Executive Summary

Leanne Huber and Kaila Jensen

University of Calgary

NURS 654: Design in Healthcare

Dr. Linda Duffett-Leger and Navjot Virk

February 18, 2024

Abstract

We argue that a mobile application has the potential to encourage communication, education and transparency for patients and their family/caregiver during the hospital discharge process. The patient/caregiver will be able to choose if they want to participate or not through a virtual agreement. At the first point of contact, the patient/caregiver will be asked to scan a QR code, which will direct the patient to download the app. The app will show the discharge process using a checklist targeted towards each specific surgical patient and provide access to pre-existing reading materials from Alberta Health Services (AHS) early in the patient's hospitalization that are typically only provided at discharge. The health care team will work with the patient/caregiver to communicate the patient's journey from surgery to home. This will empower the patient/caregiver, acting as a guide to help make them more cognizant of their own health status and recognize what resources/support they may need to help them manage when they return home. The app will provide the patient/caregiver with the tools to address their concerns, fears, and expectations surrounding their hospitalization. The app will be linked to current health technologies, such as Connect Care/Insite, to communicate with the patient if they have any outstanding tests, if they have met their daily mobilization goals, and if they have any other barriers to being discharged. The app will also feature a colour-coded graphic to help the patient visualize their progress towards discharge and communicate a pending estimated date of discharge.

Background and Context

Discharge planning in a hospital is complex and challenging, which can lead to unexpected delays in discharge (Jerath et al., 2020). This issue is compounded by current extreme bed shortages, which are occurring across Alberta (Health Quality Council of Alberta, 2024). Early discharge planning that identifies the learning needs and concerns of the patient/caregiver has been shown to help improve patient adherence to follow-ups with their doctors, decrease the risk of medical errors, and decrease the risk of mortality (Bajorek & McElroy, 2020). Due to current research and the health crisis, we believe that increasing the focus on more effective discharges will lead to decreased delays in discharge and reduced readmissions to the hospital (Jerath et al., 2020).

Design Criteria and Strategy Description

To try to solve the capacity issues within hospitals, one potential strategy is to create a discharge-focused mobile app on a smart device that will help improve communication and transparency between the patient/caregiver and the healthcare team early in a patient's hospitalization (Jerath et al., 2020). The success of such an app would be measured by decreased hospital readmission rates and increased satisfaction of elective surgical patients/caregivers' experiences (Jerath et al., 2020). The format of the app is inspired by the IDEAL discharge planning framework developed by the Agency for Healthcare Research and Quality (2017), shown in Appendix A, as well as making use of elements adapted from the SAFER bundle and the Red2Green tool checklist shown in Appendix B (Benevides et al., 2024).

The primary functional requirements of the app must consider user interface components, navigation, and structure (Alwakeel & Lano, 2022). This includes having a straight-forward login process, clickable drop-down menus, and the ability to update information such as the name of the hospital, date of surgery, and the surgeon's name. The technology must also be able to

communicate with specific aspects of existing infrastructure (i.e. Connect Care/Insite) to exchange key information with the patient/caregiver such as perioperative and discharge instructions and the estimated date of discharge (Alwakeel & Lano, 2022; Connect Care, 2024).

Meulendijk et al. (2014) also highlighted important non-functional requirements for medical apps, including accessibility, certifiability, portability, privacy, safety, security, stability, trustworthiness, and usability. To address these non-functional requirements, our app will factor in said non-functional requirements and consider different user's needs, such as those with visual impairments. The app will also follow current legal requirements, be consistently usable, and have two-factor authentication. Our app shall also accommodate both Android and iOS devices and connect with the current services provided in the hospital (e.g. WiFi). Refer to table 1 in appendix C for a table of the functional and non-functional requirements of our app, and Appendix D for user stories. Appendix E refers to wireframes where we have illustrated the structure and flow of a design solution for our app, and Appendix F contains example mockups of individual screens in our app (Interaction Design Foundation, 2016).

Project Status Update

This project is in the early stage of development. We are currently developing a mockup (refer to Appendix F) of various parts of the app and eventually we will create a prototype of the app for discharging elective surgical patients. Our future work would include app testing after it has been integrated with Connect Care/Insite, as well as expanding to more complex medical/emergency surgical patient users.

References

Agency for Healthcare Research and Quality (AHRQ). (2017). *Care transitions from hospital to home: IDEAL discharge planning implementation handbook.* United States Department of Health and Human Services. https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/engagingfamilies/strategy4/Strat4_Implement_Hndbook_508_v2.pdf

Alwakeel, L., & Lano, K. (2022). Functional and technical aspects of self-management mHealth apps: Systematic app search and literature review. *JMIR human factors*, *9*(2), 1-26. https://doi.org/10.2196/29767

Bajorek, S. A., & McElroy, V. (2020). *Discharge planning and transitions of care.* The Agency for Healthcare Research and Quality (AHRQ). https://psnet.ahrq.gov/primer/discharge-planning-and-transitions-care

Benevides Santos Paiva, M., de Gouvêa Viana, L., & Melo de Andrade, M. V. (2024). Reduction of hospital length of stay through the implementation of SAFER patient flow bundle and Red2Green days tool: A pre-post study. *BMJ open quality*, *13*(1), 1-9. https://doi.org/10.1136/bmjoq-2023-002399

