Sleep Revolution
Towards digital sleep diaries

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Abstract

The awareness of importance of good sleep has increased in the past years and the general public is beginning to realize that it is one of the fundamentals when it comes to health. Sleep diaries are a tool that is often given to patients where sleep problems are suspected. In the sleep diaries, patients answer a questionnaire at night and in the morning about their sleep and habits. Sleep diaries today are conducted on paper, which means that it takes a long time for professionals to read the data and especially long time to enter them manually into computers, at the same time it is also difficult for the patient himself to look over the diaries and see any pattern. In this project we are designing a website for a digital sleep diary in a browser. This project is therefore about answering the following research questions: First, what are the benefits, and trade-offs, of changing the sleep diary from paper to a digital platform for the patient? Secondly, how do patients want to see the data from their sleep diaries visualized on the website? Also, for the professionals, how do they want to see the data from the sleep diaries visualized on the website? Both qualitative and quantitative methods are used in this research. For data gathering, 9 interviewees were questioned during semi-structured interviews. Subsequently, 59 people were asked to fill out a sleep diary for one week and they were then asked to answer a questionnaire about their experiences. Then, 9 participants were invited to participate in a user test with the wireframe of the website, and finally, the same 9 individuals were asked to participate in a user test on a running prototype of the website. The results of the research show that digitizing sleep diaries includes some disadvantages, such as having to open a computer to fill out the sleep diary. Some people like having a pen and a paper on their bedside table and answering right before, or after, sleep instead. The benefits are many, but it is worth mentioning how accessible it is and even if an individual forgets it as soon as he wakes up, he can log in to the website anywhere with access to a smartphone or a computer. One of the biggest advantages, however, is the ability to see the data visually in real-time and over a certain time. The result also shows that both patients and professionals want to see the data displayed visually and in such a way that it is easy to read from the raw data gathered about sleep and habits. They also want to be able to see the data for a certain period as well as to be able to compare it with another period.
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1 Introduction

Sleep is one of the foundations of health, among exercise, nutrition, and well-being. Most adults need 7-9 hours of sleep. If people do not get enough sleep, there are many health problems that can occur. For the past years, the knowledge about the importance of sleep has been increasing, people have been paying more attention to the amount of sleep they are getting as well as the consequences that can occur from sleeping too little. For example, there are cases like diabetes, depression, insomnia, memory loss, stroke, and heart attack connected to poor sleep patterns (Arnardóttir, 2021). There are many different technologies used to measure sleep, but it is important to keep in mind that they are all differently reliable, and the devices that measure respiration and brain waves are the most reliable devices (Arnardóttir, 2021). As a result of the increased sleep awareness, there have been a lot of people monitoring their sleep themselves with smartwatches. There are benefits and limitations to that. It is easy to measure, and it can be measured over time, but it is not as reliable as a polysomnography (PSG), which is the gold standard of sleep measurements (De Zambotti et al., 2019). Smartwatches can overestimate sleep and underestimate wake since it mostly detects movement and heart rate. People can lie in bed watching a movie and it detects that they are asleep.

Sleep diaries are a tool that is used when sleep is being measured (Buysse et al., 2006), the subjective experience is very important and sometimes that is enough to diagnose the patient without any objective testing (Arnardóttir et al., 2021). Sleep disorders that can be diagnosed with subjective assessment are for example insomnia which is when an individual has difficulty falling- and staying asleep (Arnardóttir et al., 2021). As of today, sleep diaries are being filled out on paper and the data needs to be looked at on paper or be manually written into a computer afterwards to be analyzed. There is a need for standardizing sleep diaries so it will be possible to see the data visually without the extra work of moving the data from paper to a digital platform. A digital platform is a software that connects users’ needs with resources, whether it is a business-to-consumer or a consumer-to-service provider relationship, that is a mixture between markets, companies, and communities that aids the production of value (Islind, 2018).
The purpose of this project is to investigate what the benefits, and trade-offs, are of changing the sleep diary from paper to a digital platform for the patient, as well as how the data should be visualized on the website for the user to gain insights from it. This research is therefore performed for the purpose of designing a user-friendly website where users will get what they want and need from the website in one place. The research questions that we will look for answers to are:

- What are the benefits, and trade-offs, of changing the sleep diary from paper to a digital platform for the patient?
- How do patients want to see information about their sleep visualized on the website?
- How do healthcare professionals, and researchers, want to see information about their patients' sleep visualized on the website?

When trying to answer these questions we will use a mixed method, a combination of qualitative and quantitative approaches and go through 5 different phases. The phases are:

1) Semi-structured interviews will be conducted with 9 participants, 2) Sleep diaries will be handed out to 59 people, and as a follow up on that 3) the same people will answer a survey about their experience doing a sleep diary on paper, 4) Wireframe evaluations will be conducted with 9 participants where users will be asked to use a think-aloud method, and lastly 5) Prototype evaluations will be conducted with the same 9 participants where they will be asked to use the think-aloud method as well. There are two user groups for this project. They are the patients, who fill in the sleep diary, and the professionals, who are healthcare professionals and researchers. The professionals do sleep measurements, help patients improve their sleep and research sleep.
2 Related research

2.1 Sleep Analytics and Technology

The understanding of sleep began when a technology was developed, a technology that gives insight into the human brain. Sleep technology and the development of polysomnography (PSG) have been twined together; what experts use to record the physiologic changes during sleep as well as to diagnose sleep disorders. In 1929, a psychiatrist named Hans Berger was able to record electrical activities of the human brain. There, Berger was able to find a difference in the activities of the brain between the event of being asleep and awake. This was an enormous milestone for scientists, they were now able to investigate the brain’s activity and measure it quantitatively (Deak & Epstein, 2009). PSG is the gold standard method to assess sleep and is the main reference for device validation (De Zambotti et al., 2019). PSG tracks a person’s brain waves, heart rate, breathing, blood oxygen levels, and body and eye movements during sleep through electrodes attached to the skin and scalp. Brain waves are the only way to know if someone is asleep or not and to know in what sleep stage, they’re in at any given time.

After the sleep monitoring, the data needs to be scored. Scoring sleep is a procedure where sleep cycle information is extracted from the data. Sleep stages, movements, respiratory events, and other factors need to be correctly identified in order for the results to be right (Fiorillo et al., 2019). In 1957, after Dement and Kleitman’s description of sleep stages had been published and for the next 10 years following, the sleep community started to have concerns about the reliability of the sleep scoring, and that is why a group of researchers met to discuss a standard scoring system and therefore assure that the data could be reliably compared (Deak & Epstein, 2009).

An alternative to the PSG test is actigraphy, which is mainly in wrist-worn devices such as smartwatches. It uses an accelerometer to measure patterns of motion and estimate how long the person has been awake and asleep. That means that activity implies the person is awake and no-motion that she's asleep (De Zambotti et al., 2019).
2.2 Wearables

A great way for a person to notice if they are lacking sleep is by tracking it themself. The easiest way to do that, and the most common way recently, is by using wearables (Berryhill et al., 2020). Wearables are already having an impact on the healthcare system; they allow patients to monitor themselves at home (Dunn et al., 2018). They are a cheaper alternative and are accessible without a prescription (De Zambotti et al., 2019).

Wearable technology is a term that is used when body-worn sensors are being discussed. They are most often used to track fitness and health, and in the past few years as smartwatches have increased in popularity, they capture a variety of data about the user’s sleep. That may include heart rate, time awake, time sleeping, sleep interruptions, movements, and physical activity (Arnardóttir et al., 2021). When we sleep, we go through a few cycles, including between sleep and wake, light, deep and rapid eye movement (REM) sleep. When we don’t get enough of deep sleep that is when we might feel awfully tired the next day. The wearable technology can detect body movements, heart rate and some even detect body temperature during sleeping, but they do not measure the actual signal like breathing and brainwaves (Arnardóttir, 2021). That is how they estimate how much time we spend awake, asleep and time we spend in each sleep cycle. It can however be hard for the wearable to know exactly when a person falls asleep. If they lie completely still and calm watching television, it can be misinterpreted as sleep (De Zambotti et al., 2019). Data from wearables is not as accurate but it is easy to gather a lot of data from smartwatches since they are so easy to use (De Zambotti et al., 2019). There are no standards that are set regarding data collection, analyses, and visualizations and therefore there is no consistency between companies when it comes to measuring sleep stages and giving their users feedback. The data needs to be validated and that is often done by comparing the data from the self-trackers to PSG in a double setup (Arnardóttir et al., 2021).

Wearable technology is great for the public to understand how they sleep and to get people to think about their sleep. It is important to be cautious when looking at data from wearable technologies, however, as they are not completely reliable (De Zambotti et al., 2019).
2.3 Sleep diaries

When patients' sleep is being measured, the subjective experience is very important and sometimes that is enough to diagnose the patient without any objective testing. Sleep disorders that can be diagnosed with subjective assessment include insomnia, which is when an individual has difficulty falling- and staying asleep. There are other disorders that do not benefit as much from the subjective experience and require more objective assessments to conclude diagnoses. In many cases, the subjective assessment is looked at as being not that important and is even overlooked in the sleep disorder diagnosing process (Arnardóttir et al., 2021). Example of subjective assessment are questionnaires, interviews, and sleep diaries.

A sleep diary is a widely used tool when measuring a person's sleep. When patients keep a record of their sleep, it is possible to identify sleep disruptions like insomnia and other elements that can affect sleep quality (Suni, 2021). They are used a lot in sleep research as well as clinical practices and are considered the best data for subjective sleep assessment. There are multiple versions of sleep diaries available and there is no single, widely accepted format (Buysse et al., 2006). The difference lies in the wording of the questions, the number of the questions, the format of delivery, how regularly it should be answered as well as the length of the data collection. To make sleep diaries an even better tool there is a need for standardization (Carney et al., 2012). Sleep diaries have their pros and cons, just like every other sleep measurement technology. They are inexpensive and easy to use and it's possible to fill them out anywhere and anytime since they only require the diary and a pen (Short et al., 2017). The part that makes them not as reliable is the fact that the diaries require participants to follow them and that they answer with honesty since they are only subjective. Most diaries are set up as a series of questions that the patient answers each morning and each night. The questions include bedtime, the time it takes to fall asleep, and the sleep duration, as well as questions about caffeine intake and other variables that might affect sleep. This needs to be done for a different amount of days depending on the reason for the diary (Carney et al., 2012). William Wohlgemuth and his co-workers believe that one week of measuring sleep is enough for healthy adults to get the needed results; however,
between 2 and 3 weeks with older individuals is best when sleep onset latency and wake after sleep onset is being measured (Wohlgemuth et al., 1999).

For the diaries to be as reliable as possible, the patient needs to fill it in as they go to prevent forgetting certain information and create a memory bias. Therefore, it is good to keep them at an accessible place. It is known that patients and research participants try to fill into the diaries for few days in a row and there is no way to see when those entries were made (Arnardóttir et al., 2021). It is easy to make the sleep diary look good by writing information that the individual thinks researchers want to see, but that ruins the purpose, and therefore, it is very important to write down whatever is needed to be able to give the right treatment. The future might bring digitalized sleep diaries and by that, the answering rate could be higher, and the researchers will have an overview to see if their patients are filling in the sleep diaries as well as limiting the act of trying to fill in few days in a row (Arnardóttir et al., 2021).

2.4 Co-design

When it comes to the designing process of a subject matter, involving stakeholders in it is very important to assure that the end results will meet the prospective users' needs and that is where co-design comes in handy (Islind et al., 2019). Users are just as many as they are different, and therefore, it is crucial for designers to get users input to discover unique perspectives. Co-design is divided into different phases which are a combination of designing, testing, implementing, and learning where each phase is organized in different ways depending on the project (Beyond Sticky Notes, n.d.).

In co-design it is important to let end-users have a voice in the design processes that ultimately affect their lives. The first step to get started is to determine the user groups, and then, ask people from those groups to participate in the design process. Thus, as recommended, they are involved early in the process. Generally, the users are not trained in design work and they collaborate with the designers to reinforce the design process.
Bridging the group’s boundaries is needed in more complex situations when there is more than one user group. User groups can vary by a lot and the biggest differences usually are in the competence, profession, values, interests, age, social status, or power of the group. For that reason, co-design is beneficial since different groups generate data (Islind et al., 2019). Interviews and prototype evaluations are a critical part of co-design to get all the data from the prospective users. More than one interview is needed along the way, in between interviews the design is modified according to the interview data. Interviews are like conversations, and the setup of that conversation depends on what interview method is being used. Interviews may be semi-structured, structured, or unstructured; differentiated by how much control the interviewer has on the interview, if they are more open-ended and more like a conversation or if they are according to predetermined questions where each participant answers the same questions to keep the study standardized, or if they are a combination of all interview methods (Preece et al., 2015).

Prototype evaluations are done on prototypes, whether it is a wireframe, which is a blueprint that is created to help designers and programmers to communicate about the software that is being built, or a running prototype where designers have created something that is visual and responsive. By this, designers are gaining an understanding on specific problems regarding the design as well as getting ideas on what could be improved (Sheard et al., 2019).

2.5 Data Visualization and representation

Data visualization is a metaphorical representation of data and it is a way to make it easier for users to understand the data. Today the world is flooded with information, and therefore, it is important to find a way to represent this data in an understandable way (Tableau, n.d.). The human brain is able to process the data more efficiently when it is represented visually (Ali et al., 2016).

When looking at raw data it is hard for the users to understand or interpret the results. When the data is represented visually it becomes easier for them to see an important
pattern and from that make decisions. Designers need to know their way around data visualization and know what techniques to use to be able to give the end users the best experience. Data visualization results in some benefits like time saving, self-service for end-users as well as improved decision making (Ali et al., 2016). For these reasons, it would be wise to spend money and time on doing data visualization well, most industries benefit from making their data more understandable for their users (Tableau, n.d.). Syed Mohd Ali mentioned in his paper that, “the most important feature that a visualization must have is that it should be interactive, which means that users should be able to interact with the visualization” (Ali et al., 2016).
3 Research approach

In the beginning of the research, we decided to work with a mix of a qualitative and a quantitative approach. By using techniques from both of those approaches, a mixed method design is being used to answer the research questions (Byrne & Humble, 2007). This allows us to gain a better understanding of the subject and therefore obtain the best possible results. The research was divided into 5 different phases: 1) Semi-structured interviews were conducted with 9 participants, 2) Sleep diaries were handed out to 59 people, 3) A survey was created and sent out to those who did the sleep diary, 4) Think aloud evaluations were conducted with the wireframe with 9 participants and finally 5) Think aloud evaluations were conducted with the running prototype with 9 participants.

Both formative and summative evaluations were used in the project. Formative evaluations helps with finding out what is not working and in improving the design while summative evaluations describes how well the design performs (Joyce, 2019). First the semi-structured interviews were conducted, which was a summative evaluation, to understand the user groups and their needs of the website. Next a group of people were asked to fill out a sleep diary on paper, then a survey was sent to them about doing it on paper and how they would want the data to be visualized. That was a summative evaluation to assess their experience filling out the sleep diary on paper but also a formative evaluation since the question regarding the visualization helped to design and improve the website. After that a wireframe evaluation was conducted which was a formative evaluation and helped iterate the design of the website, it helped identify what was not working, which was then redesigned. Lastly a prototype evaluation was conducted which was both a summative and formative evaluation. The final design for this project was tested and the overall experience that the users had came from the summative evaluation. There were however ideas collected of how to iterate the design even more for the next step of the project which was a formative evaluation.

