Project Title

A Smarter Approach for Self-Management of Pain through Active and Passive Mobile Sensing: The Clinical Utility of Trac-Bot

Project Lead and Members

Project lead: Dr Yang Su-Yin, Principal Psychologist, Tan Tock Seng Hospital

Project members: Vincent Yeo, Ong Pei Gin, Ivy Ho Wei Fang, June Lim Wei Ping, Loy Fong Ling, Neeraj Khotari

Organisation(s) Involved

Tan Tock Seng Hospital, Physio Movement Pte Ltd, Cogniant

Healthcare Family Group(s) Involved in this Project

Medical, Allied Health

Applicable Specialty or Discipline

Psychology, Rehabilitation, Physiotherapy, Chronic Pain

Project Period

Start date: 01 Sep 2018

Completed date: 31 Aug 2020

Aims

To test patient engagement and mobile app usage with smartphone generated self-input and passive data to monitor patients with chronic pain for 3 months

Background

Chronic pain, defined simply as pain lasting more than 3 months after which normal tissue damage has healed, is perplexing to treat. While traditional multi-disciplinary, face-to-face treatments have some success in managing this multi-faceted condition,

sustaining treatment effects within the community has been problematic. Similar to many chronic diseases, like diabetes, chronic pain management is resource-intensive, places a high demand on longer term self-management and relapse prevention. If left unaddressed, this healthcare burden can only worsen with an aging population.

The advent of technology and smartphones, has welcome the arrival of many mobile health apps. Studies have shown the potential of integrating different simple functions like pain and mood reporting, ambient records of physical activities and simple record keeping, to create a narrative that is useful for the patients and health professionals.

The aim of this study is to enhance the self-management of chronic pain through a specially designed mobile application platform. The mobile platform which will utilise both active and passive mobile sensing, has the potential to increase treatment adherence, goal achievement rates, physical activity levels and patients' self-efficacy in the self-management of chronic pain and consequently, increase healthcare professionals' efficiency in providing care to patients.

Methods

The study was completed in 2 phases. Phase 1 Study Design: Survey and interview on utility and usability analysis of prototype features of mobile application. Development of mobile application included selected priority functions highlighted by participants.

Phase 2 was administered online. All participants first completed an online self-reported clinical measures about pain-related information, impact on daily life and self-efficacy. Upon completion of the survey, the participants will be directed to a link to download the mobile application.

The participants will use the mobile application for 12 consecutive weeks before a link is sent to them to complete another set of survey. Participants will complete the same set of online questionnaires, 1 usability user satisfaction survey and a list of open-ended qualitative questions. The user activated recording and ambient, physical recordings (in the participant's mobile application) was downloaded via the server for

subsequent analysis. Weekly average of pain-related information, accelerometer recordings were computed and analysed.

Results

Phase 1 usability study:

Based on the usability study and patient mobile health usability questionnaire (MAUQ) - the team observed 75% of the users would like to use the app again. A separate design review and user feedback sheet is attached.

Phase 2 on boarding:

Despite placing recruitment posters in the ward and general visiting areas, because of Covid related challenges, we were unable to recruit the required number of patients via clinician support. This was further made challenging by covid related lockdowns and restrictions during the study. The project team, since then made an amendment to the study to recruit patients online and the patients on boarded below are based on recruitment efforts made for online recruitment.

Total app installs: 53, Pain diary entries: 209, Pain diary entries (unique users): 24, Pain diary entries (per person) 8.7. Profile of participants who entered data for patient reported outcomes measurement form.

Female: 7 **Male: 11**	**Chinese: 13** **Indian: 5**	**Single: 13** **Divorced: 1** **Other: 4**	**GCE A/O Levels: 3** **Diploma: 6** **Degree: 6** **PG: 2** **Others: 1**

Population level pain profile based on baseline on boarding questionnaire: Average pain score (4), Average pain interference score (2.3), Average mood score (5.3)

On average, we noticed 6% more data collection via passive data collection over active mode of entering user data.

At the end of the study, patients were asked to provide feedback on the patient reported outcomes scale. 3 of the patients participated in this feedback and outcomes prior to the study and after the study as below:

		Pre Onboarding				Post Onboarding				% Change
ID	Question	P8	P17	P20	Average	P8	P17	P20	Average	
1	How intense is your pain right now?	2	6	3	3.7	2	5	3	3.1	-15.9
2	How intense was your pain on average last week?	2	6	4	4.0	2	5	3	3.4	-15.8
3	How distressing is your pain right now?	2	6	3	3.7	0	3	3	1.9	-49.5
4	How distressing was your pain on average last week?	2	6	4	4.0	1	5	3	3.1	-23.3
5	How much did pain interfere with your normal activities last week?	1	6	4	3.7	1	5	3	3.1	-16.8
6	I can remain committed to my goals even when there are times that I fail to reach them	3	6	2	3.7	3	5	2	3.1	-15.0
7	When a goal is difficult to reach, I am able to take small steps to reach it	3	3	2	2.7	4	4	2	3.3	25.0
8	I prefer to change how I approach a goal rather than quit	3	6	2	3.7	3	6	2	3.7	0.0
9	I am able to follow my long terms plans including times when progress is slow	3	2	2	2.3	3	2	2	2.1	-12.1
10	I find it difficult to carry on with an activity unless I experience that it is successful	3	6	4	4.3	3	5	5	4.2	-2.7
11	If I feel distressed or discouraged, I let my commitments slide	3	6	4	4.3	3	6	3	4.1	-5.8
12	I get so wrapped up in what I am thinking or feeling that I cannot do the things that matter to me	1	6	3	3.3	1	5	3	2.8	-17.0
13	If I cannot do something my way, I will not do it at all	5	6	2	4.3	6	6	2	4.6	5.4
14	I am getting on with the business of living no matter what my level of pain is	4	6	4	4.7	4	5	3	4.0	-14.3
15	Keeping my pain level under control takes first priority whenever I am doing something	4	6	4	4.7	4	6	3	4.4	-5.7
16	Although things have changed, I am living a normal life despite my chronic pain	5	6	3	4.7	5	6	3	4.4	-5.0
17	Before I can make any serious plans, I have to get some control over my pain	5	6	4	5.0	5	6	3	4.7	-5.7
18	I lead a full life even though I have chronic pain	3	6	3	4.0	3	5	3	3.4	-15.0
19	When my pain increases, I can still take care of my responsibilities	3	6	2	3.7	4	6	3	4.3	18.2
20	I avoid putting myself in situations where my pain might increase	6	5	4	5.0	5	4	3	4.1	-17.3
21	My worries and fears about what pain will do to me are true	3	6	4	4.3	3	5	3	3.7	-15.0
22	I can enjoy things, despite the pain	3	5	3	3.7	3	4	3	3.1	-14.5
23	I can do most of the household chores (e.g. tidying-ups, washin dishes, etc.), despite the pain	2	6	2	3.3	3	5	5	4.3	28.0
24	I can socialise with my friends or family members as often as I used to do, despite the pain	4	5	2	3.7	4	4	2	3.2	-13.6
25	I can cope with my pain in most situations.	3	4	3	3.3	3	4	4	3.6	8.5
26	I can do some form of work, despite the pain. (“work” includes housework, paid and unpaid work).	3	6	3	4.0	3	6	3	3.8	-5.0
27	I can still do many of the things I enjoy doing, such as hobbies or leisure activity, despite pain.	3	6	3	4.0	3	5	3	3.4	-15.0
28	I can cope with my pain without medication.	4	6	3	4.3	4	6	4	4.6	6.2
29	I can still accomplish most of my goals in life, despite the pain.	4	4	3	3.7	4	3	3	3.2	-13.2
30	I can live a normal lifestyle, despite the pain.	4	6	3	4.3	4	5	3	3.7	-14.2
31	I can gradually become more active, despite the pain.	4	4	3	3.7	4	3	2	3.1	-14.5

On average improvement was observed in 24 out of 31 parameters in these patients which is encouraging data and improvements were across different dimensions of pain. Post-survey showing patient reported improvements in ability to self-manage pain through the engagement in activities, reduction in pain intensity and pain interference. However, responses were limited as many of the participants who on-boarded and provided data did not complete the post-survey.

