

UX Design & Evaluation of healthQB: A Mobile Application to Manage Chronic Pain

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Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Science

in the
School of Interactive Arts and Technology
Faculty of Communication, Art, and Technology

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SIMON FRASER UNIVERSITY
Fall 2021

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Abstract

Chronic pain is a significant health issue that negatively affects the quality of life of many individuals around the world and its prevalence is increasing each year especially among the older population. Researchers believe that chronic pain is a leading cause of disability which consequently might cause job loss, economic problems, and social isolation. Up to 88% of chronic pain patients have other comorbidities such as depression, anxiety, cardiovascular and pulmonary diseases, diabetes mellitus, and cancer, thus, it is considered as an independent risk variable for mortality. There are more than 6,000 mobile apps for chronic pain for different conditions such as diabetes, migraines, asthma, vision and hearing loss, osteoarthritis, anemia, and depression. The general purpose of current apps is to monitor and acquire information about a specific physical condition. However, recent studies highlighted that chronic pain is not only biological but also psychosocial. Therefore, embedding the biopsychosocial metrics in cure solutions dramatically affects the efficiency of chronic pain management. To the best of our knowledge, there is no effective tool or app that (1) assesses the biopsychosocial elements of chronic pain; and (2) monitors patient outcome using biometric data indicating the autonomic nervous system in response to provider care and self-directed interventions. HealthQB (HQB) Technologies Inc. has developed and commercialized a mobile app that collects biodata from a wearable device (Biostrap) and integrates it into psychosocial metrics and trait assessments to deliver comprehensive and ongoing real-time assessments and to recommend relevant self-directed interventions. In this research project, I aimed to evaluate the user experience (UX) of the HQB mobile app. Therefore, I conducted a qualitative research methodology to 1) evaluate the effectiveness and usability of the HQB app by focusing on app design, content, and its intervention algorithm 2) To identify the app issues as well as broken interactions and to recommend appropriate design solutions based on the UX insights and considering the UI and user interaction design adequacy 3) To create HQB user personas following the evaluation results. The UX evaluation results revealed that the equitability and accessibility of the HQB app should be improved. Besides, there are 44 design issues including UX, UI, Content, and Interaction issues which require re-design and enhancements. Moreover, the user persona of the app should be revised based on the users' characteristics and expectations. Finally, I have provided recommendations such as design solutions and enhancements for all the issues and areas that need improvement or revisions.

Keywords: Human-Computer Interaction; Patient-Centered Design; User Experience (UX); Chronic Pain; Digital Health; Wearables; Mood Tracking; Emotion Regulation; Biofeedback

To my dad for teaching me ambition and not being afraid of challenges!

To my mom for inspiring me to live, love, care and become a better version of myself!

To my siblings, Zahra, Elham, Reza, and Amir for their unconditional love and support!

I love you all.

Acknowledgements

Doing a master's degree after five years of Ph.D. studies is so challenging and at the same time rewarding. I learned a lot in the past two years and allowed myself to be deeply immersed in HCI/UX/UI design and research areas. This would not have been possible without the guidance and research freedom that my supervisor Prof. Brian Fisher provided me.

I would like to express my sincere gratitude to you, Brian, for your continued guidance and an endless supply of fascinating projects throughout this journey which mostly looked like postdoc research to me. You have expanded my intellectual research horizons in the field of HCI. I admire your unassuming approach to research and science, which is something I hope to carry forward throughout my career. I have been lucky to have a supervisor who responds to my questions so insightfully. Thank you, Brian!

I would like to express my deepest gratitude TWO TIMES to Prof. Halil Erhan. First, for being my co-supervisor and providing me insightful feedback to sharpen my thinking and brought my work to a higher level. His expertise was invaluable in formulating the research questions and methodology. Second, I would like to offer my special thanks to him for being the SIAT graduate chair, for listening to me when I needed to be heard when I was so tired. For all his support and help. Halil, this world needs more humans like you. I cherish you forever! Thank you ever so much!

I would also like to extend my gratitude to Dr. Sonya Cressman for her support, contribution and kindly evaluating my thesis and providing insightful feedback. Thank you very much Sonya!

Prof. Riecke, I appreciate your time and kind consideration of being my committee chair.

Also, I would like to extend my sincere thanks to Tiffany, Desiree and, Lisa for all their assistance at every stage of my studies at SIAT.

Another person who has helped me a lot is Catherine Louie, Research Commons Library Assistant. Catherine, I cannot say thank you enough to you! You made a difference in my thesis. I really appreciate it.

I also thank all members of the Integrated Science lab. Besides, I am deeply grateful to the healthQB team for the good times we spent together. I have learned a lot while working at healthQB. I also thank you Dr. Azadeh Forghani for her help during this study.

I would also like to acknowledge the funding I received from MITACS Canada, The MDA (MacDonald, Dettwiler, and Associates) Canada, which gave me the peace of mind to focus on research and growth.

Last but not least, I am extremely grateful to my parents and my siblings. You are my source of energy and motivation. I love you so much.

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List of Acronyms

ANS	Automated Nervous System
App	Application
BPS	BioPsychoSocial
CIC	Citizenship and Immigration Canada
HQB	HealthQB
HRV	Heart Rate Variability
HRV-CV	HRV-Coefficient of Variation
IxD	User Interaction Design
MHA	Mobile health applications
ROI	Return of Investment
RSs	Recommender Systems
UiD	User Interface Design
WHO	World Health Organization

Chapter 1.

Introduction

Chronic pain is a significant health issue that negatively affects the quality of life of many individuals around the world [1, 2] and its prevalence is increasing each year especially among the older population[3]. Researchers believe that chronic pain is a leading cause of disability [4] which consequently might cause job loss, economic problems, and social isolation [5]. Up to 88% of chronic pain patients have other comorbidities such as depression [4], anxiety, cardiovascular and pulmonary diseases, diabetes mellitus, and cancer [6] [7], thus, it is considered as an independent risk variable for mortality[8].

Recent studies highlighted that chronic pain is not only biological but also physiological, psychological and sociological so called “biopsychosocial” [9, 10]. In 2019, the World Health Organization (WHO) also announced that chronic pain is “BioPsychoSocial” (BPS) condition [11]. As Figure 1 depicts, the PBS model of pain presents how physical factors (pain experience) affected and is affected by biological, psychological, and social factors[12]. Therefore, embedding the biopsychosocial metrics in cure solutions dramatically affects the efficiency of chronic pain management [13]. However, many medical practitioners do not acknowledge the bidirectional of these factors [14] [9].

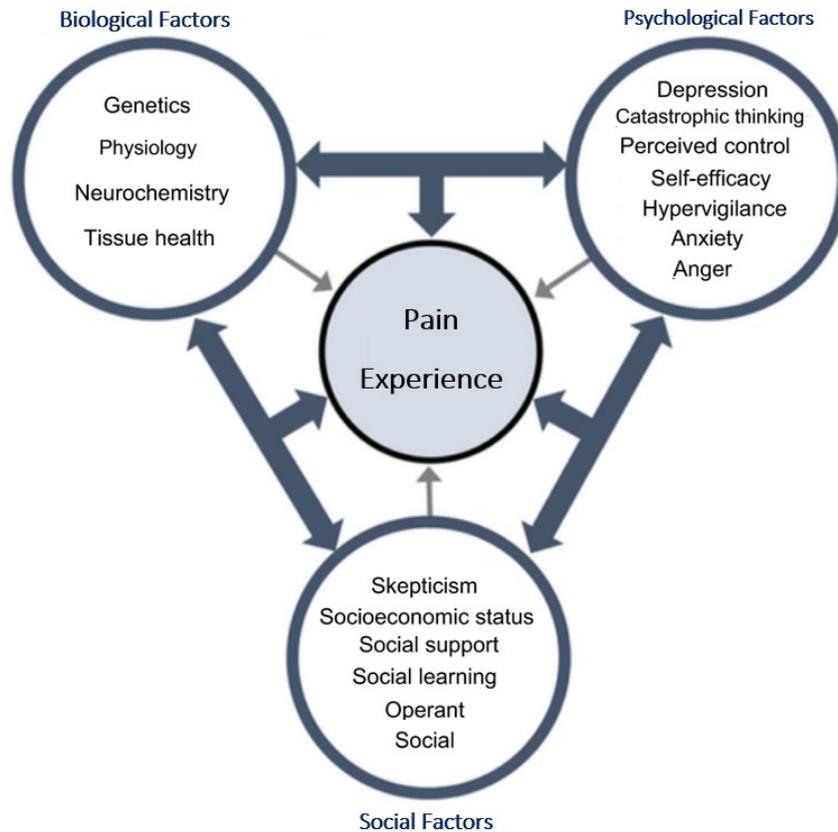


Figure 1: BioPsychoSocial (BPS) Model of Pain [12]

There are more than 6,000 mobile apps for chronic pain focusing different conditions such as diabetes, migraines, asthma, vision and hearing loss, osteoarthritis, anemia, and depression [1, 15]. Functions of existing pain applications are divided into three major categories: (a) general information about pain, its symptoms, and treatment options, (b) diary-based tracking of symptoms, medication use, and appointment reminders; and (c) general interventions for pain management, mostly relaxation strategies [16]. Besides, by review of the literature, I have identified the following shortcomings with the existing chronic pain apps.

The main purpose of current apps (54%) is to monitor and acquire general information about a specific physical condition [16-18]. Most of the existing app did not provide effective interventions for chronic pain, and only 17% included an intervention hence it was reported that the majority of current apps are not considered as health-care professional involvement [19].

Most of the apps rarely adhere to biopsychosocial model which is a scientifically proven concept for improvement of chronic pain[20]. Consequently, the foundation of existing pain apps is not based on the recent scientific findings with a very superficial understanding of chronic pain and only commercial purposes which makes them general public and nonclinical solutions [16-18].

Following the above- mentioned shortcoming, despite the commercially abundance and frequency of chronic pain apps, the scientific evaluation of the apps is scarce [20, 21].

To the best of our knowledge, there is no effective tool or app that (1) assesses the biopsychosocial elements of chronic pain; and (2) monitors patient outcome using biometric data indicating the autonomic nervous system in response to provider care and effective self-directed interventions. HealthQB (HQB) Technologies Inc. has developed and commercialized a mobile app that collects biodata from a wearable device (Biostrap) (Figure 2) and integrates it into BPS and Automated Nervous system (ANS) metrics and trait assessments to deliver ongoing real-time assessments and to recommend effective self-directed interventions. Biostrap is a clinical quality pulse oximeter to collect overnight biometric data. It pairs a wrist-worn tracker with a shoe pod sensor. The wristband counts the steps, monitors the sleep, tracks the resting heart rate, heart rate variability, respiratory rate, and oxygen saturation. The wristband is paired with HQB app via Biostrap app. Hence, the user needs to install Biostarp app along with HQB app to sync the wristband. The target customers have allied healthcare practitioners and their chronic or persistent pain clients. The third version of the HQB app is now available through Google Play and Appstore.

I have personally got involved in the whole process of HQB design and development of app during my internship at HQB company. I have been involved in all of the HQB design sections either as a consultant to provide feedback on the prototypes or as a UI/ UI designer specifically for the recommendation (BPS intervention) section.

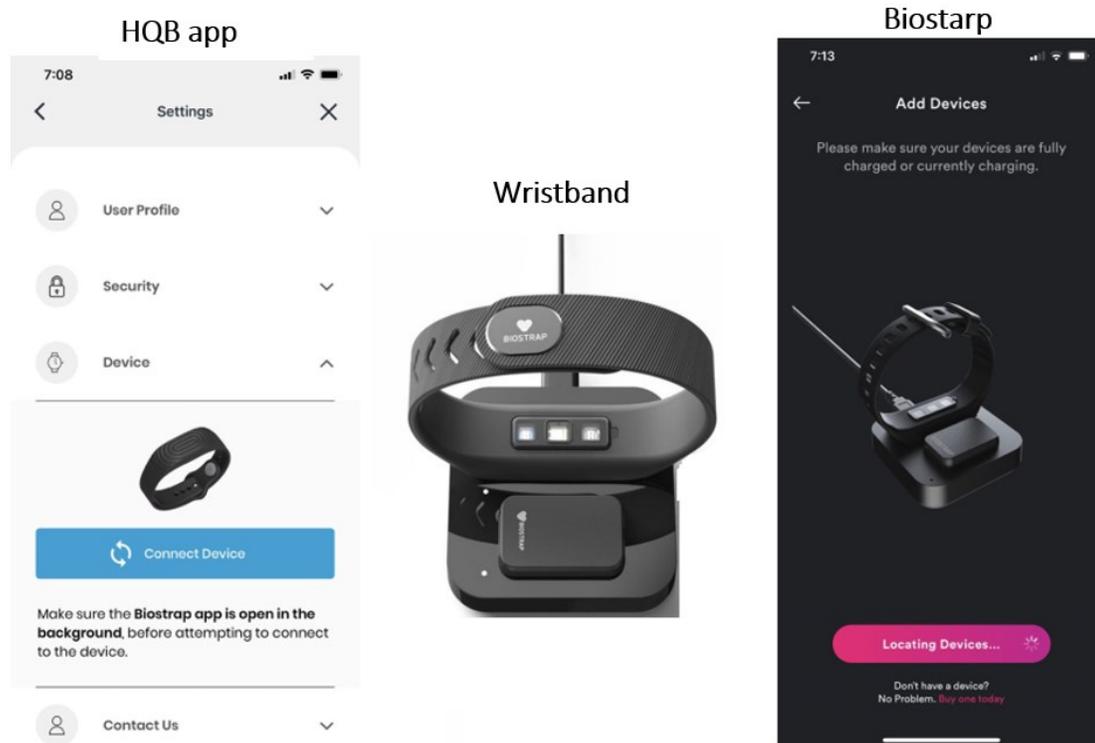


Figure 2: Three main elements of HQB platform
 Photo Source for Biostrap: Retrieved from <https://biostrap.com/>

In this research project, I aimed to evaluate the user experience (UX) of the HQB mobile app. Therefore, I conducted a qualitative research methodology with 11 patients using four methods of semi-structural interview, cognitive walkthrough, and observation as well as ABC testing in order to scientifically evaluate the usability and effectiveness of the HQB app and to identify the issues and accordingly provide applicable recommendations for developing more accessible and efficient chronic pain management apps.

The urge to conduct this research was due to investigate if the HQB app can fill the current gaps and address the existing chronic pain app issues discussed above which are also the source of motivation for conducting this research. Besides, in this study, I highlighted the user persona of chronic pain patients and recommended relevant design solutions which are based on the chronic pain patients' needs. Hence, it could be a source of information for other researchers to design effective and usable platforms for chronic pain management.

1.1. Research objectives

The main aim of this research was to provide UX insights an efficient recommendation for app development of chronic pain management using HQB app as a case study. I listed the objectives for achieving the main goal of my research.

- 1) Objective 1: To evaluate the effectiveness and usability of the HQB app by focusing on app design, content, and its intervention algorithm.
- 2) Objective 2: To identify the app issues as well as broken interactions and to recommend appropriate design solutions based on the UX insights and considering the UI and user interaction design adequacy.
- 3) Objective 3: To create HQB user personas following the evaluation results.

1.2. Research Questions

- 1) How to evaluate the effectiveness and usability of the HQB app by focusing on app design, content, and its intervention algorithm?
- 2) What are the app issues as well as broken interactions and appropriate design solutions?
- 3) What is the HQB user persona following the evaluation results?

1.3. Research Contribution

This thesis makes contributions in research and application of tools that can empower the people who are suffering or helping others who suffer from chronic pain. I briefly describe them below.

1.3.1. Decipher of biopsychosocial approach impact

By achieving Objective 1, I investigated the usability of HQB app for chronic pain management. The results give a deeper understanding of how biological, psychological, and social aspects influence on chronic pain management and could be the source of inspiration for formulating the more research studies in this area for the future.

1.3.2. Algorithm enhancement

In this research though a qualitative method, I examined the performance and usability of the HQB algorithm which generates interventions and provide recommendations for its enhancement.

1.3.3. Design and re-design enhancement

No matter how accurate the algorithm works, if the UI design (UiD) and interaction design (IxD) are poorly implemented, it negatively affects users' experience and might create an unpleasant and annoying experience for users. In this research, I attempted to investigate the UiD and IxD adequacy of HQB app and proposed design enhancements that I discussed them in chapter 5. These design suggestions could be applicable in the similar apps too.

1.3.4. Application of qualitative UX evaluation

This research emphasizes on running qualitative UX evaluation. In these days, many companies highly value UX quantitative research because it could reveal the products' problems and identify suitable methods for addressing the problems. Hence, the results of UX evaluation could play a key role in businesses' decision making.

1.3.5. Helping with fund raising

In these days, many companies especially startup rely on UX research for fundraising. Through the UX evaluation and research, the end users' requirements and their behavior are identified and exploited for providing a satisfying experience. In this study, I identified the usability and effectiveness of HQB app for chronic pain management using acceptable evaluation methods and metrics. This area is new therefore measuring users' satisfactions and providing feedbacks are considered as a success factor and could lead to fundraising for HQB company.

1.3.6. Opinion Contributions

There are a few open areas that may provide a step forward to extend this research. The future researchers are encouraged to investigate the impact of BioPsychoSocial (BPS) metrics in people's lives. Also, the identification and efficacy of all possible interventions for chronic pain management could be an open area for more investigation. Besides, making more novel interventions and the suitable ways to put them into practice for patients are other open area for the interested researchers. I discuss the open research areas more in Chapter 6.

1.4. Research Methodology

I mainly adopt the qualitative research methodology. As Figure3 illustrates, I applied four methods of observation and semi structured interview, cognitive walk-through as well as ABC testing to evaluate the different aspects of HQB app. I elaborated the research methodology and test logistics in Chapter 3.

