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USABILITY EVALUATION OF A PERSONAL HEALTH RECORD WEBSITE USING HUMAN-CENTRED DESIGN METHODS

Master's Thesis

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Author's declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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ABSTRACT

Personal health record (PHR) websites have gained popularity for being a moderator of providing patient-centered care, however, their usability and usefulness to users have received little attention. Human-centered design (HCD) methods offer a systematic way of measuring effects on users and their cognitive tasks. Using the HCD methods can help shape the design of the end-product and enhance its usability. In this study, the author sought to evaluate the usability of FollowMyHealth website using HCD methods. This PHR web portal is being used by patients of many hospitals in USA. The study participants were asked to think aloud while doing the tasks given to complete at FollowMyHealth website. Findings were later analyzed and two redesign recommendations were generated by rapid prototyping software called Axure RP 8.

Keywords: Usability, Human-centred design, PHR Systems, FollowMyHealth

Isikliku tervisekontrolli (PHR) veebisaidid koguvad populaarsust, sest nendest on saamas patsiendikesksete terviseandete moderaator. Samas on selle kasutatavusele ja kasulikkusele siiani vähe tähelepanu pööratud. Kasutajakeskse disaini (HCD) meetod pakub süsteemset võimalust mõõta mõju kasutajatele ja nende kognitiivseid ülesandeid. Kasutajakesksed disaini (HCD) meetodid aitavad kujundada tarkvara disaini ja parandada kasutajamugavust. Selle uuringu eesmärk oli hinnata FollowMyHealth'i veebisaidi kasutatavust HCD meetoddiga. Seda PHR veebiportaali kasutavad USA paljud haiglad. Uuringus osalenutel paluti mõelda valjult FollowMyHealthi veebisaidil täitmiseks antud ülesandeid tehes. Saadud tulemusi analüüsiti ning Axure RP 8 abil tuntud kiire prototüübi tarkvara sai resultaadina

List of abbreviations and terms

HCD	Human-centred design
UI	User interface
UX	User experience
PHR	Personal health record
EHR	Electronic health record
HCI	Human-computer interaction
CPOE	Computerized point order entry
UE	Usability engineering

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1. INTRODUCTION

Personal health record websites have gained popularity as a mediator for patient-centred care. PHRs are primarily used for keeping the health-related information organized in one place by users themselves. PHR websites which are interoperable with hospital EHR offer to reduce costs, improve care quality and increase access to medical information for both care providers and patients. Major challenges for PHR is that patients do not understand the medical information given as there have been distress and confusion observed with the users of PHR. Currently, the adoption of PHR is not at an optimal level, however, it is likely that the adoption of PHR would increase by 70% by 2020 [13]. One of the reasons for the failure of Google Health were usability problems [31].

Usability also plays a great role in adoption and existence of any IT solution and according to a study, it is revealed that PHR websites have received little attention for their usability [9]. Hence, it is a good time to find out the usability problems of these web portals.

1.1 Aims and objectives

The main aim of the study is to analyze the usability problems of existing web-based PHR application called FollowMyHealth. The sub-aim of the study is to find out the design preference of users.

The main objective is to investigate the usability problems using HCD methods. HCD method is to observe the users, then make prototype, get feedback on prototype, iterate and implement. The other objective is to learn and use Axure RP 8 software to come up with the new prototypes based on the observations gathered from users.

With these objectives in mind, the research will try to answer the following questions:

- Is FollowMyHealth easy to use?
- Is the design of the website visually appealing?

2. BACKGROUND

2.1 Definition and historical background

Patient Health Record (PHR) systems are designed as platforms for electronic records that enable patients to self-manage their health care data [3]. The goal of the PHR is to enable sharing of information and collaboration between the provider and the patient, which eventually would improve the patient treatment and health and reduce the costs.

The history of the PHR systems begins in the 1970s as an expansion of the traditional electronic health records (EHRs). EHRs represent health data, digitally stored throughout the life of the patient and primarily used by the healthcare professionals and organizations. EHRs do not provide patients with easy access and control options for their data and often the systems between hospitals are not compatible and do not allow sharing and exchange of information. PHR emerged as an attempt for addressing some of those issues. The Health Insurance Portability and Accountability Act of 1996 and the Fair Health Information Practices Act of 1997 legalized patients' rights to access their clinical data and the protection of the medical records [10]. The early PHR developments contained mostly general patient data and basic information about the medical encounter. PHR use has been quite restricted until early 2000s, while in the recent years its popularity has been rapidly growing. More than 35,000 mobile apps are currently available that generate huge amounts of data [7]. There is a trend of development of more and more interactive interface of the systems that can increase the patient engagement and interaction as well as increase the types and amounts of data included. For example, new data elements were added as appointment management, disease

prevention, reminders, tracking and monitoring (for example blood pressure or glucose level).

2.2 Significance and useful applications of the PHR systems

The main benefit of PHRs is represented by the opportunity for the patients to collect, maintain and control their health data in a secure way. Using a PHR, a patient could choose to share certain data or to retain its privacy. Furthermore, PHR systems allow collaboration and exchanging of information between the patients and health care providers [32]. Shared decision making of the patient and health provider and active patient participation are thought to be the best strategies for health decisions [10]. Studies of patients that already use PHR systems report increased patient-provider communication and the patient's empowerment [35]. Especially high are the benefits for the populations with high costs and high needs, such as patients with chronic diseases [33].

PHRs can contain information on the medical conditions, drugs and data on self-monitoring of the patient's health [17]. PHRs allow gathering information from external health monitoring sources, such as accelerometers, gyroscopes, wireless scales, wristbands, and smartwatches. The integration of such data can contribute for early detection of health risks for the patients. Recently, PHR are increasingly used for making appointments with the healthcare institutions [28].

With the increasing globalization, tourism and migration waves in the last decades, the risks of transmitting infectious diseases and facing global epidemies are also rising. PHRs can become very useful for patients who travel abroad to obtain the desired health services in the most efficient way [28].

The PHR systems are building up enormous amounts of organized information that conceal a unique potential for research by machine learning, pattern recognition, applied mathematics and artificial intelligence algorithms. For

example, PHR data can be extremely helpful in building models for disease prognostics and risk assessment [7].

2.3 Data types and formats

Nowadays, huge amounts of data are accessible through PHRs, and the variety of data types continues to expand. Some of the most commonly encountered data categories are the health history, treatments, general information about the patient, diagnostics, prevention data and scheduling [7]. Table 1 enlists a representative selection of the data types found in the literature.

Data type	**Description**
1. General information	
Personal information	Name, date of birth, gender, contact information, etc.
Psychographics	Interests and lifestyle
Preferences	Hospital preferences, pharmacy preferences, emergency contact information, living will, power of attorney
PHR settings	Security and privacy settings
Insurance	Insurance plan information
2. Appointments and visits	
Appointments	Date and time, reminder settings
Provider information	Name and contact information
Visit information	Clinical summary of the visit, information for visit preparation
3. Diagnostics	
Vital Signs & Anthropometric Data	Bodily functions' status and body measurements
Physiological Information	For example, electrocardiograms
Results	Laboratory tests, imaging, screenings

4. Health history	
Medical history	Clinical symptoms reported by the patient or others familiar with the patient
Problems lists	List of the clinical symptoms
Surgical history	Description of surgeries and hospitalizations
Allergies	
Genetic data	
Documents	Attached photos or scanned files
5. Medications	
Medications	List of medications
Prescriptions	Medical prescriptions

Table 1. Data types found in personal health record files [7]

The increasing amount and complexity of PHR data urged the development of variety of data formats. In addition to plain text and numbers, some records contain metadata giving additional information on the time and source of receiving the data. Images are also a common format in the PHRs, used for storing imaging, X-ray data and scanned documents. For documenting phone calls and visits, audio or video recordings have been used [7].