In the beginning of the research there were 3 user groups. That was patients, researchers and healthcare professionals. Those are the user groups that will use the website. Patients are those who are measuring and inspecting their own sleep, whether it is of their will or if
they are advised to do it by professionals. Healthcare professionals are those that measure sleep, then help the patients to improve their sleep and the researchers are those who are researching sleep.

When going into the phase 1, there were 3 different set ups, one for each user group. The reason for getting all groups involved was to understand the demands from each group. After the interviews there was a decision taken to combine the researchers and healthcare professionals into one user group, the professionals, which are then those who are measuring sleep, help patients to improve their sleep and research the sleep. The reason to combine the two user groups was that there was such a small difference between those groups which could be bridged with some access control. For the remainder of the research, these two groups were treated as one. In phase 2 and 3, only the patients took part, since they are the ones that will be using the sleep diary online, the professionals will only look at the data that comes from them. In phase 4 and 5, both user groups were involved since we have two different designs on the prototype, one for each user group and therefore need an input from potential users for each design.

Figure 1: Timeline, January to May
3.1 Qualitative approach

3.1.1 Phase 1: Semi-structured interviews

The first phase was the semi-structured interviews which is a qualitative approach. Semi-structured interviews are a combination of structured and unstructured interviews, where both open and closed questions are asked the interviewee. The interviewer has some prepared questions to ask in the interview for the purpose of keeping consistency between all interviews and to make sure that all subjects will be discussed. While the prepared questions are being asked, the interviewer will add more open-ended questions on the subject according to the answers that the interviewee gives (Preece et al., 2015). It was decided to meet the potential users and get information about them. The interviews began with an introduction explaining the interview and asking the interviewee if it would be alright to voice record the interview. Then the same background questions were asked to all user groups and then they were asked different questions depending on the user group. There were three interview guides created, one for each user group. All participants were asked if they had anything to add in the end and then thanked for participating in the interviews (see Appendix 6.1). In each interview there was one interviewee and one note taker who wrote down a summary of the interview (see Appendix 6.2). The data was then analyzed by us where we listened to the recordings and wrote down everything that was said to make sure that nothing was missing from the notes that were taken in the interview itself. That information was then used to help with the wireframe design.

3.1.2 Phase 2: Sleep diaries

A qualitative approach was used to gather information about how sleep diaries are used and how people feel about using them on paper. Printed sleep diaries were given to the participants. This is the way sleep diaries are done today, which results in professionals needing to move the data by hand to the computer to be able to work with it and make decisions accordingly. The participants filled the sleep diary out for one week, every morning and night. After one week we got the diaries back and looked at all the data from them. The purpose was to gain an understanding of the time and the work it takes to go
through all this data to be able to get the information that is needed from it. This experience gave us more reason for the need to transfer the sleep diaries and the data from written to a digital and user-friendly platform. The data from the sleep diaries was however not thoroughly analyzed since that data does not contribute anything to this project. This phase was mostly to get people to experience how the process is to fill out a sleep diary on paper to be able to get their feedback. It would also be valuable to get those people to evaluate the design of the digital sleep diaries to be able to compare them.

The version of the sleep diary that was used in this project is the Consensus sleep diary which was the result of a collaborations between insomnia experts and potential users (Carney et al., 2012) (see appendix 8.3).

3.2 Quantitative approach

3.2.1 Phase 3: Survey about the sleep diary

When sleep diaries had been filled out by a group of people, a quantitative approach was chosen to get information about their opinions regarding the sleep diary. The survey was created on QuestionPro which analyzes the data and visualizes it in pie charts and percentages. 59 people answered the survey, and they had all tried filling in a sleep diary on paper. Before starting the survey, an introduction text was shown to thank people for participating, to explain the purposes and that it was anonymous. Following the introduction, there were 13 questions asked about them, their experience filling out the sleep diary and how they would want the data visualized (see appendix 8.4). The website that we used for the survey automatically generated the data into pie charts, which made the processing of the data much more efficient.

3.2.2 Phase 4: Wireframe evaluation

Wireframes of the website for the sleep diaries were designed on an iPad and printed out for evaluations. There are two types of wireframes, one for patients and one for professionals. A quantitative approach was used for think aloud evaluation. In all
evaluations, there was one interviewer and one note taker. All evaluations began with a friendly welcome followed by a few contextual questions about the participant. Then a prototype was introduced on paper and tasks were printed out and given to the participants, which were different depending on if they were a patient or if they were a professional (see Appendix 8.5). Before the evaluation ended, each participant was asked a few debrief questions about the system and if they had anything to add. The evaluation took about 30-40 minutes. The data that was gathered from this evaluation was then put into a table where basic information about the interviewee along with each problem that the user encountered and every comment that he made. Each problem was written and ordered by severity in a smaller table. We were then able to see very clearly what needed to be improved. The design was then improved when it was set up in a prototyping tool.

3.2.3 Phase 5: Prototype evaluation

The prototype for the website was created in a designing tool called Figma and was interactive so it felt like a real website. There were two different prototypes, one for patients and one for professionals. The prototype for professionals had one view for healthcare professionals and another one for researchers. The reason for that is the researchers should not see the patients’ name, social security number and contact information. A quantitative approach was used for think aloud evaluation in order to gather data. Before the evaluations were conducted with the participants a test evaluation was done to make sure the prototype, all text and tasks and were set up correctly. In all evaluations there was one interviewer and one note taker. A few evaluations were conducted using Microsoft Teams, and in those cases the participants got a link to the prototype and shared their screen for us.

The evaluation started with a friendly welcome, followed by an introduction of the prototype. Two lists of tasks were made, one for the professionals and another for patients (see appendix 8.6). The participant got one task at a time, both verbally and printed out, or sent over Microsoft Teams. When all tasks were finished, the participant was asked a few debrief questions and if they had anything to add. In the end, a few questions regarding the
satisfaction about the design were asked using the system usability scale (SUS) (see appendix 8.7). The evaluations took about 30-40 minutes.

The way that the data was processed for this phase was the same way as in the previous evaluation. The problems were set up in a table along with basic information about the participant and comments that were said about the design, and then the problems were put into a smaller table, ordered by severity. The usability measurements were set up in a table as well, one for each usability goal, and when all the data had been collected, the average was calculated and compared to expected results.

### 3.3 Data gathering

The table below is of all the information about the data gathering, combined together for the purpose of clarity.

*Table 1: Overview of the amount of data that was gathered*

<table>
<thead>
<tr>
<th>Phase</th>
<th>Approach</th>
<th>Method</th>
<th>No. Participants</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Qualitative</td>
<td>Semi-structured interviews</td>
<td>9</td>
<td>To understand the users and their needs for the website.</td>
</tr>
<tr>
<td>2</td>
<td>Qualitative</td>
<td>Sleep diaries</td>
<td>59</td>
<td>To be able to send the survey afterwards and get them to compare the experience to the digital sleep diary. Answers in the sleep diary itself does not contribute anything to this project.</td>
</tr>
<tr>
<td>3</td>
<td>Quantitative</td>
<td>Survey about the sleep diaries</td>
<td>59</td>
<td>To understand the experience of filling out a sleep diary on paper.</td>
</tr>
<tr>
<td>4</td>
<td>Quantitative</td>
<td>Wireframe evaluation</td>
<td>9</td>
<td>To test the wireframe and iterate the design.</td>
</tr>
<tr>
<td>5</td>
<td>Quantitative</td>
<td>Prototype evaluation</td>
<td>9</td>
<td>To test the prototype and decide what should be done in the next iteration.</td>
</tr>
</tbody>
</table>
3.4 Data analysis

This section focuses on how we analyzed the results from the data gathering and the purpose of each phase.

The data from the semi-structured interviews was primarily used to gain an understanding of the user groups and understand what the patients as well as professionals’ needs are regarding the website. This helped us to start designing the data visualization for the website. The purpose of getting a group of people to fill out a sleep diary for one week was both to be able to send them a survey afterwards and to get them to experience how it is filling them out on paper. That experience resulted in these users being a more valuable source in the designing process since they already had tried the current type of the diary. The survey was sent to everyone that did the sleep diary. In the survey the participants were asked about their experience using the sleep diary on paper and if they would want to do it like that or on a digital platform. There were also a few questions about how they would want it to be designed as a digitalized version and ideas about the visualization of the data, so this helped with answering all three research questions. The data from the interviews and the survey were used to create wireframes of the website. The wireframes were then evaluated with participants using the think aloud method. That gave us a good idea of how the participants felt about the data visualization and the usability of the website. In the end, the participants were asked if they would want to fill out the sleep diaries on the paper or on a website. The data from these evaluations helped us answer all three research questions. The next iteration was a prototype evaluation with the think aloud method. The same participants as in the previous evaluation participated, and therefore, we saw if the improvements that were made worked, or if the improvements created other problems. They were asked again if they would like to fill out a sleep diary on a paper or a website like the prototype. The results from this were then used to discuss future improvements. The data from these evaluations helped us answer all three research questions. From all the data gathering we were able to come to a conclusion regarding the research questions that were proposed.
4 Results

Phase 1: Semi structured interviews

The first phase of the design process was conducting semi-structured interviews. This section covers the interview participants, the construction of the interviews as well as the results of the interviews. To maintain anonymity the participants will be referred to as characters from Disney movies.

4.1.1 Participants

There were 9 semi-structured interviews conducted. They were conducted in Reykjavik University and there was one interviewer and one note taker. Of the 9 people interviewed, there were 3 from each user group: patients, healthcare professionals and researchers. Of the patients, there were 2 males and 1 female; of the healthcare professionals, there were 2 females and 1 male; and lastly of the researchers, there were 2 females and 1 male.

The participants were all asked one question, which was how much sleep they need to wake up feeling refreshed and ready for the day. 7 out of 9 people said they need 7-8 hours and would like to get 9 hours of sleep. They said that if they sleep 6 hours or less, they can really feel it the next day. 2 people said they can sleep 6 hours and don’t feel tired the next day, they did however both say that if they do it every night for a few weeks, they do get tired.

Patients

The three patients that participated all thought that the knowledge of how important it is to sleep is getting better in society, that it is better now than a few years ago. All three of them said that when they were younger, they did not think about their sleep, but that they think more about it today, even if they could improve their sleep by a lot. None of the patients had done a sleep diary but one of them had once tried doing both PVT and Stroop tests. When asked about smartwatches and detecting sleep using them, they had tried it, but all of them said they did not find it reliable. The smartwatch was overestimating their sleep, so
when they were calmly watching the television at night, the smartwatch detected it as sleep. Mufasa said, “Why can’t we just put a notification on the watch that says: are you awake? and press yes if so, that it would be no problem to press yes if so.” Mufasa had been in a PSG test and said that he slept badly that night because of all the electrodes connected to him and all the activity involved with the test. He said:

“You can measure sleep really exact but then you are affecting the sleep with all the tools, or you can measure it roughly and not affect the sleep but then you are losing data - the question is which is better”

With sleep diaries all three participants liked the idea to be able to compare their sleep to what is considered a good night sleep by experts. Jasmine added that she might want to see a percentage of sleep quality or something visualized, which a lot of smartwatches show.

**Researchers**

Awareness of the importance of sleep is getting better but it is still not good enough from the researchers point of view. Nala, a researcher said that:

“There are more discussions on sleep related topics in the community so we are slowly getting there. People know few things but there are other things that still surprises them.”

Another researcher, Elsa who works as an associate professor in the psychology department at RU mentioned that:

“Most people do realize that it does not have a good impact on us to sleep too little, but she thinks that people don’t really know what impact it does to them and why it is bad.”

When asked about their workday all three participants answered the same, that it is different each day and varies a lot. They read articles, write articles, attend meetings,
process data, and teach. All three participants said that the most important data regarding sleep is different depending on what problem the person is having. Nala said:

“If the patient is getting tested for sleep apnea a PSG test would be ideal but if the patient is getting tested for insomnia, then it would be the history of the patient, questionnaire and sleep diary, if the focus is on short sleep then the sleep diary, questionnaire and maybe a smartwatch.”

Smartwatches are not always accurate and none of the three participants trust them. They all, however, agree that they have great potential in the future.

**Healthcare professionals**

The 3 healthcare professionals all agreed that awareness of sleep is getting better, and that people are realizing that it is important for their health. Work hours are irregular for all of them, and even those irregular hours are not always on the same schedule. They work at the hospital, set up sleep studies, and some of them score sleep. All 3 healthcare professional participants had done sleep measurements for others. When asked about how long it takes to finish looking at data from one PSG measurement, the answers were about 2 - 4 or 5 hours.

Ariel has had patients complete sleep diaries. She thinks it is good to see an overview of the sleep, if people are sleeping regularly, taking naps and so on. She thinks it is a really valid tool if people are honest in filling it out. When asked about what information is most important regarding sleep measurements, they answered the same way as the researchers, that it is different depending on why they’re doing the sleep measurement. Regarding smartwatches, they like the idea, but agree that it is not really reliable today. They talked about how interesting it would be to see the data from smartwatches and other tools side by side to compare.
4.1.2 Summary

Many interesting and helpful comments came from doing the semi-structured interviews. We got a better insight into the professionals and their lives and work. What they gained most from these interviews was an understanding of the user groups and comments about the scope of the project.

After these interviews we noticed that two user groups, the researchers and the healthcare professionals, answered a lot of the questions the same way. They had the same viewpoint and a lot of them even said they are both a researcher and a healthcare professional or have been both at some time. We then decided that they should be the same user group as they use the website for the same purpose. The scope of the project changed a lot after the interviews. Right after the first interview, which was with a researcher, it was clear that what the plan was for the project might be too much. The plan was to visualize data from a lot of sleep technologies that the Sleep Revolution uses which includes PSG, sleep- and sweat watches, sleep mattresses, sleep diaries and PVT- and Stroop tests. The professionals agreed that it would be good to narrow the scope of the project. After realizing this need to narrow the scope, we planned to focus only on visualizing data from the sleep diaries, PVT- and Stroop tests. When we started working on the project after the first interviews, the scope changed even more. We decided to only focus on the sleep diaries. Instead of only visualizing the data from them, we wanted to design the whole website for sleep diaries, where it is possible to log into your sleep diary, go to settings, look at fun facts and more. The reason for this additional change in the project was that it was much more cohesive to show all parts of the sleep diary than only the data from them. It was better to show one type of a sleep technology well then showing parts from three different types. The PVT and Stroop tests are not connected to the sleep diaries, so then we eliminated them when we decided to focus on the sleep diaries.
4.2 Phase 2: Sleep diaries

A standard sleep diary was translated to Icelandic and given out to 59 people. They filled it out for one week where they answered a question list in the morning when they woke up and at night before they went to sleep (see Appendix 8.3). The purpose of this phase was to be able to send the survey (phase 3) afterwards and to have users for the evaluations (phase 4 and 5) that have the experience of filling out a sleep diary on paper and can compare it to the digital sleep diary. Answers in the sleep diary itself does not contribute anything to this project.

4.3 Phase 3: Survey

The third phase in the process was creating and sending out a survey. A decision was made to create a survey to give out to people that took part in filling out a sleep diary. The purpose was to gather data from users about their experience, as well as what kind of data they might want to see out of those diaries. This section discusses the participants, how the survey was implemented, as well as a summary of the results.