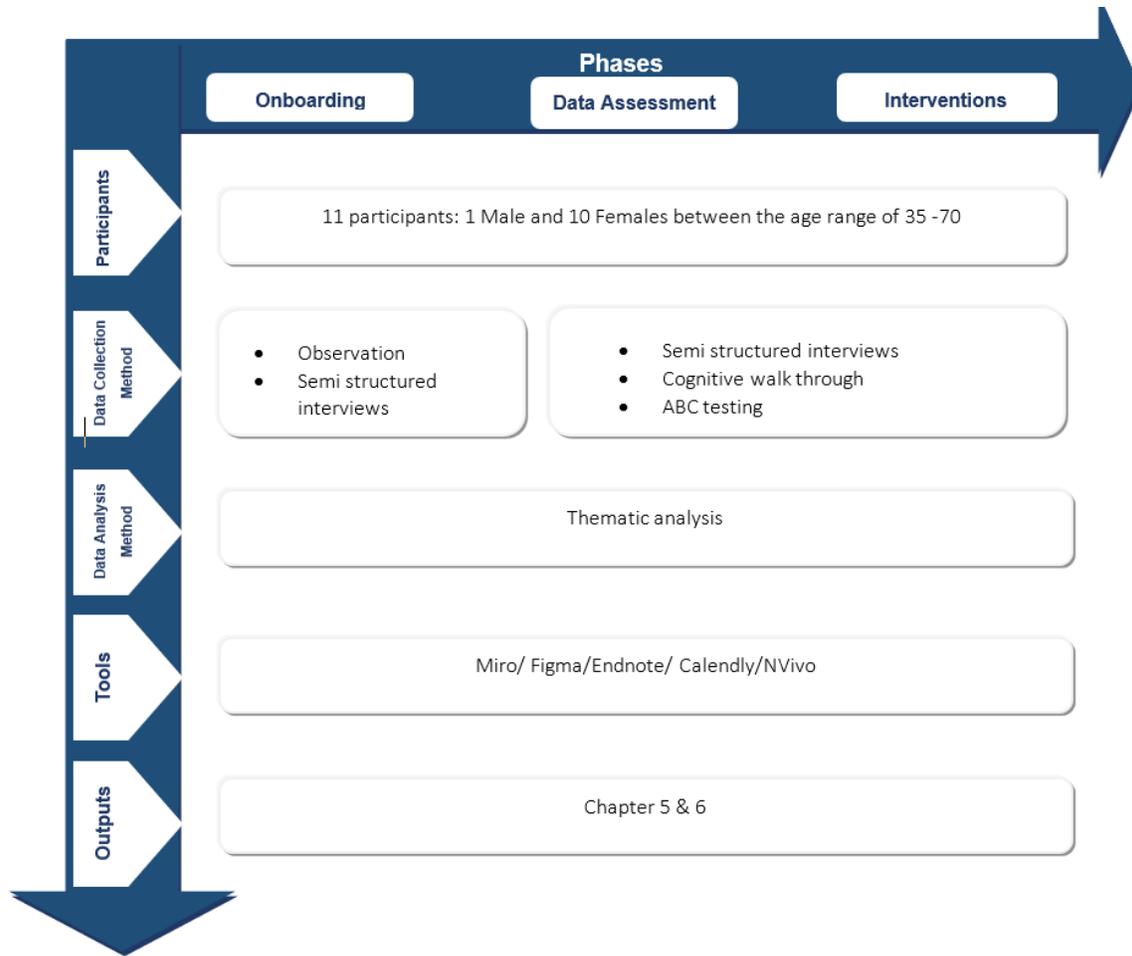


Figure 3: Research methodology and evaluation methods

1.5. Scope & Limitation

This research is an intersection of three main areas HCI, Information Systems (Data Visualization) and Medical Science. As Figure 4 depicts, UX Design, User evaluation, and UI are under the HCI area. Recommender systems research is an interdisciplinary research area, but they are mainly under the information filtering systems and data visualization. Finally, HQB is an app for chronic pain, so part of this research is related to Medical Science. However, the main goal of this study is to conduct a deep UX/UI evaluation of HQB. Therefore, this research attempts to step forward in creating effective chronic apps from a HCI perspective.

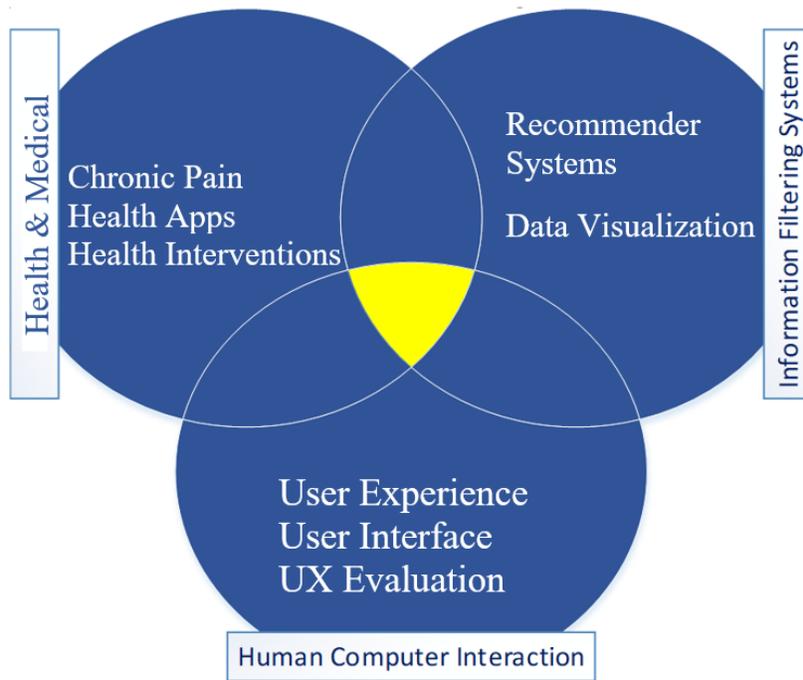


Figure 4: Research Scope

Chapter 2.

Background & Related Work

2.1. Research Background

2.1.1. Chronic pain

Chronic pain is a significant health issue that negatively affects the quality of life of many individuals around the world. It affects at least 10 percent of the world's population, approximately 60 million people [22]. Based on the report of Citizenship and Immigration Canada (CIC) in June 2019¹, one in five Canadians lives with chronic pain. When pain lasts for a long time (e.g., longer than 6 months [11]), it influences all aspects of people's life such as job, education, entertainment, family, friends, and community engagement. Consequently, unmanaged pain exerts an enormous personal and economic burden [2] [9] which causes anxiety, depression, isolation, hopeless and for some Canadians, it also has led to poverty, homelessness, and even suicide².

Pain is a complex phenomenon and arguably one of the most disruptive conditions prompting consumers to seek medical and self-management advice from healthcare professionals [18]. To this date, there is not any clear and unanimous definition for chronic pain. Chronic pain is generally used as an umbrella term referring to a wide range of clinical conditions, such as fibromyalgia, migraine, or long-standing pain states without actual known causes[23] [2]. Hence, labeling a patient's clinical condition dealing with lasting 3 months pain might be misleading.

2.1.2. Chronic pain as BioPsychoSocial (BPS) condition

In 2019, the World Health Organization (WHO) recognized chronic pain as a condition that is biological, psychological, and social [11] [9] so-called BioPsychoSocial (BPS).

^{1/2}. Reference, <https://www.canada.ca/en/health-canada/corporate/about-health-canada/public-engagement/external-advisory-bodies/canadian-pain-task-force/report-2019.html>

The BPS model was conceptualized for the first time by George Engel in 1977 [24] to understand a person's medical condition. Recently, a pain-oriented BPS model version has appeared which concentrates on several traits that describe patient's condition as a physical body (bio), a human being (psycho), and a relational being (social) [24, 25]. It considers the traits that characterize patients across time, and specifically on those which are important for their sense of wellbeing. Therefore, improving on these traits will likely result in improvement of patients' overall state and wellbeing. There are some primarily studies discussing biopsychosocial aspects of chronic pain however, there is still not enough studies and guidance for producing effective platforms or tools that can assess the condition of chronic pain through a biopsychosocial lens. HeatHQB, a Vancouver based Startup company, is trying to exploit the BPS model and to integrate it with Automated Nervous system (ANS) in order to develop an app for the chronic pain.

2.1.3. Automatic Nervous System (ANS)

ANS is an ancient part of the nervous system that regulates stress response [26] and works deeply unconsciously, however it significantly affect the stress and calmness as well as a balanced life experience. Despite the importance and influence of ANS on a wellbeing condition, there is neither physical access to ANS nor an effective ANS medication or treatment [26, 27]. Instead, there are factors, habits, circumstances, and practices that may impact the health of ANS. HQB aims to identify factors can result in the fastest improvement for a patient's ANS. As Figure 5 depicts, ANS is best described by two metrics: ANS- Heart Rate Variability (ANS-HRV) and HRV-Coefficient of Variation (HRV-CV).

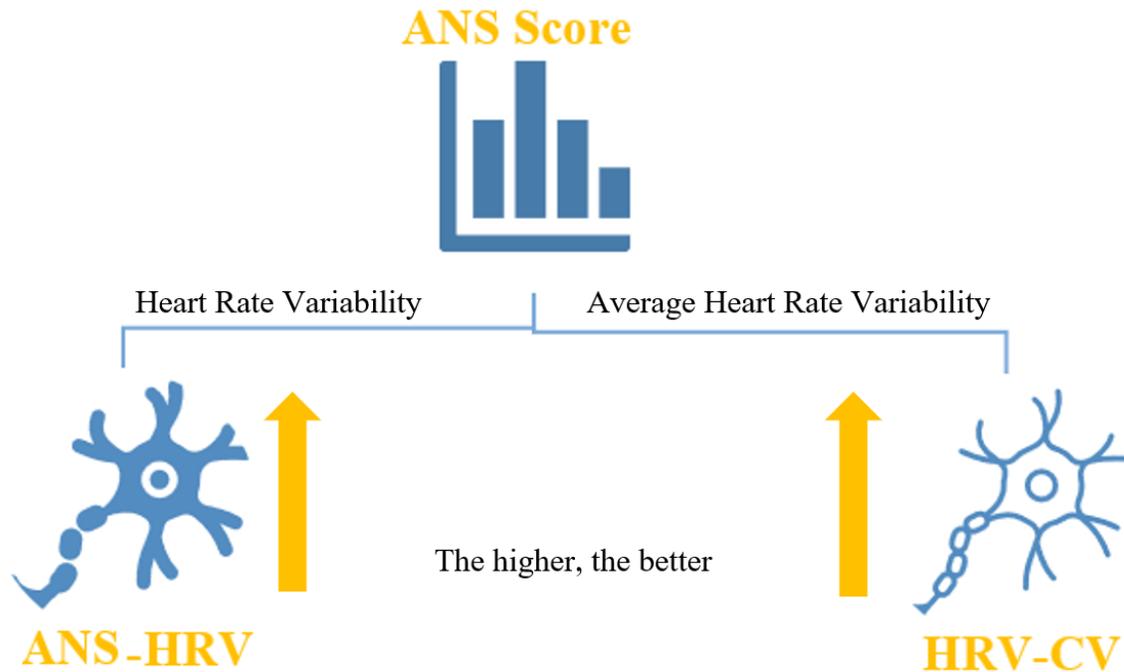


Figure 5: Two metrics for assessing Automated Nervous System (ANS)

ANS-HRV is a recognized metric in the assessment of ANS activity which reflects restorative capacity of patient’s ANS [28]. The higher ANS-HRV score is, the more quickly and efficiently the patient can restore after a workout or a stressful situation. This restorative capacity is what determines how much mentally and physically stress and challenge people can allow into our lives.

HRV-CV is the amount of day-to-day variability in person’s HRV scores (average of ANS-HRV score over the past week) [28]. A high HRV-CV score means that restorative capacity (or resilience) of person’s ANS is constant across days, seasons, and circumstances. A low score means that restorative capacity of your ANS depends on the circumstances: one day it is high, another day it is low. This instability and unreliability, hampers the sense of wellbeing, and could be related to negative outcomes. ANS-HRV and HRV-CV scores are equally significant and important. HealthQB aim is to stabilize the ANS first, and then improve its overall resilience. HQB solution prioritizes working on HRV-CV first, and HRV second.

2.1.4. Wearables & technologies for chronic pain

Over the last decade, there has been interest in developing digital health technology products that can support self-management of chronic pain conditions [29, 30]. Pain self-management by patients can be enhanced via the use of mobile apps and other wearable and digital health technologies [31, 32]. Figure 6 illustrates a few samples of these wearable devices. Several apps have been developed to support patients self-reporting their pain, in terms of pain intensity, time and frequency[33] [34]. However, as I mentioned earlier, most health-related apps have been mainly focused on monitoring and collecting data and less on behavioral health interventions [35, 36]. Moreover, as I pointed out before, there is rare studies on apps applying BPS and ANS models.



Figure 6: Wearables example for chronic pain

Photo Source: <https://www.walmart.com/ip/WiTouch-Pro-TENS-Unit-for-Back-Pain-Relief/162790088>

2.1.5. Why research on HQB app?

I chose HQB as a case study to examine how usable and effective is this app to manage chronic pain by using ANS and BPS Models. In addition, I aimed to identify the design issues to provide design guidance and accessibility solutions that might be applicable for similar apps to support the treatment of chronic pain-related symptoms. Maybe as a secondary, my involvement in the development of this tool over the last year gave me

an opportunity to learn its software features that otherwise is not directly possible in other available platforms. A study building on one tool alone may be generalizable, however can provide enough insight transferable to the design of other systems with similar intent. The need to conduct this research is due to investigate if such apps can address the discussed issues, which are also the source of motivation for conducting this research.

2.1.6. HQB app

As I stated earlier, HQB tracks the patient body's vital signs during the night with an advanced wearable wristband and computes ANS scores that can be used for discovering the disruptions in a patient's well-being. As mentioned earlier, First users need to sync the Biostarp wristband to HQB app so it can capture the data from the user's body each night.

Then, the users need to start wearing the wristband every night, each night their physical data is captured through the wristband, they also need to respond 5 different assessments that they are mainly about the patients' psychological and social status of the patients (Figure 7- Sec.1). After at least 10 days, patients will receive three areas that they need to improve which help them to manage their chronic pain. These areas are based on their BPS scores (Figure 7-Sec.2).

Please note that throughout this thesis, when I use the data assessment term, I refer to the HQB data assessment part which I explained clearly before. Also, when I apply the data collection term, I refer to the first methodology phase which I collected the data for this UX evaluation research. I have discussed the whole process of data collection methods and procedures in Chapter 3 of my thesis.

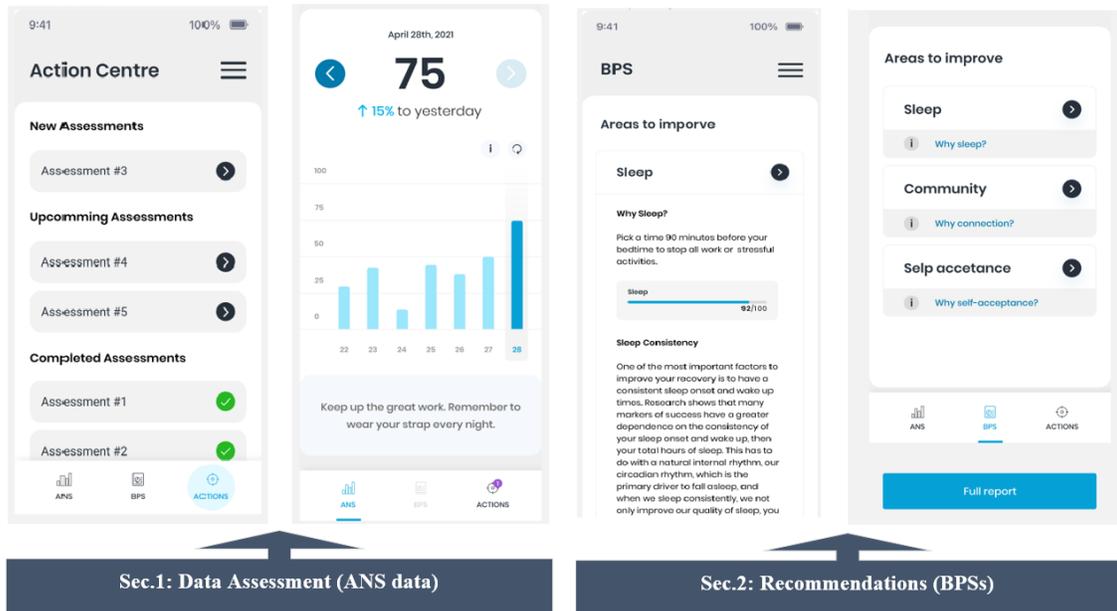


Figure 7: Presenting data assessment and recommendation in HQB app

2.1.7. UX Evaluation

Doing UX test the right way, at right time with the right set of people reduces the risk of building the wrong product; consequently, it saves time, money, and other precious resources [37]. In other words, if it is performed at an early stage even using a paper prototyping, it catches the issues which are cheap to fix. And if it is ran using a developed product, it helps to examine the user’s experience and satisfaction. There are hundreds and thousands of cases when UX testing proved to be a good exercise in terms of Return of Investment (ROI) [38]. UX testing is not beneficial only for the designers, but it is valuable and useful for all the stakeholders such as CEO, Managers, Marketers, Clients as well as developers [39]. For this research, I believe using UX evaluation helps healthQB company to Examine the effectiveness and usability of the product for chronic pain.

2.2. Related Work

There are more than 6,000 mobile apps for chronic pain focusing different conditions such as diabetes, migraines, asthma, vision and hearing loss, osteoarthritis, anemia, and depression [1, 15]. Functions of existing pain applications are divided into three major categories: (a) general information about pain, its symptoms, and treatment options[35], (b) diary-based tracking of symptoms, medication use, and appointment reminders; and (c) general interventions for pain management, mostly relaxation strategies [16] [40-43]. Approximately 40% of health related apps with self-management components promote healthy lifestyles [10, 44] [45]. Figure 9 shows components and interventions that existing apps apply to manage chronic pain [46] [47].

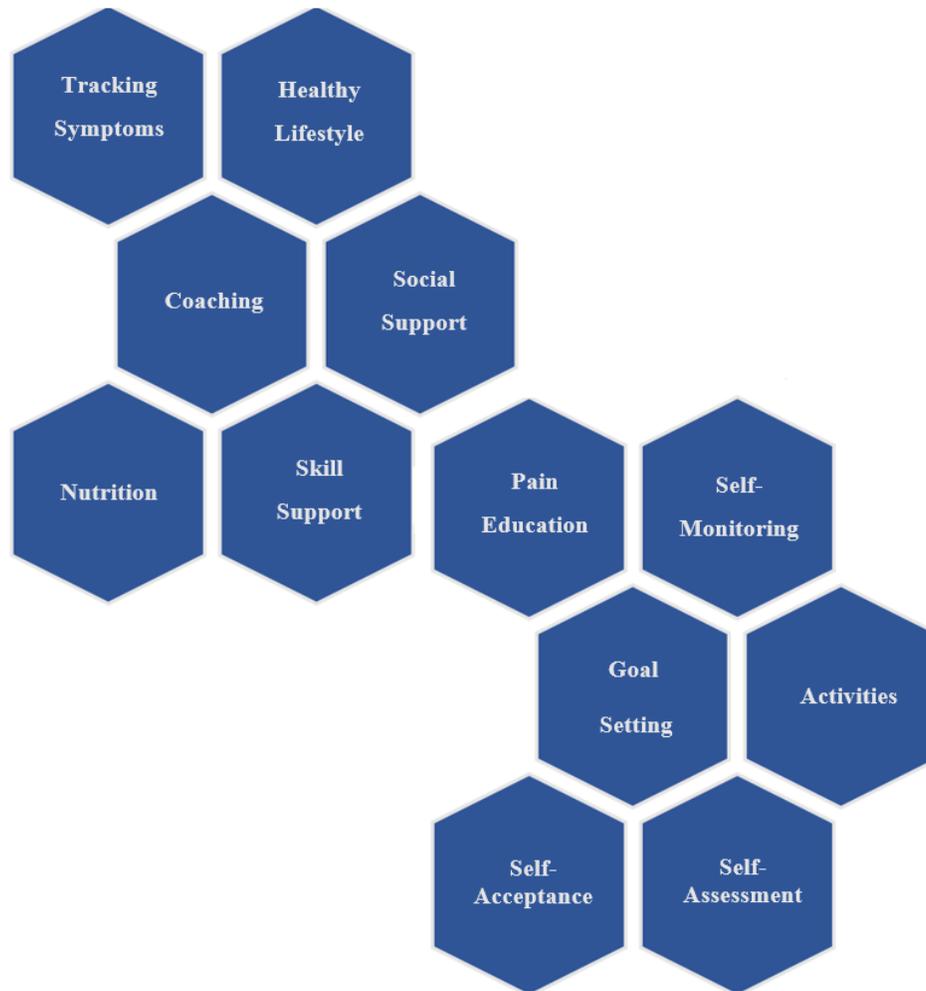


Figure 8: Chronic pain interventions/components

Several applications have been developed to support patients self-reporting their pain, in terms of pain intensity, time and frequency [48, 49] [50]. Rodriguez et al. proposed wearables with interactive displays to allow users to input information about their pain [51]. Pain apps that are directed at tracking pain levels, activities and goal setting have been assessed in hopes of supporting self-management of chronic conditions in rural regions where access to clinicians is rare [52]. These applications promise new avenues for patient-clinicians' interactions, however adherence rates are still low. Rodriguez et al. [51] studied how to design wearable devices that allow older adults with chronic pain to self-report complex information such as pain level and emotional states. Stinson et al. [53] studied needs of patients and health care providers to inform the development of an online chronic pain self-management program for adolescents, called iCanCope with Pain. These studies successfully explore the design requirements for development of a product to support chronic pain, however they lack the evaluation of these designs in the field in respect of the interaction between the end user patient and his or her clinician. While the foregoing applications and devices reviewed promise new avenues for patient monitoring and self-management, it is unclear from the studies what is the adoption by users of the applications and devices. Particularly, in the case where the after-care data is generated for use by the clinician in guiding treatment, both user groups (clinician and patient) and the interaction between the patient and the clinician with respect to the data generated must also be studied to assess adoption. Besides, several concerns affect the widespread use of smartphone pain apps including

- 1) Security issues and concerns over privacy and confidentiality of personal data [21] [54].
- 2) The need for technical support due to issues with the syncing the wristbands [21].
- 3) The increasing cost which may limit the use of these wearable technologies [21].
- 4) Limited evidence that these technologies are effective on health-care [55] [56] [16, 57] .