It would seem that there is potential for the application to be used as complementary to clinician intervention in the clinic and as an in-time adjunct intervention for those with chronic pain but not needing tertiary level care in the community. The app needs further development for commercial use.

Lessons Learnt

1. A collaborative and tight knit team working on the same page with a committed vendor such as Cogniant contributed to completion of the study despite the challenges posed by the unexpected pandemic.
2. Design features of the application needed to be more specific to gather more data – the surveys were completed online and anonymously, however we overlooked and did not make the surveys mandatory to complete and hence loss data in the process.
3. Recruitment challenges and participant adherence as reported with many other self-management applications.

Conclusion

There appears to be utility for Tract-bot to be used in the community and within tertiary healthcare settings. A closer feedback loop will be needed for clinician-patient interaction to enhance adherence to self-monitoring and shift behaviour towards self-management away from traditional top down treatment approaches within healthcare settings.

Additional Information

This study sought to explore the (1) usability of a newly developed mobile application for chronic pain management (2) utility of the mobile application in improving the monitoring and management of pain related measures, goal achievements and physical activity (3) utility of the mobile application in improving the efficacy of self-management of chronic pain conditions.

Project Category

Technology

Digital Health, Mobile Health, Digital Apps

Keywords

Pain Management, Mobile Application, Self-Management, Patient Engagement

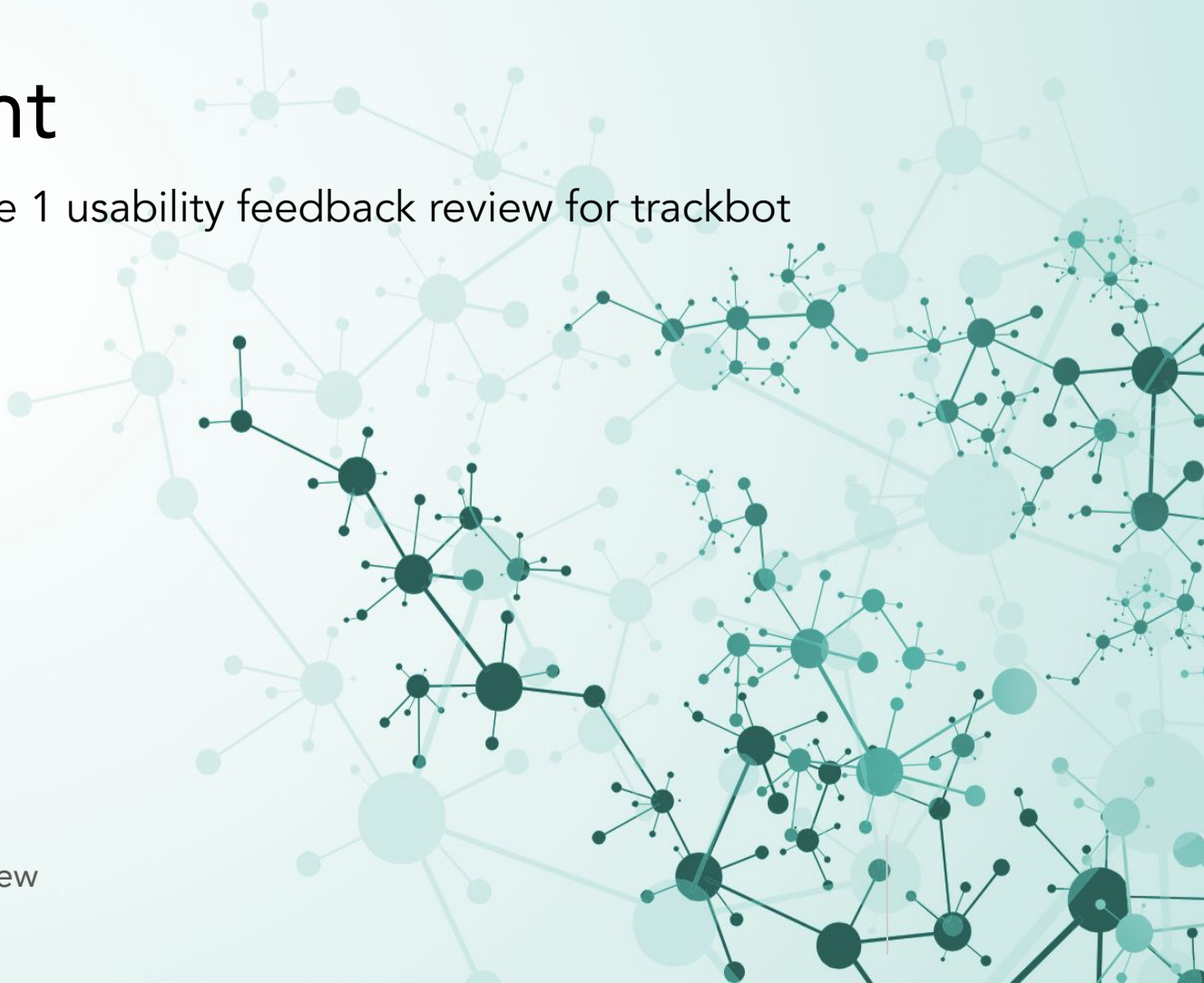
Name and Email of Project Contact Person(s)

Name: Dr Yang Su-Yin

Email: su_yin_yang@ttsh.com.sg

Cogniant

Painpal - Phase 1 usability feedback review for trackbot (Painpal)



Usability design review
July 2021

WHAT IT IS

It’s a Usability Expert Review, conducted by one of our UX specialists leveraging our application development experience and know-how.

This review is important to find specific usability problems in your application and provide you with practical and actionable recommendations that will improve the application’s overall usability, ease of use and efficiency.

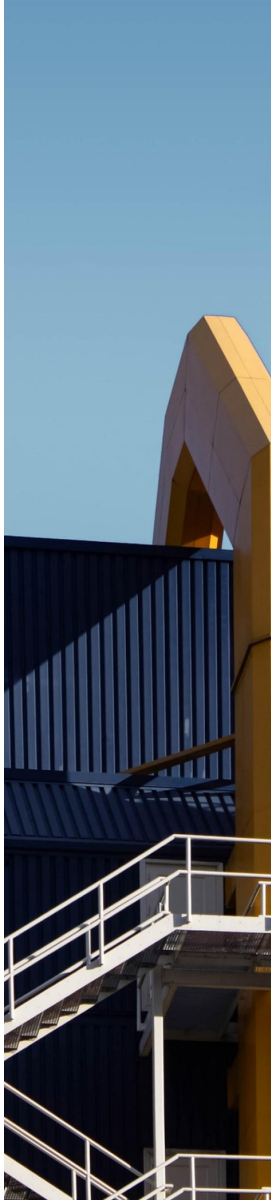
HOW WE DO IT

We follow an industry standard evaluation method based on Nielsen's heuristics and Severity Grading System.

We look at each usability problem we find and we assess their severity according to 3 factors:

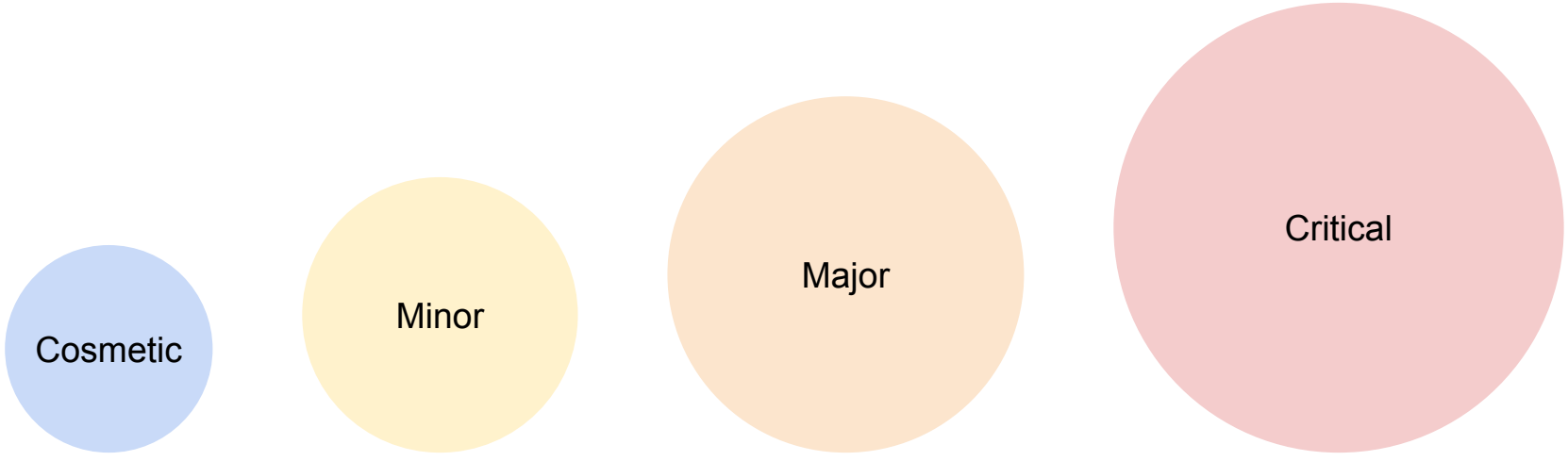
- The Frequency with which the problem occurs
- The Impact of the problem, if it occurs
- The Persistence of the problem