4.3.1 Participants

The survey was sent only to the participants that filled out a sleep diary, that helped us to know that the right people were answering the survey. The answers were limited to the number of participants, which was 59. The age range was not as distributed as we desired, 51.52% of the participant were in the age range 16 – 26, the rest were divided between the other groups as follows: under 16 years was 1.52%, 27 – 36 years old was 24.24%, 37 – 49 years old was 7.58%, 50 – 65 years old was 10.61%, and finally, over 65 years old was around 4.55% (see Figure 2). By getting answers from different age groups, we think that we will get a wider range of comments to support our work.
4.3.2 Results

The survey results showed that only 4,55% of the participants (see Figure 3) did not finish the sleep diary, according to this there were 95,45% of the participants that got a feel for what it is like to fill in a sleep diary. When asked about the experience (see Figure 4), there was only 4,8% felt it was either boring or pointless, while almost 80% thought this was a fun or interesting process, those results are very positive, it shows that people like to track their sleep, however, there were 12,50% of participants that thought it was an issue to fill it in but we hope that the digitalization of it will solve that issue partially since the users do not need to calculate their sleep. A big problem with the sleep diary is that people tend to forget it and then they try to fill it in for many days in a row which is not what is supposed to be done, so when participants were asked if they did ever forget to fill in to the sleep diary, there where 43,28% (see Figure 5) that did forget it at some point and they then filled into it when they remembered and only 17,91% did then just skip that day, which according to the instructions is what is supposed to be done. Reminders are a tool that often prevents users from forgetting certain things, when asked if participants would want to get reminded to fill into the sleep diaries, 84,75% would like to receive some kind of a reminder and 70,59% would like to get reminded with notifications through the phone, similar to what they get from other applications (see Figure 6 and Figure 7). 48 participants or 81,36% (see Figure 8) would like to fill out a sleep diary through a website rather than doing it on paper, which shows the need for transferring the sleep diaries from a paper to a digital platform. There are factors that are written into the sleep diary that may affect sleep quality, when participants were asked about what factors they would like to compare to for example sleep quality the division was very equal between all factors that were proposed, but the caffeine had the most votes or 17,45% (see Figure 9) which did not surprise us since the awareness of how caffeine can affect sleep has been getting more in the past years. To make the data visualization more efficient there are some timings that are not asked in the sleep diary, like at what time during the night the individual woke up. When participants were asked if they would feel it to be easy to say at what time they woke up during the night, 59,64% thought it to be very easy or rather easy and 3,51% did say that it would not apply to them since they did not wake up during the night (see Figure 10), those results indicate that it would be possible to make the sleep diary more accurate. When participants were asked about what
they thought was the most difficult thing to do when filling into the sleep diary, 34.88% said it to be remembering at what time they went to bed and fell asleep, 31.40% said it to be remembering the sleep diary overall was the hardest part and 23.26% said it to be calculating how long they slept (see Figure 11). 79.31% of participants felt like filling into the sleep diary did not affect their sleep (see Figure 12). When asked about how the participant would want to see the results displayed from the sleep diary, it was apparent that most of them want to see it visually in some graph, and to have it easily read (see Figure 13).
Figure 6: Would you like to be notified at a certain time to remind you to fill in to your sleep diary?

Figure 7: How would you like to receive a reminder?

Figure 8: Would you rather fill in the sleep diary in a paper or on a website?

Figure 9: You record different factors into your sleep diary. If you could see your sleep quality when you record/do those factors, or not, what factors would you want to see? For example, how good you rate your sleep quality when you drink alcohol before bed, and then how well you rate them when you do not drink alcohol.

Figure 10: In general, when you wake up at night, how easy or difficult do you think it is to estimate the morning after what time you woke up during the night?

Figure 11: What did you find most difficult to record in your sleep diary? Check everything that applies.
Figure 12: Did you sleep better or worse during the period you were filling in the sleep diary?

Figure 13: How would you like to see the results from the sleep diary visualized?
4.4 Phase 4: Wireframe evaluation

The fourth phase in the process was conducting think aloud evaluation with the wireframe of the system. This section covers the participants, the construction of the evaluations, as well as the results. To maintain anonymity the participants will be referred as characters from Disney movies.

4.4.1 Participants

There were 9 think aloud evaluations performed. 6 of them were conducted in Reykjavík University and 3 at the participants homes. Of the 9 participants, there were 3 from the professional user group and 6 from the patient user group. The reason for having more patients than professionals is that the patient user group is both larger and more diverse. The professionals are researchers- and healthcare professionals. All 3 of the professionals were females; and of patients, there were 3 females and 3 males. All professionals participated in the semi-structured interviews as well. Of the patients, 2 participated in the semi-structured interviews and the other 4 had filled out a sleep diary on paper. The reason for having 5 participants that also took part in the semi structured interviews is to show them what had been designed from their ideas and comments, and if it met their expectations.

4.4.2 Results

To analyze the results from the think aloud evaluations of the wireframes, the most important information was gathered and set up in tables. One table included the professionals and another table was created for the information gathered from the patients. Then a table was created for everything the participants had problems with and we evaluated the severity of every comment. Lastly a table was created for all improvement ideas that arose from the evaluations, and from those two tables, it was clear what needed to be improved.
<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Location</th>
<th>Background Information</th>
<th>Problems</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Nala        | Reykjavik University | Age: 39 years old  
Occupation: Assistant professor at RU  
Highest level of education: A PhD degree  
Hobbies: Reading, cross stitching and jigsaw puzzles  
Basic computer knowledge: Very good and is a quick learner on new systems | Interviewee had no problems testing the wireframe. | Important that the researchers do not see any personal information about the patient like his/her name.  
Use different words to indicate the sleep length than good/bad sleep.  
Needs to be able to compare two different weeks/days in the data and statistics about the sleep.  
When choosing statistics, it would be good to be able to choose all.  
Would only like 3 scales in the priority list, instead of 5.  
When searching for a specific group it would be good to compare those who are in treatment, and those who are not.  
Thinks the design is accessible, easy to use and likes how visual it is. | |
| Ariel       | Reykjavik University | Age: 55 years old  
Occupation: Sleep technologist  
Highest level of education: A master’s degree  
Hobbies: Cycling, golfing and spending time with her family  
Basic computer knowledge: Average but a quick learner on new systems | Confused which patient, of those with priority 1, was in the highest priority. | Important that the researchers do not see any personal information about the patient like his/her name.  
Needs to be able to compare two different weeks/days in the data and statistics about the sleep.  
When choosing statistics, it would be good to be able to choose all.  
Wants to see the date of when it is needed to contact a patient.  
Confused about the button to mark a patient as a priority.  
Wants to be able to see what medicine the patient has had before.  
Would be good for patients to get personalized feedback on their sleep. |
| Jane        | Reykjavik University | Age: 42 years old  
Occupation: Sleep technologist  
Highest level of education: A bachelor’s degree  
Hobbies: Reading, being outside and good food  
Basic computer knowledge: Good and is quite a quick learner using new systems | Confused which patient, of those with priority 1, was in the highest priority. | Important that the researchers do not see any personal information about the patient like his/her name.  
Use different words to indicate the sleep length than good/bad sleep.  
Would only like 3 scales in the priority list, instead of 5.  
Wants to see the date of when it is needed to contact a patient.  
When searching for a specific group it would be good to see numbers for the data with the infographic.  
Likes the statistics, and how visual it is, and the priority list on the front page. |
<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Jasmin</th>
<th>Mufasa</th>
<th>Belle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Reykjavík University</td>
<td>Reykjavík University</td>
<td>Reykjavík University</td>
</tr>
</tbody>
</table>
| **Background information** | Age: 33 years old  
Occupation: Teacher  
Highest level of education: A master’s degree  
Hobbies: Snowboarding, travelling and spending time with her children  
Basic computer knowledge: Above average and is quite quick at learning her ways around a new system | Age: 32 years old  
Occupation:  
Highest level of education: A bachelor's degree  
Hobbies: Reading, spending time with his family and being outdoors.  
Basic computer knowledge: Really good and is a quick learner using new systems | Age: 78 years old  
Occupation: Retired  
Highest level of education: High school diploma  
Hobbies: Swimming, walking and being with friends and family  
Basic computer knowledge: Below average and is a slow learner when introduced to new systems |
| **Problems** | Interviewee had no problems testing the wireframe. | Confused if the settings saved when he changed them. | Did not realize where to log into her sleep diary. |
| **Comments** | Use different words to indicate the sleep length than good/bad sleep.  
Have it clearer where to write what when logging in what medicine taken.  
When logging in the sleep diary, have arrows for continue and back or text for both.  
Would be good to see how many questions are left when logging in the sleep diary.  
Could have instructions for the sleep diary somewhere on the website.  
Likes how visual the design is.  
When choosing statistics, it would be good to be able to choose all. | Would be good to have logo on the login page to have it clearer what the website is.  
Wants to be able to see “log into sleep diary” on the front page.  
The donut chart is not good for sleep length since 7-9 hours is considered good.  
Wants to be able to compare two different weeks/days in the data and statistics about the sleep.  
When choosing statistics, it would be good to be able to choose all.  
The statistics could be set up more engaging.  
Likes how simple and easy to use it is.  
Does not want to log into the computer to log his sleep, rather wants a paper on his nightstand. | Use different words to indicate the sleep length than good/bad sleep.  
Would be good to see how many questions are left when logging in the sleep diary.  
Wants to be able to see “log into sleep diary” on the first page.  
Would like some personalized feedback.  
Liked the design but says she needs to use it a few times to learn how to use it.  
Thinks it is better to log her sleep on paper. |
<p>| <strong>Preference</strong> | Website | Paper | Paper |</p>
<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Moana</th>
<th>Woody</th>
<th>Baymax</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>At Moana’s home</td>
<td>At Woody’s home</td>
<td>At Baymax’s home</td>
</tr>
</tbody>
</table>
| **Background information** | **Age:** 45 years old  
**Occupation:** Consultant  
**Highest level of education:** Master’s degree  
**Hobbies:**  
**Basic computer knowledge:** Average and takes some time to learn how to use new systems | **Age:** 23 years old  
**Occupation:** Chef  
**Highest level of education:** Journeymen degree  
**Hobbies:** Hunting, cooking and going to the gym  
**Basic computer knowledge:** Average but is quick at learning how to use new systems | **Age:** 54 years old  
**Occupation:** Psychologist  
**Highest level of education:** Master’s degree  
**Hobbies:** Cycling, running, travelling and spending time with family  
**Basic computer knowledge:** Good and is quite quick at learning how to use new systems |
| **Problems** | Interviewee had no problems testing the wireframe. | Confused if the settings saved when he changed them. | Interviewee had no problems testing the wireframe. |
| **Comments** | Use different words to indicate the sleep length than good/bad sleep.  
When logging in the sleep diary, have arrows for continue and back or text for both.  
Have clearer where to write what when logging in what medicine taken.  
The statistics could be set up more engaging.  
Wants to be able to log out.  
Likes that she can remove certain questions in settings for the sleep diary.  
Thinks the design is easy to use and that this is way better than doing it on paper and having to calculate her sleep. | Wants to be able to see “log in sleep diary” on the first page.  
Would like some personalized feedback.  
The statistics could be set up more engaging.  
When choosing statistics, it would be good to be able to choose all.  
Wants to be able to log out.  
Likes that he can remove certain questions in settings for the sleep diary.  
Thinks the design is nice and easy to use. | Wants to be able to see “log in sleep diary” on the first page.  
The donut chart is not good for sleep length since 7-9 hours is considered good.  
Wants to be able to compare two different weeks/days in the data and statistics about the sleep.  
Cluster what belongs together in statistics, so it is less chaotic.  
The statistics could be set up more engaging.  
Likes that he can remove certain questions in settings for the sleep diary.  
Thinks the design is easy to use likes not having to calculate his sleep. |
| **Preference** | Website | Website | Website |
### Table 5: Problems users had in the wireframe think aloud evaluation

<table>
<thead>
<tr>
<th>Nr.</th>
<th>User group</th>
<th>Nr. of users with the problem</th>
<th>Severity</th>
<th>Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Professionals and patients</td>
<td>4</td>
<td>1</td>
<td>Needs to be able to compare two different weeks/days in the data and statistics about the sleep.</td>
</tr>
<tr>
<td>2.</td>
<td>Professionals</td>
<td>3</td>
<td>1</td>
<td>Important that the researchers do not see any personal information about the patient like his/her name.</td>
</tr>
<tr>
<td>3.</td>
<td>Professionals</td>
<td>2</td>
<td>1</td>
<td>Confused which patient, of those with priority 1, was in the highest priority.</td>
</tr>
<tr>
<td>4.</td>
<td>Patients</td>
<td>1</td>
<td>1</td>
<td>Did not realize where to log into her sleep diary.</td>
</tr>
<tr>
<td>5.</td>
<td>Professionals and patients</td>
<td>5</td>
<td>2</td>
<td>Use different words to indicate the sleep length than good/bad sleep.</td>
</tr>
<tr>
<td>6.</td>
<td>Patients</td>
<td>2</td>
<td>2</td>
<td>Have it clearer where to write when logging in what medicine taken.</td>
</tr>
<tr>
<td>7.</td>
<td>Patients</td>
<td>2</td>
<td>2</td>
<td>Confused if the settings saved when they are changed.</td>
</tr>
<tr>
<td>8.</td>
<td>Patients</td>
<td>2</td>
<td>2</td>
<td>The circle graph is not good for sleep length since 7-9 hours is considered good.</td>
</tr>
<tr>
<td>9.</td>
<td>Professionals</td>
<td>1</td>
<td>2</td>
<td>Confused about the button to mark a patient as a priority.</td>
</tr>
</tbody>
</table>

### Table 6: Improvement ideas from users in the wireframe think aloud evaluation

<table>
<thead>
<tr>
<th>Nr.</th>
<th>User group</th>
<th>Nr. of users that made the comment</th>
<th>Improvement ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Patients and professionals</td>
<td>5</td>
<td>When choosing statistics, it would be good to be able to choose all.</td>
</tr>
<tr>
<td>2.</td>
<td>Patients</td>
<td>4</td>
<td>The statistics could be set up more engaging.</td>
</tr>
<tr>
<td>3.</td>
<td>Patients and professionals</td>
<td>3</td>
<td>Would like some personalized feedback.</td>
</tr>
<tr>
<td>4.</td>
<td>Patients</td>
<td>3</td>
<td>Wants to be able to see “log in sleep diary” on the first page.</td>
</tr>
<tr>
<td>5.</td>
<td>Patients</td>
<td>2</td>
<td>Would be good to see how many questions are left when logging in the sleep diary.</td>
</tr>
<tr>
<td>6.</td>
<td>Patients</td>
<td>2</td>
<td>When logging in the sleep diary, have arrows for continue and back or text for both.</td>
</tr>
<tr>
<td>7.</td>
<td>Professionals</td>
<td>2</td>
<td>Wants to see the date of when it is needed to contact a patient.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-------</td>
<td>-----</td>
<td>----------------------------------------------------------------</td>
</tr>
<tr>
<td>8</td>
<td>Patients</td>
<td>2</td>
<td>Wants to be able to log out.</td>
</tr>
<tr>
<td>9</td>
<td>Patients</td>
<td>1</td>
<td>Cluster what belongs together in statistics, so it is less chaotic.</td>
</tr>
<tr>
<td>10</td>
<td>Patients</td>
<td>1</td>
<td>Could have instructions for the sleep diary somewhere on the website.</td>
</tr>
<tr>
<td>11</td>
<td>Patients</td>
<td>1</td>
<td>Would be good to have logo on the login page to have it clearer what the website is.</td>
</tr>
<tr>
<td>12</td>
<td>Professionals</td>
<td>1</td>
<td>Wants to be able to see what medicine the patient has had before.</td>
</tr>
<tr>
<td>13</td>
<td>Professionals</td>
<td>1</td>
<td>When searching for a specific group it would be good to see numbers for the data with the infographic.</td>
</tr>
</tbody>
</table>

### 4.4.3 Improvements

It is important to listen to the participants and react to the problems that they encountered during the think aloud evaluations of the wireframe. A lot of good improvement ideas arose as well as some problems that the users encountered, they were not a big problem for the users but by improving it, it will help create a better user experience. We want to create the best user experience possible, and therefore, the next prototype will have a solution to all problems that were gathered and the improvements the participants mentioned. This section covers how each problem will be thought about and solved in the prototype.