Canva. (2024). *Canva* [Computer Software]. https://www.canva.com/

Connect Care. (2023, March). *Accessing connect care.* https://manual.connect-care.ca/access

Farmer, A. Y., & Farmer, G. L. (2021). *Research methods for social work: A problem-based approach.* SAGE Publications, Inc. https://doi.org/10.4135/9781071878873

Health Quality Council of Alberta (HQCA). (2024). *Hospital occupancy. https://focus.hqca.ca/charts/hospital-occupancy-2/*

Interaction Design Foundation. (2016, September). *What is wireframing?* https://www.interaction-design.org/literature/topics/wireframing

Jerath, A., Sutherland, J., Austin, P. C., Ko, D. T., Wijeysundera, H. C., Fremes, S., Karanicolas, P., McCormack, D., & Wijeysundera, D. (2020). Delayed discharge after major surgical procedures in Ontario, Canada: A population-based cohort study. *Canadian Medical Association Journal, 192*(46) 1440-1452. https://doi.org/10.1503/cmaj.200068

Meulendijk, M., Meulendijks, E. A., Jansen, P.A.F., Numans, M.E., & Spruit, M.R. (2014, January). *What concerns users of medical apps? Exploring non-functional requirements of medical mobile applications* [Paper presentation]. Twenty Second European Conference on Information Systems, Tel Aviv, Israel. https://www.researchgate.net/publication/286060117_What_concerns_users_of_medical_apps_Exploring_non-functional_requirements_of_medical_mobile_applications#:~:text=A%20document%20study%20and%20interviews,stability%2C%20trustability%2C%20and%20usability

Mockflow. (2023). *Wireframe pro* [Computer software]. https://mockflow.com/

Nosov, A. (2019, July 31). *Understanding and leveraging azure SQL database's SLA.* Microsoft. https://azure.microsoft.com/en-us/blog/understanding-and-leveraging-azure-sql-database-sla/

Risling, T. L., & Risling, D. E. (2020). Advancing nursing participation in user-centred design. *Journal of Research in Nursing, 25*(3), 226-238. https://doi.org/10.1177/1744987120913590

Appendix A

IDEAL Discharge Framework

Table 1

Summary of IDEAL discharge planning strategy (AHRQ, 2017).

IDEAL Discharge Planning Strategy	
I	**Include** the patient and family as full partners in the discharge planning process
D	**Discuss** with the patient and family five key areas to prevent problems at home: 1. describe what life at home will be like; 2. review medications; 3. highlight warning signs and problems; 4. explain test results; and 5. make follow-up appointments.
E	**Educate** the patient and family in plain language about the patient's condition, the discharge process, and next steps at every opportunity throughout the hospital stay.
A	**Assess** how well doctors and nurses explain the diagnosis, condition, and next steps in the patient's care to the patient and family and use teach back.
L	**Listen** to and honor the patient and family's goals, preferences, observations, and concerns. Components of each IDEAL element are described in more detail on the following pages.

Appendix B

SAFER and Red2Green Frameworks

Table 2

SAFER patient flow bundle and Red2Green days checklist (Benevides et al., 2024).

SAFER Patient Flow Bundle and Red2Green Days Checklist

Date: _____/ _____/ _____

Patient: _____

Medical student: _____

Internal Medicine resident: _____

Professor: _____

1. Clinical criteria for discharge:
2. Expected date of discharge:
3. If going home today, can the patient be sent to the discharge lounge?
4. Does the patient have complex clinical or social issues? Would the patient benefit from a multidisciplinary meeting to discuss treatment plan and discharge?
5. If I saw this patient in out-patients, would their current 'physiological status' require emergency admission?
6. Could the care or interventions the patient is receiving today be delivered in a non-acute setting?
7. Did the patient received care today that progressed him towards discharge?
8. Is the patient waiting for something? If yes, specify.
    a. Tests
    b. Procedures
    c. Specialty consultation
    d. Transfer to other institution
    e. Family getting ready to receive the patient back home
    f. Other

Appendix C

Functional and Non-functional Requirements

Table 3

Functional and non-functional requirements and analysis (Risling & Risling, 2020).

What Do I Want (Feature identified by stakeholder)	**What Do I Want to Accomplish (corresponding outcome)**	**F/NF**	**Additional Data Prompts**	**Open Coding**
The ability to create an account	Individualized experience for user	F	What user data is required? Is the data required reasonable and only what is necessary?	Who needs access, how much access, how long will they have access (Farmer & Farmer, 2020)?
The ability to input hospital, surgeon's name, surgery type, and date of surgery	Increased communication and organization	F	Can this be edited in case of delays or a change of surgeons? Can this be automatically populated from the patient's chart or does the patient have to add this information?	What key information is needed, who is involved, when and where is the event taking place (Farmer & Farmer, 2020)?
Access to peri-operative instructions	Increased knowledge and ability to plan for future needs	F	Can the program interact with Connect Care for pre- and post-op instructions that are already	What information is provided, how is it accessed, and why is it provided (Farmer & Farmer, 2020)?