In summary, I have identified the following main shortcomings with the existing chronic pain apps by reviewing the literature.

- 1) As Figure 10 depicts, the main purpose of current apps (54%) is to monitor and acquire general information about a specific physical condition [16-18]. Most of the existing app did not provide effective interventions for chronic pain, and only 17% included an intervention hence it was reported that the majority of current apps are not considered as health-care professional involvement [19].

The number of apps specifically focused on pain is rapidly growing; there exists upwards of 300 pain apps with self-management components[58]. Also, traditional interventions are not always an effective treatment strategy for pain control [59, 60].

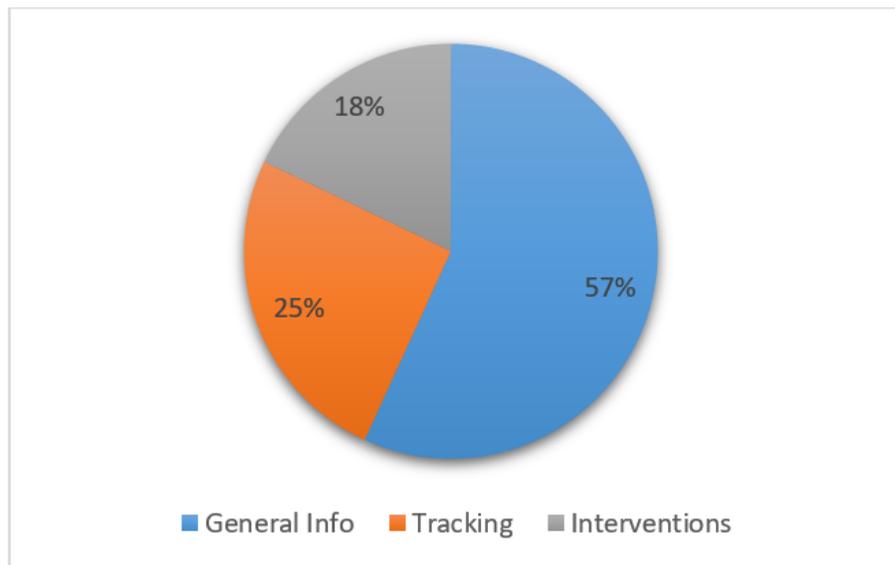


Figure 9: Chronic App's purposes

- 2) Most of the apps rarely adhere to biopsychosocial model which is a scientifically proven concept for improvement of chronic pain[20]. Consequently, the foundation of existing pain apps is not based on the recent scientific findings with a very superficial understanding of chronic pain and only commercial purposes which makes them general public and nonclinical solutions [16-18].
- 3) Following the above- mentioned shortcoming, despite the commercially abundance and frequency of chronic pain apps, the scientific evaluation of the apps is scarce [20, 21].
- 4) While the foregoing applications and devices reviewed promise new avenues for patient monitoring and self-management, it is unclear from the studies what is the adoption by users of the applications and devices [61]. Particularly, in the case where the after-care data is generated for use by the clinician in guiding treatment, both user

groups (clinician and patient) and the interaction between the patient and the clinician with respect to the data generated must also be studied to assess adoption.

To the best of our knowledge, there is no effective tool or app that (1) assesses the biopsychosocial elements of chronic pain; and (2) monitors patient outcome using biometric data indicating the autonomic nervous system in response to provider care and effective self-directed interventions. As mentioned before, HealthQB (HQB) Technologies Inc. has developed and commercialized a mobile app that collects biodata from a wearable device (Biostrap) and integrates it into BPS and Automated Nervous system (ANS) metrics and trait assessments to deliver ongoing real-time assessments and to recommend effective self-directed interventions. The target customers have allied healthcare practitioners and their chronic or persistent pain clients. The third version of the HQB app is now available through Google Play and Appstore. I have personally got involved in the whole process of HQB design and development app during my internship at HQB company.

In this research project, I aimed to evaluate the user experience (UX) of the HQB mobile app. Therefore, I conducted a qualitative research methodology with 11 patients using four methods of semi-structural interview, cognitive walkthrough, and observation as well as ABC testing in order to scientifically evaluate the usability and effectiveness of the HQB app and to identify the issues and accordingly provide applicable recommendations for developing more accessible and efficient chronic pain management apps. Also, the proposed research was aimed at understanding and predicting the adoption rate for a proposed commercialized platform for providing essential insights into the user experience that will be included in the design specifications for the commercialized product. This could help to address some of the concerns such as how the HQB recommendations needs to be communicated with allied health practitioners and the patients and how it can be adopted in a long-term usage.

The urge to conduct this research was due to investigate if the HQB app can fill the current gaps and address the existing chronic pain app issues discussed above which are also the source of motivation for conducting this research. Besides, in this study, I

highlighted the user persona of chronic pain patients and recommended relevant design solutions which are based on the chronic pain patients' needs. Hence, it could be a source of information for other researchers to design effective and usable platforms for chronic pain management.

Chapter 3.

Methodology

3.1. Qualitative methodology

I applied four methods of observation and semi structured interview, cognitive walk-through as well as ABC testing to evaluate the different aspects of HQB app.

3.1.1. Observation

Using observation method with asking users to think loudly can provide insight that testers might not even know they are missing. User observation helps to understand the usability problems and to empathize with the user and to uncover a lot of hidden messes. Observing users while they are interacting with the product extracts users' behaviors and attitudes[62]. I applied the observation method to examine the onboarding process of HQB app and to identify issues with syncing the device.

3.1.2. Semi structures interviews (SSI)

In a Semi-structured interview, the interviewer and respondents engage in a formal interview. Semi-structured interviewing, according to Galletta (2013) [63], can provide reliable, comparable qualitative data and the inclusion of open-ended and follow up questions provide the opportunity for deeply understanding the topic. I utilized SSI to assess the user experience of HQB for the whole journey when they are interacting with the app. This method mainly helped me to create the HQB user personas.

3.1.3. Cognitive Walkthrough (CW)

CW is one of the famous usability methods from an engineering perspective which is applied by designer in order to catch the UI issues [64, 65]. In this method, the users are given fairly structured tasks in service of well-defined goals to follow how they do the tasks and what paths or actions they take in order to complete the given tasks. It helps to

identify the broken interactions and the parts that users get stuck due to insufficient information or guide [66]. I applied CW method to examine the usability of the app and ANS and BPS data visualization.

3.1.4. ABC testing

Designers usually apply the ABC test to determine whether how useful are different design solutions as A, B and C design option solutions. I performed this test to get users' feedback on some design solutions such as data assessment and ANS and BPS data visualizations.

3.2. Timeline

As Figure 10 depicts, I started the logistics on 1 July 2021 and finished the data collection on 23 August 2021. The data analysis was started on 15 August and a complete report was released on 23 September 2021.

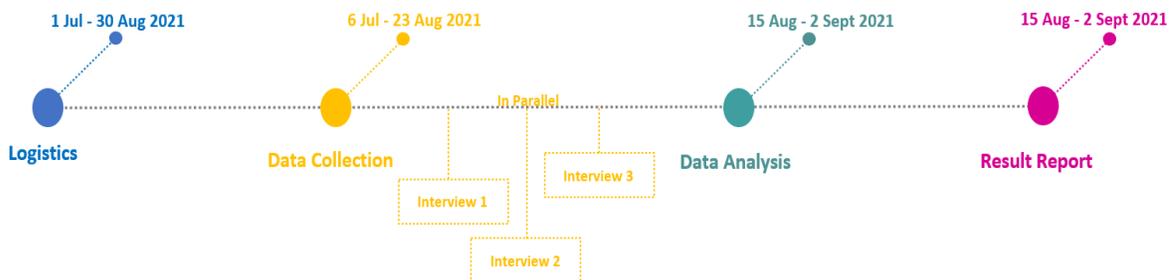


Figure 10: HQB-Test timeline

3.3. Test Plan

First, I provided a test plan for HQB (Figure 11). I ran the test sessions several times to examine the user journey in different milestones. The test plan is provided on a Miro board which is accessible [through this link](#). For details, please refer to this test plan.

I have arranged the interview time based on the availability of the participants. Also, I did my best to do the test tasks/interview sessions in parallel to minimize the test time. For

example, while I was doing interview 1 (onboarding) if a participant was ready for interview 2, I did it in parallel to interview 1.

3.4. Logistics

In the following sections, the overall process of test implementation and how participants and resources were acquired are discussed. Figure 12 depicts the flow of the logistic activities.

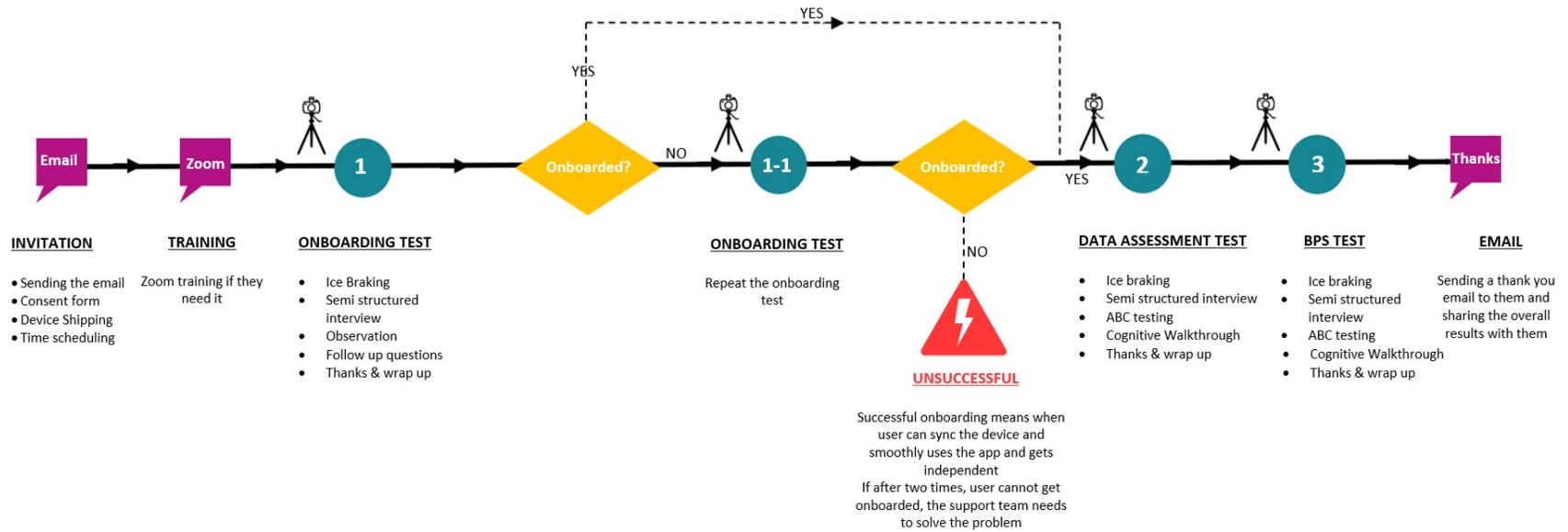


Figure 11: HQB Test Plan

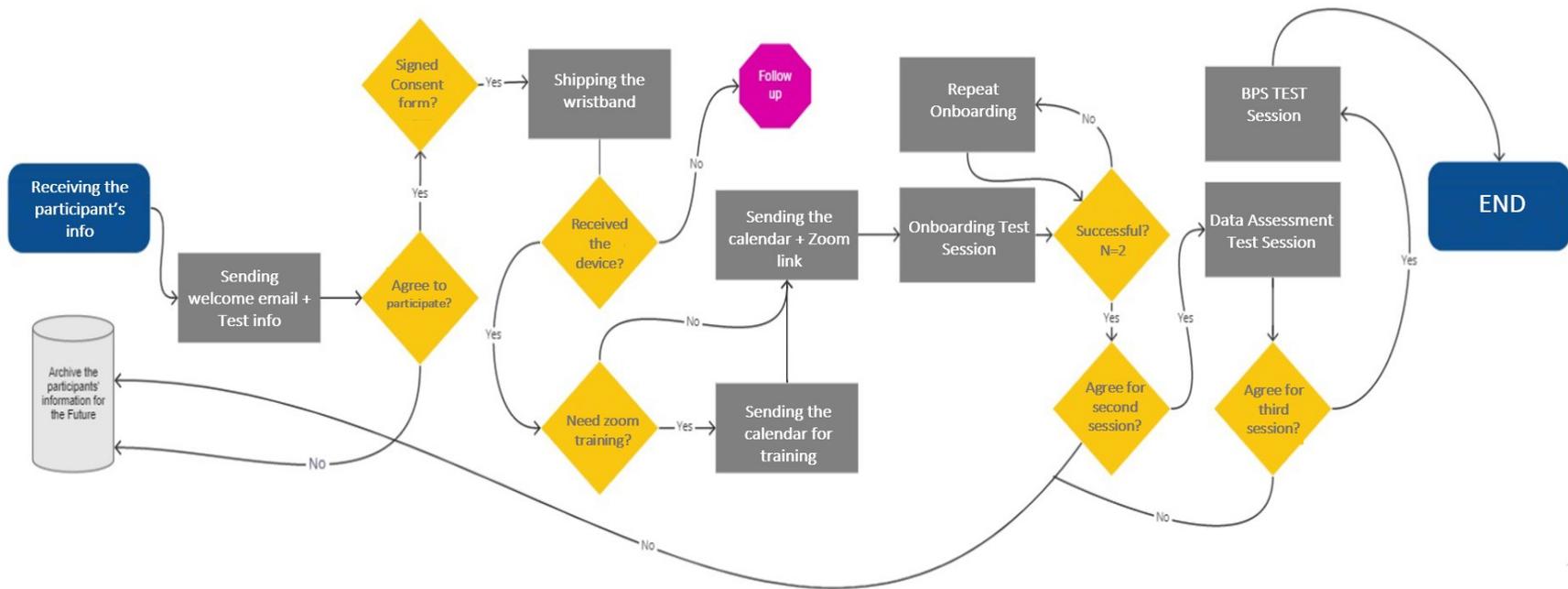


Figure 12: Test activities and logistics flow

3.4.1. Participants' Recruitment

I recruited participants through HQB networks and Customer Advisory Board as well as practitioners' networks who work or collaborate with HQB.

3.4.2. Location of Study

This study took place completely remotely over zoom due to the COVID 19 restrictions. For all interviews, I made a single zoom link room, and I used it throughout the test for all participants and test sessions.

3.4.3. Participants' Compensation / Benefits and Risks

Participants in this UX research did not require to pay the estimated \$200 price for the baseline program. A free Biostrap device has been shipped to them. Participants (patients and practitioners) did not benefit directly by participating in the study. The risks of the study are expected to be none or minimal.

3.4.4. Sample of corresponding

I first invited the participants through an invitation email (Appendix A). After receiving the participants' agreement and signing the consent form ([available through this link](#)), the HQB administrator shipped the Biostarp device to them. Once users receive the device, I send another welcome message along with a calendar (Figure 13) along with a zoom link for users to pick their time slots.

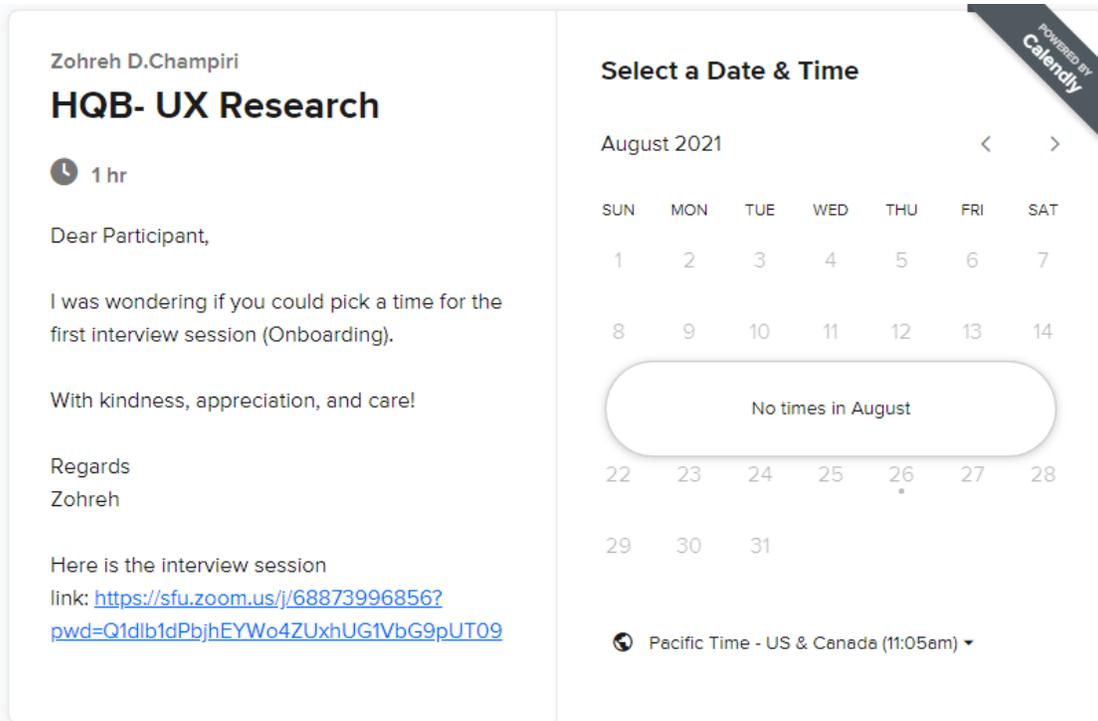


Figure 13: Calendar for picking the time for interviews

I sent the welcome message mail WITHOUT any instruction about the app and syncing the device ([the instruction is available through this link](#)) since I wanted to observe their behavior without any pre-knowledge and background. Besides, I sent out (through the welcome message) a google form to get some users' primary information and to see if they need zoom training & screen monitoring ([zoom instructions are available through this link](#)).