1. **Needs to be able to compare two different weeks/days in the data and statistics about the sleep.**
   - Participants talked about it being important to compare for example a week before, and after, the patient had started treatment to see the progress. We added a button to “compare to another week” where users could pick another week and the bar graph would change. The other week would show side by side on the graph and the user can compare those weeks.
2. *Important that the researchers do not see any personal information about the patient like his/her name.*

- This was solved by creating two different views for the professionals, one for healthcare professionals and another one for researchers. Everything looks the same and has the same functions, but researchers do not see any names or social security numbers, only codes like SR0001.

3. *Confused which patient, of those with priority 1, was in the highest priority.*

- We solved this confusion by adding a date for when the patient should be contacted. The priority list will then be ordered by dates.

4. *Did not realize where to log into her sleep diary.*

- It is important that everyone can find out how to log into their sleep diary. We added an option to logon from the front page with buttons for morning- and evening questions.

5. *Use different words to indicate the sleep length than good/bad sleep.*

- The wording was changed from good sleep to “recommended sleep achieved”, from fine sleep to “sleep should be improved” and lastly from bad sleep to “sleep must be improved”.

6. *Have it clearer where to write when logging in what medicine taken.*

- A question in the sleep diary is if a patient took any medicine to help him/her sleep. This was fixed by adding three different lines, each for one variable, and on each line, there is a description in light gray letters. When a patient checks “yes”, the patient would write on one-line what medicine it was, one for the amount taken and the last line for the time when the patient took it.

7. *Confused if the settings saved when they are changed.*

- This was fixed by adding a success message. When a box is checked or any settings are changed, a message appears that lets the user know the settings have been saved.
8. *The donut chart is not good for sleep length since 7-9 hours is considered good.*

- We agree that the donut chart might not be the best option to show sleep length since it would be full both if a patient slept 7 hours and also if he slept 9 hours. There is also a question what would happen if a patient would sleep for more than 9 hours. There were a lot of options how to show this differently, but ultimately we decided to show it in plain text beside the donut charts.

9. *Confused about the button to mark a patient as a priority.*

- When professionals looked at patients’ page there was a button that said, “mark patient as a priority”. The idea was if the patient had been marked as a priority the button would be in a darker color to indicate it had been marked. To make this clearer we added a “put patient in priority” button and if the patient was in a priority, it would have a bold text that said “priority: 1”.
4.4.4 Wireframe

This section contains the wireframes that were designed in phase 4. The wireframes are of the website for the digital sleep diaries. There are two types, one for patients and one for professionals. The patients can fill out their sleep diary there, see the data from their own sleep, read fun facts, talk to a professional and change settings. The professionals can use the website to search for patients, send them a message, see the data from patients sleep, see a priority list of patients, search for specific groups and change their settings.

Wireframe for patients

Figure 14: Login

Figure 15: Front page for patients

Figure 16: Menu

Figure 17: Menu when “Skrá í svefndagbók” has been clicked
The user can write in his email and password and then click log in. If the password has been forgotten the user can click “Gleymt lykilorð” and then he will get an email with the option to reset the password. If a user is logging in for the first time, it is possible to create an account by clicking “Stofna nýjan aðgang”. Professionals (healthcare professionals or researchers), however, need to get an account through an admin to get the professional account and be able to see all patient information.

The first page a patient sees when logging in. A bar graph shows the sleep length of the patient, this information is gathered from how the patient fills in the sleep diary. If clicked on “Skoða meira um minn svefn” the patient can see more data. One fun fact is shown as well and the option to see more fun facts about sleep and health. In the top left corner there is an icon and if clicked the menu bar opens up with all options to do on the website. The menu is shown in figures 16 and 17.

When a patient has clicked "Skrá í svefndagbók" from the menu and then “Morgunspurningar” this question list opens. One question is shown at a time and when the box for each answer is clicked, a drop-down menu appears (see figure 19) and a blinking horizontal line indicates that the user can also write in the box. When a question has been answered it fades away, moves up and the next question will appear. There is also a back arrow to go to the last question and an “áfram” button to go to the next question. When a patient has answered the question about when he woke up, the system calculates how long he slept and the system shows it clearly on the right side of the screen (see figure 19).
Figure 21) When the patient has answered all the questions, he needs to click “Klára” to send the sleep diary in. Figure 22 shows how the feedback looks that the patient gets after sending it in. It shows the sleep length, sleep quality and how refreshed the patient felt in a visual donut graph. It has the option to look at more data about the patient’s sleep or to go back to the front page. The user also gets the positive message “Thank you, have a good day!”. 
The evening questions for the sleep diary are set up in the same way as the morning questions. There are four questions about the patient’s mood and the user can slide the button to how the patient feels, or click on the line, and there are 5 scales on the line so the system can read what scale the button is closest to.
Figure 26) A patient can go to the chat in the website by clicking the menu and then “Spjall við sérfræðing”. There, all recent chats the patient has had will be available to read and they are ordered by date. By clicking “Ný skilaboð” the patient could send a new message with a new subject.

Figure 27) From the menu there is an option to go to settings. This figure shows how the settings look. If a patient does not drink alcohol for example, it is possible to check the box to “Ég drekk ekki áfengi” (see figure 26), and then the patient will not get a question every night in the sleep diary asking if he drank any alcohol that day.
Figure 29) When a patient wants to see more data about the sleep, there are a few ways to open that. The patient could click “Sjá meira um minn svefn“ on the front page, click „Minn svefn“ from the menu or click “Sjá meira um minn svefn“ when the sleep diary is sent in. This figure is what the user sees about their sleep. The first graph on that page is the same bar graph that is on the front page, that shows how long the patient’s sleep has been the past 7 days. There are three different colors indicating how long the patient sleeps and a visible line which is the recommended sleep length. When scrolled down, a horizontal bar
graph shows when the patient was in bed. The patient logs when he goes in bed, when he tries to fall asleep, when he is asleep, when he wakes up and when he gets out of bed. When the patient hovers over a specific part of the line he can see in more detail about each part (see figure 30). When the patient scrolls further down, the statistics are shown. Automatically the information about average sleep length is chosen and then the patient can pick and personalize what he wants to see (see figure 31 and 32).

**Wireframe for professionals**

![Figure 35: Front page for professionals](image1)

![Figure 34: Professional is searching for a patient](image2)

![Figure 33: Menu](image3)
Figure 33) When a professional logs in, they see another view than the patients, but the log in page looks the same. There is a search bar to look for a specific person by name or social security number. This is a responsive search bar so it would not be necessary to write the whole social security number, if 7 letters are written in the search bar everyone who have a social security number that starts like that will show up (figure 34). On the front page the professionals will see a priority list of patients that they might need to contact. They can see the name, social security number of the patient, the priority scale which is from 1-5 and the option to look at that patient’s page.

Figure 35) When the professional clicks the menu in the top left corner the menu opens up. There the professional can search for a specific group, open the chat and settings.

![Figure 36: Searching for a specific group, professional searching](image)

![Figure 37: Searching for a specific group](image)

![Figure 38: Result after searching for a specific group](image)
Figure 36) From the menu the professional can click “Leita af hóp” to search for a specific group of people. It is possible to choose a group of specific age or a specific problem with specific habits. It is however not necessary to choose all of them, just what is needed and the result filters from that.

Figure 39) Professional can look at a patients page by searching from the front page or clicking it from the priority list in the front page if the patient is in priority. This view is the same as the patient sees but there also is an information box on the right side of it. There is
a button to mark the patient as a priority and to send the patient a message. It also says when the patient was contacted last and all notes for the patient are documented or when he came for a visit the last time. It would be possible to click on each line and see more about it and what date it was written. In the bottom of the information box there are important and current information about the patient like the sleep problem the patient has, the medicine, phone number and email of the patient.

Figure 40) To mark a patient as a priority, click “Einstaklingur þarf sérstaka eftirfylgni” and a window pops up (see figure 40 and 41). The professional writes the reason and how high the priority is from 1, which is the highest priority, to 5, the lowest priority. When that is saved the button is gray and it shows the patient’s priority level. (see figure 42)
Figure 43) When scrolled down on the patients page the times of when the patient was in bed is shown and it is possible to hover over all parts of the line to see the clock of it specifically.

Figure 44) When scrolled all the way down on the patients page the statistics are shown and only the average sleep length is chosen automatically. By “Veldu tölfræði:” is a drop down menu to choose statistics to see (see figure 45).
4.5 Phase 5: Prototype evaluation

The fifth phase in the process was conducting think aloud evaluations with the prototype of the system. This section covers the participants, the construction of the evaluations, as well as the results. To maintain anonymity, the participants will be referred as characters from Disney movies.

4.5.1 Participants

There were 9 prototype evaluations performed where the think aloud method was applied. 6 of them were conducted in a Microsoft Teams meeting and 3 at the participant’s home. The reason for doing this using Microsoft Teams is Covid-19 and its related restrictions. The participants were the same as the participants in the wireframe evaluations. The reason for having the same participants was to show them the improved design, and therefore discover if the improvement worked or not as well as if there were new usability problems observed. The users would gain an understanding on how the system works and therefore the comments might turn out to be more valuable. The professionals all participated in the semi-structured interviews as well. Of the patients, 2 participated in the semi-structured interviews and the other 4 had completed a sleep diary on paper.

4.5.2 Usability goals

Before the prototype evaluations were conducted, we set goals for the effectiveness, efficiency and satisfaction of the system. To measure the effectiveness, we documented if the participant finished each task, finished it with help, or did not finish it. The success rate was then calculated. To measure the effectiveness, the time was taken of every participant completing each task, the clicks it took and how many problems the user encountered (see tasks in appendix 8.6). To measure the satisfaction, we used the System Usability Scale (SUS). The usability goals that we set before the evaluations are stated in this section.
Effectiveness

Patients:
- The success rate for login should be above 95%
- The success rate for filling out the morning questions in the sleep diary should be above 85%
- The success rate for filling out the evening questions in the sleep diary should be above 85%
- The success rate for changing settings should be above 80%
- The success rate for looking at the chat should be above 80%
- The success rate for finding the length of sleep should be above 85%
- The success rate for comparing two weeks should be above 85%
- The success rate for finding the time of sleep should be above 80%
- The success rate for finding specific statistics should be above 80%
- The success rate for log out should be above 90%

Professionals:
- The success rate for login should be above 95%
- The success rate for finding the patient in the highest priority should be above 85%
- The success rate for finding out what medicine a patient has should be above 85%
- The success rate for searching for a patient should be above 85%
- The success rate for finding out when a patient was last contacted should be above 85%
- The success rate for finding the length of sleep should be above 85%
- The success rate for comparing two weeks should be above 85%
- The success rate for finding the time of sleep should be above 80%
- The success rate for finding specific statistics should be above 80%
- The success rate for finding a chat message should be above 80%
- The success rate for searching for a specific group should be above 80%
- The success rate for log out should be above 90%
Efficiency

Patients:

Table 7: Efficiency goals for patients

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>T8</th>
<th>T9</th>
<th>T10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>8 sec</td>
<td>3 min</td>
<td>3 min</td>
<td>10 sec</td>
<td>25 sec</td>
<td>10 sec</td>
<td>12 sec</td>
<td>15 sec</td>
<td>20 sec</td>
<td>5 sec</td>
</tr>
<tr>
<td>Clicks</td>
<td>3</td>
<td>21</td>
<td>24</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

The goal is to have the system as efficient as possible, and therefore, we want to keep the problems that the patients encounter at a minimum. The goal is that each task has less than 2 problems on average.

Professionals:

Table 8: Efficiency goals for professionals

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>T8</th>
<th>T9</th>
<th>T10</th>
<th>T11</th>
<th>T12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>8 sec</td>
<td>7 sec</td>
<td>10 sec</td>
<td>15 sec</td>
<td>10 sec</td>
<td>12 sec</td>
<td>15 sec</td>
<td>20 sec</td>
<td>25 sec</td>
<td>1 min</td>
<td>5 sec</td>
<td></td>
</tr>
<tr>
<td>Clicks</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>13</td>
<td>2</td>
</tr>
</tbody>
</table>

The goal is to have the system as efficient as possible, and therefore, we want to keep the problems that the professionals encounter at a minimum. The goal is that each task has less than 2 problems on average.

Satisfaction

System usability scale

0 = strongly disagree, 2,5 = disagree, 5 = neutral, 7,5 = agree, 10 = strongly agree

- The average rating from the users should be 8 points or above from the SUS questionnaire.
- Less than 10% say that they disagree with any of the questions in SUS.
- Less than 5% say that they strongly disagree with any of the questions in SUS.
4.5.3 Results

To analyze the results from the prototype evaluations, we gathered all the data from the evaluations. The usability goals were compared to the data from the interviews and then we calculated whether it was a success or not (see appendix 8.7 for more details). The most important information was gathered and set up in tables. One table included the professionals, and another table was created for the information gathered from the patients. Then a table was created for everything the participants had problems with and we evaluated the severity of every problem. Lastly a table was created for all improvement ideas that arose from the evaluations and from those two tables it was clear what needed to be improved.

Effectiveness

Patients:

Table 9: Effectiveness results for patients

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>T8</th>
<th>T9</th>
<th>T10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>95</td>
<td>85</td>
<td>85</td>
<td>80</td>
<td>80</td>
<td>85</td>
<td>85</td>
<td>80</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>Actual result</td>
<td>100</td>
<td>91</td>
<td>100</td>
<td>83</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>83</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Professionals:

Table 10: Effectiveness results for professionals

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>T8</th>
<th>T9</th>
<th>T10</th>
<th>T11</th>
<th>T12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>95</td>
<td>85</td>
<td>85</td>
<td>85</td>
<td>85</td>
<td>85</td>
<td>85</td>
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<td>80</td>
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<tr>
<td>Actual result</td>
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<td>83</td>
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<td>83</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
Efficiency

Patients:

Table 11: Efficiency results for patients, time to finish each task

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>T8</th>
<th>T9</th>
<th>T10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time goal</td>
<td>8 sec</td>
<td>180 sec</td>
<td>180 sec</td>
<td>10 sec</td>
<td>25 sec</td>
<td>10 sec</td>
<td>12 sec</td>
<td>15 sec</td>
<td>20 sec</td>
<td>5 sec</td>
</tr>
<tr>
<td>Actual time</td>
<td>7 sec</td>
<td>160,5 sec</td>
<td>187,8 sec</td>
<td>19,3 sec</td>
<td>22 sec</td>
<td>7,7 sec</td>
<td>10,8 sec</td>
<td>30 sec</td>
<td>23,3 sec</td>
<td>4,7 sec</td>
</tr>
</tbody>
</table>

Table 12: Efficiency results for patients, clicks to finish each task

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>T8</th>
<th>T9</th>
<th>T10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clicks goal</td>
<td>3</td>
<td>21</td>
<td>24</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Actual clicks</td>
<td>3</td>
<td>21</td>
<td>24,5</td>
<td>3,5</td>
<td>3</td>
<td>2</td>
<td>2,7</td>
<td>0,3</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

The goal is that each task has less than 2 problems on average. This goal was achieved, no task had more than 0,3 problem on average.