			within Connect Care?	
Identification of who needs to be involved in my discharge planning	Increased planning to expedite discharge planning and understanding who needs to sign off (e.g. attending physician, consulted physicians, physiotherapy, social work, etc.)	F	Are all teams involved represented in the app? Can the patient see when each team has signed off? Does the patient check this off when completed, or can there be an automation when a team signs off?	Who needs to be involved and for what purpose (Farmer & Farmer, 2020)?
Ability for user to identify what life after discharge will look like at home	Identification of future care needs at home, communicate with healthcare team what I need in place before discharge	F	Can this be communicated from the app to Connect Care so that the healthcare team has access to this information?	What is the ultimate purpose, and how will success be measured (Farmer & Farmer, 2020)?
Medication review checklist	Access to a resource that will help me take my medications safely	F	Can the medication reconciliation from Connect Care automatically populate to the app?	What information needs to be addressed and how will it be addressed (Farmer & Farmer, 2020)?
List of resources where I can receive care post-discharge for various concerns, if needed	Identification of most appropriate place to seek treatment for various levels of concerns, if needed	F	Social work should be involved in the creation of this list as they are able to identify community resources.	Which means are available to aid in success and how are these means communicated (Farmer & Farmer, 2020)?

Information about supplies I may need when I am discharged	Ensuring I have supplies prior to discharge to prevent any delays	F	May be checked off by patient	Which methods are used to achieve success and who is involved to ensure accuracy (Farmer & Farmer, 2020)?
To identify when my ride is available at discharge	Communicate with the healthcare team when my ride will be available at discharge	F	This should communicate with Connect Care so that nursing, unit clerks, and physicians can prioritize what time all discharge should be completed by	How will this be communicated and who will receive the information (Farmer & Farmer, 2020)?
Updated date and time of any future appointments	Clarity of follow-ups	F	Needs to be regularly updated and accurate	When will the event take place, how long from now, and where (Farmer & Farmer, 2020)?
Estimated date of discharge	Increased communication about when I am expected to go home, and helps encourage me to fulfill all requirements by this date	F	Needs to communicate with Connect Care and be frequently updated by staff to ensure accuracy; must have clear disclaimer that it is only a guide and may not be accurate	How long is the event planned for and who will report the duration (Farmer & Farmer, 2020)?
Checklist towards	Increased interactivity to	F	Must be visual representation to	Which methods will help involve

discharge that the user can update	help me feel more involved in my care		help user see their progress	and guide the user (Farmer & Farmer, 2020).
Should have two-factor authentication	Increased security/privacy measures	NF	Are there options so the user can choose between text or email verification?	Which methods will allow the goal to be reached securely and in a safe manner, and how is this to be enacted (Farmer & Farmer, 2020)?
App must be available a reasonable amount of time with minimal downtimes in a given year	Must be usable when needed with uptime goal of 99.995% per year (Nosov, 2019)	NF	Must use reliable connections and the app itself must have minimal downtimes while be regularly updated	Which method(s) will ensure accessibility, how accessible will the service be, who will monitor accessibility (Farmer & Farmer, 2020)?
App must abide by current laws	Must be accountable to user and creators and specifically define what information is used and how it is used	NF	What is the approval process? Does an ethics board need to be involved?	Which legalities must be considered, who will oversee that standards are being met (Farmer & Farmer, 2020)?
App must be available for download on Apple store or Google Play	Increased accessibility for those with any type of mobile device	NF	Can there be options for people without mobile devices?	By which means will the service be available, how will the service be offered, and who will have access to it (Farmer & Farmer, 2020)?

App should be integrated with Connect Care	Ability to exchange specific (and only necessary) information between the app and the patient's healthcare chart	NF	The integration must be secure and only share necessary information, preventing any breaches of confidentiality	Which resources are needed for integration, who will oversee appropriate and secure use of information (Farmer & Farmer, 2020)?
The app should have an easy-to-use QR code	Easy accessibility feature for users	NF	Should be simple to create.	Which means will increase communication and accessibility (Farmer & Farmer, 2020)?
Connects with WiFi	Easily usable in the hospital or at home given WiFi is available	NF	Is WiFi easily accessible to all users?	What method will ensure easy and consistent usability, and which method will allow the simplest and most available access (Farmer & Farmer, 2020)?
The App should be legible to those who are colour-blind or who have visual impairments	Increased accessibility to ensure the app is available to a variety of users	NF	The needs of all patient populations must be considered, and the app should be updated regularly in consideration of newly identified needs.	By which means will the service be accessible, who will be able to access it, and how will they be able to access it (Farmer & Farmer, 2020)?

Appendix D

User Stories Based on Functional and Non-functional Requirements

Table 4

User stories (Risling & Risling, 2020).