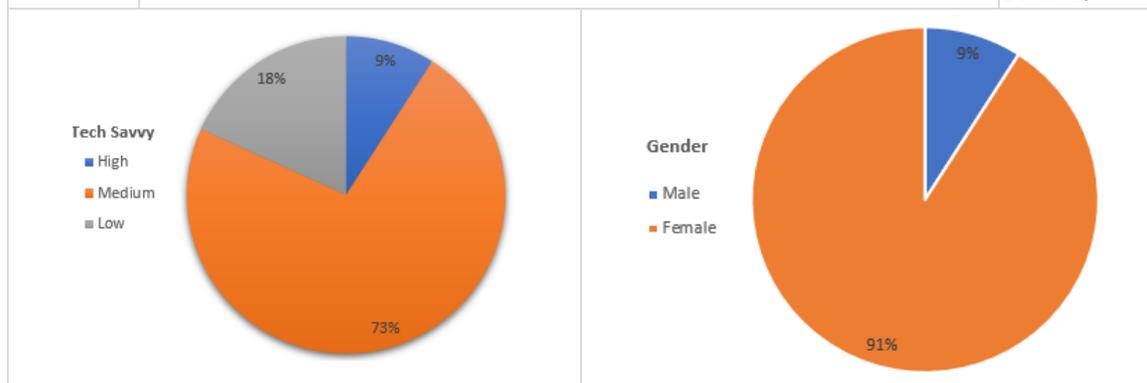
3.4.5. Participants' demographic profile

Table 1 shows the users' demographic information. I had 11 participants, 2 of them were not available to continue the test sessions for the data assessment and BPS interviews therefore the results of these two parts are based on 9 participants, and results of onboarding are taken from 11 participants. Before the study, participants filled out a demographic's questionnaire. Throughout this document, the participants are called by coding numbers of P1 to P11.

Table 1: Users' Demographic Profile

Code	New to HQB	Gender	Tech Savvy	Device	Native spoken	Interview 1	Interview 2	Interview 3	Interview (s)
P1	N	M	M	Android	×	✓	✓	✓	3
P2	N	F	M	IOS	✓	✓	✓	✓	3
P3	N	F	M	Android	✓	✓	✓	✓	3
P4	N	F	M	Android	✓	✓	✓	✓	3
P5	N	F	L	Android	✓	✓	✓	✓	3
P6	N	F	M	Android	✓	✓	✓	✓	3
P7	N	F	H	IOS	✓	✓	✓	✓	3
P8	N	F	M	Android	✓	✓	✓	✓	3
P9	N	F	M	IOS	✓	✓	✓	✓	3
P10	N	F	L	Android	✓	✓	×	×	1
P11	N	F	M	Android	✓	✓	×	×	1

Total: 29



3.4.6. Pilot Test

To make sure the main study is executed as planned, it is important to conduct a preliminary pilot before the main study. During the pilot study, I tried to identify any possible bias and fix potential mistakes which could be overlooked during the preparation. The pilot was executed exactly like the main study, following the procedure. I conducted the pilot test with ONE participant. After the pilot test, I did some changes such as the order of the tests, wording, and settings to the experiment. Also, we learned how to audio & video the experiment in an efficient way.

3.4.7. Research Ethics

This UX research was conducted using the SFU research Ethics approval protocol (on 9 April 2021) by Zohreh D. Champiri as principal investigator and under the supervision of Dr. Brian Fisher.

3.4.8. Data Confidentiality

Confidentiality was strictly maintained. Any data collected was labeled with an anonymized participant ID. No one was allowed to see or hear any of the data. The company may get anonymized data as part of the MITACS partnership.

I obtained permission from participants (patients and practitioners) to collect data in the form of researchers' notes, audio or video recordings of the interviews, participants (patients)' audio recordings of the diary portion, and images and videos of participants (patients) using the HealthQB prototype.

I obtained permission from participants (patients and practitioners) to keep participant contact information for future studies or re-contact in case there is a need.

I obtained written permission from participants (patients and practitioners) to share their anonymized data with the company.

I did interview the participants (patients and practitioners) up to two times. Each interview will last for 45-90 min at most.

Refusal to participate or withdrawal/dropout after agreeing to participate did not have an adverse effect or consequences on the participants (patients and practitioners).

Participants (patients and practitioners) could withdraw from the study at any point they would wish for. However, if patients withdraw from the study before completing the study, they need to return the Biostarp device. I used the data upon their written consent.

All collected information was anonymized. No identifying information was kept alongside the data. The collected information was digitally recorded and transcribed. Transcriptions, audio, video, and contact information were kept confidential and in an

anonymized form for public presentation. Where individual participant data is disclosed, such as exemplar comments via quotes, I will ensure that the selected data does not suggest participant identities. Video recordings may be used in anonymized form (e.g., participants will be blurred out) for presentations. I obtained written permission from participants in case I want to use any photo or video in anonymized form (based on the consent form). The interview sessions are saved on my SFU zoom cloud.

3.4.9. Consents Form

To make sure the interest of both the study and the participant are protected, an informed consent form was reviewed and signed by the participants before the experiment begins to confirm consensus. The form consisted of a summary of the study including the whole process, information about the data that would be collected and how it uses that data, as well as the participants' rights as being a part of the study. This includes the possibility to quit the experiment whenever the participant wishes to do so, and the right to decline the use of any provided data from the current session at any given time. A copy of the consent form is available in appendix B.

3.5. Data Collection

3.5.1. Preparing the test questions and task

Before turning the test phase, I asked all the different HQB teams including design, Dev, Data Science, research, CEO, and sales & marketing to let me know what they would like to learn from the test results. I reviewed those questions and included them in the test phase if it is possible to address those questions through this experiment. These questions were separated into three different phases of onboarding, data assessment, and BPS which are available in the appendix section (Appendix B).

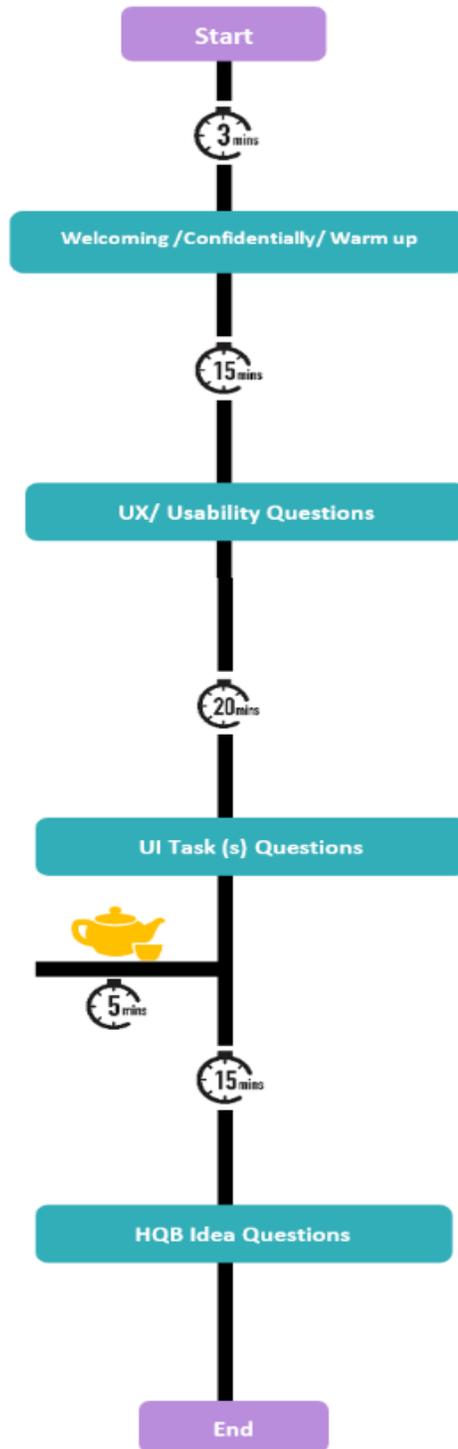


Figure 14: Test Session Procedure

Each file includes: Getting permission for recording the session; Welcoming; Confidentiality of the information; Warm-up question; Interview questions; Task questions (if there is any); ABC testing on design (if there is any); Break (if it is needed); Warming up; Thank you

As mentioned earlier, I conducted semi-structured interviews with patients to gain in-depth insights into their experience using the HQB app. The semi-structured questions have been reviewed by a senior UX researcher and professor at SIAT, SFU.

3.5.2. Data collection methods

As Table 1 shows, for evaluating the onboarding I applied observation and semi-structured interviews. I sat, watched, and recorded. I asked interviewees to share their mobile screens through the zoom to start interacting with the app, I observed their behavior and interaction while performing the task. They were asked to think aloud and share whatever comes to their mind while working with the app and sync the device.

After the onboarding session, I asked questions to better understand what they're thinking and doing, but the primary value is in observing their actions and behaviors.

Table 2: Data collection methods

Section	Method (S)	Procedure/questions
Onboarding	Observation via mobile screen sharing Semi-structured interviews	Appendix B
Data Assessment (ANS)	Cognitive walkthrough Semi-structured interviews ABC testing	Appendix B
PBS	Cognitive walkthrough Semi-structured interviews ABC testing	Appendix B

During each scenario, I evaluated the app's usability by some measures to collect additional quantitative data. These measures include participant's rates on BPS scores and recommendations, usability metrics time spent on the trial and the total time spent with each task.

I tried to make the interview session interactive and maximize participants' engagement without getting tired. Here are what I did.

Give them 5 min OPTIONAL break if they need it.

In each part of the interview, if the participant is willing to share their pain feelings/ or personal feelings, we do not cut them, I allow them to express their feeling and indirectly navigate/direct them back to the interview session

3.6. Data Analysis

For this UX research, I used thematic analysis (through open, axial, and selective coding) and descriptive statistics and data coding to analyze participant responses. I also analyzed the data via various “lenses”, e.g., theories and perspectives, where I see how actual behavior matches or differs from predicted expectation. In the following, I briefly discuss the applied analysis method.

3.6.1. Thematic Analysis

Thematic analysis is a foundational method for qualitative analysis for identifying, analyzing, organizing, describing, and reporting themes found within a data set. A rigorous thematic analysis can produce trustworthy and insightful findings[67] [68] [69].

As Figure 15 depicts, after interview transcription, I did Open Coding for line by line, every sentence, and even word by word. It is generally the initial stage of qualitative data analysis. In the analysis phase, we highlighted the important sections and added some comments or memos to each code.

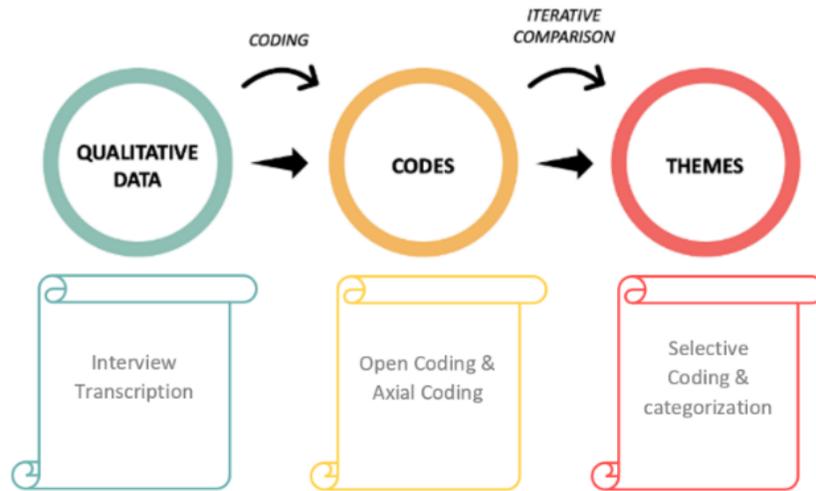


Figure 15: Data analysis steps

I stopped the coding at a saturation point when I did not find any new concepts and the concepts were repeating the existing labels. Table 3 briefly shows a sample of coding for four interviewees when I identified one of the ‘aha moments through the participants’ words.

Table 3: Data Analysis: Coding Sample

No	Sample quotes	Open coding	Axial Coding	Theme (Selective coding)
P8	“...It was interesting because somebody that I know that is doing this as well, and he was on holidays, with his family and his scores were good good good good good and he and then I saw him for treatment. His first day back at work and just sleeping. The night before knowing that he was going back to work, it was amazing how different his score was. Even though he likes his work”.	Interesting experience Same experience Amazing experience Trying to connect two cases Prediction	Scores & wellbeing Excitement Exploration Finding the logic behind the ANS score Surprising Prediction	Aha moment There is a moment that users can connect logically their pain with the receiving scores and understand the correlation between them, at this moment users are feeling exploring, excited, surprising, the moment that they find out, it resonates with their overall wellbeing.
P3	“... Oh, I was gonna say I did look back and try to remember certain days like what had happened, so I vaguely remember that when the scores went down, I was like oh that you know I've had a rough day that day something okay and it makes sense, so”	Exploration Scores & mood Oh Trying to understand Makes sense		
P5	“...It is really cool and surprising for somebody who's not very aware of what works for them, or what doesn't work for them”	Surprising experience Cool experience Prediction Trying to connect it with wellbeing		
P4	“Which day was it? Wednesday, I had just a terrible day and the app knew that. Absolutely reflected how my day was that day so, it was reflected in the data for sure”	Data & wellbeing Scores & wellbeing Prediction		

3.7. Limitation (s) & evaluation scope

Here are some of the limitations of this UX research study.

In this research, I tested version 2 of the app. In this version the onboarding and Data assessment journeys are complete however the BPS part, only three recommendations are shown to the users (and a pdf report also is sent to users through email), and the user will not receive deep data/ information about how to apply the recommendations.

In this study, 91% of participants have been previous users that have used the app before. Therefore, they have some background about HQB product. However, the design of version 2, is quite different from what these participants have experienced before.

We hired the participants through the HQB practitioner network and the majority of patients that accepted our test invitation have been females.

This UX research has not investigated the users' registration and purchase journey since the users have received a free device and app. It has been the company decision to provide a free device as the compensation and has been beyond my control to change the process of compensation.

HQB is platform that works with using the medicine for managing the chronic pain too. It could be a mix method that can be applied with a practitioner or without a practitioner. If the patients want to receive medicine, they might use the HQB with the help of a practitioner and get the medicine while they are using the HQB interventions. If the patients want to only receive the BPS interventions (without medicine), they might apply HQB without a practitioner. The practitioner portal and its link to HQB has not been part of my master research so I did not include that in my research.

Chapter 4.

Results

4.1. Usability Examination

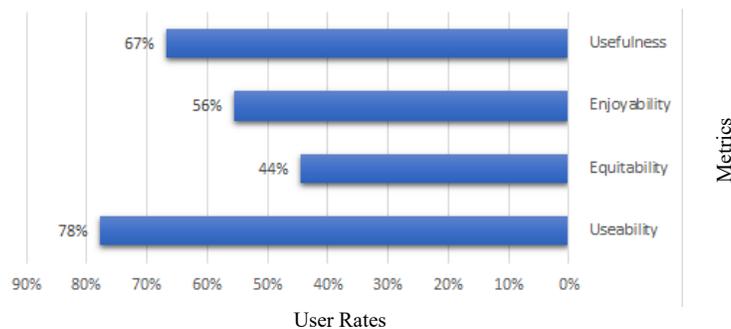
I assessed the usability of the HQB app in different aspects of design, recommending algorithm and content. Based on the usability results, I have provided some recommendations and enhancements in chapter 5.

4.1.1. Design Usability

I applied four metrics including useability, equitability, enjoyability, and usefulness to measure the overall design usability shown in Table 4. The results showed that useability has the highest rate (67%) which means the app is easy to use. In addition, according to the results, the HQB app can solve the users' problems. However, from the participants' point of view, the accessibility (44%) and enjoyability (56%) of the HQB app need improvements.

Table 4: HQB app design usability

Metrics	Description
Useability (easy to use)	The app is easy to use
Equitability (accessibility)	Different people with different backgrounds and abilities have access to the app and can use it easily
Enjoyability	The experience of working with the app is pleasant despite having some difficulties
Usefulness	The app can solve a problem



Sample quote

It was simple ... easy to work...pretty easy once I just got used to always remembering to open the app. (P4)

4.1.2. Content eXperience (CX)- Usability

As Figure 16 shows, 91 % of participants in this study were English native spoken and only 9 % were non-native English language spoken (fluent English).

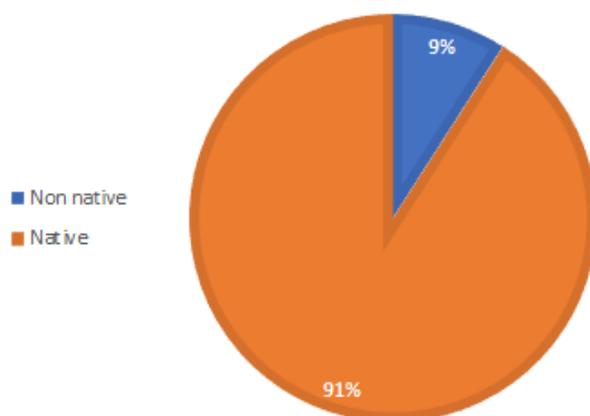


Figure 16: Demographic info: Participants' language

I assessed the content usability using two metrics of legibility and readability. Legibility refers to whether people can see, distinguish, and recognize the characters and words in the text. Legibility is thus mainly determined by visual design, specifically typography. Readability refers to how easily users read the words [70]. Based on the results of this UX research, the text legibility and readability are satisfying. Also, the HQB tone of voice (text) is friendly and simple however participants would like a more encouraging, empowering, and motivating tone of voice in wordings. They mentioned that they especially need an encouraging tone of voice during the ANS data collection and after receiving BPSs when they want to put the recommendations or interventions into practice. Besides, they expect bidirectional dialogue-based feedback which also shows their progress.

Sample quote

"Yeah, what is that what I should do. You know journal writing is fine, but it's just what, how is it going to manage my paint what is this going to mean". (P1)

There are some parts in the app that participants were not able to understand through provided texts and explanations in-app. They mentioned that even after referring to the FAQ section in the app, they did not easily comprehend several texts or wordings listed in the following.

