

Appendix 1

1. App interface/ design/ features

The app is designed to have two interfaces.

The app (**at patient interface**) is designed for remote monitoring of heart failure patients. The app has a validated questionnaire for symptom/sign reporting, feature to enter self-measured body weight, blood pressure, heart rate and fluid intake; swiping functionality to acknowledge intake of medications and a feature to store medical records and share images of prescriptions.

The app (**at care provider interface**) is designed to capture demographic data of patients, to enter a few key investigation values and to store and share medical records such as discharge summaries, prescription re-fills or fresh prescriptions and investigation reports with the patients. The app has a feature where care providers can assign tasks to patients such as entering measured blood pressure values, heart rate, fluid intake, and body weight; medication intake notification reminders and symptoms/signs monitoring and reporting (Details in **Table 1**). The app is also designed to receive alerts when these measurements are outside the mentioned cut off ranges (Details in **Table 2**).

Table 1: List of tasks at care provider interface and patient interface

Care provider/ Nurse		Patient / Caregiver	
Task 1	Enter demographic details of patients from source documents and save	Task 1	Identify task list
Task 2	Capture medical records by either taking a picture/ selecting it from the phone gallery and share those with the patient (e.g.: discharge summary, recent lab investigation reports, prescriptions)	Task 2	Acknowledge medications taken throughout the day by tapping against each medication reminder
Task 3	Enter comorbidities (select the comorbidities/ add comorbidities if they do not appear in the existing list) and save	Task 3	Enter measured BP (both systolic and diastolic, correctly against each)
Task 4	Enter key investigations and save	Task 4	Enter measured weight
Task 5	Set medication reminders	Task 5	Enter measured heart rate
Task 6	Instruct patient to enter BP value and weight measured	Task 6	Enter fluid intake of the previous day
Task 7	Instruct patient to enter heart rate value measured	Task 7	Swipe against symptoms which are present
Task 8	Instruct patient to measure fluid intake of the previous day and enter the same	Task 8	View shared medical records
Task 9	Monitor the six symptoms and respond as Yes or No	Task 9	Share medical records
Task 10	Recognize alerts (heart rate, diastolic BP, systolic BP, weight, symptoms, fluid intake, medication)		

Table 2: Alerts for limits in values for measurements and symptoms/signs

Vitals to be measured	With symptoms		Without symptoms	
	Minimum	Maximum	Minimum	Maximum
Heart Rate	50	100	40	110
Blood pressure (Systolic)	90	160	80	170
Blood pressure (Diastolic)			60	100
Fluid intake	> 1 litre / day			

Alerts are also generated if the patient answers ‘Yes’ for any of the following questions:

1. Have you felt more short of breath since yesterday?
2. Have you noticed swelling since yesterday?
3. Have you had dizziness in the last 24 hours?
4. Did you wake up with cough along with shortness of breath last night?
5. Did you sleep on a chair propped up with a pillow last night?

If the patient responds to the question below as ‘Worse’ or ‘Much worse’

6. Compared to yesterday are you better, same, worse or much worse?

2. Definitions/ terminologies

Background: We have created the mobile health application, named *Suhriday* for remotely monitoring patients with chronic heart failure. As a part of remote monitoring, we will ask patients to report worsening of symptoms or signs, blood pressure, body weight and fluid intake every day, measured at home, for duration of 4 weeks. The data will be monitored centrally by a trained nurse. Issues will be escalated by nurse to physician/cardiologist (treating team). Further actions will be documented by the nurse in a diary.

Definitions – The following definitions are in compliance with ISO 9241-11 ^{1,2}

1. Usability - Usability means that any part of a system must be easy to operate, learn, remember and helpful to the user and must guide the designers in the design process. “It is the extent to which a product can be used by specified users to achieve specific goals with effectiveness, efficiency and satisfaction in a specified context of use.”

1.1 Usability/ Effectiveness – To what extent the user can achieve a goal with accuracy and completeness.

1.2 Usability/ Efficiency – The level of effort and resource usage which is required by the user in order to achieve a goal in relation to accuracy and completeness.