User	User Story
Patient	As a surgical patient, I want to feel empowered before, during, and after my hospitalization because having surgery is scary. This means I want to have a personalized experience through a secure app, which is also easy to use. I want easily accessible information located in one place that includes the type of surgery I am having, my surgeon's name, and the specific pre- and post-op instructions for my surgery. I also want to be aware of my future needs when I am discharged from the hospital, and I want to be able to update my discharge status through the app so I can track my progress and work towards my goal of going home. I ultimately want to feel like I am in control, and I am an active participant in my hospital experience and understand what is happening each step along the way, not having to return to the hospital due to preventable complications.
Caregiver/family member	As a caregiver/support person, I want to better understand the hospitalization/discharge process of my family member/friend/other person. This means I want to be a more active participant rather than a passive observer. I want a resource that allows me to access information about their hospitalization, and that regularly updates me about their progress when I am not able to be at the bedside due to work or geographical barriers. I also want easy access to this information to better understand what the discharge process looks like and how/why my person is being discharged. This information will enable me to prepare for my family member/friend/other person and better manage after their discharge. I do not want to be surprised by family members' discharge as I have my own life and I need to plan accordingly. An all-encompassing discharge app will also help me organize any questions or concerns I have well in advance of my person's discharge, leading to increased confidence in the care/support I can provide/arrange for them at home. This will optimize their health and support them on their goal of returning home and managing their health, ultimately minimizing the risk of them being readmitted to the hospital.
Healthcare Provider	As part of the healthcare team, I want my patient to feel prepared and supported for life after discharge so they can thrive at home. I believe this uncertainty can be reduced by addressing their questions and concerns appropriately. Early identification of future needs will allow staff like me to communicate their potential needs/barriers to the appropriate healthcare team member, thereby setting the patient up for success by identifying

	any barriers and finding appropriate solutions and resources. This will help to prevent delays in discharge. I also want to improve communication with my patients about their progress in the hospital so they feel empowered and take ownership in their own health journey, and an app would help give them the tools to set goals and provide resources and information that they can use as they progress towards their discharge. My goal is to advocate for my patient's care and reduce any potential harm by improving education and transparency through the discharge process; thus, this will directly prevent unnecessary readmissions to the hospital.
Hospital Administrator	As a hospital administrator, I want the hospital to have efficient discharges through a tool which will communicate and educate patients and/or their support person in a transparent and straightforward way. A pre-op and discharge-focused app will help to increase education and promote patient/caregiver/support person involvement through the entire hospital journey. This will ultimately help prepare the patient for discharge by clearly identifying any potential barriers they may encounter early in their hospital admission. The app will be able to direct the user to pre-existing resources in Connect Care/Insite that will assist them with their surgical experience and/or discharge. In addition, the app will allow the patient/caregiver/support person to input their needs/concerns that will automatically update staff through Connect Care, opening early communication about barriers and helping identify needs early to prevent any potential discharge delays. The hospital will have fewer readmissions and create more in-patient beds because the app will better prepare and empower the patient/caregiver/support person to manage their own care in the community and provide resources while reducing uncertainty.

Appendix E

Wireframes

Figure 1

Wireframe for discharge app (Mockflow, 2023).