- ANS term & score (how it is calculated?)
- BPS term & score (how it is calculated?)
- Agency (BPS intervention)
- Journaling (BPS intervention)
- Purpose (BPS intervention)
- Compliance: This word has negative meaning for users (ANS chart)
- Charging explanation part in instruction

Users have indicated that they don't understand ANS and BPS terms and would like to know what these terms stand for (abbreviations) and how they are calculated clearly. Also, they mentioned the explanation for ANS, and PBSs is readable, but the amount of information is not sufficient to make these terminologies transparent for them.

After receiving BPSs interventions through the app, a PDF file (Appendix C) including a summary of the BPS and ANS target Zone is emailed to the participants. I have evaluated the content of this PDF file and Table 5 provides detailed information about the content that was not clear for the participants.

Table 5: Unclear content/ text of BPSs areas in PDF file

User	PBS's	Is text Clear?	Sufficient BPS info?	Sufficient Rec info?	Understanding the BPS logic?	Is spider chart easy to Understand	Understanding why this target zone?
P1	1. Thought Awareness: Meditation and thought awareness	✓	x	x	✓	x	x
	2. Emotion recommendation: Journaling	✓	x	x	✓		
	3. Purpose recommendation: Define your core values	x	x	x	x		
P2	1. Self-Acceptance recommendation: Practice gratitude	✓	✓	x	✓	x	x
	2. Agency recommendation: Goal setting & future planning	x	x	x	x		
	3. Emotion recommendation: Journaling	✓	✓	✓	✓		
P3	1. Agency recommendation: Know your strength	x	x	x	x	x	x
	2. Purpose recommendation: Define your core values	x	x	x	✓		
	3. Self-Acceptance recommendation: Practice gratitude	✓	✓	x	✓		
P4	1. Agency: Goal setting and future planning	✓	x	x	✓	x	x
	2. Self-Acceptance: Practice gratitude	✓	✓	x	✓		
	3. Interoception recommendation: STOPP technique	✓	✓	✓	✓		

User	PBS's	Is text Clear?	Sufficient BPS info?	Sufficient Rec info?	Understanding the BPS logic?	Is spider chart easy to Understand	Understanding why this target zone?
P5	1. Agency recommendation: Know your strength	✓	×	×	✓	×	×
	2. Self-Acceptance: Practice gratitude	✓	✓	✓	✓		
	3. Purpose: Define your core values	✓	✓	✓	✓		
P6	1. Interoception recommendation: Meditation	✓	×	×	✓	×	×
	2. Agency recommendation: Know your strength	×	×	×	×		
	3. Emotion recommendation: Journaling	✓	✓	×	✓		
P7	1. Movement: Consistent physical activity	✓	✓	×	✓	✓	✓
	2. Agency recommendation: Know your strength	✓	×	×	✓		
	3. Interoception recommendation: Mindfulness-based meditation	✓	✓	×	✓		
P8	1. Self-acceptance	✓	✓	×	✓	✓	×
	2. Movement	✓	×	✓	✓		
	3. Agency	×	×	×	×		
P9	1. Agency recommendation: Know your strength	×	×	×	×	×	✓
	2. Purpose recommendation: Define your core values	×	×	×	×		
	3. Self-Acceptance recommendation: Practice gratitude	✓	×	✓	✓		

× No ✓ YES

4.1.3. Usability of HQB algorithm

The performance of a recommending algorithm in Machine Learning (ML) is usually assessed by quantitative methods like offline and online evaluation methods applying different metrics such as Recall, Precision, *F*-Measure, and Mean Absolute Error [35]. In offline methods, the dataset is split into two parts of training and test datasets and then by applying accuracy metrics the algorithm performance is measured [12] [29]. Online evaluations provide users with real recommendations from the running system. Instead of users rating recommendations, the RS monitors users' responses as to how they accept a recommendation given to them [29]. Feedback from the users is mostly analyzed by various metrics such as (CTR) or sometimes by CiTR (Cite-Through Rate) but commonly measured by CTR. For example, the CTR of 1.2% shows that 120 of 10,000 recommendations were clicked. [36]. However, some studies mentioned user studies evaluation as an add-on to these methods to measure recommender systems (RS) quality [8] [10] [36]. User studies evaluations are carried out when users explicitly quantify and qualify their expectations and contentment [36] [29].

In the RSs literature, accuracy is how relevant the recommendations are from users' perspectives. Novelty is defined as an item that users might forget that she/he consumed the item some time ago. Also, it could be an unknown item that the user has never consumed [71]. In other words, the indicators that users have not previously experienced or seen before. It could be an item that the user experiences unexpected and fortuitous [72] so-called serendipitous (surprising items) and novel (new item).

In this UX research, I applied user studies evaluations to examine the accuracy and novelty of the ANS & BPS score algorithm. Therefore, I asked participants to rate the following items on a scale of 1 to 5 (questions are listed in the interview questionnaires files available in the appendix).

1. The accuracy of the ANS score
2. The accuracy of the BPS score
3. The novelty of the BPS focus areas (Recommendations)

As results show in Figure 19, the accuracy of BPS and ANS scores are stratifying (near 4 out of 5) but the novelty of the algorithm is low (2.3/5), and it needs to be optimized and enhanced in the future.

I have applied the Linkert scale of 1-5 points, typical multiple-choice options include strongly agree, agree, no opinion, disagree, and strongly disagree as to the Likert item.

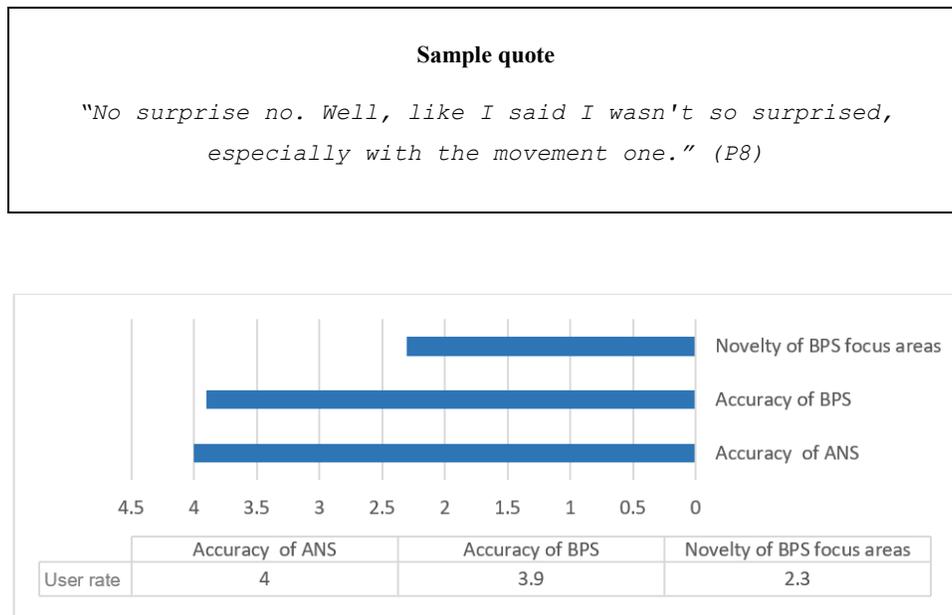


Figure 17: HQB Algorithm Usability Evaluation:

4.2. Effectiveness Examination

I evaluated the effectiveness of the app in the whole process of onboarding, data assessment, and BPS interventions to investigate if the app is

Helpful to reduce or manage the pain

Reasonable for participants to pay (Affordability)

Engaging enough to keep using it (Activation, Retention, Referral & Empowering)

Supportive enough with pain management and tracking

4.2.1. Helpful to manage the pain

Based on the results of this UX research, most participants believe that HQB app is helpful for them to manage or reduce their pain. I have listed the reasons that they mentioned to support their ideas listed in Table 6.

Table 6: Why users like the idea behind HQB?

Reasons	Percentage
It can solve or reduce the pain	100 %
It addresses pain problems as a biological, psychological, and social condition	83 %
It builds trust between the body and nervous system	67 %
It helps a better communication with users' doctors, practitioners	83 %
It predicts the overall wellbeing (level)	67 %

Sample quote

"This (HQB platform) is based on bio psychosocial...the medical doctors don't generally believe in the bio psychosocial (Considering that it is very important) because they are very, very based on the medical practice, there are doctors who working with chronic pain management program they have that awareness, but family doctors (are)off the street, they're useless... (P2)

Most of the participants appreciate the HQB app idea that assesses the condition of chronic pain through a biopsychosocial lens, and they believe it helps to be aware of their pain. However, they expect more than what is presented in v.2 for ANS data visualizations and BPS recommendations. I discuss their expectations in the next chapter as areas for improvements for the future app versions.

4.2.2. Reasonable to pay

As Figure 18 depicts, although the majority of participants believe that the HQB app helps them to reduce the pain, 67% of participants mentioned that they will not pay for this version and 33% mentioned that they pay for it.

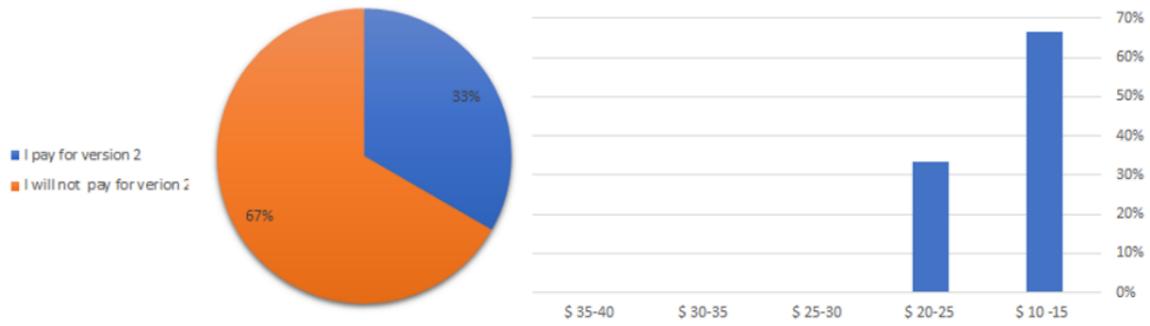


Figure 18: Users' willingness to pay for HQB

Sample quote

"... I feel like if there's some customization, I would appreciate it. More data, and then adding some other things... like having, you know, the recommendations come through a little more clearly like what I can do, and if there are would be better so until I see that that's going to happen, I not super inclined to want to pay for it". (P3)

For people who are willing to pay, the app is affordable \$25 per month which is a max of \$300 per year. I have summarized the reasons associated with not paying for HQB-V.2 based on the participant's explanations and justifications in Table 7.

Table 7: Why participants will not pay for HQB-V.2?

Why not pay? (reasons)	Percentage
Not knowing how to practice the BPS and recommendations	67 %
Lack of enough data for ANS	83 %
User's mindset (They believe this kind of apps should be free for them)	33 %
The app is not interactive enough	67 %
Comparison to other existing apps + their prices	33 %
Partially free (maybe until the end of the data assessment part)	67 %
Lack of detailed info/data about the BPS	83 %
Unable to afford it	17 %
Having difficulty with wearing the wristband (skin irritation bumps)	17 %
Bad experiencing about inappropriate notifications	33 %
Not receiving novel/ new information (what they did not know already/)	33 %
Lack of customization and personalization	33 %

Sample quote

"I'm just (saying) maybe some more features, more information. Good info, but it would be nice to have even more info like I'd be willing to pay more (P8)

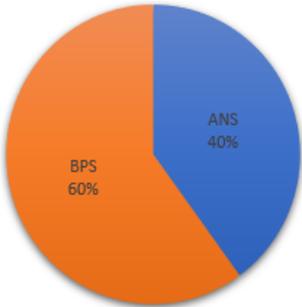
Currently, the HQB app price is \$ 300 yearly including the price for the Biostrap. The users need to pay it at once. Considering the above-mentioned reasons, some of the users do not pay for the app because they are jobless and have no income, so the price of the app is not affordable for them. however, the majority of the people do not pay because of the existing issues and shortcomings they experienced during interacting with the app. In addition, the payment method is also not appropriate considering the chronic pain user personas. I discuss it more later in the next chapter and provide suitable recommendations.

4.2.3. Engaging

I have investigated the four below factors to examine if HQB is engaging enough for the participants to keep using it.

- 1. Activation:** It examines if users have been active in the app. The majority of the users mentioned that they opened the HQB app twice a day and also when they received any notification. They spent on average at least 10 mins per day on the HQB app. There is not any rule or benchmark for a right users' activation time. However, between the UX designer, 30 -60 mins per day are considered as a good threshold. Therefore, HQB activation time is low, and it might be because the app is not motivating and encouraging enough. There are design issues. Moreover, the users do not completely understand of ANS and BPS scores which could lead to a low engagement time.
- 2. Retention:** It examines if users identify the value of the HQB product (Aha moments) that makes them return to the app. An 'aha moment' is the moment a (new) user first realizes the value of a product. It is called a 'moment' however it also might be a set of actions that happens and then some of the users understand the value and set themselves up to return or stay in the app. The aha moment helps users solve a problem and they might love the company and product for it. For HQB, as Table 8 discusses, the 'aha moment' happens for users mostly after receiving the BPS scores. Once the 'aha moment' happens most of the users get committed to the product and would like to continue using the product and app. For HQB, it might happen in two parts, when users get ANS and BPS scores and can find out the correlation between his/ her pain and the scores. Besides, it happens when users receive the recommendations and BPS score especially when the user finds those recommendations novel and relevant. Unfortunately, I did not catch any Aha moment for the onboarding process.

Table 8: HQB-Aha moments

Aha moment (s)	Occurrence Frequency	Aha moment
The moment that user can connect logically his/ her pain with the receiving scores (understanding the correlation between the pain and scores)	4	 <p>A pie chart titled 'Aha moment' showing the distribution of two categories: BPS (60%) and ANS (40%). The BPS segment is orange and the ANS segment is blue.</p>
When the user receives recommendations & BPS scores and finds relevant and novel recommendations	6	

- 3. Referral:** It examines if users recommend HQB to other people or their friends. The majority of participants mentioned that they will recommend the app to other people provided fixing of existing issues like notifications, ANS data visualization, and BPS tracking.

Sample quote

"I'm just (saying) maybe some more features, more information. Good info, but it would be nice to have even more info like I'd be willing to pay more or recommend it (P8)

- 4. Empowering:** It examines if the app makes users stronger and more confident, especially in controlling their life and managing the issues caused by chronic pain.

Sample quote

"... I would prefer to know more information because I could feel more empowered, ...give me a reference point, tell me how you calculate it, I know there are just so many little details that you can't write effectively into an app because you also need to have that dialogue... give me more information that might be less anxious more engaged, but I want to more to know how to empower myself". (P2)

As Figure 21 depicts, participants pointed out that though the app is simple, cool, and friendly, they need the app to be more reliable and empowering. They have some

concerns about the privacy of their medical data. Besides, the main goal of this app is to help people to manage their pain, therefore, empowering is an essential factor for users' engagements. Moreover, providing more interactive data visualization by presenting appropriate data is one of the ways that could lead to an empowering app.

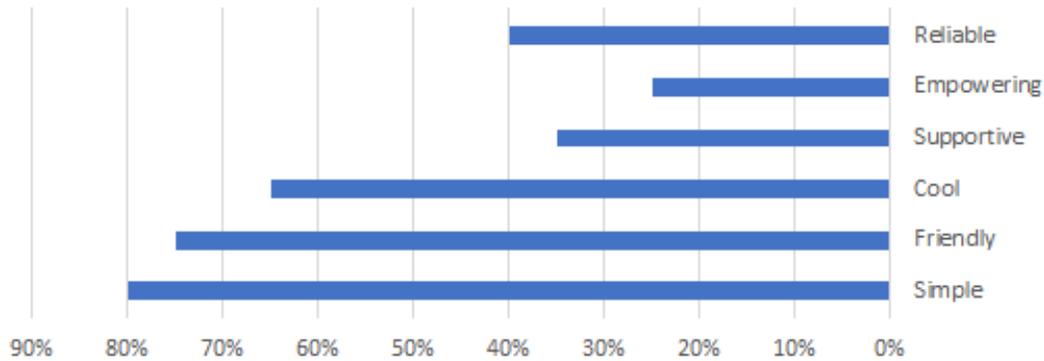


Figure 19: User’s feedback about the app’s voice

Sample quote

"... (helping me to change,) knowing that change is really valuable to feel confident and to see improvements it doesn't mean that is better it doesn't mean that it's not you can't improve it's just that we forget what it was like a month ago, so I think showing the trend line (graph) (progressing) is really important" (P2)

4.2.4. Supportive

Participants need an app to help them with habit management and tracking. They said they already knew about some of the BPS improving areas (interventions), but they don't adhere to practicing or forget to do them. Besides, as I mentioned before, they expect HQB app to help them with seriously practicing the BPS focus areas and showing their progress. They need to receive empowering, and encouragement from the app for those days that they fell down and frustrated to keep practicing the interventions.

Sample quotes

I knew about them (BPSs areas), but I need to practice (P8)

"I expect to see the improvements, is it at certain points like say over the three months, you know if the average client is going to be with you guys for three months, and then they reach kind of a baseline at the intended zone. I would like to being able to see how I should get there" (P9)

Moreover, as Figure 20 depicts, users strongly feel they need *human support* in two touch points during their journey with HQB app. First, they need human support in onboarding when they face an issue especially if the issue is a technical issue.

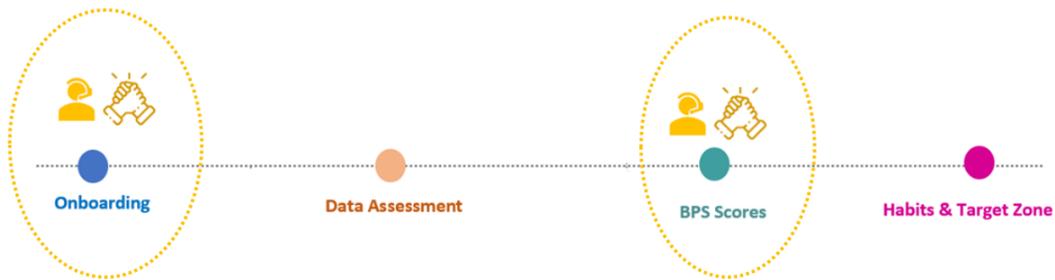


Figure 20: App touchpoints that user needs human supports for them

For example, 33% of users (out of 11 people) did not go through the instruction for troubleshooting while facing an issue in the onboarding process. Therefore, the automated (digitalized) process for these touchpoints will not be effective and the instruction might not be used by all the users during the onboarding process for troubleshooting.

Sample quote

"...yeah, I mean, I think that would be somebody from your organization to be able to go through it (report) answer any questions you know if people are hesitant or stock or don't understand that you know someone who knows the product and who knows recommendations...". (P9)

Second, once they receive the BPS scores (areas to focus) and don't understand an area. For example, HQB app recommends some of them to work on agency, but the provided information was not sufficient for them. They said they want to call or talk with someone to get more information.