There are several ways in which the data can be input into the PHR. In the first scenario, the data is obtained through collaboration with different healthcare providers. The patient remains the owner of the data, but the providers can add data in a controlled fashion. The second scenario is when the patient is solely responsible for inputting the data, for example menstrual period information. In a third case, the data is collected from different platforms and sources, like patient reports and EHR, and is further integrated and combined. The patient and external providers are collaborating in this process. Fourth, the patient can share clinical data anonymously through a social network or blog in order to receive feedback from other users [28].

2.4 Challenges and problems

One of the main challenges concerning PHRs is the correct understanding of the health data from the patients. There are reports of patient's confusion and distress concerning the medical terminology, for example the one in imaging reports. A systematic review of the effects of PHR access to the users reports no significant anxiety and distress reactions in the majority of the patients. However, specific subgroups of the users appeared to be more susceptible to such reactions, in particular cancer patients who are likely to show anxiety responses [8]. Therefore, more investigation is needed on better data representation models targeting specific patient groups.

Large amounts of input data can also create information "overload" problems, where storage and analysis issues may arise. The integration of data originating from different sources can create risks for violating the privacy of the data, forcing to put more resources into improving the data security.

Another point of concern is keeping the increasingly complex data error-free and with high quality. The data entered by patients can be generally trusted regarding the simpler information as demographic data, but it tends to be inaccurate when it concerns more complex reports. A way of addressing this issue is providing the patients with very detailed guidelines and additional information and trainings. Additionally, there is a need of developing widely accepted standards for data quality and methods of data integration between different platforms and sources [7].

2.5 Challenges to adoption and use of PHRs

There are many challenges to the development, adoption and use of PHRs and these can be divided into three separate categories:

1. Patient/Consumer-related challenges

2. Provider/Organizational-related challenges

3. Technical challenges

4. Usability challenges

2.6 Challenges faced by consumers

PHRs for sure have the ability to improve the quality and safety of healthcare by making it easy for patients to seek healthcare. However, it won't be of any good unless patients actually use them. Despite a significant increase in the use of PHRs during the last few years, the current adoption of PHRs among patients is still low (i.e. around 7%) [14]. Computer competency, Internet access, and health literacy are important barriers to PHRs adoption [22]. Although access to computers and the Internet may act as an obstacle to PHR adoption, the increase in technology and the ease of accessing Internet through mobile phones and tablets could be seen as an opportunity as they need less computer competency and access to Internet is much easier through these devices [22].

Health literacy is another factor that plays a role in consumer adoption of PHRs [22]. The Canadian Public Health Association defines health literacy as "skills to enable access, understanding and use of information for health". However, a worry intertwined with patient literacy issues is precision of data. Interviews led by Witry [36] discovered that healthcare suppliers were uncertain about the adequacy of information, interpretation and understanding

of treatment. In Canada, according to the Canadian Council on Learning, the majority of adults (60%) do not have the necessary skills to manage their health adequately.

One of the major concerns amongst patients/consumers when it comes to using PHRs is security and privacy. According to a recent survey, 75% of respondents who do not use PHRs reported that they are concerned about the privacy of their personal health information [14]. A review by Nahm and Kim in 2012 found that 75% of grown-ups who did not utilize PHRs were worried about the confidentiality of their healthcare information in the PHR framework. However, less than half of the PHR users are concerned about the privacy issues [14]. These privacy issues have led to a need to address other challenges/barriers such as authenticity, audit measures, etc.

Security has been one of the main issues in consumers' minds. Patients usually have hard time trusting nurses and doctors when they come in with a laptop or a tablet due to the recent breaches in security over the Internet. Moreover, some patients have raised their voices against nurses/doctors leaving their laptops/computers unattended when they go for lunch, which should be looked after as with the increase of technology comes additional responsibility [1].

Many authors have agreed that care providers and the patients encounter problems when they are utilizing PHRs. Dontje conducted a study with six adult focus groups [12]. These groups consisted of 21 participants and the average age of participants was around 64 years. Four-fifths of the participants was literate and had an undergraduate or graduate degree. Before the study, these participants had concerns about their ability to access their information on PHR, the value and usefulness of access, and security. During the study, the participants discovered an incentive in viewing medical records, updating medicinal information, reaching care providers, and offering records to different care providers. Many of the participants accessed the PHR only once as they struggled using the system and found it hard to understand

information. It was concluded that the portal has been difficult to navigate, and the participants found it hard to understand their medical information [12].

2.7 Provider/organizational-related challenges

Challenges of PHR use and adoption are faced not only by patients but by providers and organizations as well. Adoption of PHRs may also result in a bit more work, which can also lead to the expectation that there will be physicians who will be reluctant to use them.

A survey conducted in 2011 proved that only 55% of office-based physicians in the US had adopted an EMR [21]. There are other organizational challenges, however, elaborating on these would go out of scope of the study, so they will not be further discussed.

2.8 Technical challenges

It seems that the most important and challenging technical issue about PHRs is interoperability. The following definition of interoperability was approved by The HIMSS Board on April 5, 2013:

In healthcare, interoperability is the ability of various data technology frameworks and programming applications to convey, trade information, and utilize the data that has been traded. Information trade schemes and models should allow information to be shared across clinician, lab, doctor's facility, drug store, and patient regardless of the application.

This means that a lack of interoperability could be a huge barrier to integration and exchange of data between PHRs and other health information systems. The functionality of a PHR is limited unless it is connected to other information systems to pull data from. Even if there isn't a debate about the appropriate blueprints of a PHR, interoperability is going to be the main issue. All models of PHR i.e. tethered and interconnected ones need to be

interoperable. Even the PHRs on a national level will need to be interoperable in an international standard scope.

Since technology plays a major role in the adoption of these PHRs, the need to educate people of all ages about PHRs is necessary and needs to be done as soon as possible. In one study of 112,893 patients who were offered PHRs, 28,910 accepted and signed up. Limitations included a participation rate of only 25.6% and the fact that the patients took an average of 59.5 days to access their PHR. One-third of the patients aged 60 to 69 years registered for access to their PHR. This finding recommends a mix of discrimination and reluctance with respect to elderly patients to figure out how to utilize the technology. Programs have not been established to help patients understand and be able to successfully navigate through the systems. Also, new technology will always be met with backlash from certain individuals regardless of age group [25].

2.9 Usability challenges

Usability and user experience are important factors in the adoption of any IT solution. Simply put, usability is a quality standard which accesses the ease of use of the interface. However, user experience (UX) is defined as the ability of the design to fulfill the exact needs of a user without any bother [11].

However, in the academic writing on human-computer interaction (HCI) and usability engineering (UE), a few definitions have been displayed for the concepts of ease of use and UX. Commonly cited definitions for usability are given by the ISO 9241-11 standard [6]. These definitions share similar usability components – for example, productivity, fulfillment, and effectiveness − and emphasize the part of the context. At a stronger level, ease of use has been portrayed as follows: “A framework with great usability is easy to utilize and effective. It is natural, pardoning of mistakes and enables

one to perform fundamental tasks rapidly, effectively and with least mental exertion. Tasks which can be performed by the software (for example, information recovery, association, summary, cross-checking, ascertaining, and so forth) are done out of sight, enhancing precision and freeing up the client's subjective assets for other tasks." Moreover, as usability lies in the cooperation of the user and the system, quality of use has been described as the object of usability. A quality of utilization model, depicted by the ISO 25010 standard, incorporates five attributes: adequacy, productivity, fulfillment, flexibility from risk and context coverage. The initial three of these segments are likewise part of broadly known usability definitions [6].