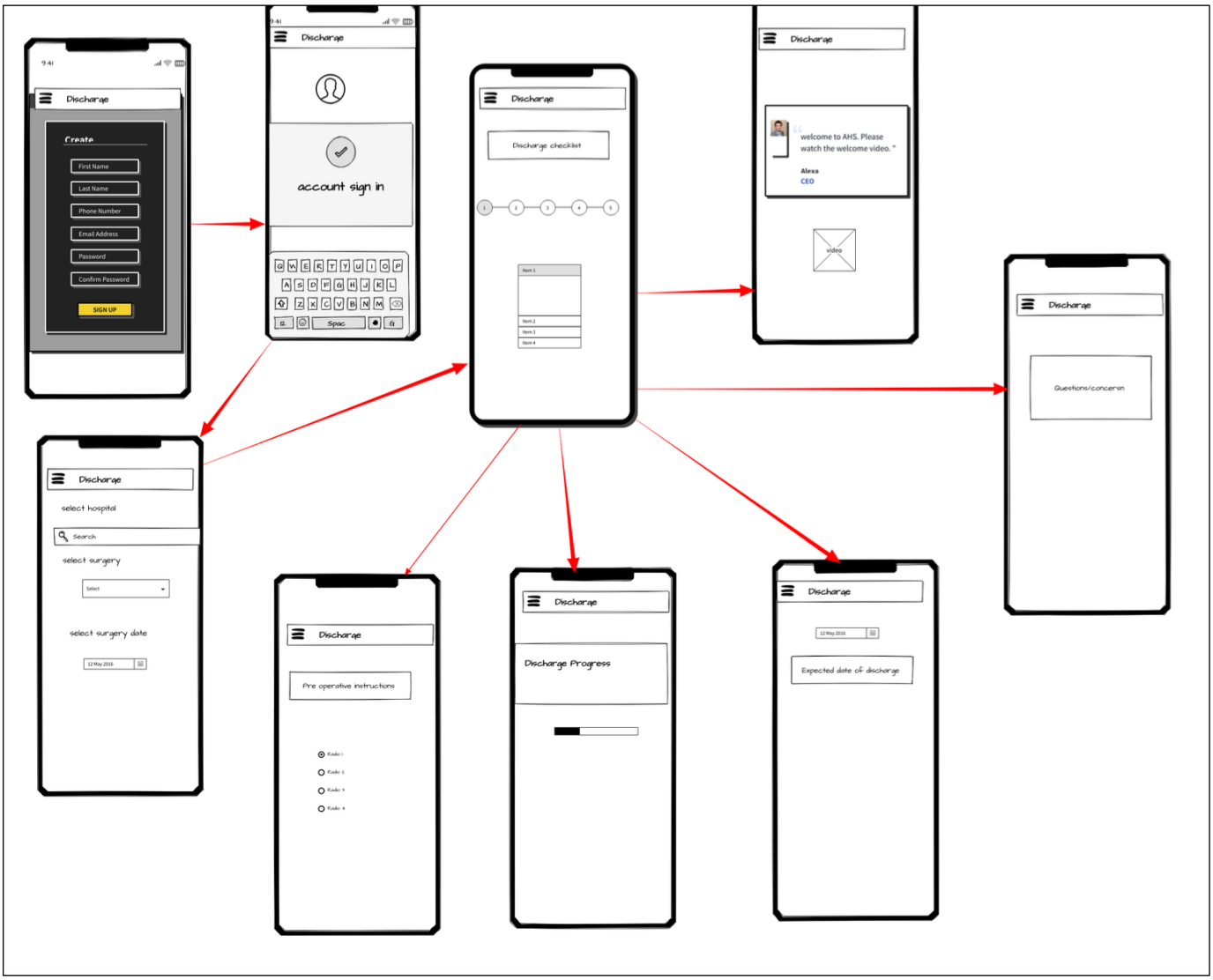
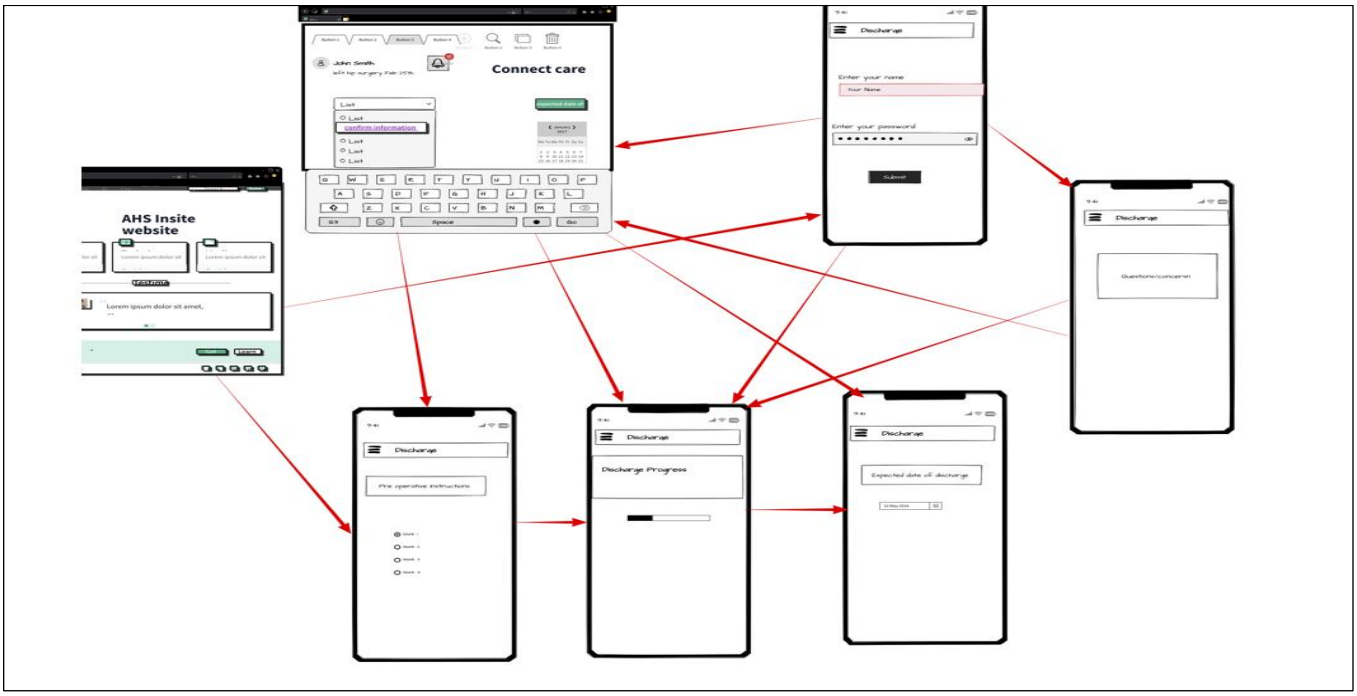


Figure 2

Wireframe for integration of app with Connect Care and Insite (Mockflow, 2023).



Appendix F

Discharge App Mockup Screens

Figure 3

Example mockup of initial login screen for Discharge app (Canva, 2024).