1.3 Usability/ Satisfaction (based on ease of use, ease of learning, error minimization and recall capacity) – The positive associations and absence of discontent that the user experiences during the performance.

2. Description of evaluation approaches -

2.1 Think Aloud Approach ^{2,3} – The think aloud approach involves the subject speaking out loud, whatever s/he sees on screen regarding the content of the application, the tasks that appear on screen, while navigating between tasks or pages, **difficulties encountered, likes/ dislikes and any other errors or difficulties encountered through to task completion.** The patient/caregiver’s speech and the screen navigation will be recorded using the mobile phone’s in-built recording system (has both audio recording of what participant speaks and video recording of screen).

Observer will note whether tasks are completed successfully or not (effectiveness) and the time taken to complete tasks (efficiency). The audio content will be analyzed for errors related to breaks in flow, patient preferences and dislikes and salient themes will be identified by content analysis.

2.2 System Usability Scale for assessment of subject Satisfaction -

SUS instrument – 10-item Likert scale, items have a range of 1-5. For items 1, 3, 5, 7, 9 one point subtracted from resulting score, for items 2, 4, 6, 8, 10 five points subtracted from resulting score. To get overall satisfaction value, final sum of all scores should be multiplied by 2.5. SUS scores ranging from 0-100. The following cut-offs will be used –

> **70** - acceptable/ good usability, ≥ **85** - high level of usability or excellent score, ≤ **50** – Poor/ unacceptable usability.

mHealth _ Appendix 1

References:

1. Georgsson M, Stagers N. Quantifying usability: an evaluation of a diabetes mHealth system on effectiveness, efficiency, and satisfaction metrics with associated user characteristics. *J Am Med Inform Assoc JAMIA*. 2016 Jan;23(1):5–11.
2. Kushniruk AW, Patel VL. Cognitive and usability engineering methods for the evaluation of clinical information systems. *J Biomed Inform*. 2004 Feb;37(1):56–76.
3. Blank E, Tuikong N, Misoi L, Kamano J, Hutchinson C, Kimaiyo S, et al. Usability of implementing a tablet-based decision support and integrated record- keeping (DESIRE) tool in the nurse management of hypertension in rural Kenya. *Stud Health Technol Inform*. 2013;192:1002.

mHealth _ Appendix 1

5. I found the various functions in this app were well integrated

1 2 3 4 5

6. I thought there was too much inconsistency in this app

1 2 3 4 5

7. I would imagine that most people would learn to use this app very quickly

1 2 3 4 5

8. I found the app very cumbersome to use

1 2 3 4 5

9. I felt very confident using the app

1 2 3 4 5

10. I needed to learn a lot of things before I could get going with this app

1 2 3 4 5

SUS score:**Open ended questions**

- i. If you strongly agree that the app was complex, what was complex? Can you specify?
- ii. If you strongly agree and think that you need the support of a technical person to be able to use this app, can you please specify which point you needed assistance?
- iii. If you strongly agree and think there was too much inconsistency in this app, can you please specify what was inconsistent?
- iv. If you strongly agree and find the app very cumbersome to use, can you specify what was cumbersome?
- v. If you strongly agree and felt that you needed to learn a lot of things before you could get going with this app, can you please specify, what was that learning you needed to do?

3.2.1 Feasibility interview guide

1) You have used the Suhriday application for about two months. Could you please describe your overall experience using the application and interacting with the study team?

Probes – As they start off, the objective is to elicit their emotions and opinions about the utility of the system. We are looking for a very general response with words like ‘difficult’, ‘cumbersome’, ‘thankful’, ‘re-assuring’, ‘useful’, ‘easier contact with the system’ and so on.

The following probe questions to be used –

- If it was difficult or cumbersome, please tell us what difficulties?
- If it was helpful, please tell us how it was helpful? Can you remember and tell us about some situations where it helped?