According to these factors, we grade each usability problem with a Severity Grade that ranges from 1 to 4.



SEVERITY GRADES

How we grade each Usability Problem



Cosmetic problem only: need not be fixed unless extra time is available on project

Minor usability problem: fixing this should be given low priority

Major usability problem: important to fix, so should be given high priority

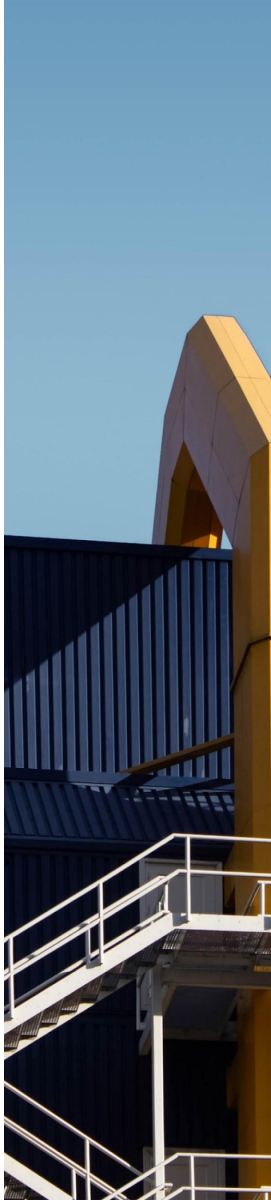
Usability catastrophe: imperative to fix this before product can be released

THE SCOPE OF THE REVIEW

We reviewed the following sections of the application:

Following the core objectives of PainPal we have put the most focus on addressing the following:

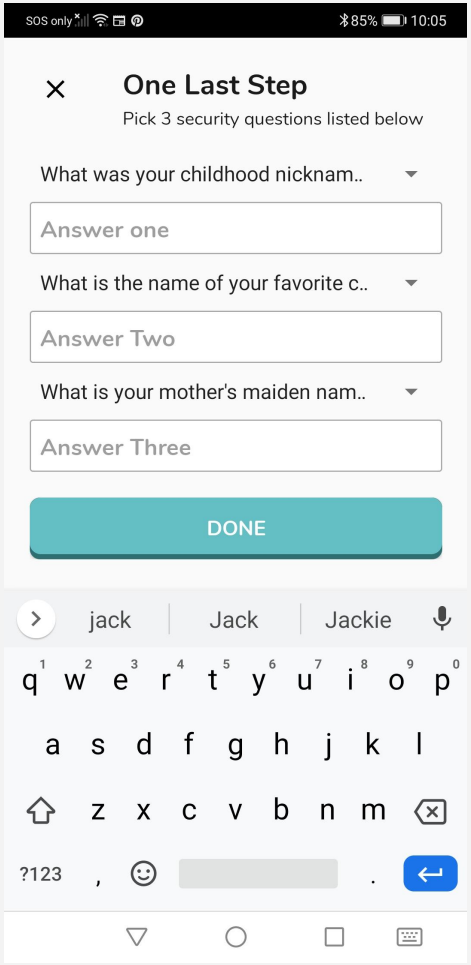
- Homepage
- Pain Diary
- Treatment
- Insights
- Chatbot
- Goals



Onboarding

HOMEPAGE 1 ISSUES

1



1

Text is clipped making it hard to read the question.

Instead allow the text to wrap onto 2 lines.

1

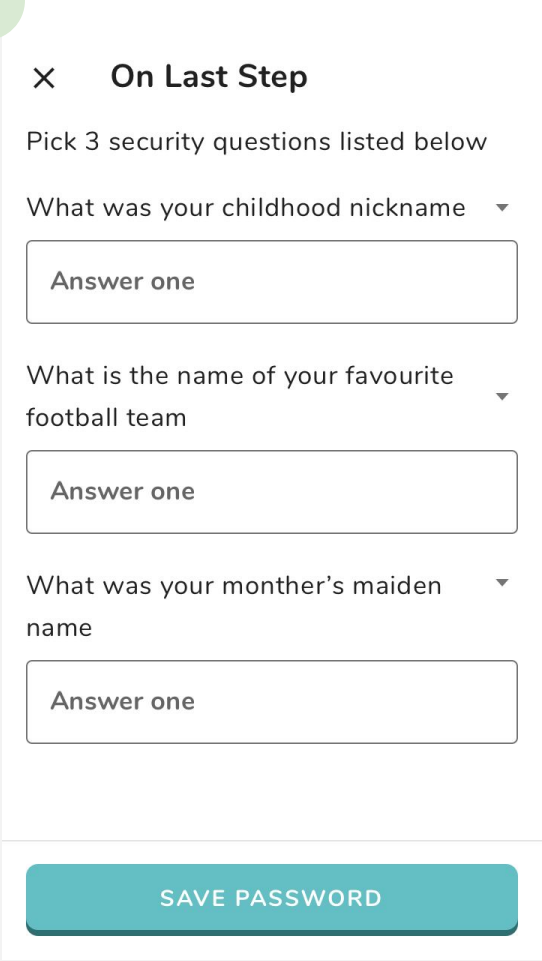
Progress to login without camera access - CRITICAL

So just now I was trying to say at the login part, they will ask you whether umm can the program take photo, video? So if I put no I cannot go on. I mean I may not want to have that video or photo which means means that I have to put yes if not I can't continue into the program.

Suggestion: If they say no, allow them to continue anyway. Later if a feature needs the camera again then ask for permission again then. It actually might make more sense to only ask for permission when they really need the camera.

HOMEPAGE 1
SUGGESTIONS

1

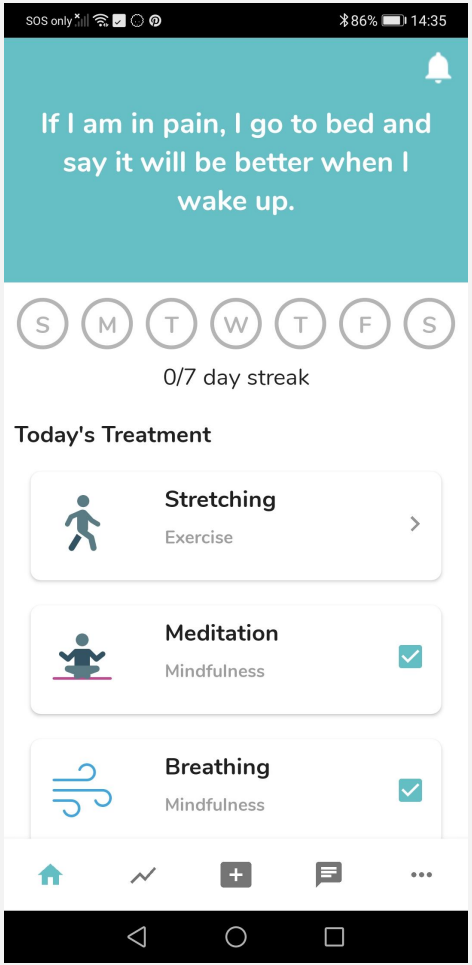


1

Allow the text to wrap onto 2 lines.