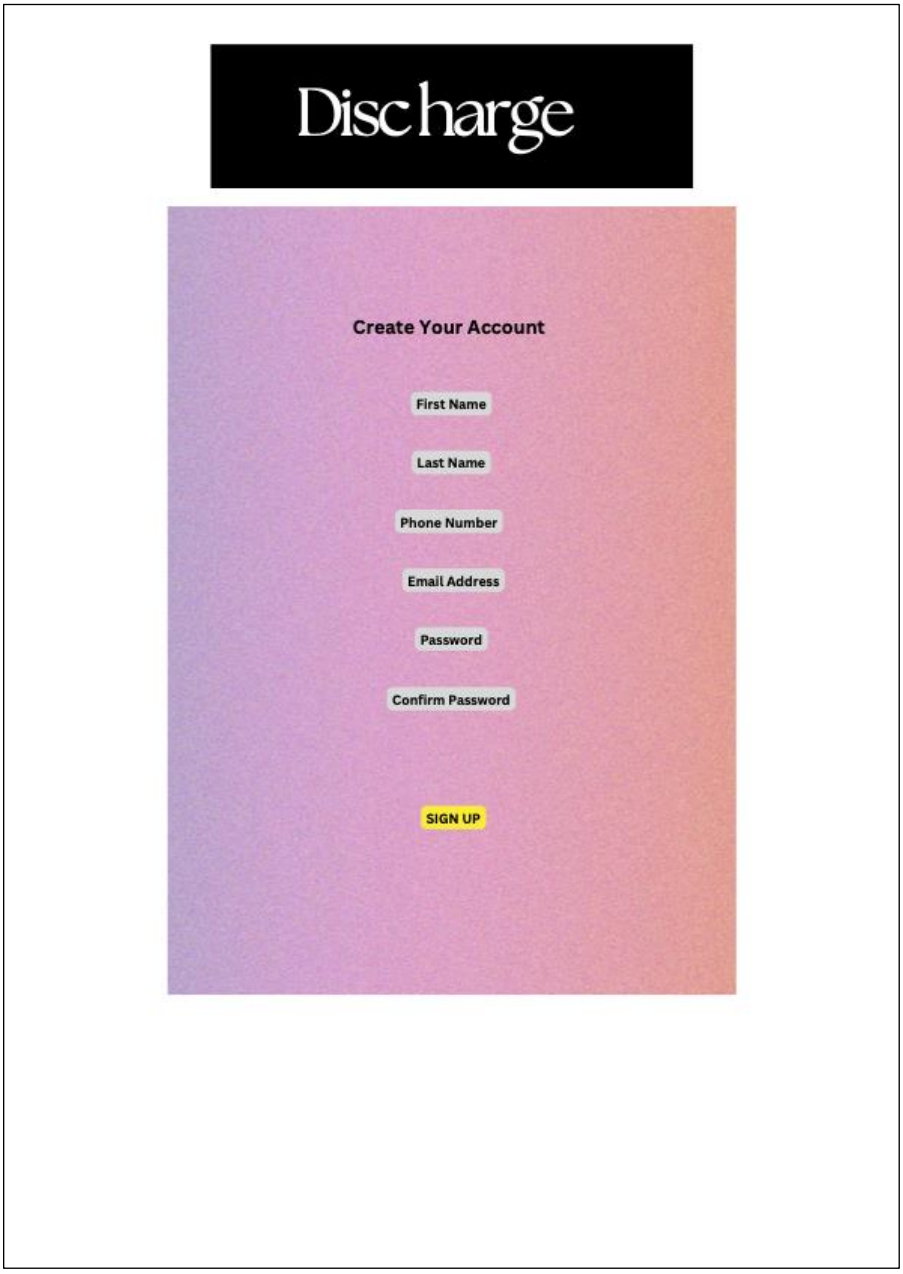


Figure 4

Example mockup of drop-down menu screen for Discharge app, seen immediately after logging in for easy navigation (Canva, 2024).

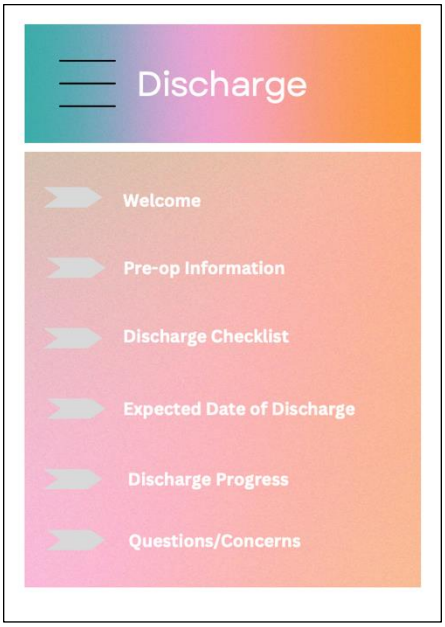


Figure 5

Example mockup of welcome screen, follows drop-down navigation screen (Canva, 2024).