Professionals:

Table 13: Efficiency results for professionals, time to finish each task

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>T8</th>
<th>T9</th>
<th>T10</th>
<th>T11</th>
<th>T12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time goal</td>
<td>8 sec</td>
<td>7 sec</td>
<td>10 sec</td>
<td>15 sec</td>
<td>10 sec</td>
<td>10 sec</td>
<td>12 sec</td>
<td>15 sec</td>
<td>20 sec</td>
<td>25 sec</td>
<td>60 sec</td>
<td>5 sec</td>
</tr>
<tr>
<td>Actual time</td>
<td>4,7 sec</td>
<td>5 sec</td>
<td>14,3 sec</td>
<td>12 sec</td>
<td>9 sec</td>
<td>7 sec</td>
<td>17,3 sec</td>
<td>4 sec</td>
<td>15,3 sec</td>
<td>33,7 sec</td>
<td>45,3 sec</td>
<td>4,7 sec</td>
</tr>
</tbody>
</table>

Table 14: Efficiency results for professionals, clicks to finish each task

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
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<th>T7</th>
<th>T8</th>
<th>T9</th>
<th>T10</th>
<th>T11</th>
<th>T12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clicks goal</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Actual clicks</td>
<td>3</td>
<td>1</td>
<td>0,7</td>
<td>4,3</td>
<td>0</td>
<td>0</td>
<td>3,3</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>13</td>
<td>2</td>
</tr>
</tbody>
</table>
The goal is that each task has less than 2 problems on average. This goal was achieved, no task had more than 0.3 problem on average.

Satisfaction

Three goals were stated for the satisfaction of the system, and they were all achieved. The average system usability score (SUS) rating from patients was 8.05 and for professionals the average rating was 9.51. One patient disagreed with 2 questions, which is 3.2% and one patient strongly disagreed with one question in the system usability scale, which is 1.6%. No professional strongly disagreed, or disagreed, with any questions.

Table 15: Patients in the wireframe prototype evaluation, 1/2

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Jasmin</th>
<th>Mufasa</th>
<th>Belle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Reykjavík University</td>
<td>Reykjavík University</td>
<td>Reykjavík University</td>
</tr>
</tbody>
</table>
| Background information | Age: 33 years old  
Occupation: Teacher  
Highest level of education: A master’s degree  
Hobbies: Snowboarding, travelling and spending time with her children  
Basic computer knowledge: Above average and is quite quick at learning her ways around a new system | Age: 32 years old  
Occupation:  
Highest level of education: A bachelor’s degree  
Hobbies: Reading, spending time with his family and being outdoors.  
Basic computer knowledge: Really good and is a quick learner using new systems | Age: 78 years old  
Occupation: Old-age pensioner  
Highest level of education: High school diploma  
Hobbies: Swimming, walking and being with friends and family  
Basic computer knowledge: Below average and is a slow learner when introduced to new systems |
| Problems | Interviewee had no problems testing the prototype. | Interviewee had no problems testing the prototype. | Did not understand the burger menu |
| Comments | Likes the personalized feedback when filling out the sleep diary.  
Likes how clear and easy to use the design is, the colors are nice.  
Thinks it would be valuable to be able to see the data from the sleep diaries like this instead of on a paper. Would want to get a notification to remind her to fill it out. | Unnecessary to have the bar graph color coded for length, users see straight away how long it is on the bar size.  
The purple line for “asleep” in the timeline is confusing if a person wakes up a lot during the night.  
Would like to see stars in the feedback, when a sleep diary is sent in, instead of the donut chart. | The burger menu should say “menu” not only have a logo for it.  
Likes that she can fill in her sleep diary from the front page.  
Likes the design but still would rather fill out a sleep diary on paper because she does not use a computer every day and is more confident in using a pen and paper. She does like the visual feedback though |
Does not want to only see a week at a time, wants to be able to choose the dates entirely and how many days.

Is the design responsive so I could use it on an iPad or my phone?

Likes the smiley faces on the emotional scale.

Likes how easy to use the design is, the colors are nice.

Thinks that it is good to be able to fill in the sleep diary anywhere not just where the paper is.

Preference: Website

Table 16: Patients in the wireframe prototype evaluation, 2/2

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Moana</th>
<th>Woody</th>
<th>Baymax</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>At home</td>
<td>At home</td>
<td>At home</td>
</tr>
</tbody>
</table>
| Background information | Age: 45 years old
Occupation: Consultant
Highest level of education: Master’s degree
Hobbies: Basic computer knowledge
Basic computer knowledge: Average and takes some time to learn how to use new systems | Age: 23 years old
Occupation: Chef
Highest level of education: Journeyman degree
Hobbies: Hunting, cooking and going to the gym
Basic computer knowledge: Average but is quick at learning how to use new systems | Age: 54 years old
Occupation: Psychologist
Highest level of education: Master’s degree
Hobbies: Cycling, running, travelling and spending time with family
Basic computer knowledge: Good and is quite quick at learning how to use new systems |
| Problems    | Interviewee had no problems testing the prototype. | Interviewee had no problems testing the prototype. | Interviewee had no problems testing the prototype. |
| Comments    | The burger menu should say “menu” not only have a logo for it.
Likes the personalized feedback when filling out the sleep diary. | Unnecessary to have the bar graph color coded for length, users see straight away how long it is on the bar size.
When comparing dates it would be better to see the dates of this week as well. | Unnecessary to have the bar graph color coded for length, users see straight away how long it is on the bar size.
Likes the look of the statistics and how visual it is.
Easier to fill out the sleep diary on this than paper. More |
Is the design responsive so I could use it on an iPad or my phone?  
More accessible on a website than on paper, thinks that it is good to be able to fill in the sleep diary anywhere not just where the paper is. Likes how easy it is to see how her sleep was the last days and how regular it was.  
Likes the personalized feedback when filling out the sleep diary.  
Likes the smiley faces on the emotional scale.  
Easier to fill out the sleep diary on this than paper. It takes less time and I don’t need to calculate my sleep. Would want a notification to fill it out.  
accessible so if he forgot to fill out in the morning he could do it online when he arrives at work. Likes that he doesn’t need to calculate his sleep.

<table>
<thead>
<tr>
<th>Preference</th>
<th>Website</th>
<th>Website</th>
<th>Website</th>
</tr>
</thead>
</table>

Table 17: Professionals in the wireframe prototype evaluation

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Location</th>
<th>Background Information</th>
<th>Problems</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Nala        | Reykjavik University      | Age: 39 years old  
Occupation: Assistant professor at RU  
Highest level of education: A PhD degree  
Hobbies: Reading, cross stitching and jigsaw puzzles  
Basic computer knowledge: Very good and is a quick learner on new systems | Interviewee had no problems testing the prototype. | When comparing 2 weeks, it would be better to have the first week on the left side and the current week on the right side.  
Unnecessary to have the bar graph color coded for length, users see straight away how long it is on the bar.  
Likes how user friendly the design is, the colors are nice and it is easy to use. |
| Ariel       | Reykjavik University      | Age: 55 years old  
Occupation: Sleep technologist  
Highest level of education: A master’s degree  
Hobbies: Cycling, golfing and spending time with her family  
Basic computer knowledge: Average but a quick learner on new systems | Interviewee had no problems testing the prototype. | It would be good to have the logo in the banner to press and go home.  
The priority list should be lower on the home page so the search is more obviously the front page.  
Have a date when a patient had last been contacted instead of “2 weeks”.  
Show the date in all graphs, not just the day of the week.  
The purple line for “asleep” in the timeline is confusing if a |
| Jane        | Reykjavik University      | Age: 42 years old  
Occupation: Sleep technologist  
Highest level of education: A bachelor’s degree  
Hobbies: Reading, begin outside and good food  
Basic computer knowledge: Good and is quite a quick learner using new systems | Interviewee had no problems testing the prototype. | When comparing 2 weeks, it would be better to have the first week on the left side and the current week on the right side.  
Unnecessary to have the bar graph color coded for length, users see straight away how long it is on the bar.  
Would like to click a specific statistic and see the numbers behind the average.  
Likes the look of the statistics and how visual it is. |
person wakes up a lot during the night.
Would like to be able to drag and drop the statistics to organize it the way she wants.
Would like to click a specific statistic and see the numbers behind the average.
A search in the chat is missing.
Likes how simple and easy the design is.

**Table 7: Problems users had in the wireframe prototype evaluation**

<table>
<thead>
<tr>
<th>Nr.</th>
<th>User group</th>
<th>Nr. of users that made the comment</th>
<th>Improvement ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Patients and professionals</td>
<td>5</td>
<td>Unnecessary to have the bar graph color coded for length, users see straight away how long it is on the bar.</td>
</tr>
<tr>
<td>2.</td>
<td>Professionals</td>
<td>2</td>
<td>When comparing 2 weeks, it would be better to have the first week on the left side and the current week on the right side.</td>
</tr>
<tr>
<td>3.</td>
<td>Patients</td>
<td>2</td>
<td>The burger menu should say “menu” not only have a logo for it.</td>
</tr>
<tr>
<td>4.</td>
<td>Patients and professionals</td>
<td>2</td>
<td>Show the date in all graphs, not just the day of the week.</td>
</tr>
<tr>
<td>5.</td>
<td>Patients and professionals</td>
<td>2</td>
<td>The purple line for “asleep” in the timeline is confusing if a person wakes up a lot during the night.</td>
</tr>
<tr>
<td>6.</td>
<td>Professionals</td>
<td>2</td>
<td>Would like to click a specific statistic and see the numbers behind the average.</td>
</tr>
<tr>
<td>7.</td>
<td>Professionals</td>
<td>1</td>
<td>Would like to be able to drag and drop the statistics to organize it the way she wants.</td>
</tr>
<tr>
<td>8.</td>
<td>Professionals</td>
<td>1</td>
<td>Have a date when a patient had last been contacted instead of “2 weeks”.</td>
</tr>
<tr>
<td>9.</td>
<td>Professionals</td>
<td>1</td>
<td>It would be good to have the logo in the banner to press and go home.</td>
</tr>
</tbody>
</table>

**Table 8: Improvement ideas from users in the wireframe prototype evaluation**

<table>
<thead>
<tr>
<th>Nr.</th>
<th>User group</th>
<th>Nr. of users with the problem</th>
<th>Severity</th>
<th>Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. **Patients and professionals**
   - The purple line for “asleep” in the timeline is confusing if a person wakes up a lot during the night.

2. **Professionals**
   - A search in the chat is missing.

3. **Patients**
   - Does not want to only see a week at a time, wants to be able to choose the dates entirely and how many days.

4. **Professionals**
   - The priority list should be lower on the home page so the search is more obviously the front page.

### 4.5.4 Improvements for the future

1. *Unnecessary to have the bar graph color coded for length, users see straight away how long it is on the bar.*
   - This can be solved by having the whole week in the same color and making it clearer what is considered as a recommended sleep length. That way patients can see clearly if they are sleeping enough by the size of each bar. Participants in the prototype evaluations said this was especially confusing when they were comparing two weeks. There it would be better to have one week in one color and the other week in another color.

2. *When comparing 2 weeks, it would be better to have the first week on the left side and the current week on the right side.*
   - We agree with this statement since that would be the correct time order.

3. *The burger menu should say “menu” not only have a logo for it.*
   - We want the design to be as user friendly and easy to use as possible. To be sure that all users can use the website it would be better to write “menu” with the logo for it, to have it clearer.

4. *Show the date in all graphs, not just the day of the week.*
   - This is a good improvement idea to have all the graphs as easy to read from as possible.
5. **The purple line for “asleep” in the timeline is confusing if a person wakes up a lot during the night.**
   - This is a problem that we had thought of. The idea was to create a gap in the line when the patient woke up but that was not possible since patients only say how many times they woke up and for how long, but the time of when awake.

6. **Would like to click a specific statistic and see the numbers behind the average.**
   - This is a good idea to be able to read more from all the data gathered from the sleep diaries. It would be good if a user could be able to click each statistic and see the data that week and how the average was calculated.

7. **Would like to be able to drag and drop the statistics to organize it the way she wants.**
   - This is a good idea to personalize the users experience and have it more interactive.

8. **Have a date when a patient had last been contacted instead of “2 weeks”.**
   - We agree that it would be better to say that a patient was last contacted on 22nd of March than to say 2 weeks. It is clearer that way.

9. **It would be good to have the logo in the banner to press and go home.**
   - To have this option users could go on the front page in a single click, instead of having to click the menu home from there.
4.5.5 Prototype

This section contains the prototype that was designed in phase 5. The prototype is of the website for the digital sleep diaries and there are two types, one for patients and one for professionals. The functionality of the website is the same as in the wireframe design.

Figure 46: Login page

Figure 45) The login page looks the same for all users of the website.
The happy path for a patient to open instructions about the sleep diary is to click the menu (figure 46), then “Skrá í svefndagbók” (figure 47) and then click “Almennar leiðbeiningar” (figure 48).
The happy path for a patient to fill in the sleep diary is to do it from the front page (figure 50). The unhappy path would be to press the menu in top left corner and do it from there since that takes 3 clicks instead of 1, which makes it less efficient.
Figure 57: Evening question about the medicine the patient took

Figure 58: Emotional scale for questions in the evening questions

Figure 59: Evening questions have been sent in and the user gets this feedback

Figure 60: Chat with a professional

Figure 61: Settings

Figure 62: Settings changed
Figure 63: Data about the patients sleep – length of sleep the past week

Figure 64: Data about the patients sleep – comparing sleep length to the week 5-11. April

Figure 65: Data about the patients sleep, the two weeks compared

Figure 66: Data about the patients sleep – scrolled down to see times when the patient was in bed and hovered over a line
Prototype for professionals

Figure 67: Front page for healthcare professionals

Figure 68: Menu

Figure 69: Front page for researchers

Figure 70: Chat for the healthcare professionals

Figure 71: Chat for the researchers
Figure 72: Searching for a specific group

Figure 73: Searching for a specific group when drop down menu has been clicked for age

Figure 74: Searching for a specific group when drop down menu has been clicked for the problem

Figure 75: Results when the professional searched for a specific group
Figure 76: A patients page for healthcare professionals

Figure 77: A patients page for researchers

Figure 78: Statistics when only a few have been chosen from the drop down menu
5 Discussion

The understanding of sleep began when a technology was developed, a technology that gives insight into the human brain (Deak & Epstein, 2009). There are many different technologies used to measure sleep and recently people have been thinking more about their sleep and how important it is (Arnardóttir, 2021). When patients sleep is being measured, the subjective experience is very important and sometimes that is enough to diagnose the patient without any objective testing (Arnardóttir et al., 2021). An example of subjective assessment are questionnaires, interviews, and sleep diaries.

The purpose of sleep diaries is recognizing sleep patterns and habits that might affect the quality of sleep (Suni, 2021). To this day, they are being done on paper (Short et al., 2017). If the sleep diaries would be done digitally it would give the opportunity to visualize the data and in that way, it is easier to see an important pattern and from that make decisions (Ali et al., 2016).