Personalisation

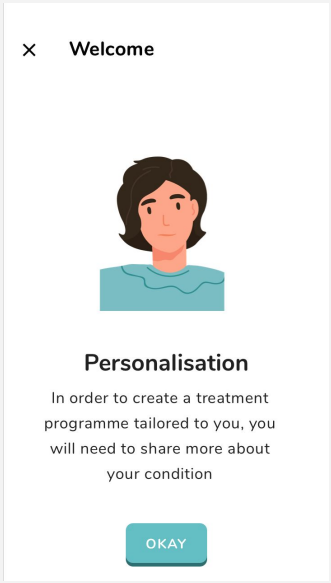
PERSONALISATION ISSUES

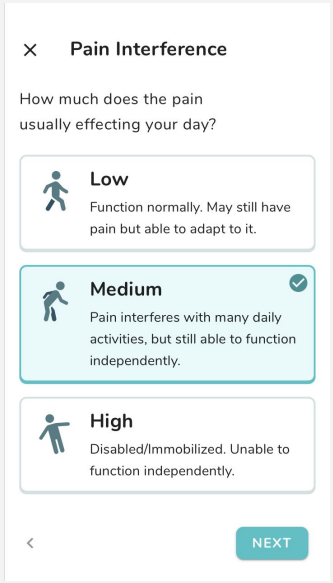


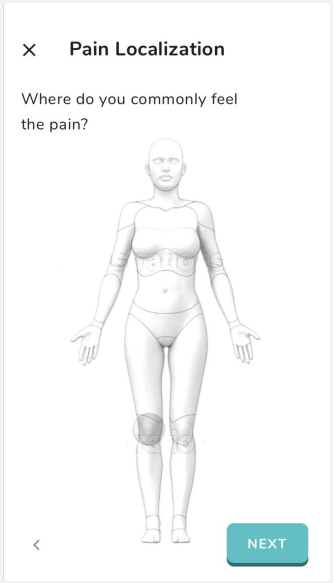
1

Currently the the treatment offered is the same for each patient and is allow the same each day. Patients do not feel confident these treatments will help them.

PERSONALISATION SUGGESTIONS







1

Uses the same rules form the pain diary to recommend treatments. These treatments can now be shown on the homepage.

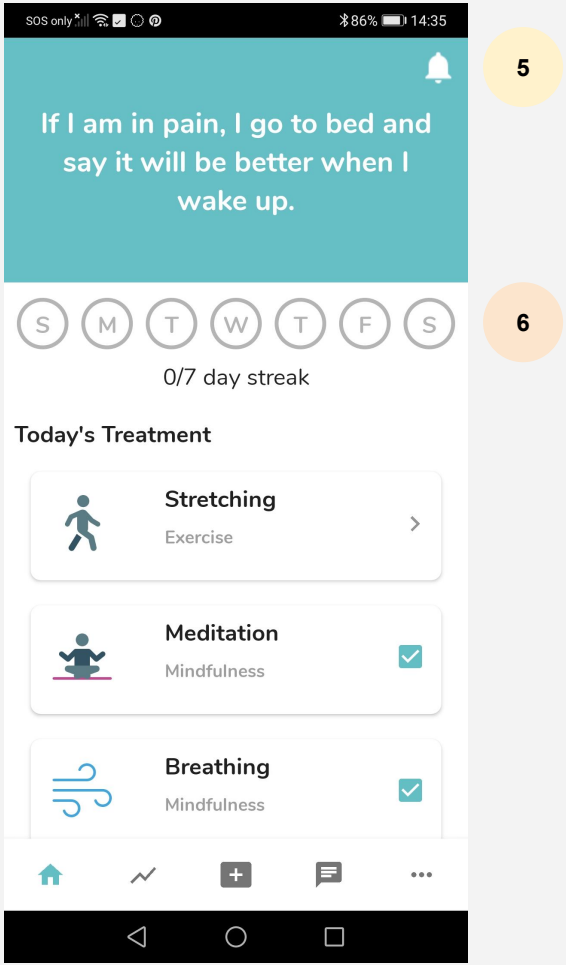
There should only be a maximum of 3 treatments displayed on the homepage, these should be randomised each day to create a variety of things to do and increase engagement

This can be edited from the settings

Homepage

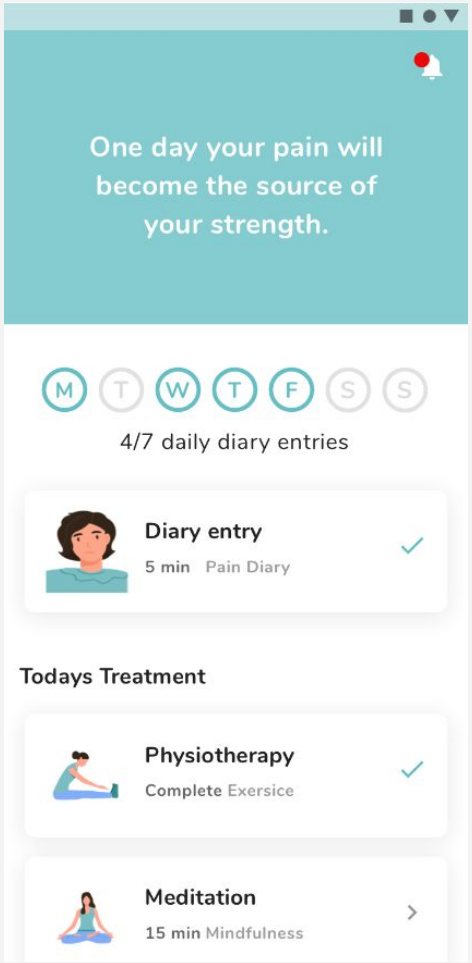
Lacks updates, feels static and does not evolve with the user.

HOMEPAGE 1 ISSUES



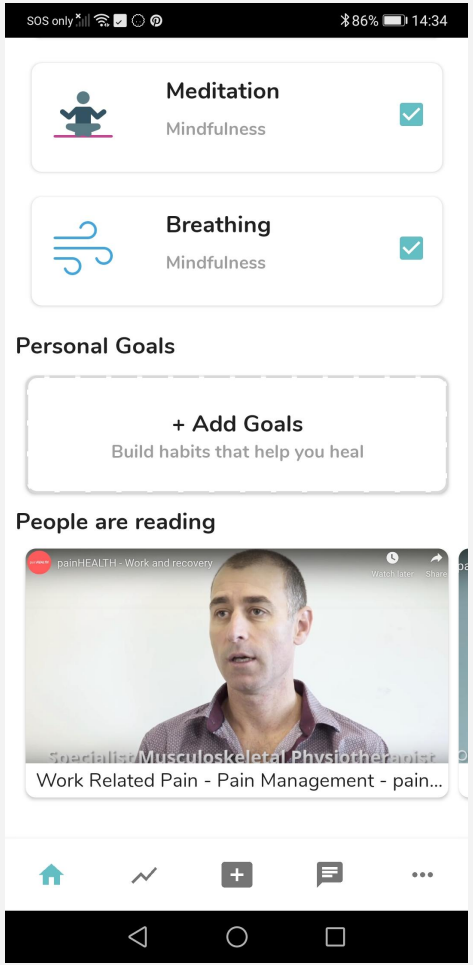
1. Homepage feels static and does not offer new content on a daily basis to keep the user engaged
2. Is not clear I have done my diary today
3. Does not prompt you to do your diary today
4. Shows me the exercises I have done but does not update instantly
5. No notification highlight for unread or new notifications
6. Unclear what streaks are for, is it Diary, Treatment, Goals?