2) What were the changes that happened in your everyday life with regard to caring for your own health due to the education that was given at discharge and the system that we implemented?

Probes - The patient may be asked to imagine and compare with his previous (prior to intervention) care behavior. Specific questions pertaining to symptom and sign recognition, medication taking/planning and management, lifestyle modification to be enquired for.

3) Were you satisfied with the manner in which we (our team) responded?

Probes–We’re looking for issues concerning (i) mode of issue resolution (over the telephone, by SMS, etc.) (ii) time taken to resolve the problem (iii) any issues with the solutions proposed such as ‘restrict fluids’, ‘increase the dose of x drug’, etc., and (iv) trust in our team.

4) You may have now stopped using the application. Are you continuing to take care of your health in the same manner?

Probe – We need to ascertain whether they are continuing home BP, fluid and body weight monitoring; documenting it and whether they have taken any action if parameters are abnormal.

5) Do you have any suggestions to further improve the mobile application?

Probe – for responses pertaining to *frequency of entering information*, language, font size, font type, navigation issues, and color.

6) Lastly, do your caregivers or family members have any opinion about the app and the system? Has our education brought about any changes in their lifestyle?

3.2.2 Feasibility assessment of Patient/ Caregiver for Suhriday app pilot - End of study**Satisfaction - System Usability Scale**

Please choose any one between 1 to 5 where 1 = strongly disagree; 5 = strongly agree

1. I think that I would like to use this app frequently 1 2 3 4 5

2. I found the app unnecessarily complex 1 2 3 4 5

3. I thought the app was easy to use 1 2 3 4 5

4. I think that I would need the support of a technical person to be able to use this app 1 2 3 4 5

5. I found the various functions in this app were well integrated 1 2 3 4 5

6. I thought there was too much inconsistency in this app 1 2 3 4 5

7. I would imagine that most people would learn to use this app very quickly 1 2 3 4 5

8. I found the app very cumbersome to use 1 2 3 4 5

9. I felt very confident using the app 1 2 3 4 5

10. I needed to learn a lot of things before I could get going with this app 1 2 3 4 5

SUS score:

mHealth _ Appendix 1

3.2.3 Acceptability questionnaire (Likert scale):

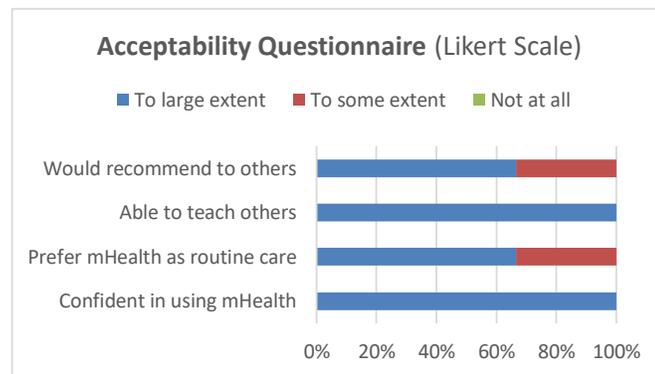
1. How confident do you feel using the mHealth application?
 - a) Not at all
 - b) To some extent
 - c) To large extent

2. Do you prefer using mobile health application as routine care?
 - a) Not at all
 - b) To some extent
 - c) To large extent

3. Will you be able to teach other patients/their caregivers how to use this application?
 - a) Not at all
 - b) To some extent
 - c) To large extent

4. Would you recommend using mobile health application to patients with similar conditions?
 - a) Not at all
 - b) To some extent
 - c) To large extent

Figure 1: Summary of the results from the acceptability questionnaire

**3.2.4 Overall satisfaction of App features, functionality, ease to use**

Adjective rating (Circle any one of the below)

- a. Worst imaginable
- b. Poor
- c. OK
- d. Good
- e. Excellent
- f. Best imaginable

3.2.5 Acceptability

(Circle one of the below)

- a. Not acceptable
- b. Marginal - low
- c. Marginal - high
- d. Acceptable