This research has data from 9 semi-structured interviews, survey answers from 59 people, 9 wireframe evaluations and 9 prototype evaluations. All this data helps us to answer the research questions. After the first interview, a wireframe was designed for the website and the data visualization. Then a wireframe evaluation was conducted where the participants used a think aloud method to get the most data from it. The data helped us improve the design, and in the wireframe all problems, or comments, that participants had was thought about and we tried to solve it. Then it was iterated again with prototype evaluations using the think aloud method, and all data was gathered, and a list of improvements needed was created. By iterating, designers get an opportunity to redefine the design based on feedback, it is essential to revise ideas based on users’ feedback to be able to give the best outcome on the design (Preece et al., 2015).

We found many benefits with having the sleep diary on a website for the patient, but the most important ones are the accessibility, the real time data available, and the reminders. The patient needs to fill in the sleep diary regularly to have it as reliable as possible to prevent forgetting certain information and create a memory bias (Arnardóttir et al., 2021). The sleep diaries on a digital platform make it accessible for the user anywhere where he
has a computer or a smartphone. Users can get daily notifications to remind them to fill out the sleep diaries and therefore prevent memory bias in the answers. It also takes less time since patients do not need to calculate their sleep themselves and if certain questions are answered no, the follow-up questions will not be proposed while a paper would always ask all questions. As soon as the patient sends in the sleep diary, the data is shown on the patient’s page. There were some trade-offs as well. One of them is that some people, especially the older generation, think it is easier on paper. They think it is easier to have a pen and paper on their nightstand rather than having to open up their computer. The best result might be to change the sleep diaries from paper to a digital platform but still be able to offer the paper sleep diary to patients who want that instead. In those cases, it would be good to be able to scan the paper to import the information and the patients could still see the data about their sleep visualized.

The data from the interviews, evaluations and the survey show that patients want to see the data from their sleep visually, to have it simple and easy to read. For users to look at raw data it is hard for them to understand or interpret the results (Ali et al., 2016). They want to see it right away instead of having to finish a week and then get the results gathered together or try to see a pattern from numbers on the paper. They want to be able to choose specific dates or time periods and be able to compare that to another time period. On the graphs, patients would also like to be able to hover over specific parts and see it more detailed, for example, at what time specifically the patient was asleep. The patients like seeing the statistics about what they fill in the sleep diary for a specific time, but they want it to be put up in an interesting way, and what belongs together should be clustered together. The data also shows that professionals have the same opinion as patients and want a lot of the same things regarding the data visualization. That surprised us since we were expecting that they wanted the data shown more technically. They also want to have the data easily read and the ability to see more about it by hovering or clicking on the graph. They however see more information since they see the personal information about the patients as well. They want the most important information shown and then buttons for more detailed data about it. The professionals for example want to see all medicine the patient has had, when the patient visited a healthcare professional and what the problem was and how it was handled. We found that the best conclusion for that was to show what
medicine the patient is currently on and then a “medicine history” button to see what medicine he has had before. For the visits there is a subject shown and when clicked on that more information is available for them. They wanted to see a list of patients that are in priority and when they should contact the patient next. It is, however, important to make sure that researchers do not see the name and social security number of each patient but only a code like SR0001.

The data from the interviews, evaluations and the survey show that more people would want to use a digital sleep diary than a paper one. It is interesting that in the wireframe evaluations, 2 patients would rather use a paper diary, and in the prototype evaluation 1 of them had changed their mind. When the participant saw the prototype and it looked more like a real website and then thought that it would be better to do it digitally. That might result from the fact that it is important for users to be able to interact with the design (Ali et al., 2016).

5.1.1 Limitations

In the beginning the scope of the research changed a few times which was an obstacle we had to overcome. At first, we were going to visualize data from all the sleep technologies used within the Sleep Revolution. When we talked to professionals, they all thought that it was too much especially since we are only two working on the project, that it would be better to have a smaller scope and therefore be able to do it better. The scope had then changed to only visualizing data from sleep diaries, PVT and Stroop tests. When we had started working on researching those topics, we came to the conclusion that it would make more sense to focus only on the sleep diaries, both the data visualization and the design of a digitalized sleep diary, with this we felt there was a better context and that it would result in a clearer result.

Since the sleep diary is a standard question list there was not any room for change. We wanted to create a timeline for all hours of the day and put an icon of a cup of coffee when the person drank caffeine, a wine glass when the person drank alcohol, a sleeping icon when the person was napping and so on. The problem is that the patients only says when the last
caffeine- or alcoholic drink of the day was and not the other ones. The patient does not say when he woke up in the middle of the night but only for how long and the same goes for exercise. Since this was the idea with the timeline graph there was a question proposed in the survey if people would find it difficult to say at what time they woke up in the middle if the night. The result was that 5,26% felt it would be really easy, 29,82% felt it would be rather easy, 24,56% felt it would not be a big problem. In total 36,84% felt it would be hard and 3,51% said it does not apply to them since they do not wake up at night. This shows that majority of people do not think it would be a problem to say when they woke up. When patients fill out their sleep diaries, they answer a lot of questions with a number (like the quantity of caffeine drinks) and a time (like when they went to bed). We wanted to show the timeline there as well on one side of the screen and the questions on the other side so when they put anything in the questions it would show up on the timeline right away. For people to understand their sleep in the best possible way we had the idea to show how different variables affected their sleep, so people could see how they slept when they drank caffeine the day before compared to how they slept when they did not drink caffeine. We wanted to give people a choice to pick variables and see how they affect their sleep. The variables to choose from would be everything that the patient writes into the sleep diary like alcohol drinking, napping in the daytime, stress, exercise and so on. When we talked to professionals about this, they agreed that this would be great for the users, but we needed to put a lot of thought into this. There would need to be a lot of data collected about the patient and their sleep for this to be possible. It also might be dangerous to put this information on the website if the variable chosen was not really the reason why a patient was sleeping poorly. An example is if a patient had only filled in the diary for 4 days, one day the patient would drink caffeine but the same day he was fired from his job. Then the patient would want to see how the caffeine drinking was affecting the sleep and it would show he sleeps worse than when he does not drink it, but the main reason might be that the patient had been fired from his job the same day and was in a bad place mentally. For this to be on the website we would need to be confident in the reason for the different quality of sleep, so we do not give the users wrong information.

A big part of this research is taking interviews and conducting evaluations on the designs with participants. Covid-19 restrictions made this difficult at times since we could not meet
as many people as wanted in person and the school was closed at time. In the last round of interviews some of the evaluations were conducted over the internet. Almost all meetings we had with instructors were online as well. In the end this was not as big of an obstacle as we had thought and we were able to solve all issues that came with these restrictions.

5.1.2 Future work

In section 4.5.4 there are many improvements proposed that would be good to implement to have the website as user friendly as possible. We have some more ideas that would help improve the website and one of them is to design it for more screen sizes. We want it to be responsive so if a patient likes to use their phone or a tablet instead of a computer it would still look nice, and the experience should be just as good. Another idea we had was for the researchers and healthcare professionals. If a patient was not filling in their sleep diaries the researchers would be alerted or if the patient is sleeping dangerously bad the healthcare professional would be alerted or the patient will appear on the professional’s priority list. To have the website accessible for more people we would want the website to be available in more languages so users could choose their preference. The long-term goal for the website is to show data from other sleep measurements in the Sleep Revolution on there as well. That way both patients and professionals could see all information about the sleep in one user friendly website.
6 Conclusion

In this project we explore the benefits, and trade-offs, of changing the sleep diary from paper to a digital platform for the patient. More specifically we focus on two specific aspects, on one hand how the patients want to see information about their sleep visualized on the website and on the other hand how the healthcare professionals, and researchers, want to see information about their patients sleep visualized in the digital platform. The conclusion is that there are many benefits about having the sleep diary on a digital platform for the patient. The most important ones are the accessibility of it, the real time data available and the reminders. There were some trade-offs found as well, some people think it is easier to have the sleep diary on paper. They think it is easier to have a pen and paper on their nightstand then having to open up their computer. Regarding the visualization of the data both patients and professionals want to see the data about their sleep visually, to have it simple and easily read. They want to be able to choose specific dates or time period and be able to compare that to another time period. It is also important for the professionals that researchers will not see the name of the patients. In conclusion this research paper confirms that it would be good to change the way sleep diaries are done, from a paper to a website. Hopefully this will be available to use for patients as well as professionals soon on a digital platform.
7 References


Arnardóttir, E. S. (2021). *Sleep 101* [Teams presentation]. Teams@RU. http://teams.com


8 Appendix

8.1 Interview guide for semi-structured interviews

Góðan daginn, takk kærlega fyrir að taka þátt í þessu viðtali. Það skiptir okkur miklu máli að fá athugasemdir frá fólki sem myndi mögulega koma til með að nota kerfið og skoða það sem við erum að vinna að.

Við heitum Bergrós og Birta og við erum í tölvunarfræði hér í Háskólanum í Reykjavík. Við erum að útskrifast í sumar og erum að vinna að lokaverkefnið okkar.

Verkefnið okkar er partur af stærra verkefni sem heitir Svefnbyltingin. Markmið svefnbyltingarinnar er að umbylta svefnrannsóknum, með því að gera rannsóknir notendavænni og skilvirkari. Okkar verkefni snýst um að Hanna birtingarmynd á gögnunum úr svefnmælingum á notendavænan hátt.

Markmið viðtalsins er að fá betri innsýn inn í notendahópana okkar, átta okkur á venjulegum degi hjá þeim og hvaða gögn þau telja nauðsynleg úr svefnmælingum.

Viðtalið er allt er í nafnleynd og er einungis gert í þeim tilgangi að hjálpa okkur að Hanna sem bestu birtingarmyndina á gögnunum. Viðtalið mun taka um 40 minútur. Er í lagi að við tökum það upp?

Takk aftur fyrir að gefa ykkur tíma í þetta viðtal.

Bakgrunnspurningar

1. Hvað ert þú gamall/gömul?
2. Ertu í námi og eða starfi? Ef svo er hvað?
3. Hvert er þitt hæsta menntunarstig?
4. Hvaða áhugamál hefur þú?
5. Notar þú tölvur daglega?
6. Hversu fljót/ur ert þú að tileinka þér ný tölvukerfi á skalanum 1 (mjög lengi) til 5 (mjög fljót/ur)?
**Spurningar fyrir sjúklinga/einstaklinga**

- Hvernig telur þú svefninn þinn vera?
- Hversu langan svefn finnst þér þú þurfa að ná til þess að vakna hress?
- Hversu oft í viku telur þú þig ná 7-9 tíma svefn á nóttu?
- Hversu oft í viku vaknar þú endurnærður eftir svefn?
- Hvernig finnst þér vitund fólks í samfélaginu vera um svefn?
- Hefur þú notast við svefndagbók? Ef svo, hvernig fannst þér það sem mælikvæði á svefninn þeirra?
- Hefur þú tekið PVT eða Stroop test? Ef svo, hvernig fannst þér það?
- Notast þú við eitthver mæltæki sem mæla svefninn þinn? Ef svo, hversu oft skoðar þú mælingarnar og hversu lengi í senn?
- Hvaða gögn finnst þér mikilvægt að sjá þegar þú ert að skoða svefninn þinn?
  - Spurja viðmælanda hvort hann sé með síma eða birtingarmynd sem hann notar núna og ath hvort hann vilji sýna okkur - hvernig finnst þér þessi birtingarmynd?
- Berð þú mælingarnar þínar einhvern tímann saman við aðra sem mæla líka svefninn sinn?

**Spurningar fyrir rannsakendur**

- Hversu langan svefn finnst þér þú þurfa að ná til þess að vakna hress?
- Hvernig finnst þér vitund fólks í samfélaginu vera um svefn?
- Hvernig er venjulegur vinnudagur hjá þér?
- Skoðarú gögn úr svefnmælingum daglega?
- Hvað eyðir þú miklum tíma á dag að skoða gögn úr svefnmælingum?
- Hvað telur þú vera mikilvægustu gögnin/mælingarnar úr svefnmælingum?
- Er einhver sérstök röð sem þér finnst best að sjá gögnin í?
- Ert þú með einhverja hugmynd um hvernig þér myndi finnst þægilegt að lesa úr gögnnum á vefsíðu frekar en á blöðum eins og mikið er í dag?
- Sérðu fyrir þér að þú myndir nota vefsíðuna til þess að skoða gögnin?
- Sýna logið og ath hvað þeim finnst um litina?
Spurningar fyrir heilbrigðisstarfsmenn

- Hversu langan svefn finnst þér þú þurfa að ná til þess að vakna hress?
- Hvernig finnst þér vitund fóls í samfélaginu vera um svefn?
- Hvernig er venjulegur vinnudagur hjá þér?
- Skoðar þú gögn úr svefnmælingum daglega? Ef svo, hversu lengi á dag?
- Á hvernig formi eru gögnin? (blöðum, tölvu..)
- Hefur þú tekið fólk í PVT eða Stroop test? Ef svo, hvernig finnst þér það ferli?
- Hefur þú fengið sjúklinga til þess að notast við svefn dagbækur? Ef svo, finnst hvernig finnst þér það sem mælikvarði á svefninn þeirra?
- Hvernig er ferlið þegar þú útskýrir niðurstöður svefn mælinganna fyrir sjúklingum?
  Hvað tekur það langan tíma?
- Hvað telur þú vera mikilvægustu gögnin úr svefnmælingum?
- Hvernig fannst þér gögn úr snjallúrum?
- Sýna logið og athuga hvað þeim finnst um litina

Þá eru spurningarnar okkar komnar, er eiththvað sem þú vilt bæta við? Allar athugasemdir eru vel þegnar.

Takk kærlega fyrir að gefa þér tíma í að gera þetta með okkur.

8.2 Semi structured interviews

Interview 1 – a patient

Simba is 22 years old and is in school finishing a bachelor degree in computer science at RU where he is working as a teaching assistant. He is also working as a technician at Tækniskólinn. His highest level of education is an undergraduate. His hobbies are mostly playing computer games. He uses computers every single day and for a big portion of it. His basic computer knowledge is well above average, in other words he has an excellent computer knowledge and is really fast at learning how to use new systems (5 on the scale of 1 to 5).
Simba says that his sleep is something that could be improved. He considers himself going too late to bed which results in him waking up too late and therefore he feels like he has wasted his day, since he feels more ambitious in the morning and is able to do much more than in the afternoon. Simba considers himself as a person that needs at least 8 hours of sleep to be fully functional and he manages to achieve that at least 5 days a week. It has a lot of impact on him if he doesn't get those 8 hours, a 6-hour sleep results in a bad day where he’s tired.

Simba feels like sleep awareness is getting more, feels like people are starting to realize how important sleep is and that people that he surrounds himself with are really trying to take care of their sleep.

Simba has never experienced using a sleep diary and the only way he has kept track of his sleep is through a smart watch and an app on his phone, so no manual filling in. Simba has tried a PVT and Stroop test but not in a clinical sense.

He has used sleep monitoring apps for smartwatches and feels like that they’re pretty accurate from his perspective, the time when he went to sleep as well as when he woke up. Simba is not sure if these apps are recording the sleep stages right though. This is not something he does on a regular basis but it’s something that he has tried for research purposes and during that time he checked on the data maybe once a week because the data gathering was just happening in the background all the time so therefore he didn’t feel the need to check on it daily. As of today, he doesn’t have anything on the phone recording his sleep.