Usability problems are common in digital systems of healthcare industry.

2.9.1 Usability challenges in PHR

A challenge which can result in a low adoption of PHR is usability, is a failure in designing systems that meet users' needs and that are easy to use [22]. Systems having a low usability have very limited value to the end-users and would be the cause of a lower rate of adoption. Due to the complex design of the PHRs and every company using a different PHR, it is difficult for patients/consumers to adopt the new technology. In a study conducted by Kahn et., al 2009, it was shown that unfriendly user websites' navigation and tasks posed difficulty due to problems with comprehension of the information on the web pages [22]. Tasks where the percentage of patients viewed a necessary page in the PHR include:

- Locating upcoming appointments, 61% of patients viewed the correct page
- Interpreting a graph of results, 38% viewed the correct page
- Determining how to manage a missed dose, 46% viewed the correct page
- Insulin dose from a dosing schedule, 61% viewed the correct page

Another study published involves patients of the Duke University Health System. They evaluated the usability of their PHR website called HealthView in order to find out the usability problems and give recommendations based on the analysis. Twenty participants completed the usability tests given to them, and a moderator was there to observe when participants were completing the tests. After the tests, a survey was completed by them and moderator asked open-ended questions. The results shown that navigation was not simple, about 30%- 60% of the participants found it difficult to find lab test results, allergies, introduction video, payment history, vital signs and add children page. Few of the tasks were difficult or frustrating for the participants to complete; for instance, finding lab results was a very time-consuming task when sorting through long list of results. No problems occurred when it comes to adding medicine and finding instructions to take these. Based on these problems that occurred during the tests, the author gave suggestions to the website and they incorporated these in their next release [30].

Another study gets the users' perspective on two commonly used PHRs Microsoft HealthVault and Health Companion. Namely, 90 students from State University in San Marcos, Texas participated in this study. The author used Usefulness, Satisfaction and Ease of use (USE) surveys to get the data from the participants. Statistics was performed on the data and it turned out that one-way analysis of variance (Anova) favored Microsoft HealthVault over Health Companion. The author concluded with the recommendation for future developers of PHRs to consider Microsoft HealthVault as the model when it comes to usability [34].

2.9.2 Usability challenges in EHR

It has been indicated by the author Kaipio et., al 2017 that healthcare IT systems get little attention when it comes to problems encountered by users [23]. Therefore, a nationwide usability survey was conducted in Finland. The participants of the study were physicians who use the system on daily basis.

Aim of the study was to measures usability and user experience with EHR. In total, 3081 physicians participated to complete survey from year 2014 while 3223 physicians from year 2010. The physicians were using most commonly used EHR systems in Finland. The rating scale used was from 1 (fail) to 7 (excellent). The average overall ratings ranged between 3.2 to 4.4 in 2014 while in 2010 it was from 2.5 - 4.3. The results have shown some improvements in usability and satisfaction with the functionalities of EHR [23].

A UX expert in healthcare is of the view that UX in healthcare is poor and call for more designers to be needed in this field. The EHR vendor does not care much about the needs of the users and the disastrous truth of healthcare is seen. It is seen as a zone regularly experiencing such poor UX, which has an impact on our lives at a considerably more profound yet more individual level than almost any other region [6].

Specific healthcare programming has had a tendency to be a territory onto itself, regularly conservative and slow-moving. By and large, when a health association gets tied up with an EHR framework, and these frameworks are often valued in millions, if that framework was sent with little worry for usability, then the usability of these frameworks would be much better [2].

Usability of EHR has been linked to patients safety as well. Poor usability can lead to severe risks including but not limited to incorrect medicine given to patients. For example, one study concluded that usability issues associated with computerized provider order entry (CPOE) contributed to 22 types of medications error risks [37] [24]. Another study mentioned that CPOE caused a severe overdose of potassium due to usability issue [20]. As referred by Staggers [37], a hospital in US transplanted infected kidney to a patient due to usability issue.

2.10 Reasons of usability problems in healthcare

There are many reasons why healthcare doesn't receive much attention when it comes to usability. They are given below:

- Lack of interaction between developers, clinicians and patients [29]
- Finding usability problems involves users, is expensive, repetitive and it takes long time to complete [18]
- The users involved in the process are usually care providers and patients and they are hard to be kept as users for longer period of time

In a study published by Rudin et al, 2017, the author state the reasons of poor usability in healthcare and also give recommendations to overcome these problems. The study says that the creator of apps and IT systems do not interact with any of the end users which are patients and clinicians. This in turn leads to little understanding of why the tool is needed how it would be used [29].

Moreover, the study concludes that there is also disconnect between the needs of physicians of developers as they are not always able to properly express the changes and additions needed in the system [29].

To overcome these issues, the author suggests to create teams that consist of IT professionals and clinicians and patients, so they can take part in the innovation programs and help in better collaboration. Moreover, during the development process a direct interaction with the end users (patients, physicians) through interviews and observations would help shape the design of the end product. Additionally, the author mentioned that with new developed technologies there might be a redesign of care of process [29].

To grow past these difficulties, other usability experts say that it is critical to include the end users early and frequently in the development process. Lessons from client-focused outline and configuration thinking – systems effectively

embraced by different ventures – can similarly profit the healthcare industry. For instance, programming engineers should endeavor to create sympathy with their objective clients and would profit essentially from watching the setting of utilization and their needs and objectives. Mockups, reenactments or representations of the last item should be made (if not in real code, then utilizing instruments, such as InVision, Marvel, Axure RP) to evaluate client engagement and ease of use well before the development team is fully dedicated to building in a particular direction. Quantitative reviews can be embraced to affirm speculations revealed through subjective work or, on the other hand, to uncover patterns that should be additionally investigated through subjective research [19].

2.11 Human-centered design methods

The basic principle of HCD is to empower the end users and hear their voice when making any type of solution. It has few stages like observation, ideation, prototyping, feedback, iteration and implementation. During the observation stage, one can be expected to observe how they are using the product and then come up with ideas on how to improve it. During prototyping, a quick solution which explains the idea can be made. The prototype can be given to the users to get feedback from them and based on the feedback one can iterate and finally implement the solution [26].

3. MATERIALS AND METHODS

The study focuses on analysing several web-based applications in the category of personal health record. The applications were analysed using http://bluebuttonconnector.healthit.gov/apps/ with an aim to get inspiration about the design and usability of different systems.

3.1 Selection of website for usability tests

About 10 web-based applications in the category of PHR were analysed. FollowMyHealth was chosen because the data model in the website is very similar to what is outlined in Table 1. Moreover, the website has strong user base and many hospitals recommend their patients to use the website. It has been developed by Allscripts company based in the USA [15]. According to the Alamance Regional Medical Center, the website is open to be used by their patients. Additionally, the website can also be used by the patients of following hospitals in USA:

- Burlington Family Practice
- Cornerstone Medical Center
- Ely Surgical Associates
- Mebane Medical Clinic
- West Burlington Medical Center
- South Graham Medical Center
- Encompass Women's Care
- Alamance Regional Psychiatric Associates
- Burlington Urological Associates [15]

To double-check this, the author also searched on Google with keyword FollowMyHealth and found that other hospitals were also offering the portal to their patients. More than 10 hospitals were found to be offering their

patients FollowMyHealth PHR for free. The list of all the hospitals with the URL can be seen in the appendix.

Moreover, the author tried to find out the actual user base (visitors) of the website which came out be 2 million monthly [38].

