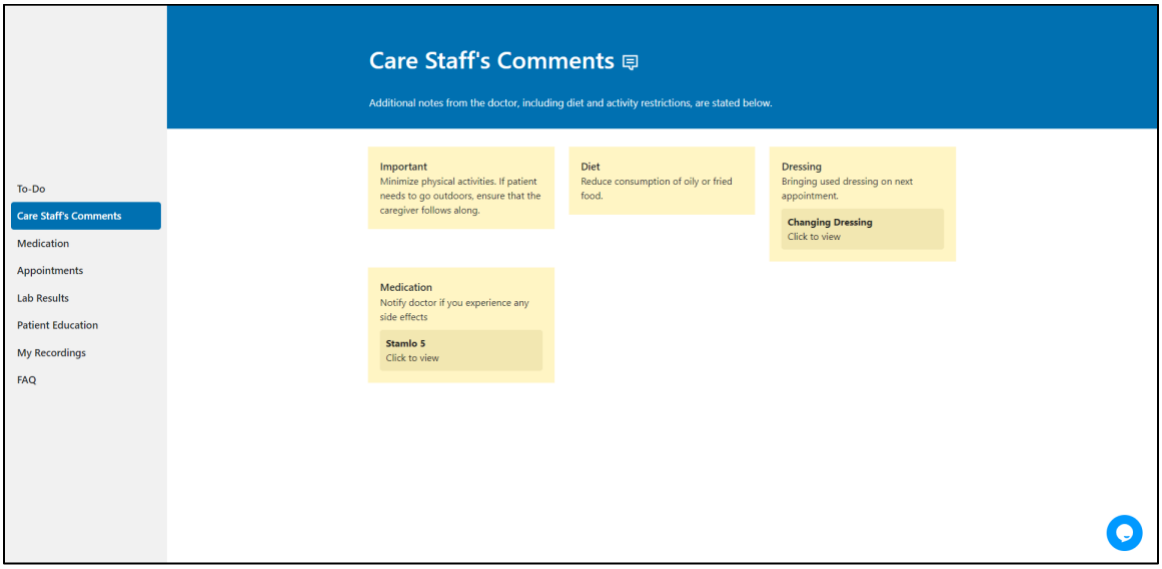


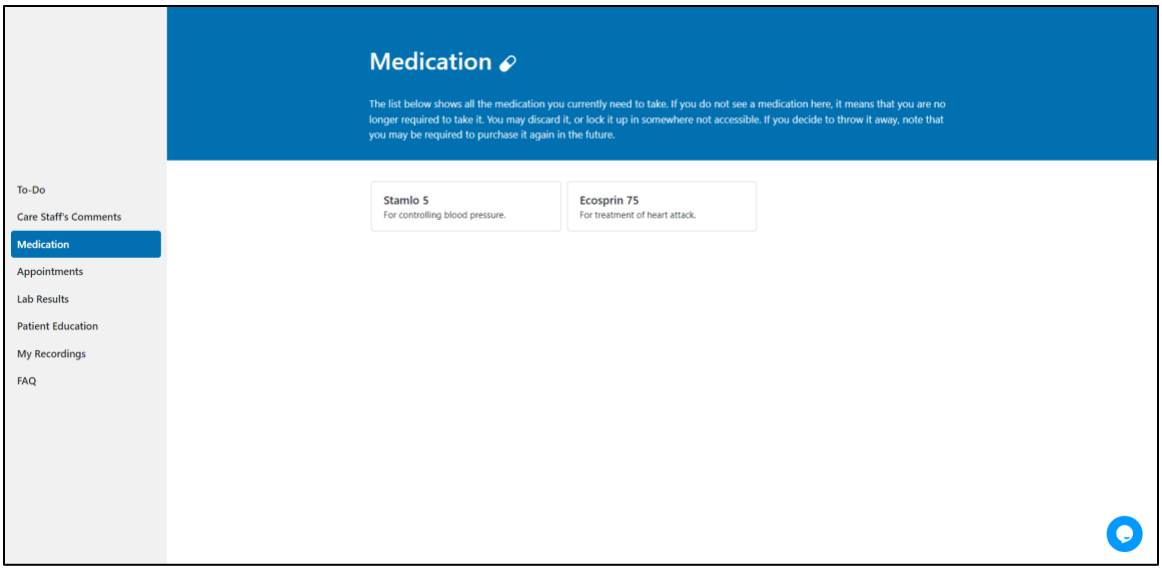

**Features**

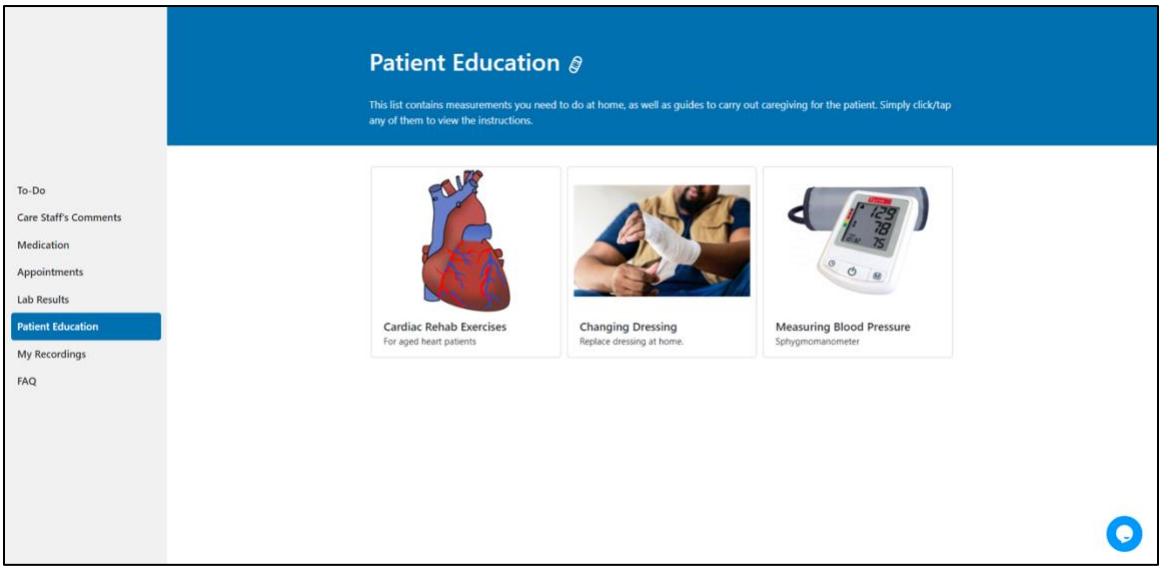
- Alarm for hospital when new message comes in
- Send images
- Multiple users from the hospital's staff team can join the same conversation

### Care Staff Comments, Patient Education & Medication Screen

These 3 screens show a list of all items of that type for the patient. An explanation has been added below each header to explain what each section is for.