When Simba was monitoring his sleep he never compared his results to others but that would be something he would like to be able to compare his result to results from experts etc. how much sleep on average is recommended and some ideas on how he could improve it, but maybe not the person next to him since people are different.
Interview 2 – a patient

Mufasa is 32 years old. He is finishing a master’s degree in machine learning and has a bachelor’s degree in physics. His hobbies are reading, spending time with his family and being outdoors. He uses computers almost every day and is a fast learner on new systems (4 on the scale of 1 to 5). His sleep is fine, could sleep more and regularly. He sometimes has a hard time falling asleep and has a tendency to go too late to sleep and wakes up quite late. Mufasa has slept badly before and knows how that is but is better now. Mufasa needs 7-8 hours to sleep and feels a lot of difference if he sleeps 6 hours one night. He gets enough sleep around 5 days a week.

Mufasa thinks sleep awareness is getting better in society and is becoming more as one of the health factors. According to him it’s a long way to go left but in the last 5 years people have given it more attention and thought about it.

One time, when Mufasa slept badly, he tried using a sleep diary. He logged when he fell asleep, for how long and so on for a month and he thinks it was good for him and helped to see the problem.

Mufasa has never done PVT or Stroop test. He has worked with Stroop tests though and helped setting it up and knows something about it from there.

Usually, Mufasa does not use any tools to track his sleep. He once tried using a smartwatch (a Fitbit) for maybe 3 weeks but it was so inaccurate he quit doing it. He talked about how it was overestimating his sleep and detecting sleep at night when he was calm and still, reading or watching television. He added a comment why the watch can’t just put a notification on the watch that says “Are you awake?” and press yes if so, that it would be no problem to press “yes” if so.

He thinks a little bit about his sleep but not that much, mostly just for how long then. He would like to see his sleep compared to both a good sleep and maybe the average in his age group.

Mufasa did a PSG recently and slept badly because of all the stuff connected to him. He thinks it was really interesting though and showed us his results.

“You can measure sleep really exact but then you are affecting the sleep with all the tools, or you can measure it roughly and not affect the sleep but then you are losing data - the question is which is better"
Talks about an effect button where people input how they feel for the sleep diary. (pictures of emotions). Mufasa does not have a smartphone.

**Interview 3 - patient**

Jasmine is 33 years old, is in school getting a doctors degree and works as a teacher in HR at the computer science department. Her highest level of education is a master’s degree in computational engineering, she has a BSc degree in mathematics. Her hobbies are snowboarding, travelling and spending time with her children. She uses computers every day and her basic computer knowledge is above average. She is fast at learning her ways around a new system (4 on the scale of 1 to 5).

Jasmine says she is lucky for how well she sleeps. She used to go to sleep too late but has matured from that and now usually goes to bed around 11 pm. She would say 4-5 days a week she gets enough sleep and is well rested the next day and for her that is 8 hours. She always wakes up at 7 am. She talked about if she sleeps 6 hours, she is fine the next day but if she does it a few nights in a row she starts getting tired.

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Jasmine thinks sleep awareness is getting more or better than it used to be. She talked about when she was younger it was popular to sleep way too little and brag about it. When she was studying, she and her classmates often slept way too little or nothing, and “pulled an all-nighter” before exams and so on which she recognizes now is really bad. People who were all in the healthy lifestyle also talked about only sleeping 5 hours a night like that was “cool”. Jasmine thinks this is getting better and sleep awareness is becoming more.

Jasmine has never tried using a sleep diary and used to not think a lot about her sleep. She talked about in the last 5 years she has begun thinking more about sleep but is lucky and has no problems, she says she can sleep anywhere and is fast at falling asleep.

Jasmine thinks sleep diaries would be a good tool if people remember to log in it quite soon after they wake up in the mornings and right before sleep at night. Jasmine thinks if she would let some time go by, for example one day and try to log for two days the day after, that she would have forgotten how her sleep was. Jasmine talked about how it would need to be accessible and easy, for example on her phone and just a few clicks.

Jasmine has never done PVT or Stroop test so we explained loosely to her what it is about. She knew or had heard of Stroop tests but not PVT tests.
Jasmine has a Withings watch and has had it for about 3 months. She checks the data on her phone maybe once a week and then most often for the whole week. She especially checks on it when she has had a bad night of sleep or slept really long. She has thought about how reliable it is and talks about how it overestimates her sleep a lot, if she is calm watching TV at night, it thinks she is asleep. That however does not irritate her because she knows it’s not reliable and understands why. Jasmine added a comment regarding that and why it’s not possible to erase data so if she knows she was awake when the watch detected her as asleep, she could go on the app and erase it. With that the data would be more correct. With sleep diaries Jasmine likes the idea to be able to compare her sleep to what is considered good night sleep and adds that she might want to see a percentage of sleep quality or something like that like a lot of smartwatches show.

**Interview 4 – a researcher**

Nala is 39 year and is working as assistant professor at RU where she’s mostly working on scientific research. Her highest level of education is a doctor’s degree. Nala’s hobbies besides sleep are reading, cross stitching and jigsaw puzzles. She uses computers a lot every day in her job and is a fast learner on new computer systems (4 on the scale of 1 to 5). Nala feels like she needs at least 8 hours to wake up refreshed. She thinks that the awareness on importance of sleep is getting better, there are more discussions on sleep related topics in the community so we’re slowly getting there. People know few things but there are other things that still surprises them.

A normal work day for Nala is a combination of writing articles, processing data, teaching and attending meetings since she is instructing bachelor-, master- and doctoral students. Her day is all about scientific research or like she says, her life is mostly about sleep and science.

Nala is mostly doing research, she used to look more at sleep data before but today there are other people that are working with the raw data, she has less time than she would want because she feels like it’s a lot of fun working with data. She does not look at sleeping data on a daily basis.
When looking at sleeping data Nala thinks it depends a lot on what data is important at any given time, it depends on what research question is being answered. If the patient is getting tested for sleep apnea a PSG test would be ideal but if the patient is getting tested for insomnia then it would be the history of the patient, questionnaire and sleep diary, if the focus is on short sleep then sleep diary, questionnaire and maybe a smartwatch. Nala thinks there are a lot of potentials for the smartwatches in the future but right now she doesn’t trust them or the sleeping mats and that is one of the reasons why they want to validate them. Most researchers and scientists do not trust them and there is a reason for it. It is important to get data from both the patient experience and the data from the sleep tests, because the test doesn’t necessarily tell the whole story. Almost all of the data that Nala looks at is on the computer except for the sleeping diaries, since they’re still done on paper.

**Interview 5 – a researcher**

Elsa is 50 years old and is working as an associate professor in the psychology department at RU. Her highest level of education is a doctor’s degree. Her hobbies are the traditional hobbies like outdoor activities, reading and being with her family. Elsa uses computers every day and considers herself to have an average computer knowledge, knows how to use the basic programs to do what she needs to do. She considered herself to be a 3 on the scale of 1-5 how fast she is at learning how to use new computer systems. Elsa feels like she needs around 7-8 hours to wake up refreshed. Elsa feels like the awareness of the importance of sleep is more than it was maybe 10 years ago. There has been a lot more discussion about this topic, most people do realize that it doesn't have a good impact on us to sleep too little but she thinks that people don’t really know what impact it does to them and why it’s bad. A normal work day for Elsa includes a lot of meetings, she is over the undergraduate degree program in psychology and she teaches, then when there is time she tries to do some research writing, but overall it’s mostly endless meetings. When asked about Elsa’s position in the Sleep Revolution she says that she’s the psychologist in the project so she is very rarely looking at sleeping data.
Elsa has never used sleep diaries, she thinks that they’re a good measurement with other things so not just on their own. It doesn’t matter if you’re looking at sleep or other things, it is good to use different measurements because each one has their pros and cons. When you’re asking the participant himself to give some information about their sleep or other factors you can never be 100% sure that it’s reliable, it all depends on if he is willing to give the exact results or if he’s trying to adjust the answers to look better. It’s very subjective.

When asked about PVT and Stroop tests, Elsa says that those tests are on the psychological side of the project which is her field in this project. Both of those tests can measure how much you’re awake, they’re measuring the attention and the reaction time. Elsa doesn’t really know what information people would like to see from those tests, it could be a bit dangerous what information you’re giving to people regarding mental skills. You don’t want this to be something that will make people worry. Both PVT and Stroop are tests that don’t have an independent scale that says this was a good performance and this was a bad one. Elsa says that they usually have a comparison whether people are doing better on the different kinds of Stroop tests. You can’t make people take those tests and then tell them that they’re this or that compared to some overall numbers, that would be something to put a question mark on. It would be interesting to compare the person’s results from over time, if they would be taking those tests over some time period and therefor you could get information’s about if you’re doing better in the morning or the evening, is there a difference when you’ve been working a lot for many days in a row or when you’ve been sleeping badly. That would be information that could possibly be given to the users.

As a scientist, Elsa is very excited about what comes out of the big Pilot research, where they’re going to compare those smart watches with other measuring devices. She admits that she’s a bit skeptical but she’s not forming an opinion beforehand, because she knows that the technology is evolving fast and therefore it will be interesting to see what comes out of this. If this results in what they’re hoping for it would solve so many problems in the research if those smart watches could give us reliable results. Elsa does not use any kind of smart watch and if she would be using it she would look at it with notice. She doesn’t have anything against those measurements.
Interview 6 – a researcher

Peter is 31 years old, works in RU as a researcher and is working in the Sleep Revolution. Peter has a master’s degree in neuroscience, psychology. His hobbies are travelling, hiking, snowboarding, and going to the gym. He uses computers every day and his basic computer knowledge is very good, and he is learning more advanced computer skills like programming in R now. He considers him as a fast learner on new computer systems (5 on the scale from 1 to 5).

Peter needs around 7 hours of sleep. If he only sleeps 5 hours a night he is fine the next day but if he does it for 3 weeks he will get a little bit tired. Sleep awareness in society is not good. He thinks people don't know how much sleep is important.

Peter works at RU as a researcher and does a lot of article reading, writing papers as well setting up for sleep studies. He will soon start learning how to score sleep data. He has a basic knowledge of how to read from sleep studies but not a lot. He reads results from the computer.

Peter has a withings watch but earlier he had an amazon watch. He tried to track his sleep a little bit with the Amazon watch but it was not accurate. It was underestimating his sleep and only saying he slept like 3 hours when he slept more. (interesting)

Peter has never used, or worked with, a sleep diary. Peter has been working with PVT and Stroop tests to track cognitive abilities. PVT is a golden standard for the attention and how fast you react. Quite a good test and simple. Stroop tests might be hard now that they want to use a non-vocal version because it would take a lot more time.

PVT and Stroop tests would be good to see side by side to how they sleep and it is quite possible that they will have different scoring depending on how they sleep and if they have sleep deprivation and so on. Stoop and PVT could be good to see early cognitive impairment like dementia or other brain problems.

Interview 7 – healthcare professional

Ariel is 55 years old. She works with sleep measurements and works in the Sleep Revolution and she used to work in the hospital. She has a masters degree. Her hobbies are cycling,
golfing and spending time with her family. She uses computers a lot every day and thinks she is a fast learner when she starts using new systems (5 on the scale of 1 to 5).

Ariel says she is a short sleeper. She sleeps 6 hours and is good the next day and not tired. She says that of course people should get more sleep but that works for her. Sometimes she crashes if she doesn't sleep enough. Ariel thinks sleep awareness is more now than it used to be and that people are taking interest in sleep and realizing it is important for health. She works at RU and at the Sleep Institute so her work hours are irregular. She works at nights at home often. She views sleep measurements everyday, 6-9 hours a day. Each patient's sleep measurements take 10-30 minutes but PSG take 2-5 hours. They are all reviewed in computers.

Ariel has had patients do a PVT test a long time ago, it was done in a box that was then downloaded and has not been doing that for a while now.

Ariel has gotten patients to do a sleep diary on paper. She thinks it is good to see an overview of the sleep, if people are sleeping regularly, taking naps and so on. It is a really valid tool if people are honest in filling it out.

Sleep measurements are different, depending on what is being looked at and they don't usually start with the most expensive tests, like PSG, that also need a lot of manpower.

Ariel says it will be interesting to see data from smartwatches and other tools side by side. She has used an apple watch and noticed it detects sleep when she is just watching TV before sleep.

**Interview 8 – healthcare professional**

Jane is 42 years old. She works in HR doing sleep measurements as a sleep technologist. Jane has 2 bachelor degrees. Her hobbies are reading, going outside and good food. She uses computers every day, in her job and at home, and learns fast how to use new systems (5 on the scale of 1 to 5).

Jane needs nearly 8 hours of sleep to be refreshed and if she sleeps under 7 hours she is tired the next day. She thinks sleep knowledge is more now than it used to be and people are hearing more and more about it. The book „Why we sleep“ might have helped since a lot of people started reading it and sharing facts from the book to their friends.
She works in sleep measurements and sleep research. Her work days vary a lot from day to day, she is also helping students regarding setting up the sleep measurements. She scores sleep, helps students and other things related to sleep. At least half of her work day, or 4 hours, goes into looking at sleep data and analyzing it. PSG takes around 2-4 hours but other sleep studies might take less time. She only looks at sleep data in computers, not papers like in the old days.

Jane has had patients use sleep diaries. If people are honest, and remember to document in there, you can see a lot from the diary and it is very helpful. Jane thinks every patient that need a sleep study should use a sleep diary for 2-3 weeks before they meet a sleep specialist. It is a valid tool and shows us a lot of good information and trends. Jane has never talked to patients regarding sleep, and she says that the doctors do that. She only meets the patients in the beginning and gives them sleep study tools if needed and then analyzes the sleep and gives the doctor the results.

For insomnia, or young people who are always tired but don’t know why, a sleep diary can help a lot in diagnosis. However if a fat mid age man comes Jane would maybe put him in a simple repertory study to see if he has sleep apnea.

Sleep diaries and smartwatches are both good tools for ordinary citizen to be more aware of how they are sleeping.

Jane has a smartwatch and most often sleeps with it and likes to look at her sleep data there. She however is aware that it is not correct. She told us a story of when she was working at the hospital and walking a lot and her heart rate was up, when she got home she calmly watched the TV before bed. The next day she saw that the watch thought she was in deep sleep at the time she was watching TV. She also once fell asleep at 10, woke up at 12 and was awake for an hour. The next day she saw that the watch only thought she fell asleep at 1 and excluded the nearly first two hours of her sleep.

She liked the colors of the logo because it is “the colors of the night” but also talked about how it is good to use green and red - colors that people realize what means. So if something is alarming, show it in red. Same as if something is ok, show it green and yellow means in the middle. People realize this. It might be good to mix this together - the logo colors and this.
Interview 9 – healthcare professional

Nemo is 45 years old. He works as a researcher. His highest degree of education is PhD. His interests are sleep research. Nemo uses computers almost every day and his computer knowledge is above average. He is quite a fast learner on new systems (4 on the scale of 1 to 5).

Nemo says he needs around 7-8 hours of sleep to wake up refreshed and he feels bad if he sleeps 5 hours one night. He feels like the knowledge of the importance of sleep is improving, that there is some knowledge but not the right focus. Etc. there are a lot of newspapers that are making stories about how dangerous it is to sleep little and how bad the consequences is but not how to improve it.