HOMEPAGE 1 SUGGESTIONS



1. Add more treatment options and randomise them proving more variety and engagement for the user
2. Add UI to confirm the user has completed a diary entry for the day
3. Add a new card for to prompt a diary entry
4. Refresh page on load
5. Add a red dot to highlight new/unread notifications
6. Reword 0/7 day streak to 0/7 daily diary entries

HOMEPAGE 2
ISSUES



7

8

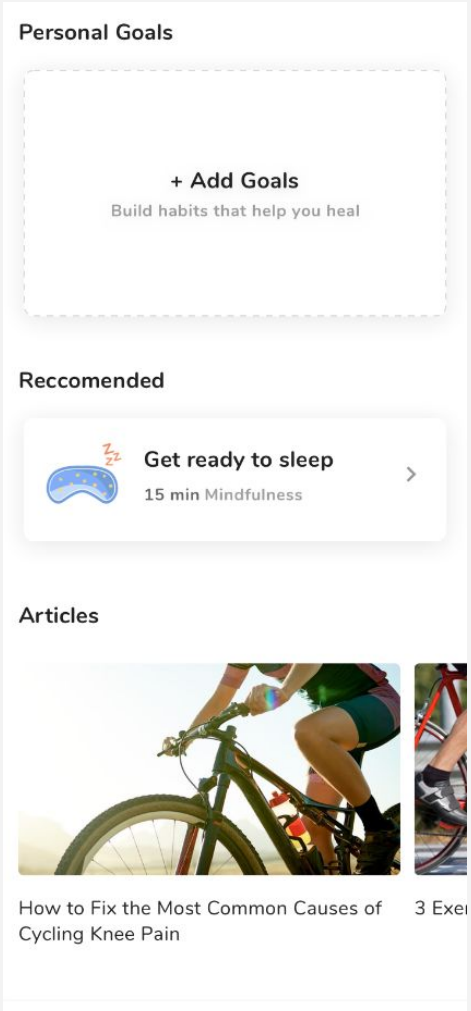
9

7 Does not show me my personal goals

8 Outline for + Add Goals is too heavy does not match the original design

9 Article cards for “People are reading” have a shadow and misplaced corner radius.

HOMEPAGE 2 SUGGESTIONS



7

8

9

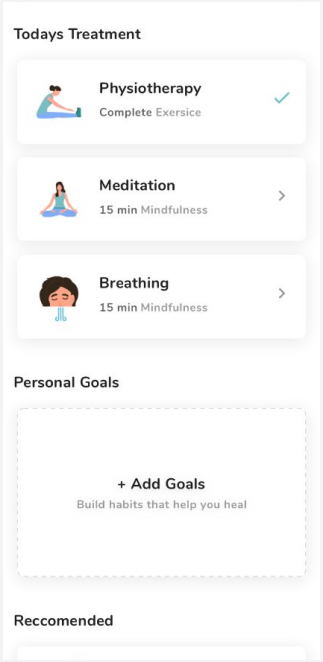
7 Once a user has created a personal goal it should be added to the homepage.

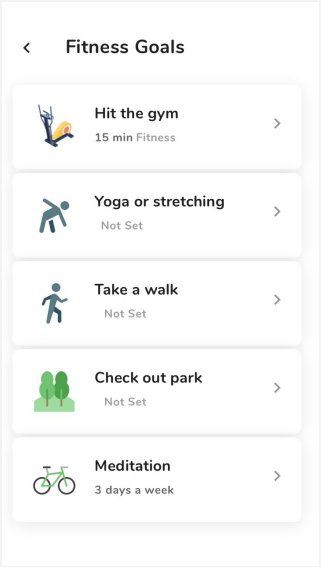
To manage the list of the list of goals on the homepage and to increase variable rewards we can randomise the 1 or 2 daily goals for the user on the homepage

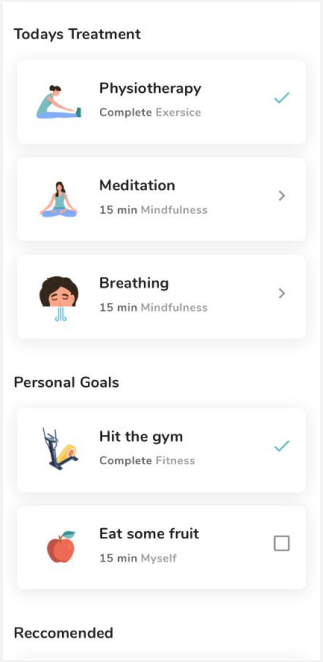
8 Double check original design for colour code, size of border and size of dashes

9 Double check original design, remove shadow and apply the border to the image container only

HOMEPAGE 2
SUGGESTIONS







Add goals to homepage

Once a goal has been setup in the goals page then they should be added to the homepage

There should only be a maximum of 2 personal goals displayed on the homepage, these should be randomised each day to create a variety of things to do and increase engagement

Pain Diary

PAIN DIARY ISSUES

1

1

Pain Diary

The biggest issue with the pain diary is it does not allow patients to exit at any stage. Causing them to feel trapped and potentially leaving before recording anything.

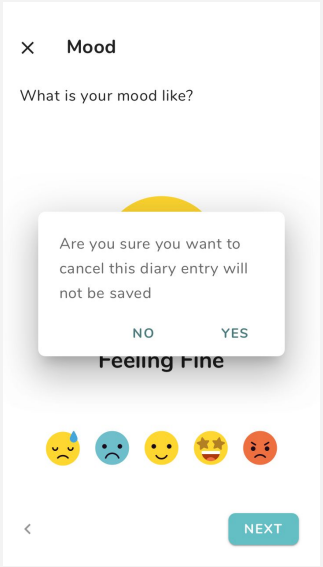
PAIN DIARY SUGGESTIONS

1

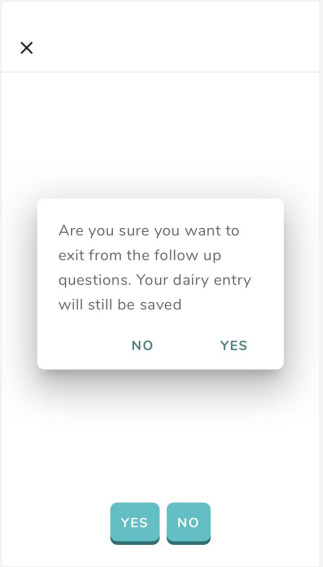
Pain Diary

Allow users to exit during the follow up questions while still saving their diary entry.

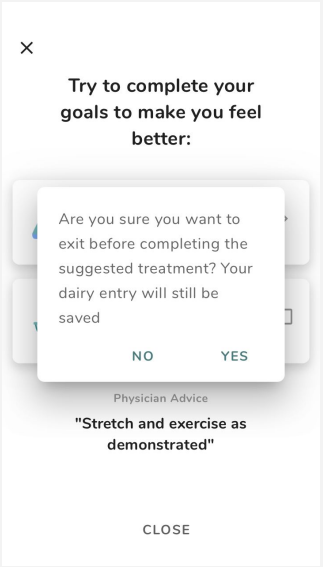
Potentially adding the recommended treatments that have not been completed to the homepage.