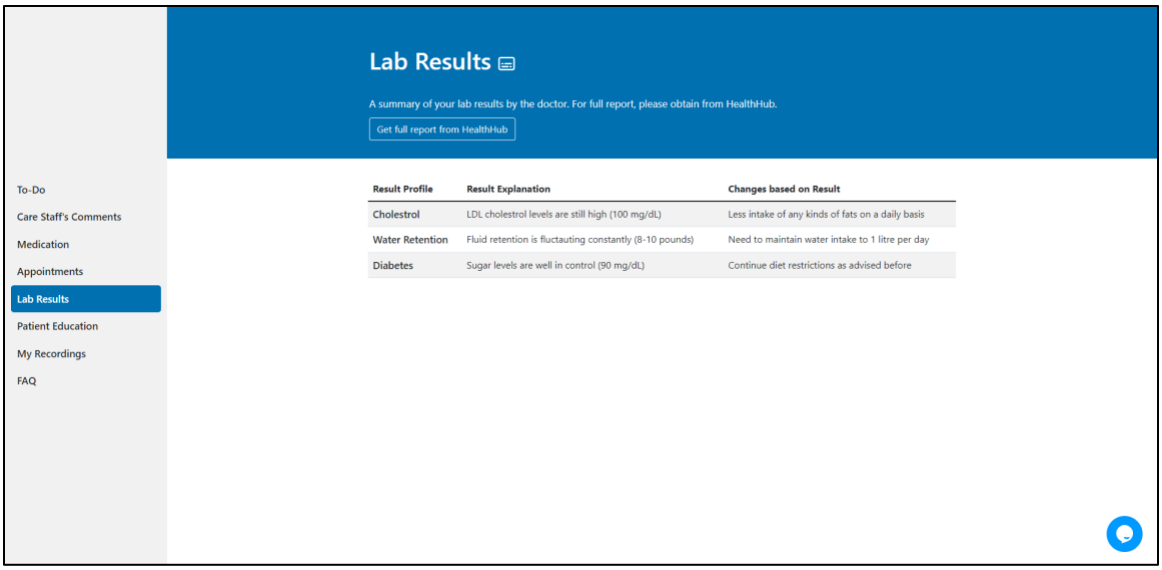




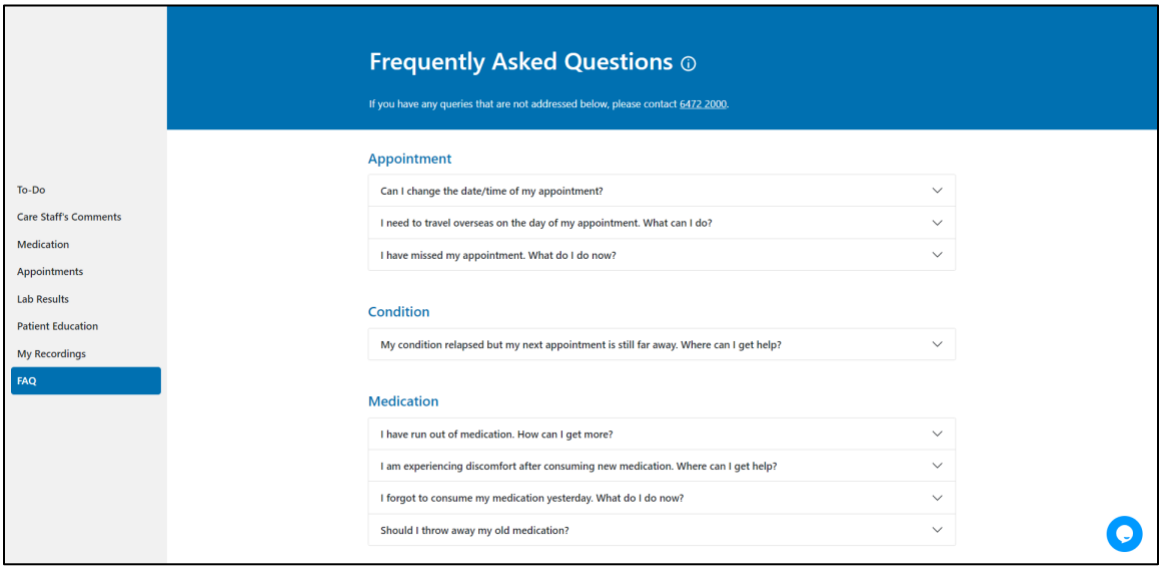

**Lab Results Screen**

On this screen, patients can see a short summary of their report by the doctor. For more details, they can click on the “Get full report on HealthHub” toggle to open HealthHub and get the report from there.




## FAQ Screen

The FAQ screen contains many of the common queries that a patient may have, across different categories. For any question not here, patients can ask via the chat feature instead.



# Appendix F: Testing with AH

## *F*.1: Testing Round 1

**Creation Tool**

| Section | Likes | Concerns | Suggestions/Comments |
|---|---|---|---|
| Patient Search | Searching for patients was easy and straightforward via the search bar | Patients with same names can be difficult to find and result in confused profiles or a mix-up | Login & accessibility for different users. Using other forms of patient identification such as ID, DOB, picture, NRIC last 4 digits etc. (use encryption) |
| Medication | Adding medications from the library was extremely straightforward and convenient | Cannot specify the start and end date of medicines | Sections with more pre-populated content could aid the process |
| Articles | Adding caregiving articles from the library was very convenient | The name "Articles" was not intuitive and caused confusion | Rename to 'Patient Education to clarify the purpose and more articles on diet can be useful |
| Lab Results | Organized well | The purpose of this section was not clear at first, nurses got confused on whether it shows the full report or not | Section should mention the purpose and clarify that patients view full report from Health Hub, and this section is only meant for additional comments or explanations of the results |
| All sections | Editing the information within sections was quite intuitive and easy. | Helpful way to organize and disseminate patient's care information | Showing a warning for unsaved changes after editing would be better<br><br>Customizable themes/font sizes to adapt to the |