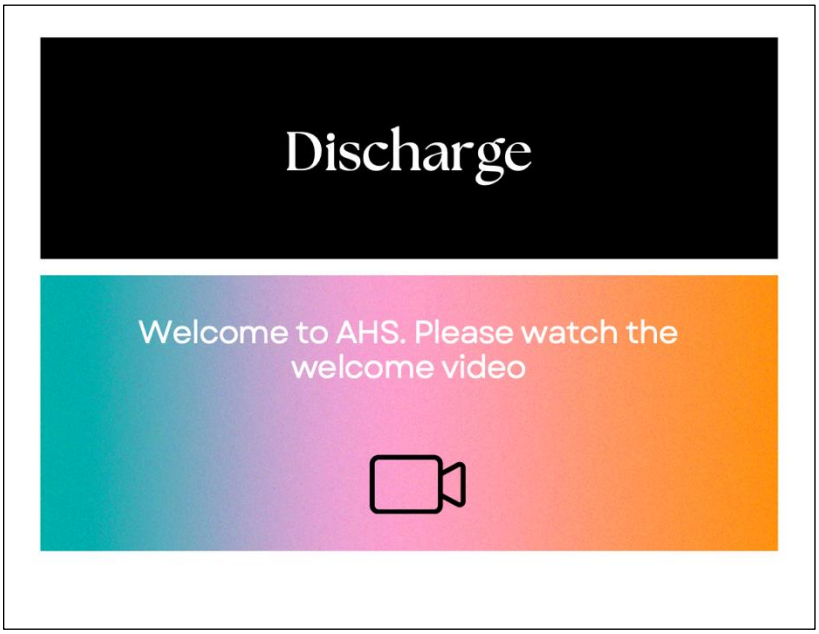


Figure 6

Example mockup of pre-operative information screen, follows welcome screen (Canva, 2024).

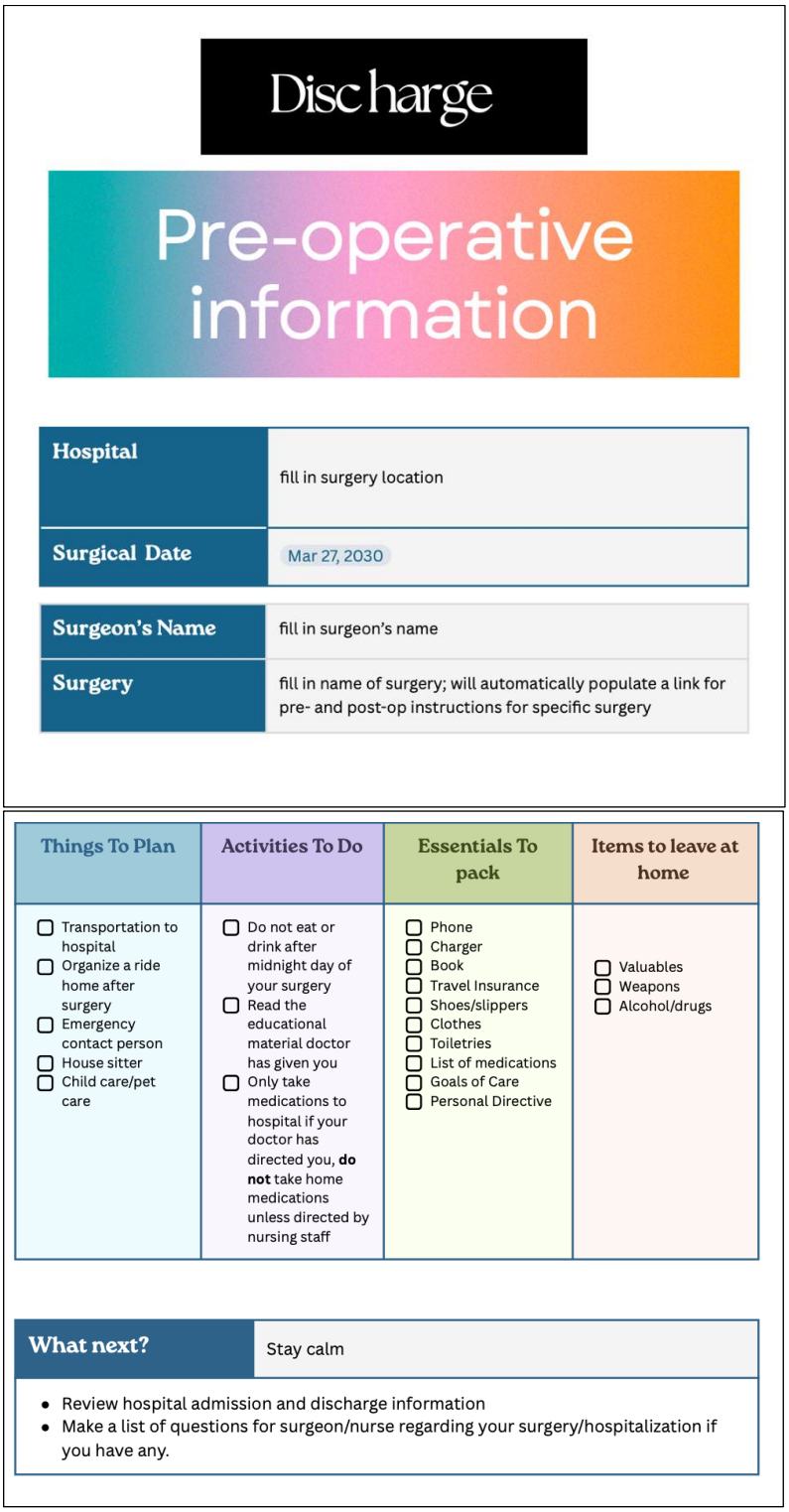
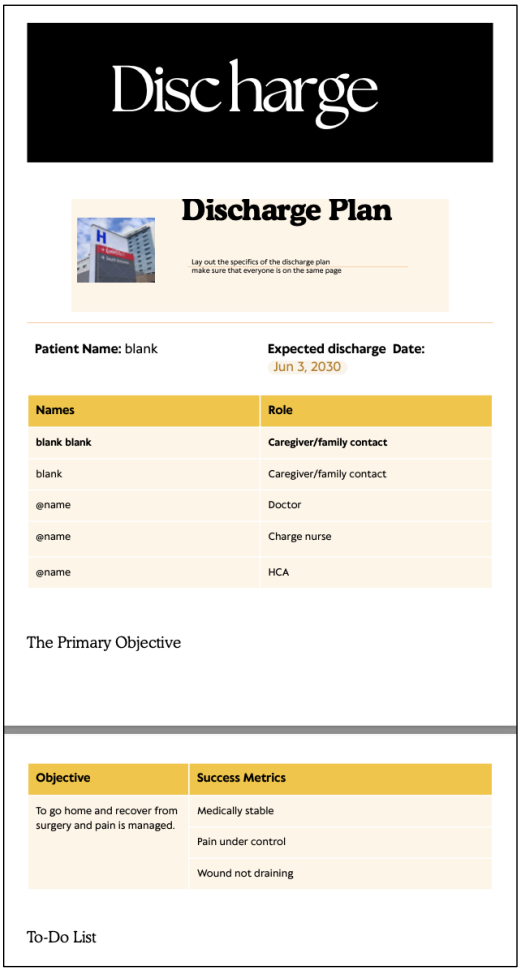