During diary questions



During follow up questions

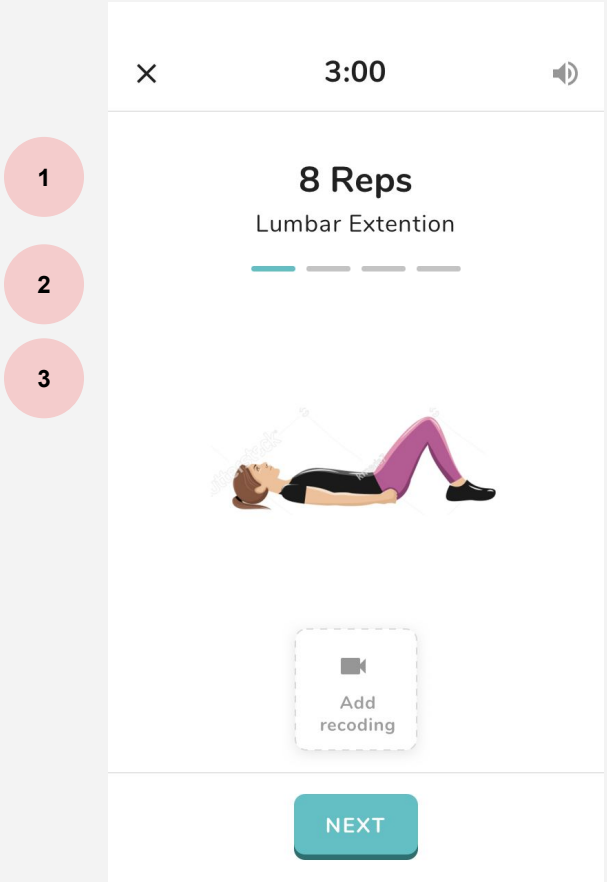


During recommended treatment

Treatment

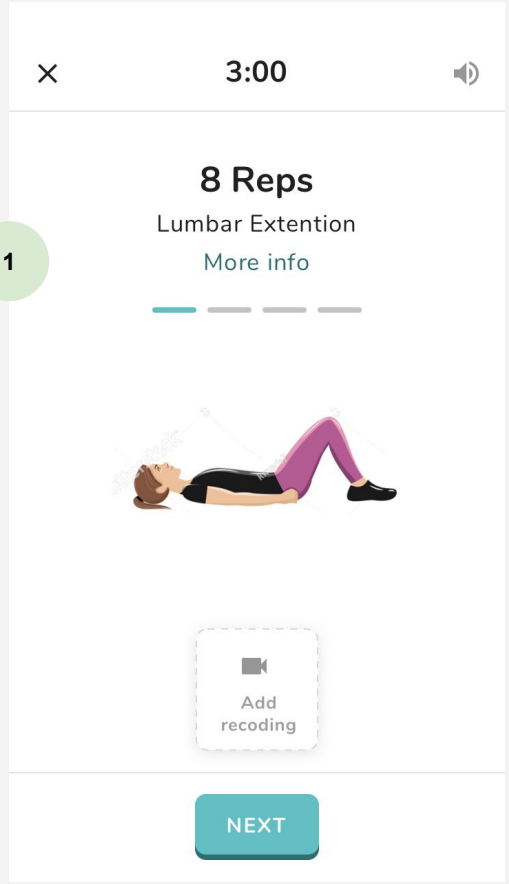
More information

TREATMENT ISSUES



1. Lack of understanding to why a patient is being recommended an exercise.
2. Offer modified exercise to help with common issues.
3. No description of how to do the exercise

TREATMENT SUGGESTIONS



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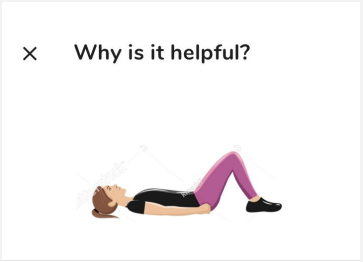


1 Add “More Info” link to Provide reason to why treatment is recommended and what are the benefits

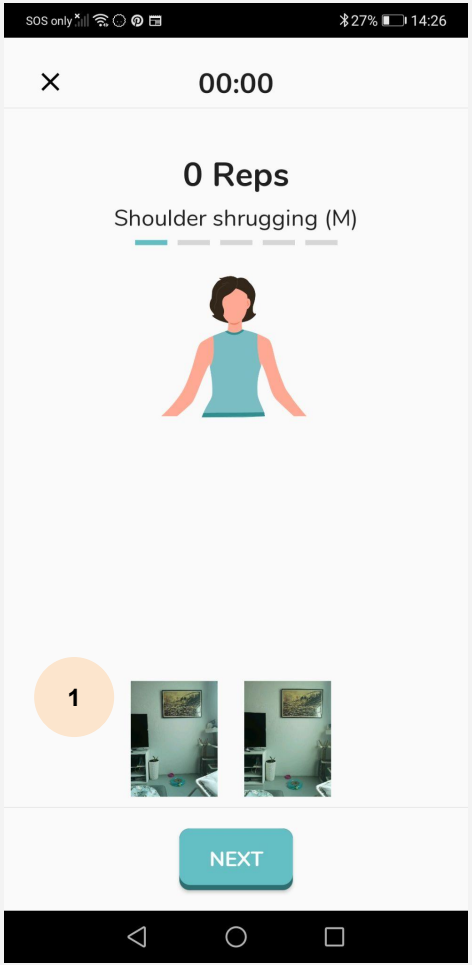
3 With the “More Info” link include optional regression for common issues

3 With the “More Info” link include a description of how to do the exercise

Treatment

Delete Video

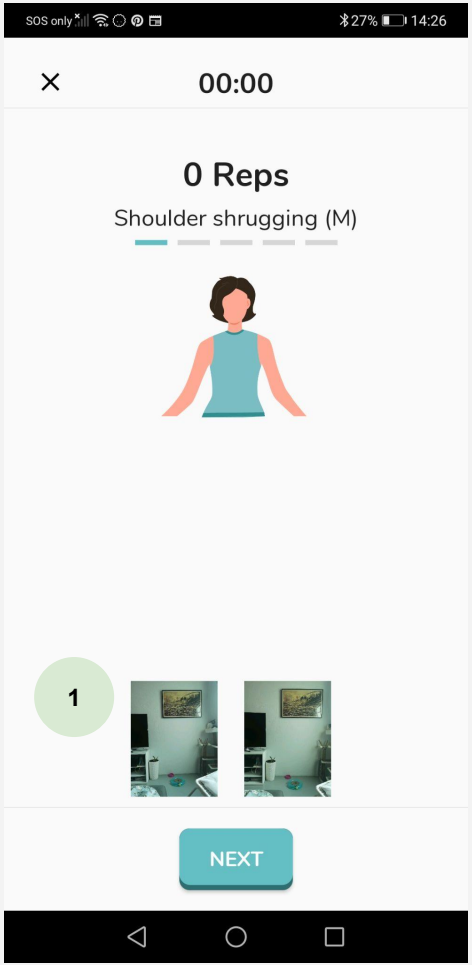
TREATMENT RECORDING
POTENTIAL ISSUES



1
2
3

1. How can I delete/replace the videos I have taken
2. It is not clear how long you should be hold a pose for.
3. Screen blacks out during exercise

TREATMENT RECORDING SUGGESTIONS



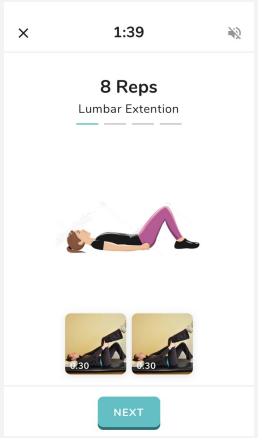
1

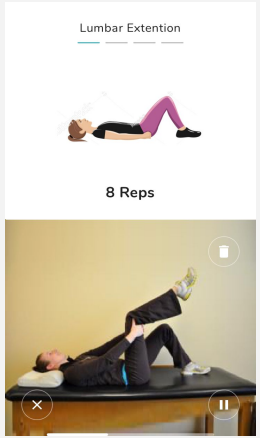
2

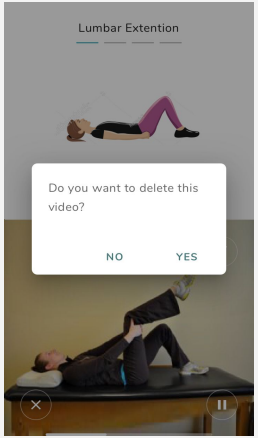
3

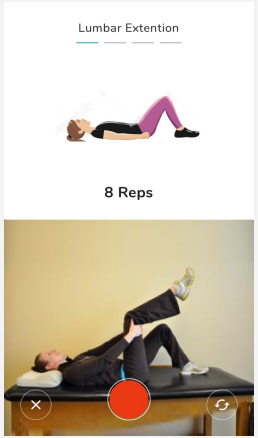
1. Create functionality for deleting and replacing uploaded videos
2. Review this in more detail, see if is there anything we can do to improve this.
3. Double check blackout bug. It didn't happen when I tested but can be tested further to ensure there is a problem or not. Speak to the developers on how to fix this.