| | | | |
|---|---|---|---|
| | | | preferences of different users. |
| Care Staff Comments | Liked the idea of having a place to write any end comments or instructions | Some nurses were not sure if information should go under 'Article' or 'Care Staff Comments' | Better to attach an article/instruction with the comments for reference |
| In-patient | Nurses appreciated this section the most for keeping track | | |
| Recording | Monitoring readings, especially representation with graph was useful for them | Past recordings cannot be viewed together | The option to view past recordings and readings can be helpful |

**Care Synopsis**

| Section | Likes | Concerns | Suggestions/Comments |
|---|---|---|---|
| All sections | The layout was quite professional; contained just the right amount of well-summarized information | | Cannot find difference from Health Hub at first but seemed familiar for patients – less learning curve<br><br>Providing language translation can make it more user-friendly |
| Onboarding to platform | Extremely smooth and convenient.<br><br>Accessing it again for future use was easy to understand | | A demo video within the app that guides the patients on how to use the interface |

| | | | |
|---|---|---|---|
| To-Do List | Summarizes and highlights the relevant information and organizes it well | Patients may not realize that they could click on the to do list item to view more details | Add ‘click item for more info’ at the top of to-do list to make it obvious |
| Medication | The dos and don’ts specified add a personalization for patients | It is difficult to understand which medicine is consumed and which one is not taken yet, and hospital staff cannot monitor medical adherence too | Adding a checkbox after each medicine taken will make the process easier for patients to track.<br><br>This also helps the hospital be informed of what the patient has done/not done. |
| Home Monitoring | | In cases when the medicines or instructions must be immediately changed if the patient’s recorded readings are too low or too high. | Some of these could be simply added as an additional note but may be confusing if the synopsis is not updated accordingly. |
| Notifications | The reminders and updates each time a change is made, or a medicine/home monitoring task is due, are very useful | When a notification regarding the patient’s discharge information is sent, the hospital won’t know if the patient has received and completed the necessary tasks | Adding an option for patients to acknowledge the notification for confirming that they have followed/completed the necessary |
| Recordings | The home monitoring measurements gives a | Only numeric recordings or single | Allowing recording to be numeric, characters and |

| | | | |
|---|---|---|---|
| | personalized experience to patients | recordings can be made which cannot be edited as well | even images so progress can be observed too as well as allowing edit to the recordings in case of error |
| Chat Function | Enables two-way communication and will ensure faster communication | Chat doesn't load properly always | Chat history within the app, instead of using email transcripts as some may not have emails |

## *F*.2: Testing Round 2

This round of testing includes the changes that were made from testing round 1

**Creation Tool**

| **Section** | **Likes** | **Concerns** | **Suggestions/Comments** |
|---|---|---|---|
| Care staff Comments | Linking care staff comments to medication and patient education addresses their concern | Care staff comments function like the extra notes in the medication section so the purpose is still vague but adds flexibility of whether they want to add it as an extra note within the medication or as a care staff comment in general | |
| All Sections | | | Different themes/colors can make it better |
| Medication | | Most medications names can be confusing for patients, and some have same design, so | Allow adding photo to identify medication for both |

| | | | |
|---|---|---|---|
| | | doctors cannot confirm these | |

**Care Synopsis**

| **Section** | **Likes** | **Concerns** | **Suggestions/Comments** |
|---|---|---|---|
| To-Do List | | Check-in term to mark that the medication has been taken is a bit vague | Instead of “check in”, it can be changed to “Done” to make it more clear |
| Medication | | Most medications names can be confusing for patients | Allow adding photo to identify medication for both |