3.2 Screenshots of FollowMyHealth

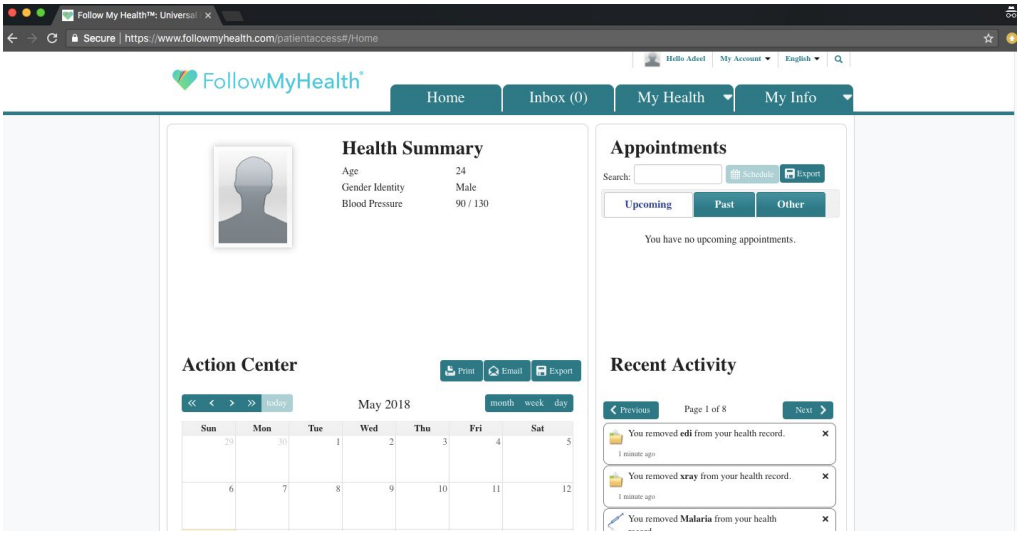

Figure 1. Home page of FollowMyHealth

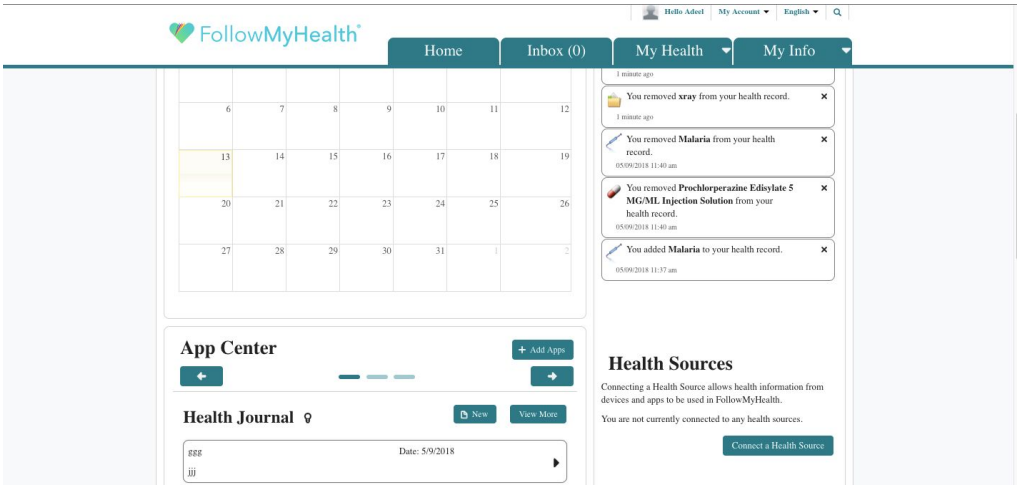

Figure 2. Home page of FollowMyHealth

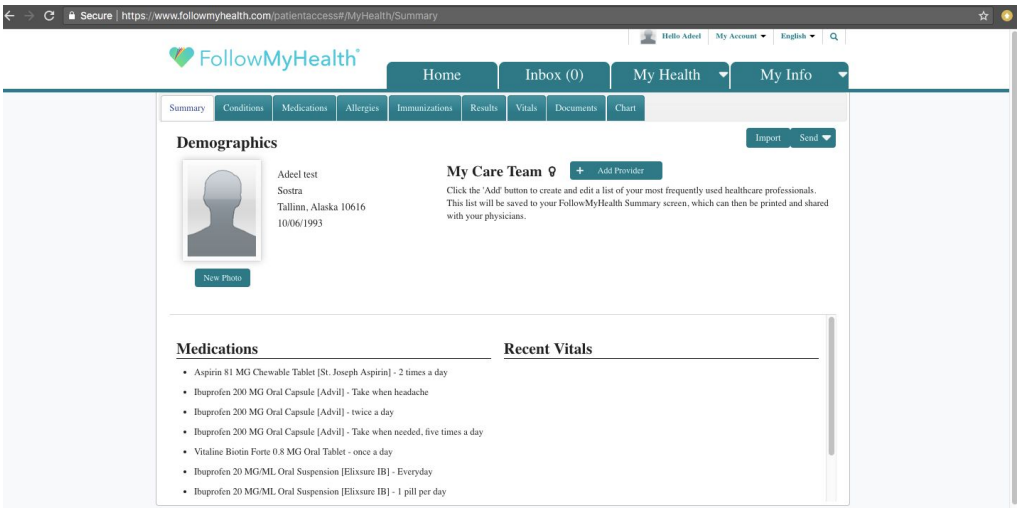

Figure 3 My Health tab of FollowMyHealth.

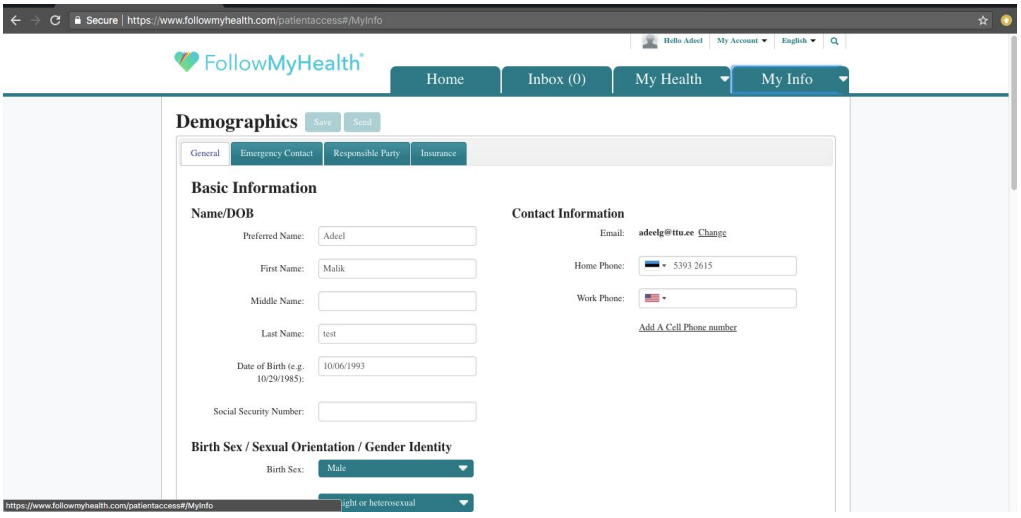

Figure 4. My Info tab of FollowMyHealth

3.3 Participants and usability tests

Ten participants volunteered for the study. It has been researched in one study that even 8-10 participants can lead to identification of 80% of the usability problems in the application [27]. Hence, 10 was the sample size chosen by the author for the purpose of this study.

Each participant was given 11 tests or scenarios to complete in the order given in Table 2.