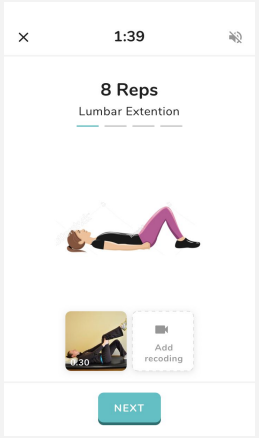
TREATMENT RECORDING SUGGESTIONS









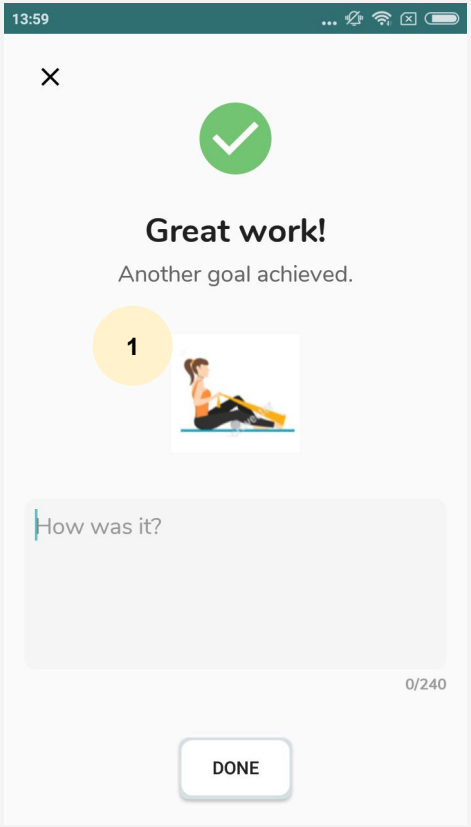


Edit/Delete recording

Once the user has left the recording screens and have saved recordings they should still be able to edit them.

This can be solved easily by allowing the user to to tap on the saved recording to reopen the recording page and using the existing flow to go back and edit or delete their recording.

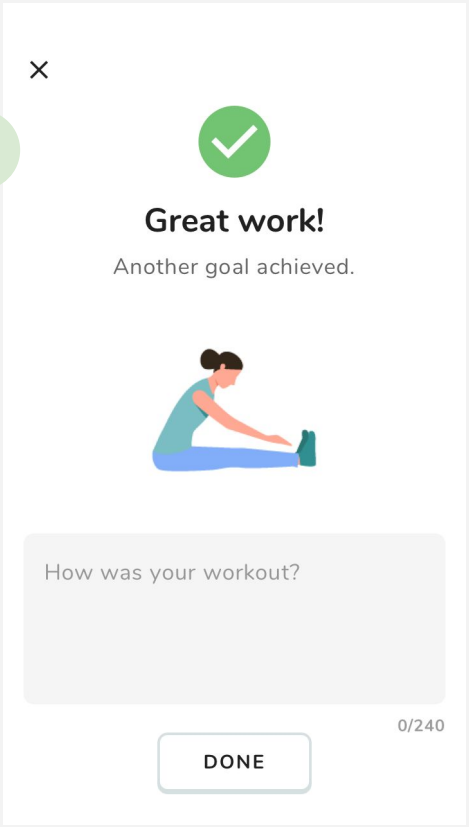
TREATMENT SUMMARY
ISSUES



1 Wrong image. This image has a watermark on in and needs to be changed.

TREATMENT SUMMARY SUGGESTIONS

1

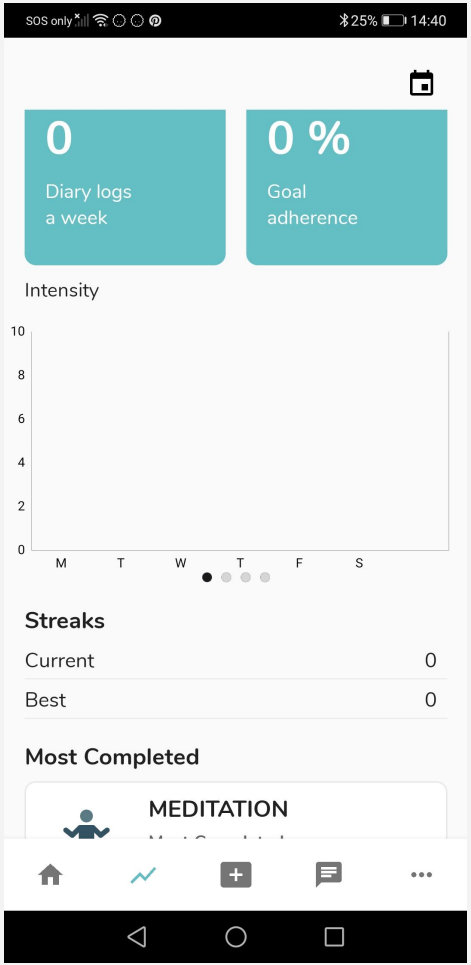


1

The image used here should be the same as the treatment card at the start. Eg: Physiotherapy

Insights

INSIGHTS
ISSUES



3

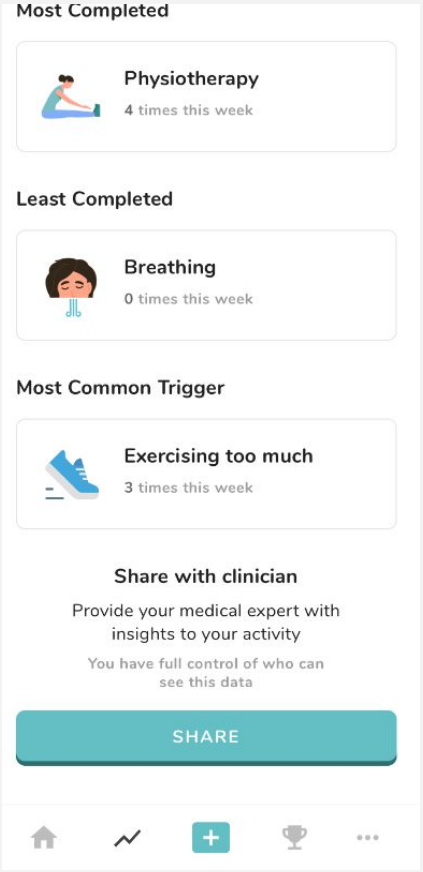
2

1. Currently there is no way for clinicians to receive the patients data in order to discover patterns in the behaviour

2. Most common trigger would be very insightful to help avoid that trigger

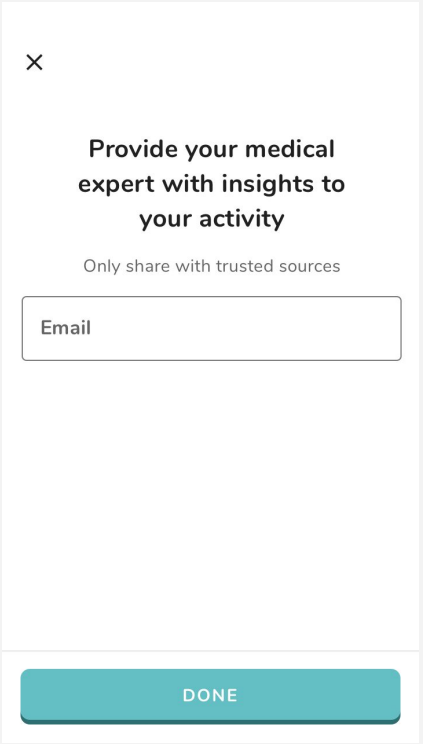
3. Swiping charts has an dramatic animation that feels distracting.