Figure 7

Example mockup of discharge checklist screen, follows pre-operative information screen (Canva, 2024).



Task	Task	Status
 Wound care	Received directions how to care for wound(s) and/or seen by transition services and home care arranged (if needed).	☐ Yes ☐ Ongoing ☐ Paused ☐ N/A
 Medically stable	Add more rows as needed Cleared by all medical teams involved in my care (Surgeon, Internal Medicine, Cardiology, etc.)	☐ Yes ☐ Ongoing ☐ Paused
 Mobilize	Mobilizing at least 3 times per day (or as recommended by physiotherapy). Up in chair for all meals.	☐ Yes ☐ No
 Pain	Pain controlled	☐ Yes ☐ No
 Transportation	Ride home	☐ Yes ☐ No
Medication 	Medication(s) have been reviewed by MD and/or Pharmacist, discussed with patient	☐ Yes ☐ No ☐ N/A
 Physiotherapy	At baseline mobility level (prior to hospital admission) or new mobility level, passed by physiotherapy	☐ Yes ☐ Ongoing ☐ Paused ☐ N/A
 Supplies	Oxygen, equipment, dressing supplies organized and at home.	☐ Done ☐ Ongoing concern ☐ Paused ☐ N/A
 Feelings about discharge	How are you/your caregiver going to manage at home?	☐ Concerns addressed ☐ Ongoing concerns ☐ No concerns
Bladder 	Is your bladder functioning in its pre surgery state ?	☐ Yes ☐ No ☐ Ongoing concern
Bowels 	Have you had a bowel movement? or are you having diarrhea and unable to control your bowels	☐ Yes ☐ Ongoing concern

Notes

- Provide links to relevant resources
- Write down questions and decisions
- Add reminders for everyone
- Enumerate miscellaneous information

Figure 8

Example mockup of expected date of discharge screen, follows discharge checklist screen (Canva, 2024).

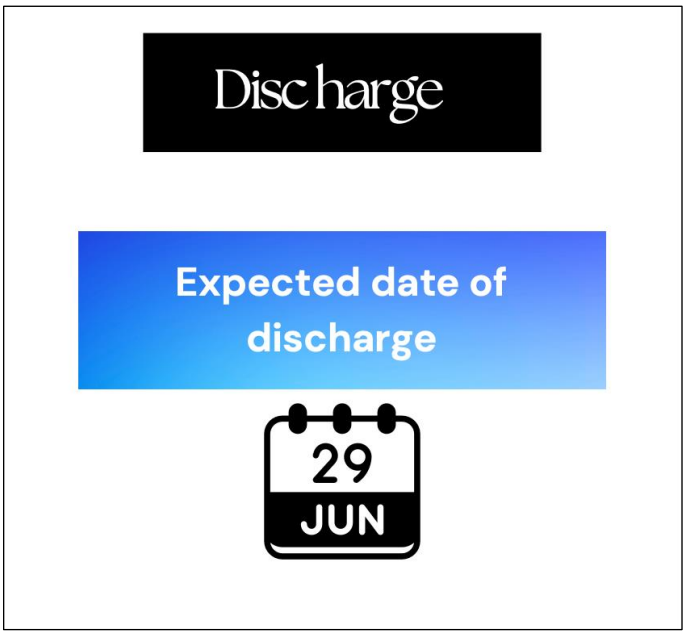


Figure 9

Example mockup of discharge progress screen, follows expected date of discharge screen (Canva, 2024).

Figure 10

Example mockup of questions/concerns page. This is the final page and follows the discharge progression screen (Canva, 2024).