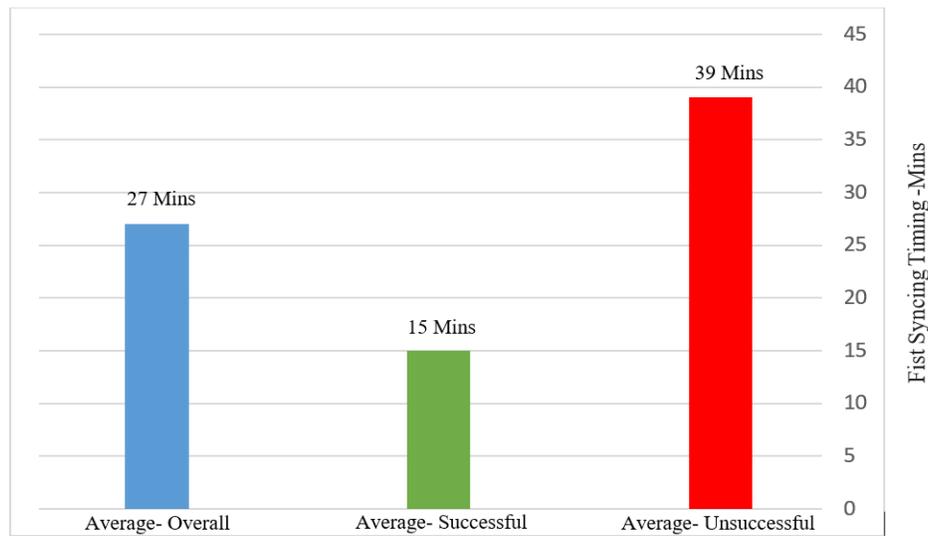
4.3. Design issues and broken interactions along with re-design solutions

To catch the issues of the onboarding process, I applied the observation and semi-structural interview methods. For the Data assessment and BPS parts, I used semi-structural interviews, cognitive walkthrough as well as ABC testing. In the following table, I discussed the design issues along with some enchantments or recommendations. Besides, for each part, I have included the relevant quotes.

Successful onboarding means when the user can sync the app with the wristband properly and start interacting with the app independently. Once the users successfully sync the device, they receive notifications in both HQB app and the Biostrap app. Among 11 participants, 3 of them were not able to sync the app with the Biostarp wristband in the first session which means unsuccessful onboarding. As Table 9 discusses, the average successful syncing time for onboarding is 15 mins and for unsuccessful syncing is 39 mins. It is also discussed where users got confused or stuck.

Table 9: HQB- app onboarding timing

Participant	How many Session	Result	Fist Syncing Timing	Second Syncing Timing	Blok part (s): where the user got confused or stuck
P1	One	Successful	10 Mins	-	Biostarp terms and conditions
P2	One	Successful	14 Mins	-	Changing the pass
P3	One	Successful	13 Mins	-	-
P4	One	Successful	21 Mins	-	Changing the pass Biostrap account creating
P5	Two	Un-Successful	37 Mins	17 Mins	Bluetooth problem Tech savvy
P6	One	Successful	11 Mins	-	Bio strap account creating
P7	One	Successful	17 Mins	-	Changing the pass Biostrap account creating
P8	Two	Un-Successful	35Mins	14 Mins	Could not find the app in Appstore Changing the pass Biostarp settings
P9	Two	Successful	16 Mins	-	Changing the pass
P10	One	Un-Successful	46 Mins	28 Mins	Charging problem Tech savvy
P11	One	Successful	23 Mins	-	Charging problem Biostarp terms and conditions



I discussed the issues and broken interaction in the onboarding Data assessment and BPS interventions process respectively in Appendix D, E and F10. Also, I recommend appropriate design or re-design solutions for the identified issues.

4.4. HQB User Persona

User personas represent the different categories of users considering their abilities, characteristics, and goals. It is one of the most useful tools, taken from the UX research phase, for a better understanding of the users’ needs and expectations and growing and improving the business. Through this UX evaluation, I found out that the HQB user persona should be revised considering the UX results and new insights. Therefore, I created it by answering the following questions:

- What are the main characteristics of the users?
- What are the needs and goals of the users?
- What are their main barriers to achieving their goal (pain points)?
- What healing methods have users applied before?

For users’ characteristics, I noticed that the below factors (Table 13) are important and influence users’ experience.

Table 10: Chronic pain user's characteristic

No	Characteristics	Condition
1.	Age	15- 90 years old
2.	Gender	Female, Male, Intersex, Trans, Non-Conforming
3.	Marriage status	Single (never married), Married, Widowed and not remarried, Divorced and not remarried, Married but separated
4.	Employment status	Employee, Worker, Self-employed, Jobless
5.	Financial well being	Low, Medium, High
6.	Job title	E.g., accountant
7.	Pain background knowledge	Basic, Intermediate, Advanced
8.	Personality traits	Sense of belonging, Feeling lonely, Self-motivated Resilience, Anxiety
9.	Tech-savvy level	Basic, Intermediate, Advanced
10.	Chronic pain	Background (years), Duration, Frequency, Timing

11.	Disabilities and limitation	Physical, Mental
12.	Sports & Exercise	Walking, Biking, Swimming, ...
13.	Social Activities	Volunteering, Dancing, Playing games, Meetups...

Table 14 summarizes the chronic pain user’s needs, goals, pain points, and previously applied methods.

Table 11: Chronic pain users’ expectations, pain points, and used methods

User persona	Item
Expectation & needs	<ul style="list-style-type: none"> • Self-management solution for chronic pain • Motivation and encouragement • Knowing about the pain level • Knowing when they might have pain (pain prediction) • Information about how to practice and make a habit • Knowing about the stress level • Improving stress level and mood • Improving practicing goals like exercising • Improving sleep quality • Improving sleep efficiency and length • Improving general well being • Undersigning about the impact of different food and diet on the pain level • A reliable platform in terms of their data privacy • Sufficient information about ANS and BPS scores • Clear information and supportive methods about how to keep practicing the interventions • Improving their daily performance
Pain points	<ul style="list-style-type: none"> • Sleep issues • Tech-savvy • Stress and anxiety • Mal functioning in daily life • Distraction • Feeling lonely • Job losing • Depression and Frustration
Used methods	<ul style="list-style-type: none"> • Medical • Traditional, and herbal medicine • Acupuncture • Cognitive therapy • Movement • Massage therapy • Physiotherapy

User persona	Item
Methods for dealing with momentary pain	<ul style="list-style-type: none"> • Making jokes about my pain • (Funny) naming my pains • Candle therapy • Reding books, journals, papers • Photography • Watching TV, Movie (distraction) • scream sometimes • Crying • Go sound the house • Going to check the mails • Crystal therapy • Smelling (garlic, cookies and onions, lavender rose, ---cardamom) • Cooking

Figure 21 illustrates the user persona samples taken from this UX research data.

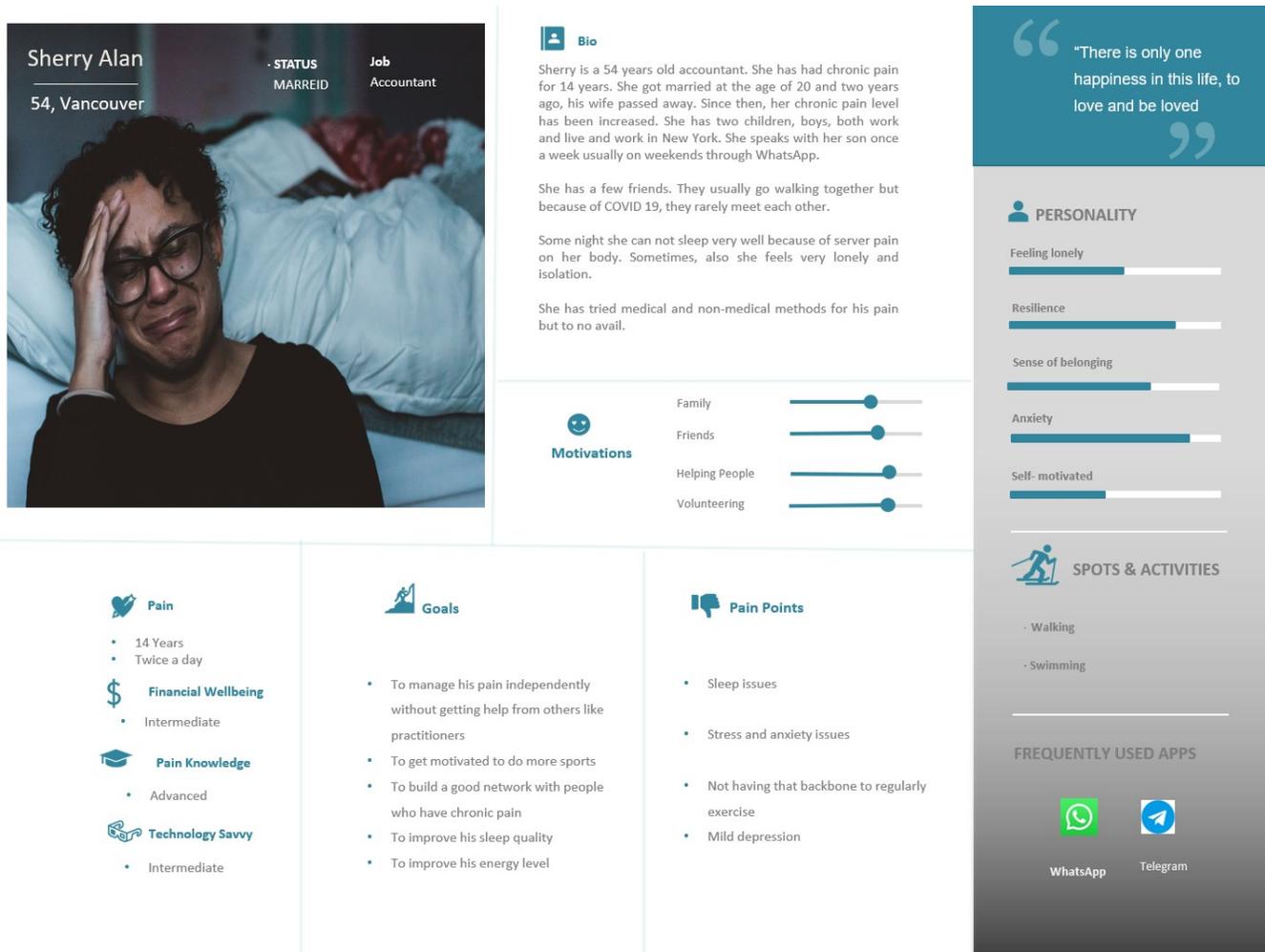


Figure 21: Chronic pain user persona sample photos

Photo Source: Retrieved from <https://unsplash.com/photos/owBcefxgrIE>

Photographer: Claudia Wolff

Chapter 5.

Conclusion & Recommendations

In this research project, I aimed to evaluate the user experience (UX) of the HQB mobile app. Therefore, I conducted a qualitative research methodology with 11 patients using four methods of semi-structural interview, cognitive walkthrough, ABC testing, and observation to 1) Assess the usability and effectiveness of the app for chronic pain management 2) identify the app design issues and provide design and re-design recommendations. 3) create a chronic pain user persona based on the results of objectives 1 and 2. Apart from 44 identified design issues with the HQB app discussed in Chapter 4, the results of this UX research showed that the usability and effectiveness of HQB need improvement hence. I discuss the following recommendations which might be applicable for a similar chronic pain app as well.

5.1. Usability improvement

One of the main usability factors is accessibility or equitability which makes the app more inclusive and easier to use for different people.

5.1.1. Design based on user personas

User persona presents the main characterizes of users. For example, chronic pain users have different tech-savvy backgrounds from basic, intermediate, and advanced. The app should be accessible for all these people. Most of the successful onboarding test results were due to the patient's low-tech savvy for syncing the device. Also, usually chronic pain people are impatient so providing long instructions does not work. I have discussed the user persona of chronic pain people in the previous chapter. A good example of designing based on user persons is about the app payment strategies. Currently, patients need to pay \$300 at once for one year using the HQB app including the wristband. I have indicated before in chapter 4, there are several reasons that people do not pay for HQB app and one of them is the app payment strategy that I would classify into accessibility

issues. Because it prevents people to have access to the app. There is a quote that says, “show loyalty first, then ask for favors”. It means that you need to first convince people that the app works for them, and they see the value behind the app. More than that, people with chronic pain might be jobless and they might not be able to afford the app.

Sample quote

“... You know I don't make money I've had I lost a career, I lost so many things, and when you lose you have to be independence to help your body.” (P2)

As Figure 23 shows, I recommend a combination of Freemium and Subscription models is recommended for HQB- pricing app. Freemium (partial Free): App is free to download, making the app available partially free for all users until the users reach the aha moments or understand the value of the product. Service-oriented subscription (monthly): Users might pay a fixed \$ X monthly to receive a certain service package. Providing financial aids for users who cannot afford to pay. Some of the participants have lost their jobs so they mentioned that they have financial problems. It is good to know that one user persona that we have is chronic pain patients who are unable to work because of their pain with no or low income therefore, we need to have some financial support resources from different channels for them. A monthly subscription is also another way which could help them.

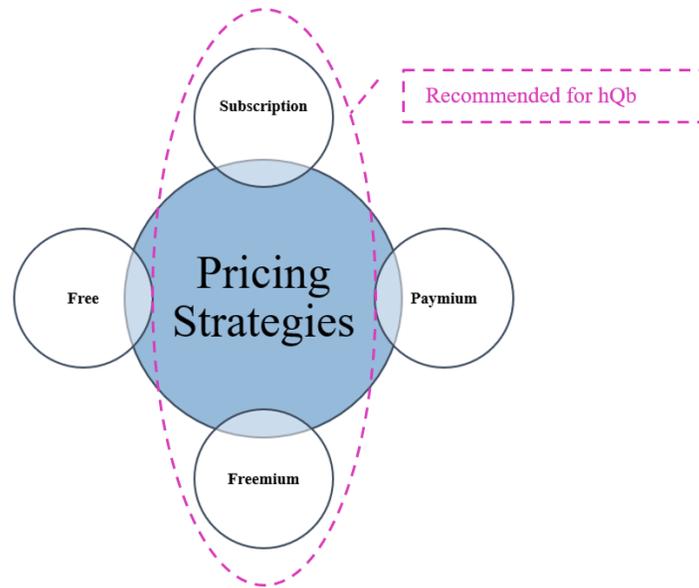


Figure 22: Suitable HQB-Pricing Strategies

5.1.2. Speech recognition

If users are not able to use their hands or have vision impairment, they might not be able to answer HQB assessments by using a slider element. Therefore, building up the speech recognition functionality is beneficial for people with chronic physical disabilities and makes such apps more equitable.

5.1.3. Graphics and visual designs

All the graphic and visual elements should be designed based on the user persona of the chronic pain people. For example, patients might have anxiety so any warning design element or coloring might make them more anxious and increase their pain too. Also, some people might experience recurring seizures or epilepsy, therefore, flashy visual and UI elements especially without any warning are not recommended. Moreover, a considerable number of chronic pain apps are elderly people which needs the colors and visual elements to be easily distinguishable from each other.

5.1.4. Consistency

Being consistent not only in visual layout and UI design for different platforms (IOS, Android) or websites but also using the same language and actions, is one of the biggest factors for enhancing the accessibility of the app.

Sample quote

"...Yeah, if you present changes (to me), I think that would be really encouraging, I think that would be a cool thing to see yeah... I mean if I'm going to be doing something consistently, like most days, then usually about two weeks after that I stopped kind of feeling like I have to make myself to it and it starts to feel more on the natural side..."
(P7)

5.1.5. Cognitive barriers

When doing a task that takes so long or it is difficult or a lot of steps to be completed, it might prevent users to perform the task and reach their goals. In HQB, several parts create cognitive barriers for the users. One of them is the back-and-forth actions between the HQB app and Biostrap app while doing onboarding. Another place is when the users face a technical issue for syncing the device which is difficult for them to solve.

5.1.6. Customization

Through this UX research (discussed in chapter 4), participants want a more personalized and customized app. The more customization possibilities HQB app provides, the more users can get exactly what they want out of the app. Calling people names, giving them customized interventions (not general), personalized practices and motivations, and providing options for changing the background colors and themes or notifications based on their preferences, are the probabilities for making a more customers app in HQB.

Sample quote

"... I feel like if there's some customization, I would appreciate it. More data, and then adding some other things... like having, you know, the recommendations come through a little more clearly like what I can do, and if there are would be better so until I see that that's going to happen, I not really super inclined to want to pay for it". (P3)

5.2. Effectiveness improvement

5.2.1. Interaction Design (IxD)

Interaction is a bidirectional action between the user and the system. IxD is a fundamental pillar in UX design. It should be designed like a natural interaction. In HQB, the users need more powering and encouraging interactions and dialogue which should be taken into consideration in wording, visual design, even physical objects and, audio-video as well as behavior (how users' behavior and how system behavior).

Sample quote

"Different colors for stress-wise and game-wise or different beeps. Do you know, try to put like a SMILEY like I said last time I am SMILEY face if it's a worse situation if it's a kind of a mild simulation also kind of it tells you a SMILEY face if it's higher or lower-middle wise, you know something like that, and a naughty boy it's good that you know something? You know, like a feeling like a smartwatch kind of a thing so kind of monitors your heart rate monitors maybe grey and monitors maybe suggest level how it is A dancing girl (P1)

5.2.2. Information architecture

Based on the results of the content usability, the information architecture (IA) of the HQB app should be enhanced. IA is a logical, friendly way we classify, arrange, and present the content in the app to make it easy to find for the user or navigate.

Sample quote

"I want more information I'll be. On recommendations and BPS. Like I'm just not sure how to interpret it fully so like it looks familiar but it's a little different so I'm like Oh, can I improve this I don't so". (P3)

"The amount of information that is provided for me is not enough to know what I should do. yeah, what is what I should do you know journal writing is fine, but it's just what, how is it going to manage my pain what is this going to mean most of the time" (P1).

5.2.3. Engaging experience

- Tracking and habit management: as I discussed before, without habit management the user journey is incomplete. As a result, the user is not interested in paying and leaves the app if there is not a mechanism to help them to apply and practice the BSPs focus areas. Also, providing bidirectional feedbacks means the user can provide their feedback on the interventions that they have received which also makes the recommending algorithm optimized and also gives some feedback about patients' practices on the intervention.
- A smart notification system: It alerts the users and makes them more engaged with the app. The users expect notifications to be smart, not stupid. For example, if they have charged the wristband and it is already full, they don't need to keep receiving notifications. The same also goes for notifications for responding to the assessments.

Sample quote

"Oh yes, I like getting notifications and reminders and even little like quotes you know I have things like that, on my phone a little quote of the day, something that just makes you, you know start your day off thinking about it and then. Then the seed is planted and then you think about it for the whole day. (P9)

"This, like some kind of notification or beep beep thing that your stress has high or your stresses low or something you know lower down and your pain is. Like saying that your stress is becoming high your pain is becoming high or something they should be like a one maybe a suggestion or notifications and then". (P1)

"I'm just (saying) maybe some more features, more information. Good info, but it would be nice to have even more info in a bit like I'd be willing to pay more (P8)

- Receiving progress along with the motivation quotes or ways. Users expect to get some motivational quotes every day that are related to the tasks they need to take or based on their scores. Users would like to receive emojis or smiley faces when they are doing good and reaching the target zone. Users would like

to also receive some mild warning signs if they need to work more to reach a good score.