No.	Test / Scenario
1	Add care provider
2	Make an appointment with your doctor
3	Upload a medical document (it could be any document)
4	Add medicine **Ibuprofen 200mg capsule** as regular taking medicine and also make a note to take when needed
5	Send care provider information to your email address
6	Find and see the email that you just sent
7	Update personal information
8	Find and print health summary
9	Find and add Vaccine that you received in childhood
10	Find a way to add FitBit data with the website
11	Find an introduction video
12	Remove Immunization and Medication that you entered in other tasks

Table 2. Usability tests given to the participants

Before starting the tests, the participants were explained the reason behind conducting these tests; it was made clear that the purpose of the study is to test

and get feedback on the usability of the website. Thus, the participants would feel more comfortable when doing the tests. They were also asked if they were aware of FollowMyHealth website. None of the participants did know FollowMyHealth website prior to this study.

The participants were requested to think aloud or describe their thoughts as they carried out the tasks. During the tests, the author was sitting next to the participants as a moderator observing the users and the activity on the screen for all the tests. The moderator also took the notes for each participant for analysis. The conversation with the participants were also recorded for later analysis. The participants were informed about the recording and they gave their consent to be recorded. However, one of them did not give the consent to record the voice but to record the screen. Two of the participants did not give consent to either record voice or the screen.

Afterwards, the participants were interviewed about the problems they encountered, whether they would use the website in the future or recommend it to a friend or colleague. They were also asked to answer the usability questions given below:

Please rate the following questions. 1 disagree, 2 slightly disagree, 3 slightly agree, 4 agree, 5 fully agree

- I can navigate FollowMyHealth website easily
- I can find the information I need quickly and easily
- I understand health information presented on FollowMyHealth
- Using the website can help me manage my health
- The information on FollowMyHealth can help me make better decision about my health
- The information on FollowMyHealth can improve my interactions with doctors and nurses

All of above mentioned responses were filled by the participants in Google Forms.

Afterwards, they were asked the following open-ended questions by the moderator:

- If you could make one significant change to the FollowMyHealth website, what change would you make? Are there other changes you would make?
- Would you consider opening a FollowMyHealth account?
- Would you recommend FollowMyHealth to a friend or colleague? Why or why not?

As a result, quantitative and qualitative measures were collected.

3.3 Prototyping

After the initial phase of usability testing of FollowMyHealth website, the author found the pattern of usability problems. To give design and usability recommendations, the author started prototyping using a rapid prototyping software called Axure RP 8 [4].

4. RESULTS

Ten users from the author's work place, which is an IT company in Tallinn, and students from Tallinn Technical University volunteered to participate in the study. The participants completed the usability tests and their survey data are included in the analysis. The participants ranged in age between 20-30 years. All the participants had graduated Bachelor's degree and can be considered as tech savvy.

4.1 Task 1

When the participants were given access to FollowMyHealth website for the first task, most of them were a bit confused and they went straight to My Info session of the website thinking the option to add the care provider would be there. However, after not finding the option, they clicked on My Health tab and found the button to add care provider there. The first task was completed successfully by 9 participants.

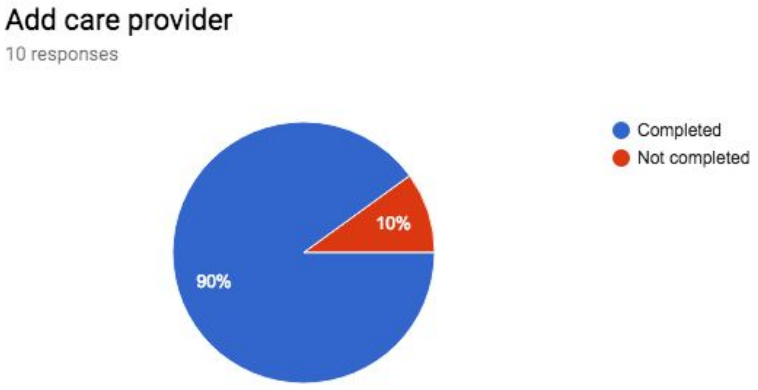

Figure 5. Task 1: Add care provider

4.2 Task 2

50% of the participants couldn't finish the task to make an appointment with the doctor. The information to make an appointment is given on the left hand side on Home Page; however, the participants were scrolling My Health section of the website for this option. When they navigated to the Home Page, they thought Action Center (with Calendar) is an option to make an appointment, so they kept on clicking on the calendar or trying to locate in My Info but couldn't complete it and they requested for help. The author then explained how the appointment system works.

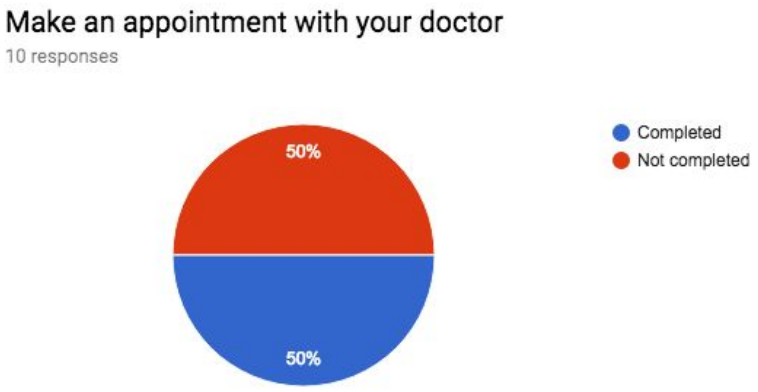

Figure 6. Task 2: Make an appointment with your doctor

4.3 Task 3

It was completed by 90% of the participants, however, for few participants it took a little time to find the document tab where they can upload the document. One participant wasn't able to find the tab at all after several tries. When asked about it, the participant mentioned the button looks the same and there was not enough visual aid to complete the task.

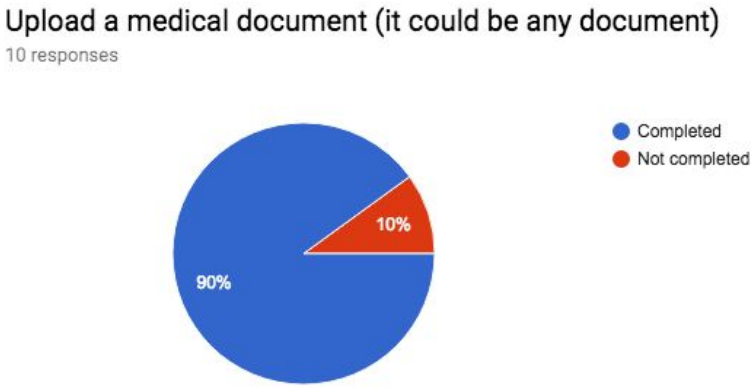

Figure 7 Task 3: Upload a medical document

4.4 Task 4

It was completed by all the participants, however, few participants found it difficult to locate the option to add the medicine. The participants first thought that the option would be in My Info tab of the website. When they couldn't find any option, they clicked on My Health and found the Medications option.

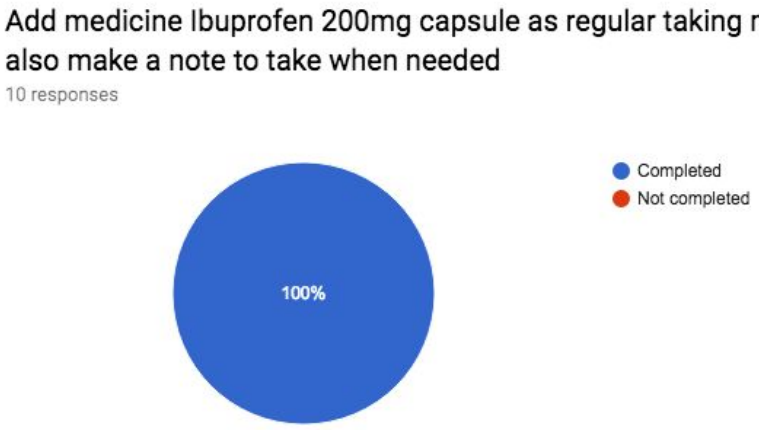

Figure 8 Task 4: Add medication

4.5 Task 5

The task was also completed by all the participants although few participants struggled with it. They were clicking on buttons next to the care provider, i.e. Edit and Remove buttons. However, after few tries they managed to find the Send button.