INSIGHTS
SUGGESTIONS



2

1



1. Send data feature for patient to send their activity to their clinician

2. Include Triggers in the most commonly occurred section.

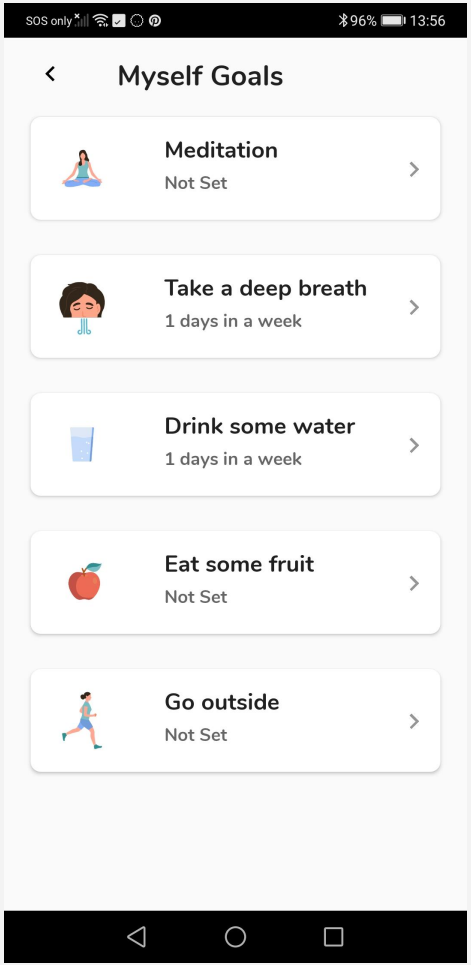
3. Remove additional scaling interaction when swiping between charts

Additionally I recommend showing the number of times each has been completed in the week

Goals

GOALS
ISSUES

1

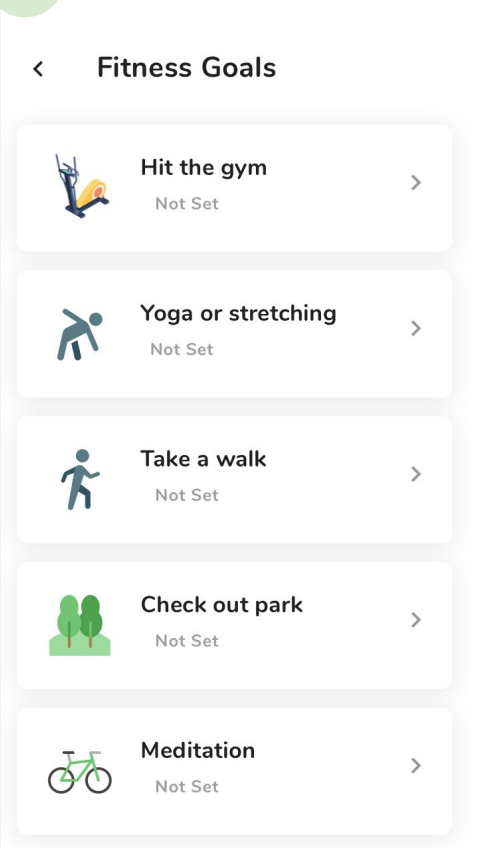


1

Too much padding between items.

GOALS SUGGESTIONS

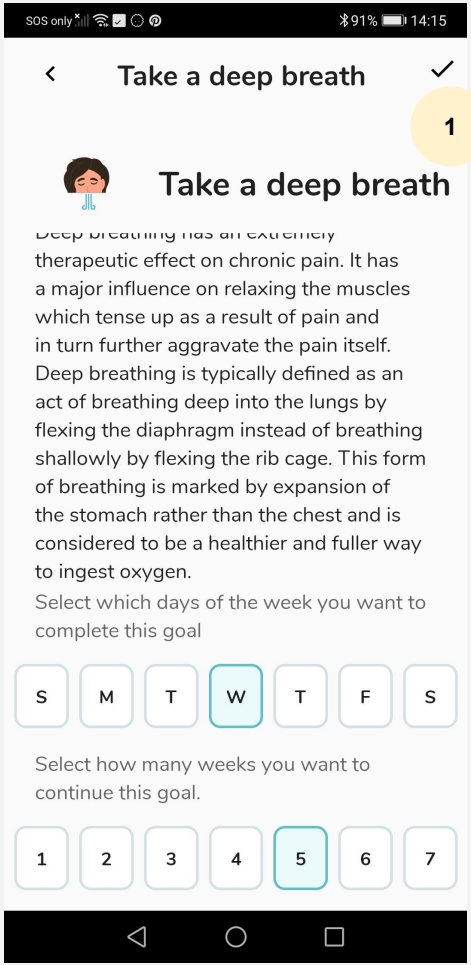
1



1

Reduce space between each goal.

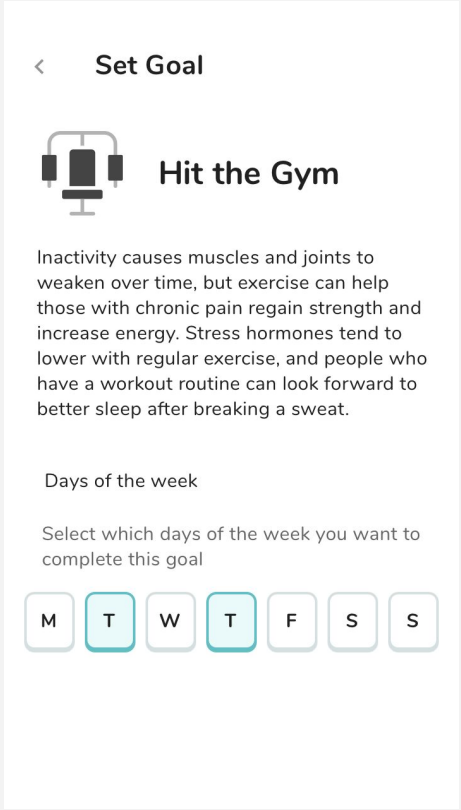
GOALS
POTENTIAL ISSUES



1

Fixed footer for selecting the frequency is too big and takes up too much of the screen.

GOALS SUGGESTIONS



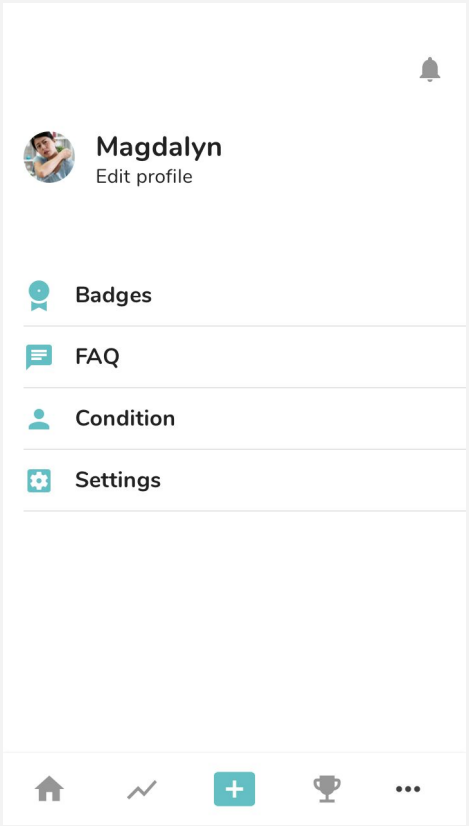
1

It would be better if there was no fixed footer, the user can scroll to the bottom of the page to add frequency.

Remove how many weeks you want the goal to run for. Only have day of the week you want to do the goal.

Navigation

Navigation
SUGGESTIONS



Navigation

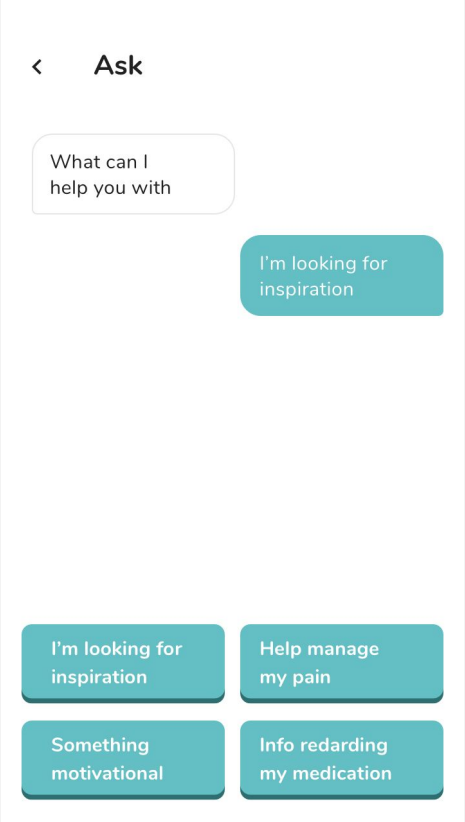
Condition allows the user to update the personalisation flow from the onboarding. (updating their treatment on the homepage)

Moved the chatbot to the more tab to help reduce the expectations of the chatbot.

Swapped goals to the main navbar to keep 5 tabs on the main navbar.

Chatbot

CHATBOT SUGGESTIONS



Simplified Chatbot

Create a simple multiple choice chatbot in order to remove errors in responses to free text questions