Sample quote

"A little like badges or something saying you know you've done good. On this day you've done yeah great and then maybe another day you could do better little reminders that I do like little like yeah notifications little things to show me instead of waiting and to see how I like to be told how I'm doing." (P8)

"I'd expect the APP to just yet to show me just how I'm improving I guess every. So often, and to give me a recommendation saying you, you have improved after two weeks or you're not improving, you need to do more". (P8)

"For example, for journaling, you can send me a notebook and pen with healthQB logo on it" (P8)

- A message system: Giving patients this opportunity to communicate with the practitioner through the app, if they have any questions and face any issue especially when they are working on the interventions.

5.2.4. Control and freedom

Users do not feel control and freedom in HQB app because of the lack of a good conversation or dialogue-based interaction in the app, lack of data about BPS and ANS as well as not providing info about data privacy.

Chapter 6.

Future Studies

This study was a primitive UX evaluation on HQB as a case study of the chronic pain apps that exploits BPS and ANS models to manage chronic pain. Although the results are promising and indicate the effectiveness of ANS and BPS models for handling chronic pain, there are still some open areas that I would like to offer to other researchers to work on for future studies.

1) Effectiveness of interventions for different chronic pain

There is still no study to investigate the efficacy of BPS interventions for chronic pain originating from different factors or diseases. For example, is journaling (as a BPS intervention) effective for both back pains caused by an accident injury and back pain caused by strains and sprains.

2) Cognitive barriers for using chronic pain devices

Understanding the obstacles and barriers that prevent users to use a device or put pressure on users' minds to have a good experience, is very helpful create more effective devices. For example, the application of warning signs in visual design for users with chronic pain might make them more anxious. Therefore, it might be considered as a cognitive barrier to using the device or app.

3) Including momentary pain interventions

Most of the existing apps including HQB are designed and developed for managing chronic pain, not in a short time. Users of HQB at least need to apply the interventions for 3 months to see the results. However, during this study, some patients mentioned that they would also like to receive interventions for the momentary pain, the sharp and sudden pain that they temporarily experience for a short time during the day. Patients have some self-identified solutions for their momentary pains such as watching TV to distract themselves, smelling the rose, or lighting the candles. Including some interventions along with long-

term interventions for the patients seems a good way to make them more engaged with the app and make the app more useful for them. However, I propose it based on the results of this study and needs more research and investigation before including them in the chronic pain apps and devices.

4) Food and diet interventions

HQB interventions do not include food and diet, but participants indicated that they would like to get dietary interventions as well. This area also is an open area for interested researchers to dig into and investigate more.

5) More accessible apps and device

As I mentioned earlier, chronic pain people might have disabilities therefore methods for making more accessible and equitable apps are the important areas that require significant attention.

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Appendix A:

Sample of primary corresponding with participants

Hi Zohreh,

Thank you for your patience and hope you've stayed cool during this hot weather!

We're happy to provide an update on our testing plans for this summer. Your time and insights mean so much to us as we continue to refine our solution to help chronic pain patients manage their condition and work towards recovery. HealthQb is a practitioner-recommended solution for people with chronic or persistent pain that supports the development of nervous system resilience.

HealthQb is now deep into development of its proprietary software and will be testing out product versions over the summer. We are so grateful you're open to re-engaging with us to help us build our product to fit the special needs of people with chronic pain.

We have a few options for your involvement:

SFU User Experience Study. This study is being led by Zohreh Champiri, PhD in collaboration with SFU. Zohreh will be collecting learnings on how users experience our app and how we may be able to improve upon it and prioritize next features for development. The requirements of you would be to install our new smartphone app, wear a Biostarp wristband nightly, and tell us about your experience using the app by participating through surveys and interviews. We anticipate we'll need approximately 30 minutes of your time every couple week for a period of 4 – 6 weeks. There is no cost for you to participate and you may decide to discontinue the study at any time. **If this is of interest to you, please reply directly to Zohreh, cc'd in this email.**

Let me know if you have any questions and thank you again for offering your time and feedback – we are so appreciative!

Have a great long weekend,

Appendix B.

Sample of interview questions for three test sessions

HQB-Interview-Patients (Onboarding Test)

Pre- Checks (For Zohreh)

1. Transcription (on)
2. Transcription (Hide)
3. Recording (permission)

Ice Breaking

1. Zohreh introduces herself
1. Thank you so much for taking the time and participating in this study. I truly appreciate your help as it helps us to improve our product and the experience of many people who will eventually use this product.
2. Everything is confidential. No one except me can access your identifiable data. At SFU we are very concerned about doing the ethical study and in fact, SFU has a very difficult process of ethics approval. You can read more in your consent form.
3. During the interview, if at any moment you feel uncomfortable answering a question, you can let me know, or **we can stop the interview.**
4. You can withdraw from the study at any point that you feel uncomfortable

[Explaining the whole process]

Pre semi-structured interview questions

I will first ask you a few questions about you and then we do onboarding and connecting the device.

1. Would you please explain a bit about yourself and your pain?
2. What are your motivations for using this product?
3. What do you expect from this program?
4. What and how do you expect this product to reduce your pain?
5. What are you hoping to get from this program? (If any?)
6. Do you think how this program can help you to communicate with your practitioner and with managing your pain? How?
7. How did you get motivated by your practitioner to go for this program?

HQB-Interview-Patients (BPS-Recommendations)

Pre- Checks (For Zohre)

1. Transcription (on)
2. Transcription (Hide)
3. Recording (permission)

|

Ice Breaking (For Zohre)

1. Zohreh does greetings
2. Thank you so much for taking time and participating in this study. I truly appreciate your help as it helps us to improve our product and the experience of many people who will eventually use this product.
3. Everything is confidential. No one except me can access your identifiable data. At SFU we are very concerned about doing the ethical study and in fact SFU has a very difficult process of ethics approval. You can read more in your consent form.
4. During the interview if at any moment you feel uncomfortable answering a question, you can let me know, or **we can stop the interview.**
5. You can withdraw from the study at any point that you feel uncomfortable
6. [Explaining the whole process]: I will first ask you a few questions about your overall experience so far with the app then I will get your feedback on a few screens.

Pre semi-structured interview (possible) questions

[These questions might be changes based on the participants' responses]

1. What do you think about the report or BPS Focus Areas that you received?
2. What did you learn from the report?
3. If you want to rate the recommendation on the scale of 1-5 ?
4. Do you like to add the target score to the ANS page (since the beginning you are doing the data assessment?)
5. Youtube link / book / another app for recommendation?
6. Recommendation personalisation?
7. Momentary pain recommendation? (make the Recs personalised)
8. What specific aspects of the report were helpful and relevant to you?
9. Did you learn anything new about yourself through the report? (what was that and why did you find that new?)
10. Was there anything in the report that you did not understand? (Tell them to walk you through the report)

11. Do you feel that the information provided to you in the report (and as reviewed with your practitioner) was worth the challenges with the user experience during the data assessment - i.e. onboarding, amount of information requested, etc. Why or why not?
12. How do you think this report can help your practitioner to help you from now on? (Do you feel your practitioner now has a better understanding of your pain?)
13. How can this app/report help you to communicate with your practitioner?
14. What are your expectations now of your practitioner because of the report?
15. We might provide you with expert recommendations?
16. Do you like to link to practitioners through this app?
17. Which category do you like to go for first? (why?) (prioritise)
18. How are you planning to apply this recommendation in your daily life? (to understand how they make a habit)
19. How long do you need to make Recs as your daily habit?
20. Do you like to receive notification for applying for the recommendations?
21. What would you change about your experience? (why)
22. Do you understand what BPS is? (overall user feeling about BPS)
23. Number of recommendations - would you like to see more, fewer?
24. Are you able to connect the BPS scores and ANS scores (Does it make sense to you?)
25. Is that easy for you to understand what you need to do next or what you need to do everyday? How did you find that out? (to see if action center works properly)
26. Getting feedback on branding, logo, color overall UI design/ visual for recommendations
27. Would you pay money for V2? What would you need to see in the product to pay a monthly fee to access the product?
28. How much is reasonable to pay for this app based on your experience so far?
29. Is the recommendations report clear? Does it show new suggestions/information that you've never received before to treat your chronic pain?
30. Is it motivating to help you continue working on chronic pain management?
31. What additional features would motivate you to keep engaging with/using the app?
32. Is privacy of your information/health data a concern?
33. Getting the recs by email (PDF file) and app?
34. Any thoughts, ideas?

Wording Feedbacks

35. How was your overall feeling around wording?
36. Any wording issues?
37. Are the recommendations clear enough and
38. How do you feel about the word "score"?
39. How do you feel about the "Your BPS Focus Areas" ?
40. Which one do you like: "BPS Focus Areas" OR BPS Areas of Improvement" ?

41. Which line or sentence specifically do you not understand in your report?
42. Do you think the amount of information/explanation for each recommendation is sufficient?
43. Do you understand the logic behind each recommendation/ why you have received that recommendation? Does the logic make sense to you?
44. Can you connect your logic with your ANS or PBS scores?

Feedbacks on the report file

45. Would you please take a look at your report and share with me what you understand from BPS categories?
46. Did you find your novel recommendations? (surprise)/ something that you did not know at all and it is new for you? (rate scale 1- 5) ----
47. Did you find your recommendation relevant or appropriate? (accuracy) / something that you think if you apply it is helpful for you? (rate scale of 1- 5)
48. Did you find the recommendations in general? Something that you already knew or already applied or you could find anywhere? (rate scale of 1- 5)
49. Overall experience (rate 1-5 scale)

Design Feedbacks on Figma

[Showing the design of the recommendations|through figma]

50. Do you think the way that you receive the recommendation is appropriate?
51. Would you like to also see the area you are doing really well at? (Are you interested in learning about the areas you are doing well in?)
52. Would you like to know the score of each category, or are you purely interested in what area you can work on?
53. Which visualization do you find easiest to understand? (BPS)
 - Bar Chart
 - Dot Plot
 - Icon + Number
 - "Deep Variation"
- 54.
- 55.

Wrap up & Appreciation & Reach out after 21 days (if possible)

Appendix C:

Sample of Report

Your healthQb

Love your nervous system™

HealthQb Recommendations

1. Movement recommendation: Consistent physical activity

Why exercise?

Regular exercise will improve your wellbeing because physical activity is one of the most effective interventions to promote health and longevity. It will also improve your mental health, as well as your ability to deal with life stressors.

How to do it?

Physical activity is any bodily movement produced by skeletal muscles that requires energy expenditure. This can be walking, gardening, training at the gym, playing sports or doing house work. To achieve basic health benefits, you should accumulate about 150 minutes of moderate intensity exercise per week. Activities such as walking, cycling/spinning and aqua-aerobics are ideal exercises for those looking to get into exercise.

2. Self Acceptance recommendation: Practice gratitude

Why gratitude?

Self-Gratitude is a key skill required for you to fully love and accept yourself. Raising your level of gratitude will provide you with a stronger foundation. Without it, it's too easy to be critical and hard on yourself and then fall into a negative cycle. Much nicer to have a positive cycle!

How to do it?

To accept yourself, it is important to celebrate and acknowledge your strengths as well as imperfections. One way to do this is to journal each morning. Write something that you are grateful for about yourself. Celebrate this and really let it sink in. Then, write something you are not pleased about yourself. Reflect on what this is and see if you can learn something from it. This exercise may feel strange at first, but with regular practice, it will transform your life.

3. Agency recommendation: Know your strength

Why is it important?

Knowing your strengths will help increase your autonomy because you will start to trust your judgement instead of relying on others. It will give you freedom to rely on your instinctive decisions without clouding your judgement based on other's opinions.

How to do it?

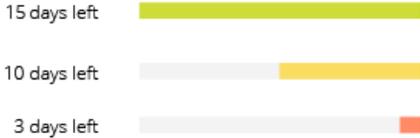
There are many ways to regularly reflect on your strengths, on your own or with help from others. Journaling is the easiest and most accessible way - you can try it out right away. Here is one example of a journaling technique:

Everyday, before bed, take note of the following:

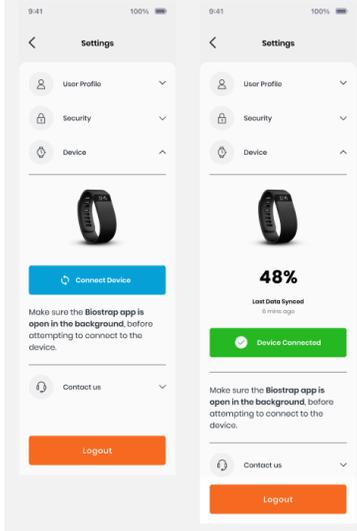
1. Something I did well today..
2. Today I felt proud of..
3. Today I had fun when...
4. Today I felt good about myself when..

Appendix D:

Onboarding broken interaction/issues & re-design solutions

Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
Wristband	<p>The following items are not clear for users</p> <ul style="list-style-type: none"> • How many days do users need to wear the device? • What happens if they forget to wear it one night or more? • What do users need to do if they see any skin sensitivity? Due to the heat, it might irritate users' skin. (The itching is not on the metal clasp part. The user has applied hydrocortisone cream and it helped) • What if they wear it all the time? Day time and nighttime • How they should wear it, how loose or tight it should be on the wrist? • Should they still wear the device after receiving the BPSs? 	<p>Clarification of un-clear parts for the users not only through the text/content but also through the design. For example, it is not sufficient that somewhere in the app, it is written that the users need to wear the 15 days, this feature should be designed in a way that the app shows it in a progress bar design and track it for users.</p> 
 <p>User's quote</p>	<p><i>I'm having a lot of trouble getting my phone to recognize and pair with the device this time around. I've accidentally removed the wristband from the app a number of times trying to get it to connect to the app. I do go through the HealthQB app to reconnect and then it redirects to the Biostarp app, but it often won't connect and takes a few tries and 5-10mins to get it to connect. (P3)</i></p>	

Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
	<p><i>"The only I fell asleep on the couch I think one or two nights that I didn't get it on so my question with that is. If I wake up at three or four in the morning, is it better just not to put it on at all or put it on for the few hours and then have it think you only slept for a few hours? So no so I fell asleep on the couch and then I moved to bed say at four in the morning. But I didn't have it on so at that point, is it better, just to leave it off, because then the data will be inaccurate because it will only be saying I slept for three hours or is it better to put it on and get some data. That you saw when a being away, it was easy to I took it and it was easy to you like, to be away and use it so that still didn't have an impact on it so that was nice". (P8)</i></p>	
<p>Wristband charging</p>	<p>The users are not aware of</p> <ul style="list-style-type: none"> • The right way to charge the device • What the red and white lights mean when they plug in the device • How the device should be located on the charging board 	<p>Make effective and clear instructions to teach the users how to charge the device. This instruction should be in a video format, not text instruction (currently there is text/ paper instructions and based on the test results user ignore that).</p>
	<p><i>"And I really don't know what was going on there, I tried everything I knew what to do and it just wouldn't charge, and then I came back a few hours later, and it did". (P7)</i></p> <p><i>"I got it (that I should put the device right on the logo) by trial and error". (P6)</i></p>	
<p>Wristband Syncing</p>	<ul style="list-style-type: none"> • The device is not very close to the user's phone while the user is syncing the device • The device has not had enough charge, or it is plugged • The device is not in the correct position (logo) on the board (if it is plugged), please play around with the device while it is trying to sync • The users' phone's Bluetooth is connected to other devices at the same time • Users do not know that they need to turn off and turn on your Bluetooth • Users do not know that they need to reset the phone and try again if it does not work 	<p>I recommend HQB provide human support or AI customer service so users can access the support at any time that they are syncing the device and face an issue.</p>

Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
	<ul style="list-style-type: none"> Users do not know that they need to delete the previous (HQB or Biostarp) app if there is any on their phones 	
	<p>"Syncing never occurred for the night of July 30/31. It does take at least 4 hours to sync with the healthHQB app and it's been fine since. Last night's data won't be there - I got distracted several times just as I was about to put on my strap and forgot" (P3).</p>	
<p>HQB & Biostarp app</p>	<ul style="list-style-type: none"> 65 % of users mentioned that the back-and-forth process between the Biostarp app and HQB app is annoying. They wish they had everything through the HQB app. They said if they want to change one thing it would be not using the Biostarp app during their experience. 	<p>Minimizing the use of Biostarp app by applying the useful APIs (Application Programming Interface). Therefore, users can see the device connected through the HQB app not navigating to the Biostarp app</p> 
	<p>"Oh, about changing my experience, umm ... I mean if there was a way to not use the bio strap up that would be, I find that APP so frustrating" (P3)</p>	

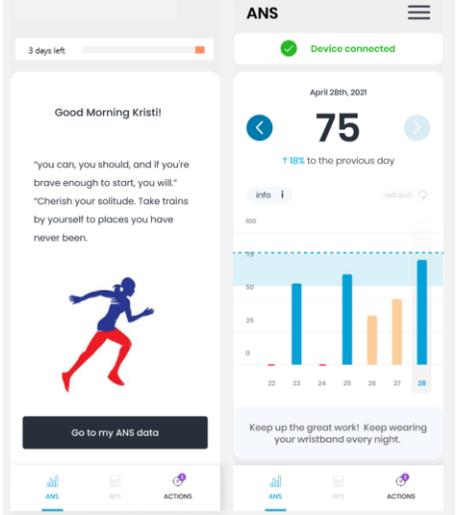
Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
Privacy of data	<ul style="list-style-type: none"> The majority of users mentioned that they want to be clear about their data privacy. 	<p>This item should be explicitly addressed in two places; First, in the onboarding process, the user's agreement should be received. Second, it should be noted clearly in FAQ (Frequently Asked Questions) part of the app.</p>
FAQ	<ul style="list-style-type: none"> 54% of users don't refer to the FAQ part to look for their questions 65% of users did not understand the ANS and BPS concepts after reading the FAQs Navigation from the home or landing page to the FAQ page should be considered 	
 <p>User's quote</p>	<p><i>"I went to FAQ; I am reading, still it (ANS) is not clear to me" (p1)</i></p>	
Icons	<ul style="list-style-type: none"> Some of the icons are not intuitive enough like the refresh icon for ANS data Users like using colors of purple and dark pink They like using more icons instead of using text 	<p>This icon is recommended to the ANS data refresh</p> 
 <p>User's quote</p>	<p><i>"You know I don't have all the answers (about branding and colors), but my eyes don't always appreciate a mishmash... I like things that should be prominent to be bold-colored so that there's a lot of contrast between the lettering or the logo in the background, ... I like the design (colors) that Biostarp uses". (P4)</i></p> <p><i>"it's still pretty ...but I like using the purple color". (P7)</i></p>	

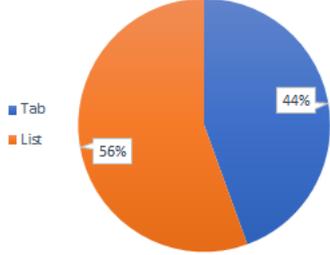
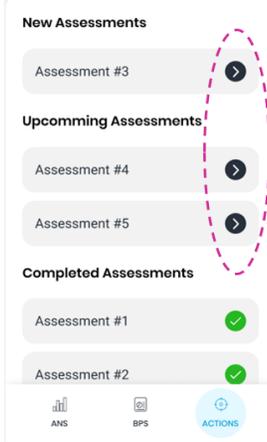
Appendix E:

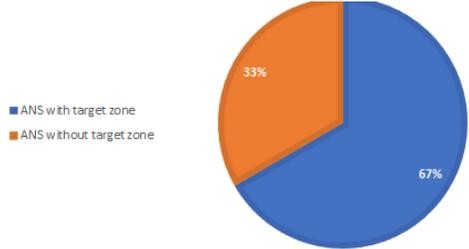
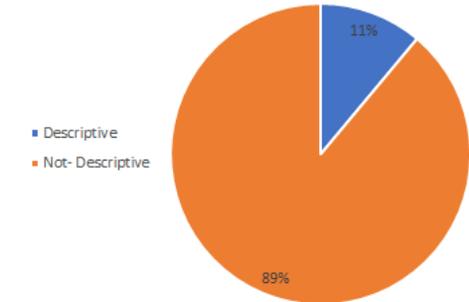
Data Assessment broken interaction/issues & re-design solutions

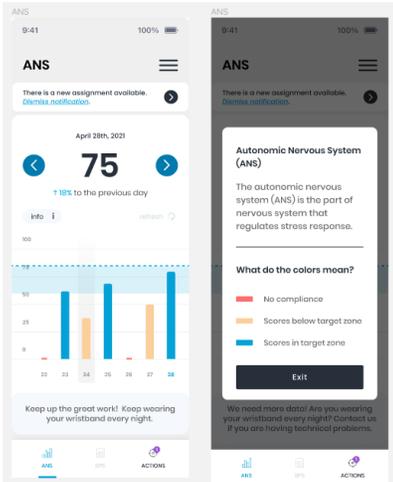
Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
<p>Frequency of notifications</p>	<p>50 % of participants would like to get twice a day notification and not more than that.</p>	<p>The best time to send notifications is between 10 AM and 1 PM or after 6 PM.</p> <p>Participants would like to have smart notifications, meaning that if they already have taken an assessment do not get the notification again even if they have set for two times a day reminder.</p> <p>It is annoying for the users to get notifications for the actions that they already have taken.</p> <p>Some of the users stated that they did not receive any notifications while in the action center there is an action for them to take.</p>

Feature	Broken Interaction/ Issue		Enhancement & Re-design solutions
 <p>User's quote</p>	<p>"I want you to know how frequently I would have the assessments, and that told me in the frequently asked question um I wanted to know more about that, I wanted to know more about sort of how that was being collected, which was okay with that." (P2)</p> <p>"Umm.. that (notification)is definitely one thing ((that I would change about my experience)), I suppose the notifications would have been better so because I didn't remember, I mean I actually don't think I asked you or did I really know that the assessments are coming in a certain interval... get completely forgotten, so if the notifications for that worked a little better, that would have been nicer ...to keep me on track, I like I said I need that push in either a reminder. But some of the other notifications, I was getting a little annoying like I don't even need this (repeating synced notification) I've already synced. To me, like it keeps writing me the sync and I'm like I don't want this is just irritating me because I've done that, I did that this morning..." (P3)</p> <p>There was a red icon for the assessments on that section. But I didn't see a notification like that" (P3)</p>		
<p>Responding to the assessments</p>	<ul style="list-style-type: none"> 98% of participants would like to take the assessment over the two weeks. <p>The users are confused about</p> <ul style="list-style-type: none"> Frequency and time interval of assessments What will happen if they forget to take an assessment If the user does not answer the whole assessment, do they still get the recommendations? 	<p>They would like to receive notifications for the assessments.</p> <p>Users would like to get a notification on the day that they have received the assessment on the action center.</p> <p>Users are confused about the assessment time intervals, and it is annoying for them that they don't know or are not informed.</p>	
 <p>User's quote</p>	<p>"To like I am curious about how that little questionnaire, and I have to say that questionnaire it doesn't cover everything like well, I guess, I feel this way, but I mean that's not really how I feel that's the closest". (P3)</p> <p>"And so, from what I got in the APP no, I have no idea why I was not told through the APP why you chose those. When I reflect back on how I answered the questions on the assessment, I very easily see how I got those recommendations, but it wasn't explicitly said to me". (P2)</p>		
<p>Rate your daily emotions</p>	<p>The user like to have this option to put comments while they are responding to the assessments</p>		

Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
	<p>Apart from the assessment, the users like to put daily text comments or have a voice recording option that can be converted to the text. They would like to have this option to in connecting the device to the laptop send the comments to their laptops Some of the users would like to have Fuzzy responses instead of numeric</p>	
	<p><i>"Also, it is cool if I can comment daily and then connect it to my laptop" (P2)</i></p>	
<p>Landing page</p>	<ul style="list-style-type: none"> Some of the users mentioned that they don't like to jump into the ANS page (landing page) right after the device connections. They like to see some motivational sentences every day or welcoming messages before seeing their data 	
<p>Data Assessment UI Screen</p>	<p>56 % of participants would like the list design for the data assessment no tab design.</p>	<p>A few participants recommended the word "Future for" "Upcoming assessments". They found it clearer than "Upcoming assessments".</p>

Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
	 <p>A pie chart with a legend. The legend shows a blue square for 'Tab' and an orange square for 'List'. The chart shows 44% for Tab (blue) and 56% for List (orange).</p>	<p>Some participants would like to see different colors for arrows in list design, for example, the upcoming arrows should not be like the new assignments.</p>  <p>The screenshot shows a mobile app interface with three sections: 'New Assessments', 'Upcoming Assessments', and 'Completed Assessments'. Each section contains assessment items with arrows. A red dashed oval highlights the arrows in the 'Upcoming Assessments' section, which are different from the arrows in the 'New Assessments' section.</p>
 <p>User's quote</p>	<p>"Having tabs, uh you know you just see what you need to do in front of you and you don't need to like there isn't other information. Especially, I guess, with some people who I find chronic pain drains, you're not always clear, you haven't slept well and so. it's just a lot of information to process, so the tabs for me would probably be just if you want to be very clear." (P9)</p> <p>"It was pretty easy for me to know which assessment to do (in list design) because of course, they're an order ... would be a good idea, or if the little if there could be a red dot next to the one that needs to be done now, I think it was clear because of the ones that you've done... Because for the assignment I was like am I supposed to do this, one now or oh yeah, it is a different color from the other ones, so if it had" (P4)</p>	

Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
<p>Adding the target score to the ANS page since the data assessment</p>	 <p>■ ANS with target zone ■ ANS without target zone</p>	<p>67% of people mentioned that they would like to see the target zone since the beginning. However, 33% have mentioned do not like it (e.g., P6) because they would like to get it later and wait for it.</p>
 <p>User's quote</p>	<p>"Okay, and so this would be target zone so you're looking at the furthest over to give you okay score below target I do like it." (P9)</p> <p>"I don't think that would be helpful to me... in fact, it could be leading somebody... two weeks is probably the most you want to keep somebody waiting. I think, yeah, the last time I did this, it was like went on forever like six weeks or something, and that was way too long, but it is (now) 10 days, two weeks. Just sort of like a just keep waiting and keep waiting for it. I think ...it's showing you a score and then it's showing you a target like I don't that could lead to an invalid baseline if that makes sense as it could just be leading in some way. Because you are already thinking after day one, I need to improve this and so that's not a baseline that's you know". (P6)</p>	
<p>Lack of enough transparency for ANS data</p>	 <p>■ Descriptive ■ Not-Descriptive</p> <p>89% of participants believe that ANS data is not descriptive enough for them to fully understand it</p>	<p>Participants would like to see immediately more information about the ANS score that clarifies /explains it in detail.</p> <p>All of the participants mentioned that they would like to know what the ANS score is clearly and how the ANS score is calculated.</p> <p>They won't think of a new name for ANS scores, but they would like to fully understand it.</p> <p>Some of the users still are confused about what a higher or lower ANS means</p> <p>The users are not sure if the ANS data is equal to their stress level</p>

Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
 <p>User's quote</p>	<p>"I need to get that; I want to know about my stress level equal to overall wellbeing" (P1)</p> <p>"I would love to see more, and I wonder to like you know what about daytime then is there, why is it only nighttime Is there something What if you weren't during the day, would it tell you something different. I'm just curious yeah. (P1)</p> <p>"I know it's measuring something during the night your different levels that come together. likely so not completely clear". (P9)</p>	
<p>Physical metrics</p>	<ul style="list-style-type: none"> • Most of the users would like to get data about the physical assessment like HR (Heart Rate), HRV (Heart Rate Variability), like physical data in Biostarp • Most of the users mentioned that they would like to see sleep quality level every day after they wake up • Users would like to get data that shows their pain level and stress level 	
<p>ANS data visualization</p>	<ul style="list-style-type: none"> • The word of compliance is not good and has a negative sense for the users. • Most of the participants (67%) like having different colors for different scores. • Color suggestion: they mentioned the color they like that I discuss in the enhancement section. • They like to be able to zoom in if it is possible • They would like to know what the ANS score means (using for example emojis), up and down does not clear to them. 	

Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
 <p>User's quote</p>		<p><i>"I would rather it be fearful because I like purple, and I don't like orange right where it's like." (P3)</i></p> <p><i>"It'd be nice if I could zoom in and out to see like if it was a point that I could zoom in to see a few days and zoom out, I think that, and then I would like to see" (P2)</i></p> <p><i>"No, it is not bad (coloring)you grab my attention and for me it because I am very proactive about my body and pain so I would like to see it" (P10)</i></p> <p><i>"Like I said last time, I would like to see it like emoji-wise. If it's good or bad, saying that so you did a good thing with SMILEY face or sad face, it's kind of in the borderline or something or you didn't sleep ..."</i> <i>(P1)</i></p>

Appendix F:

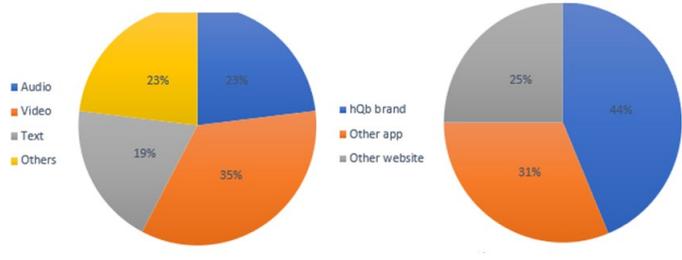
BPS broken interaction/issues & re-design solutions

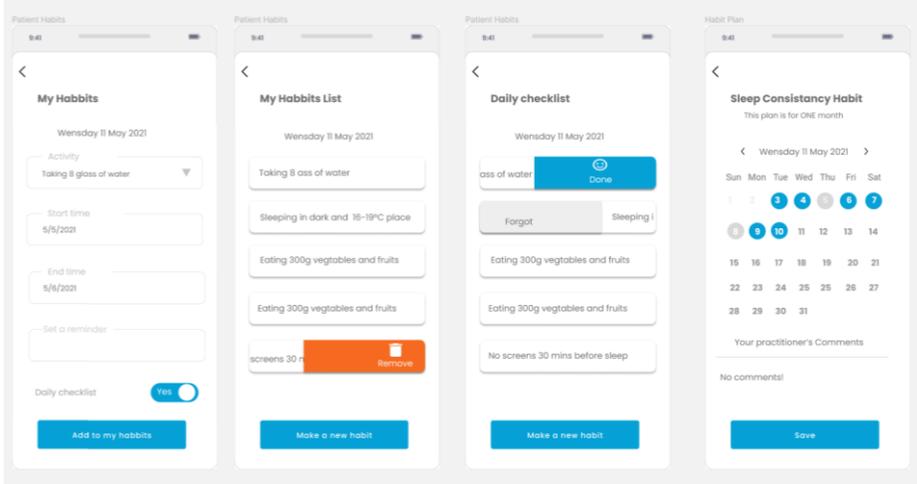
Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
<p>BPS UI screen</p>	<ul style="list-style-type: none"> • 45% of participants would like to have meaningful icons for BPSs • Users would like to see the icons, especially that hug icon gives them every good feeling • One of the users suggested the present UI along with icons (a combination of what we have now in version 2 + adding the icons) • Four participants liked the “keep it going” green part. They said it is very motivating. They suggest adding that for any design that we choose. • They would like to see the comparison page apart from the other page. It means that they want to see that comparison page in addition to the data visualization page. 	
 <p>User's quote</p>	<p><i>"Yeah, I like the icon ones I like the percentages, so I mean it fits it ticks boxes for me self-belief, I, like the icon of Giving the heart, a hug, I just feel that's more to me that's more emotional and more connected" (P9)</i></p>	

Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
	<p><i>"Okay, ... colors differentiation and having that target because knowing where that is supposed to be and it's helpful. Weird associations with red because you know there's a psychology behind that I'm sure you guys know. It does have a lot of negative associations. Like yellow, blue, and green. Maybe the things aren't going so great like it's a warning (yellow). To me like it was more of a warning sign, not you aren't doing your job. So, what are the most to do like? I don't think that it could say that that's an option, then change it up a little bit..." (P9)</i></p> <p><i>"For a data person like me, I love to see how it is calculated". (P2)</i></p>	
BPS notification	<p>The Majority of users indicated that the HQB notification system is weak and annoying. This is also among the reasons that user is not willing to pay. therefore, it should be fixed</p>	<ul style="list-style-type: none"> • Providing feedback based on the users' actions (errors/ messages) • Providing updates and relevant notifications (e.g., if there is any new data for the user) • Making the main actions/ structure and elements visible (not hidden) • Feedback to the users to inform them of what is happening. • Communicating with users' language • Not using technical words especially for errors • The best time to send notifications is between 10 AM and 1 PM or after 6 PM. • Participants would like to have smart notifications, meaning that if they already have taken an assessment do not get the notification again even if they have set for two times a day reminder. • It is annoying for the users to get notifications for the actions that they already have taken

Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
PDF report	<ul style="list-style-type: none"> • Sending the PDF file to users has been impacted their experience and satisfaction so without sending that the usability of the BPS part in the app would be low • Users received three PBS interventions. Users like it get three in the app but they are willing to receive more in PDF files. 	<ul style="list-style-type: none"> • The spider chart is not clear • 76% They like to receive PDF reports to print it out and have it as a record for themselves • They like to get more BPS areas through the PDF file • They ask us to clarify what the Target zone is and why their target zone is that particular number
 <p>User's quote</p>	<p><i>"And I mean again I really didn't find a report this time very helpful like that it was just a hey here's three areas, and this is what those are as opposed to really I didn't find out to be. recommendations in it, and maybe I just missed it, but I was just like Okay, these are the areas I need to focus on. What just focusing on those areas mean or what would be the next step, so I think there wasn't a lot of help, for me, I mean I can again". (P7)</i></p> <p><i>"Ya, it is good, I like it, you know, I print it put and have it here near my bed and I can go through it anytime I want" (P8)</i></p> <p><i>"Honestly I think I was expecting a little bit more than two pages I don't know why but. Okay, I think the last one I got you to know, in the first round of this was quite like the if I recall". (P6)</i></p>	
Personalization & customization	<p>This is a very critical issue and as I mentioned before it is correlated with the reasons for not paying for the app. Meaning that a lack of personalization and customization is felt by users, and they compare HQB app with similar apps and are not willing to pay for it.</p>	
 <p>User's quote</p>	<p><i>"I feel like there's some customization I would appreciate. More and then adding some other things would be better so until I see that that's going to happen, I am not really super inclined to want to pay for it." (P7)</i></p>	

Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
Lack of alignment of focus areas with physical conditions (other users' limitations/ disabilities)	Since we don't get any information about their physical status, they have mentioned that some of the BPS focus areas are not suitable considering their physical and other constraints that prevent them to practice and apply the BPSs.	
		<p><i>"I mean, because I had an accident in 2007 then (there are) problems at my feet, you know it's like continuously like there's always been every time you know... sometimes movement is hard" (P1)</i></p> <p><i>"Movement is a tribble example for me because anytime people like to want to recommend movement practices to me because my body is in pain all the time there's so limited to what I can do that it's like. Usually, recommendations for movement stuff for me is like okay at 90% of it is outside of what I can do, and maybe 10% is accessible to me" (P7)</i></p> <p><i>"The plan should be matched with my body --- So, even just not writing it down, but just mentally making it is what works for me as soon as I like to schedule it schedules it then all of a sudden, I feel like performance anxiety around it and that causes a whole other level of things that's not great". (P?)</i></p>
Novelty of BPSs	As I discussed it before the BPS focus areas (recommendations) are not novel for the users. Novelty products "aha moment", aha moment leads to knowing the product values and consequently, users are willing to pay once they know the value of the product	
		<p><i>"No surprise no. Well, like I said I wasn't so surprised, especially with the movement one". (P8)</i></p>
BPS area prioritization	The majority of users would like to see the BPS areas prioritization and know clearly which areas they should start first	
Momentary pain	This program works for long-term pain healing but some of the users are wondering what the HQB app recommends for momentary pain that they have	
		<p><i>"If we can have a list of actions that we can do when we are in pain ... yeah, I mean, I think that would be great yeah I think that's really great. I love that idea of it being linked to the list, so that it's like on you know today I woke up and I'm a 56 so the list of things that I'm suggested to do is very different than the day I woke up and as 100 that's pretty that's a pretty cool idea". (P7)</i></p> <p><i>"You know, when I have particular pain, I sort of look at the pain um you know I joke I call my different body parts, like my neck is a certain name I'm having pain. Susie is having a bad day "(p2)</i></p>

Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
<p>Interventions resources</p>	 <p>■ Audio 23% ■ Video 35% ■ Text 19% ■ Others 23%</p> <p>■ hQb brand 44% ■ Other app 31% ■ Other website 25%</p>	<p>Users need more information, for example, like a video or like a mentor or guidance from a specialist to teach them how to apply the recs</p>
 <p>User's quote</p>	<p><i>"Recommending book, website: No, I do like visual and audio like things I can. hear the or actually you know guided things like you know with gym classes, I don't like going to just open gym I need like a coach to. You know, tell me what to do, and like encourage me and whatnot so in this way I kind of see the same thing, like. It kind of helps when I have someone working with me specifically to say Okay, these are the things you could do, or this is, this is a meditation video, or I can walk you through one thing like that so. Referring to other app and HQB app is good" (P3)</i></p>	

Feature	Broken Interaction/ Issue	Enhancement & Re-design solutions
<p>Habit Management – Helping user to practice the BPSs</p>		 <p>I designed these sketches to show the way we can track the interventions and help patients to make habits. The items they should be considered in a tracking and habit management journey are the length of practicing the intervention, frequency per day, notifications, prioritization, the intensity of the intervention, and the method of practicing the intervention.</p>
 <p>User's quote</p>		<p><i>"I knew them (BPSs), but I need to practice" (P8)</i></p> <p><i>"I Would go first for the gratitude. I thought one just really resonated with me, I felt like that. is really something that we forget to do, and I forget to do, and I think. It does help it puts you in a better frame of mind when you're young remember what you need to be grateful for" (P5)</i></p> <p><i>"don't know exactly where to start you know my emotions are all. it's all over so exactly which point you know if I take off or do if I write a journal where it's going to start you know. Should I start It was a child, or something should I start way in had the accident in 2007 or in 2019 or 2020 you know I don't know where to start you know all my life is this basically". (P1)</i></p>