Figure 9 Task 5: Send care provider information to your email address

4.6 Task 6

It was a bit tricky for them to complete it, all of them completed it but most of them found it quite hard to locate the sent email in the Inbox.

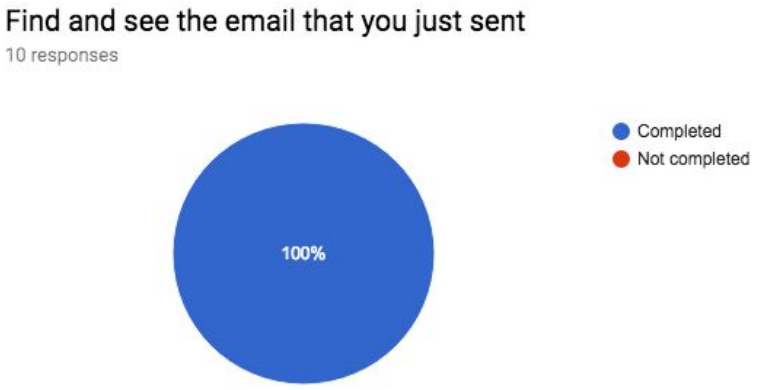

Figure 10 Task 6: Find and see the sent email

4.7 Task 7

This task was fairly simple for all the participants. As users were visiting My Info in most of the previous tasks by error, they learnt that the information about themselves would be in My Info tab.

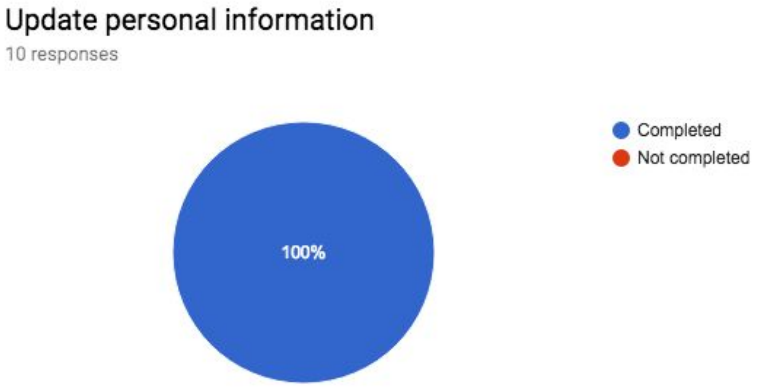

Figure 11 Task 7: Update personal information

4.8 Task 8

It was quite tricky for almost all of the participants. For this task they couldn't find the option to print the summary without aid from the moderator. Most of the participants were of the view that having Print option within the send button menu is not a good place for a print. Most of them suggested to have the option somewhere else.

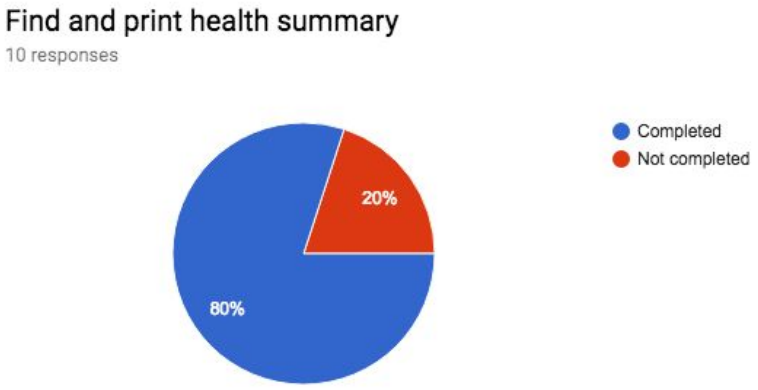

Figure 12 Task 8: Find and print health summary

4.9 Task 9

All the participants completed this task successfully.

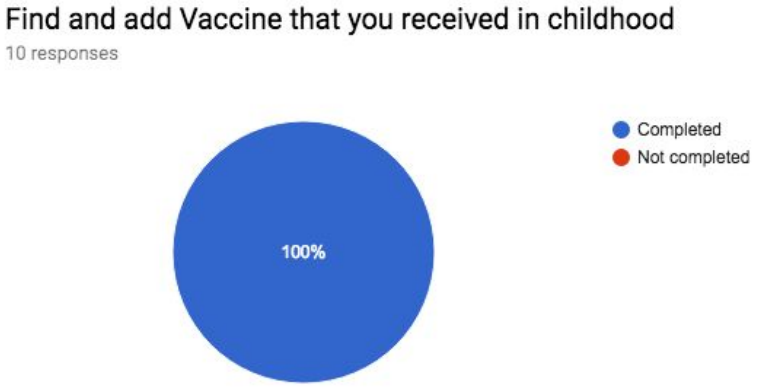

Figure 13 Task 9: Find and add vaccine

4.10 Task 10

It was complicated for most of the participants as they couldn't locate the button to add the Fitbit with the portal. Most of the participants navigated to the page where the option actually is, but they kept looking and clicking at the center of the page where App Center functionality is located. With the aid of the moderator, the participants completed the task, but they mentioned that the

option is not visible enough or not clearly written for them to understand. One of the participants mentioned that the text looked like a disclaimer-type of information, which she usually ignores.

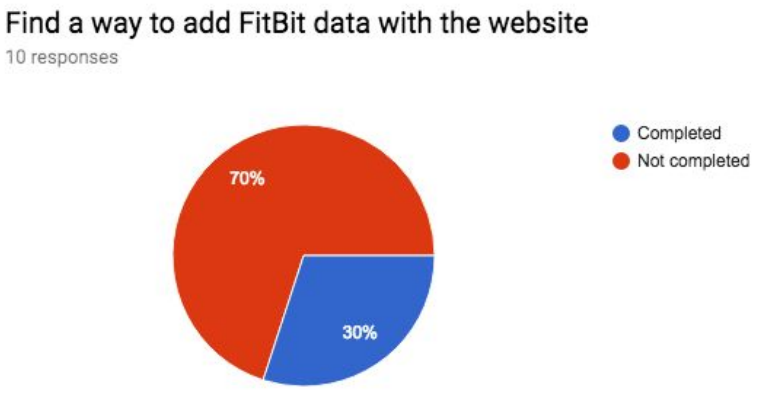

Figure 14 Task 10: Find a way to add FitBit data with the website

4.11 Task 11

This task was also not easy for the participants to complete as they were saying that help option is quite hidden. Those who completed the tasks requested help from the moderator. Those who couldn't complete the task just gave up after trying for several minutes.

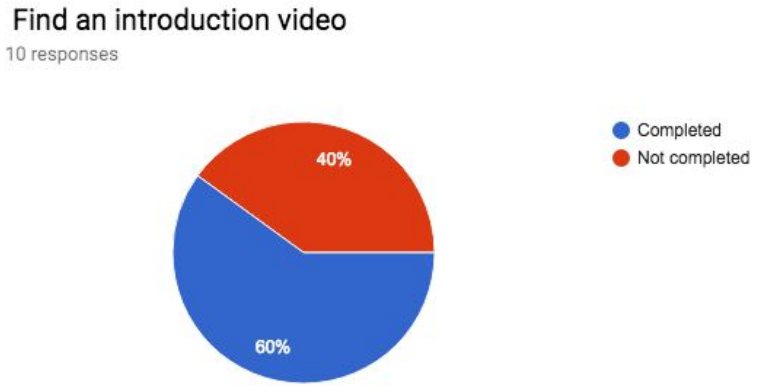

Figure 15 Task 11: Find an introduction video

4.12 Task 12

It was a bit tricky for few of the participants because on the Immunization page deleting the entry is different than deleting the entry on Medication, so they got confused when they were deleting the Immunization entry. However, they all completed it successfully.

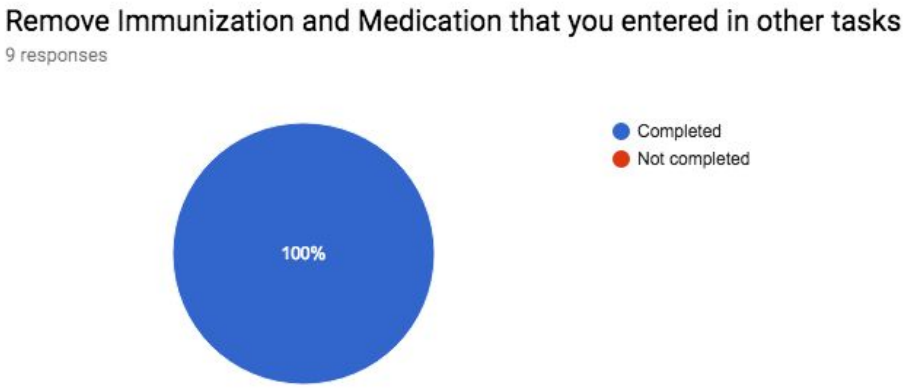

Figure 16 Task 12: Remove immunization and medication you entered in previous task

4.13 Feedback on tests

I can navigate FollowMyHealth website easily

Most of the participants slightly agreed and agreed to the question of navigating through the website easily, however some participants disagreed with this as they thought that everything looked the same. My Health and My Info tabs were confusing for them. 70% slightly agreed, 20% agreed and 10% totally disagreed with this question.

I can find the information I need quickly and easily

When talked about finding the required information quickly and easily 40% agreed, 40% slightly agreed, 10% disagreed and 10% totally disagreed. The participants who disagreed were of the view that the Toggle on the My Health and My Info tab is misleading. They kept on clicking the toggle instead of the

link. Those who slightly agreed said that they could find the information easily but rather not quickly.

I understand health information presented on FollowMyHealth

When it came to understanding the information present on the website, 40% fully agreed to it, 30% agreed to it, 20% slightly agreed to it and 10% disagreed to it. Those who slightly agreed and disagreed said that the wording terminology used on the site can be simplified.

Using the website can help me manage my health

For using the site to manage the health, 40% fully agreed, 30% agreed, 10% slightly agreed, 10% slightly disagreed and 10% fully disagreed with the statement. Those who disagreed said that they do not need this type of information to manage their health. One of them also mentioned being skeptical when it comes to trusting their health data on the Internet.

The information on FollowMyHealth can help me make better decisions about my health

30% fully agreed, 50% participants agreed, 10% slightly agreed, 10% slightly disagreed on this question. The participants think that when they have summarised view of their health over, they can make better decisions based on that information. However, those who disagreed said that if the website gives personalized recommendations to user, then it would help making better decisions.

The information on FollowMyHealth can improve my interactions with doctors and nurses

80% of the participants fully agreed to the statement while 20% slightly agreed to it. Those who slightly agreed mentioned it is only the matter of filling the data. They also mentioned that if there is an automatic way of

collecting the information, then it would be easier for them to share the data with the care providers before their visit.

How often do you use the Internet to look up information about medications?

70% of the participants answered that they do not look for information on web about medications. However, 30% of the participants mentioned they often use Internet to find medication information.

How interested would you be in using the internet to make a doctor appointment?

100% of the participants mentioned they would be very interested to make an appointment with the doctor online. All of the participants mentioned that it would be a very useful feature instead of making calls.

4.14 Open-end questions

If you could make one significant change to the FollowMyHealth website, what change would you make? Are there other changes you would make?

Almost all the participants mentioned that the website looks quite outdated, so they would change the user interface. They would make the sleek layout of the website, which is visually appealing and easy to use.

Other changes suggested are given below:

1. Repetition of information throughout the website. For instance, Health Summary can be found at the Home page as well as My Health tab. Also, Help and Support are essentially the same things, so there is no need to have two links.
2. How to use the website aid should be included in the Home page when user visits the website for the first time.

3. The footer of the website is too big and is empty, so the footer should be shrunk to fit the content.
4. One participant suggested that the website lacks grouping of information e.g. appointments are related to the doctor, so this section should be somewhere next to the care provider.

Would you consider opening a FollowMyHealth account?

Most of the participants said that they would open the account at the website if it has better usability. Those who said they won't open an account mentioned that they do not need this website or an app to manage their health.

Would you recommend FollowMyHealth to a friend or colleague? Why or why not?

Majority of the participants said that they don't think any of their friends or colleagues need the website at the moment, however, if it makes someone's life simpler, then they would recommend the website to their friends and colleagues.

5. DISCUSSION

The human-centered design methods, human interaction theory and principles of interface design were studied for this research.

All of the participants were new to FollowMyHealth website, and when the tasks were given to them, they were a bit confused, which is an obvious behavior from any user to be curious about a new thing. However, by the time they completed second or third tasks, they felt a bit more comfortable and memorized the parts of the website where they were performing the tasks. This may indicate that learnability of the website is good. The behavior of the users is aligned with the similar study which gives usability tests to the patients for PHR called HealthVault. When users were asked to add care provider to their profile, they spent some time in the beginning, however, on second and third tests they started to feel comfortable about the website [30].

Tasks 3, 7, 11 (make appointment, update personal information, find an introduction video) can also be found in a study conducted on HealthVault. For making an appointment, 45% of the participants either gave up or requested help from the moderator. When updating personal information, 18% of the participants gave up or requested help from the moderator. Moreover, for finding instructional video, 5% gave up on the task and 25% requested help [30]. However, in this study making an appointment was also confusing for the users, 50% of the participants couldn't complete it and others asked for help. Moreover, the participants did not get into trouble when updating the personal information in their profile. When asked to find the instructional video, 40% couldn't find it.

Few design and usability recommendations were made based on the results from usability tests and surveys.

5.1 Design recommendations

It was clear from the open-end questions after the usability tests that the participants wanted to change the design to make it look modern and visually appealing. Hence, designed two layouts for the website were designed.

Screenshots for the new design looks can be seen in Figure 17 and Figure 18.

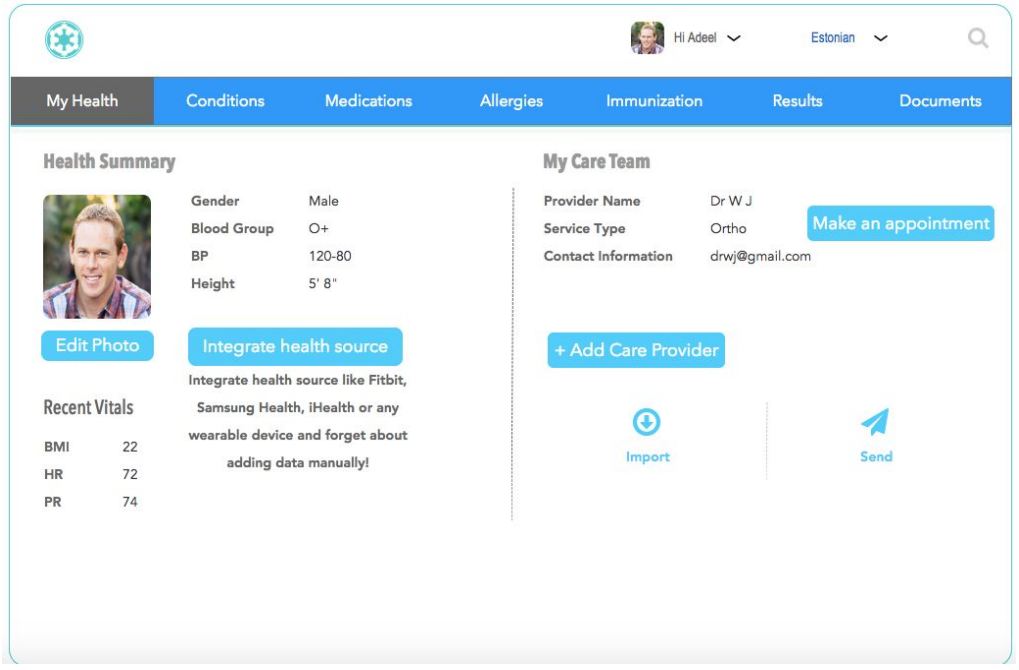

Figure 17. First design recommendation for FollowMyHealth.

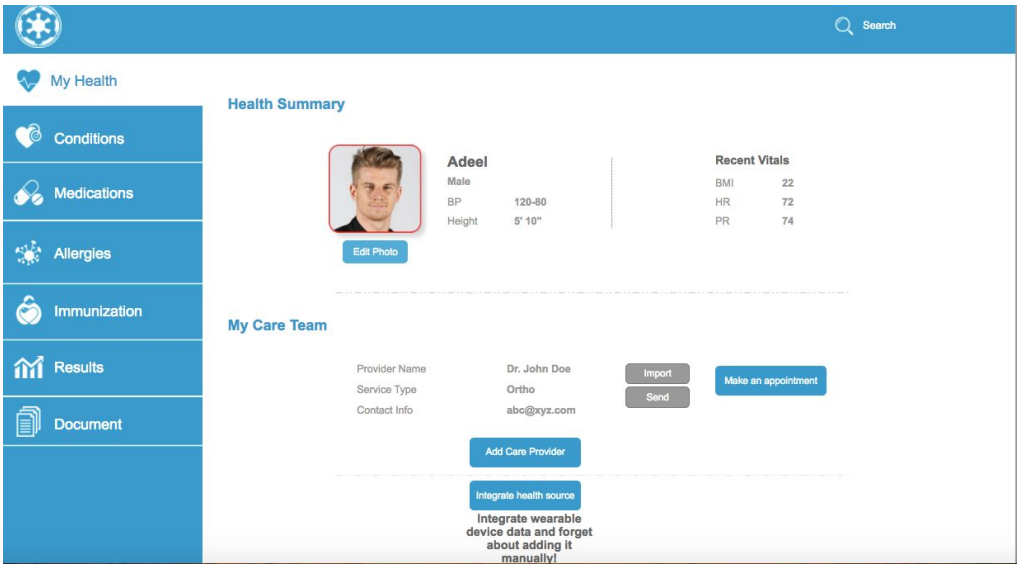

Figure 18. Second design recommendation for FollowMyHealth

The rapid prototypes for these designs can be seen in below mentioned links:

1. https://a2psf1.axshare.com/summary.html
2. https://mazfwx.axshare.com/#c=2

The major change made is adding colors to the website. In psychology, it is said that the blue color is the color of calm, peace, clarity and it is universally liked color. A study showed that blue color proved to be an intervention for anxiety in students [5]. The blue background was chosen on the question pages of the first prototype. Moreover, the menu bar has blue color and there is white color text on it in both the prototypes.

It is an interesting observation that most of the participants were paying more attention to the top left and left section of FollowMyHealth website when they were doing usability tasks. They also paid attention to the center of the page. This observation is aligned with the latest study's results by Nielsen Norman Group [16]. The study track the eyes of website visitors. The study suggests that visitors scan through the website in F shaped pattern, which means that top left content of the website gets the most attention [16]. Therefore, in the second prototype menu bar was developed on the left hand side of the screen.

Appropriate icons were also used next to buttons. It gives pleasant visual effect on the site.

Moreover, effects were added on all the buttons where user is adding data for instance Medications, Conditions etc.

The other change made is not including the My Info tab in the Home screen. My Info tab can be used in My Account section of the app where user can see, edit, update, and delete their information.

5.2 Usability recommendations

The first recommendation is to ask health related questions in an interactive way. This can be implemented on successful user sign up, system may ask questions about the person's health. Elements of gamification can also be helpful in boosting user engagement. However, users can still skip the questions and go to the Home page.

Appointment can be added next to the care provider details, so users can make the appointment right next to the name of the doctor.

Another recommendation is not to have My Info tab next to My Health tab as it confuses the users. My Info can be used in My Account as one of the menu options.

At Home page the site may introduce the features like small pop-ups which tell how to do what. It will help users understand what is what and where they can find the information needed.

Additionally, the logo of the prototype was made clickable, It is personal feelings that users are used to of clickable logos as it can be used on major social media platforms. This behavior was also observed during the usability test sessions. However, the logo of FollowMyHealth wasn't clickable.

6. CONCLUSION

With the increase in the adoption of PHRs comes an increase of effect on user's health. Usability of a PHR website is an important aspect in this technological world, and to overcome usability problems, it is critical to include end users early in the development process.

In this study, the usability of PHR website called FollowMyHealth using human-centred design (HCD) methods was evaluated. Usability testing and interviews were conducted to gain an insight of user's needs and requirements when managing their health online.

Based on the results of usability tests, the study was concluded with the statement that the website is more or less easy to use however, some recommendations on changes in the way information is presented was generated by the users. Moreover, there is a need to change the design of the website.

One limitation of the study is that the participants chosen were tech literate and did not have any chronic disease. As the web portal is being used by the patients of different hospitals, it would be more insightful to do the usability tests with patients. Due to time constraints, interview with the patients wasn't arranged. Moreover, the study also lacks the testing of the prototypes developed by the author, which can be a material for future studies.

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8. APPENDIXES

Usability tests

https://docs.google.com/forms/d/e/1FAIpQLSepuxGm8JJm6vDKRgQ8PurrjgB5F1ukU7FdPsdlDfLT81-9_w/viewform

The table below enlist the hospitals that are offering their patients the ability to make PHR accounts.

Name of hospital	Link
Heritage medical associates	https://www.heritagemedical.com/followmyhealth/
Sharp Healthcare	https://www.sharp.com/patient/followmyhealth/
Revere Health	https://reverehealth.com/follow-my-health/
The GW Medical Faculty Associates	https://www.gwdocs.com/patients-and-visitors/my-health
Northwell Health	https://www.northwell.edu/manage-your-care/patient-portal/followmyhealth
Health Texas provider network	http://healthtexas.com/followmyhealth/
Marine Healthcare district	http://www.marinhealthcare.org/followmyhealth
Ridgeview Medical center	https://www.ridgeviewmedical.org/followmyhealth
Hendrick Health System	http://www.ehendrick.org/main/follow-my-health.aspx
UofL Physicians	http://www.uoflphysicians.com/follow-my-health/register
Acton Medical Associates	https://www.actonmedical.com/access-follow-my-health/

Washington University Physicians	https://wuphysicians.wustl.edu/followmyhealth-patient-portal
The Jackson Clinic	https://www.jacksonclinic.com/follow-my-health
Flagler hospital	http://www.flaglerhospital.org/Followmyhealth.aspx
Phoenix Children hospital	https://goo.gl/oeCrJR