Nemo works at the hospital 3 days a week and 2 days a week he is focusing on the research. One or two days a week Nemo is working with sleep patients where he’s mostly talking to them about their results and then he’s briefly looking into sleep data. He’s not scoring the data, he’s overseeing the data before making clinical decisions.

The process of explaining and consulting the patient takes about 30 minutes per patient. Nemo looks at data using the Noxturnal software.

Nemo does not use PVT and Stroop tests but he used the Stroop test in his PhD paper and he has no experience with the PVT tests. He thinks the concept of the Stroop test is interesting, you can use it to get cognitive results.

Nemo has used sleep diaries a lot with research patients but not with other patients because they have not been using it at the hospitals. But in the research he has been using sleep diaries on paper for about 10 years. He thinks sleep diaries are a very important tool in treating insomnia, the sleep diary is way more valuable than PSG or other sleep measurements. Nemo feels like the diaries should be as simple as possible, something that could be finished in less than one minute.

When at the hospital Nemo mostly uses the home apnea testing when measuring patients and they only use the PSG for research purposes.

Nemo says that they don’t have any experience on using wearables as a measurement in previous research so it will be interesting to follow the Withings research. He has used a Fitbit wearable and he feels like it’s interesting in the beginning but after couple of weeks you start forgetting it.
8.3 The sleep diary

The questions in the sleep diary were as following:

**Morning Questions:**

<table>
<thead>
<tr>
<th><strong>Date</strong></th>
<th><strong>Step 1</strong></th>
<th><strong>Step 2</strong></th>
<th><strong>Step 3</strong></th>
<th><strong>Step 4</strong></th>
<th><strong>Step 5</strong></th>
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<td>23.6.2021</td>
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<tr>
<td>1. Morning routine</td>
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<td>2. How long did it take you to fall asleep?</td>
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<td>3. How long did you sleep?</td>
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<td>4. How many times did you wake up?</td>
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<td>5. In total, how long did you sleep?</td>
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<td>6. What time was your first awakening?</td>
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<td>7. After your first awakening, how long did you stay in bed before you got up?</td>
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<td>8. If you woke up before you planned, how much earlier?</td>
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<td>9. How much sleep did you get today?</td>
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<td>10. How much sleep did you get on the day before?</td>
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<td>11. How would you rate the quality of your sleep?</td>
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<td>12. How much sleep did you get on the day before?</td>
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<td>13. How much sleep did you get on the day before?</td>
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Figure 79: Morning questions in Icelandic

Figure 80: Morning questions in English
Evening Questions:

The first question proposed was about their age. The second question was if the participants finished a whole week of filling in the sleep diary on paper. If answered “no” they are given three options to explain why, that is “I thought it was too much trouble”, “I forgot it”, “I thought it was pointless” and then a text box to write if there is any other reason for it. The next question was if they ever forgot to fill in the sleep diary and if so, if they filled it in when they remembered or left it blank. Then they are asked if the participants would want a reminder to fill in the sleep diary, and if so, what kind of a reminder do they want.
options are “in a text message”, “as a notification in my phone, like from other applications”, “in an email” and then there is a text box is the participant wants a notification somewhere else. The next question is if they would like to fill in a sleep diary on a website or on paper. The next question was about what variables the participants would like to see in regard to how they sleep, an example is proposed that is for example how good do you rate your sleep quality when you drink alcohol before sleep, and how good do you rate it when you don’t drink alcohol. The variables to choose from are alcohol, caffeine, medication, drugs, if you had a nap the same day, if you were working today or not, how stressed you were, how your mood was, if you exercised, none of the above or it is possible to write in a text box if there is anything else. In the next question the participants were asked how difficult or easy they think it is to know at what time they woke up, if they woke up, in the middle of the night. The following question was about what was the hardest thing about filling in the sleep diary. The options to choose from was “to remember it”, “to remember when I did what”, “to calculate how long I slept”, “I did not find anything hard” and there is a text box if they thought of something else. The next question was if people thought they slept better, worse or the same when they filled in the sleep diary. The last question was how the participants would like to see the data from the sleep diary and had a text box to write in the answers.

8.5 Interview guide for Think aloud interviews with wireframes

Góðan daginn, takk fyrir að koma í viðtal til okkar.
Við heitum Bergrós og Birta og erum við að vinna að lokaverkefnið okkar í Tölvanarfræði við Háskólann í Reykjavík. Verkefnið okkar snýst um að hanna veflausn fyrir svefnadagbækur og að hanna birtingarmynd fyrir gögnin sem koma úr þeim.
Tilgangurinn með þessu viðtali er að prófa frumgerðina okkar, ekki þig, og allar athugasemdir eru vel þegnar. Ef þú lendir í vandræðum þá er það ekki þér að kenna og hjálpar það okkur mikið við að betrumbæta frumgerðina okkar. Viðtalið er allt í nafnleynd og er einungis gert í þeim tilgangi að hjálpa okkur að hanna kerfið á sem bestan hátt. Viðtalið mun ekki taka meira en 40 mínútur.
Ert þú með einhverjar spurningar áður en við byrjum?
Okei, ég þá ætla að byrja á því að spyra þig nokkrar bakgrunnsþurningar.
Bakgrunns-spurningar

7. Hvað ert þú gömul/gamall?
8. Hvert er þitt hæsta menntunarstig?
9. Ertu í námi og eða starfi? Ef svo er hvaða?
10. Hversu mikið hugsar þú um svefninn þinn á skalanum 1 (mjög litið) til 5 (mjög mikið)?
11. Hefur þú notast við svefndagbók áður?
12. Notar þú tölvar daglega?
13. Hversu fljót/ur ert þú að tileinka þér ný tölvukerfi á skalanum 1 (mjög lengi) til 5 (mjög fljót/ur)?

Kynning á frumgerð

Núna ætlum við að sýna þér frumgerðina okkar, ertu til í að skoða hana með okkur?
Hún er aðeins á pappír eins og er og engin virkni er í henni. Þú mátt endilega benda á það sem þú myndir vilja smella á og þá rétt í þér næstu síðu. Það er ekkert rétt eða rangt svar og við erum ekki að prófa þig, bara frumgerðina. Gagnrýni er mikilvæg og er tilgangurinn með þessum prófunum einmitt að fá sem flestar athugasemdir sem myndu hjálpa okkur að betrumbæta frumgerðina.

Við erum með nokkur verkefni sem við ætlum að biðja þig að reyna að leysa. Ég mun lesa eitt verkefni fyrir þig í einu og rétt þér það svo, þannig engar áhyggjur, þú þarf ekki að leggja neitt á minnið sem ég segi.

Verkefni fyrir sjúklinga

1. Þú varst að vakna eftir næturesvefn sem var svona:
- Þú manst eftir því að hafa farið upp í rúm um klukkan 21:30 til þess að horfa á einn sjónvarpsþátt sem var 30 mínútur. Þegar þátturinn var búinn ákvaðst þú að reyna að sofna og tók það þig um 20 mínútur.
- Þú vaknaðir 2x í nött vegna jarðskjálfta, fyrst klukkan 02:00 og vaktir í 10 mínútum og í seinna skiptið klukkan 04:00 og vaktir þa í 20 mínútum.
- Þú varst með vekjaraklukku kl. 06:30 snoozaðir ekkert og þóð fram úr rúminu 5 mínútum seinna.
- Þrátt fyrir að þú hafir vaknað 2x í nött fannst þér þú hafa náð sæmilegum svefn og þér leið eins og þú værir vel úthvíld/ur.

Notaðu kerfið til þess að skrá þessar upplýsingar inn í svefndabókina

2. Nú ert þú að fara að sofa, dagurinn þinn var svona:
- Þú var mikið að gera í vinnunni í dag þannig að þegar þú komst heim þá lagðir þú þig í 40 mínútur.
- Þú drakkest engan áfengan drykk í dag. Þú drakkest samt sem áður einn kaffibolla til þess að byrja daginn. Eftir hádegismat, klukkan 14:00, fékkstu þér svo annan kaffibolla inni á kaffistofu með samstarfsfélögunum þínun.
- Þú tókst eina 250 mg Advil PM töflu kl 22:00 til þess að hjálpa þér að sofna.
- Þú finnur fyrir fyrir hausverk og veist að það mun mögulega hafa áhrif á það hvernig þú munt sofa í nött og vilt hafa það skráð niður.
- Þú varst smá þreyttur en geispaðir líka mikið og fannst fyrir frekar mikilli syfju.
- Það gekk vel í vinnunni, þú varst ekkert stressaður og varst líka í frekar góðu skapi - sérstaklega eftir klukkutíma morgunæfinguna þína.

Notaðu kerfið til þess að skrá þetta inn í svefndagbókina


7. Þú hefur mikinn áhuga á að sjá hvernig þú metur svefngæðin þín, hversu endurnærð/ur, þú ert oftast og hversu lengi þú vakir að meðaltali á nóttu. Notaðu kerfið til þess að finna meðaltalið á því.

Verkefni fyrir sérfræðinga

1. Þú ert rannsakandi og/eða heilbrigðisstarfsmaður á vegum svefn byltingarinnar, þig langar að skoða upplýsingar um ákveðna sjúklinga og skoða önnur gögn. Þú skalt byrja á því að skrá þig inn á síðuna með netfangi og lykilorði, notaðu kerfið til þess.


3. Anna Rósa er einstaklingur sem þú ætlað næst að skoða, kennitalan hennar er 280592-4079. Notaðu kerfið til þess að opna síðuna hennar.
4. Þú ert komin/n inn á síðuna hjá henni Önnu. Þú ætlar að byrja á því finna út hversu langt er síðan að það var síðast haft samband við hana, notaðu kerfið til þess að finna útúr því.

5. Þú tekur eftir því að það þarf að heyra í Önnu og þú vilt merkja hana sem einstakling sem þarf sérstaka eftirfylgni, með forgang sem mikinn. Ástæðan fyrir því er að hún var að byrja á nýjum svefnlyjum og það eru 3 vikur síðan það var heyrt í henni síðast.Notaðu kerfið til þess að gera þetta.

6. Núna vilt þú skoða tölfræði um svefninn hennar Önnu. Þú vilt sjá:
   - Hversu lengi hún sefur að meðaltali
   - Hvernig hún metur svefngæðin sín og hversu endurnærð hún er
   - Hversu lengi hún vakir á nóttu að meðaltali
   - Hversu marga koffíndrykki hún drekkur á dag og hvenær síðasti er
   - Hversu syfjaða hún telur sig vera
   - Hversu mikið hún hreyfir sig
Notaðu kerfið til að sjá þetta.

7. Þú hefur nú klárað að skoða Önnu og vilt fara aftur á forsíðu. Notaðu kerfið til þess


**Quick debrief**

1. Hvað líkaði þér, eða líkaði þér ekki, við þetta kerfi?
2. Hvernig myndir þú lýsa þessu kerfi fyrir fólkinu í kringum þig?
3. Myndir þú mæla með þessu kerfi við fólkið í kringum þig?
4. Ef þú gætir bætt eitthvað í þessu kerfi, hvað myndir þú bæta?
5. Hvort myndi þér líka betur að sinna þessu á mögulegri vefsiðu eða á pappír?
6. Er eitthvað sem þú vilt bæta við?

Takk aftur kærlega fyrir þátttökuna.

8.6 Interview guide for prototype evaluations

Góðan daginn og takk fyrir að koma í þetta viðtal til okkar.
Við heitum Bergrós og Birta og erum við að vinna að lokaverkefnið okkar í Tölvunarfræði við Háskólann í Reykjavík. Verkefnið okkar snýst um að hanna veftlausn fyrir svefnadagbækur og að hanna birtingarmynd fyrir gögnin sem koma úr þeim.

Tilgangurinn með þessu viðtali er að prófa frumgerðina okkar, ekki þig, og allar athugasemdir eru vel þegnar. Við viljum sjá hversu notendavæn síðan er í notkun og hvort það sé eitthvað sem þyrfti að laga. Viðtalið er allt í nafnleynd og er einungis gert í þeim tilgangi að hjálpa okkur að hanna kerfið á sem bestan hátt. Viðtalið ætti ekki að taka meira en 40 minútur.

Ert þú með einhverjar spurningar áður en við byrjum?
Ég þá ætla að byrja á því að spyrja þig nokkrar bakgrunnsþingar.

**Bakgrunnsþingar**

7. Hvað ert þú gömul/gamall?
8. Hvert er þitt hæsta menntunarstig?
9. Ertu í námi og eða starfi? Ef svo er hvaða?
10. Hversu mikið hugsa þú um svefninn þinn á skalanum 1 (mjög litið) til 5 (mjög mikið)?
11. Hefur þú notast við svefnadgökk aður?
12. Hversu góða tölvuþekkingu telur þú þig hafa?

**Kynning á frumgerð**

Núna ætlum við að sýna þér frumgerðina okkar, ertu til í að skoða hana með okkur?
Við erum búnar að setja hana upp í hönnunartóli og því er aðeins takmörkuð virkni í henni. Þú getur smellt á það sem þú vilt smella á og kerfið færir þig sjálfkrafa á næstu síðu. Það er ekkert rétt eða rangt svar og við erum ekki að prófa þig, bara frumgerðina. Gagnrýni er mikilvæg og er tilgangurinn með þessum prófunum einmitt að fá sem flest athugasemdir sem myndu hjálpa okkur að betrumbæta frumgerðina.


Verkefni fyrir sjúklinga

Innskráning

1. Þú ætlar að byrja á því að skrá þig inn á síðu svefnbyltingarinnar með netfanginu anna@gmail.is og lykilorðinu anna123, notaðu kerfið til þess að gera það.

Morgunspurningar:

2. Þú varst að vakna eftir nætur-svefn og ert að fara að fylla inn í svefnadgóbókina, notaðu kerfið til þess að gera það

3. Þú manst eftir því að hafa farið upp í rúm um klukkan 21:30 til þess að horfa á einn sjónvarpsþátt sem var 30 mínútur. Þegar þátturinn var búinn ákvaðst þú að reyna að sofna og tók það þig um 20 mínútur. Notaðu kerfið til þess að skrá þessar upplýsingar inn

4. Þú vaknaðir 2x í nótt og leist á klukkuna. Fyrst klukkan 02:00 og vaktir í 10 mínútur í seinna skiptið klukkan 04:00 og vaktir þá í 20 mínútur. Notaðu kerfið til þess að skrá þessar upplýsingar inn

5. Þú varst með vekjaraklukku kl. 06:30 snoozaðir ekkert og først strax framúr rúminu. Notaðu kerfið til þess að skrá þessar upplýsingar inn
6. Þrátt fyrir að þú hafir vaknað 2x í nót fannst þér þú hafa náð sæmilegum svefn og þér leið eins og þú værir vel úthvíld/ur.Notaðu kerfið til þess að skrá þetta inn.

Kvöld Spurningar

7. Nú ert þú að fara að sofa og ætla að fylla inn í kvöldspurningarnar. Það var mikið að gera í vinnunni í dag þannig að þegar þú komst heim þá lagðir þú þig í 30 mínútur. Notaðu kerfið til þess að skrá það inn

8. Þú drakkst engann áfengann drykk í dag. Þú drakkst samt sem aður einn kaffibolla til þess að byrja daginn og annan eftir hádegismat, klukkan 14:00. Notaðu kerfið til þess að skrá það inn

9. Þú tókst einna 500 mg Advil PM töflu kl 23:00 til þess að hjálpa þér að sofna. Notaðu kerfið til þess að skrá það inn

10. Þú finnur fyrir fyrir hausverk og veist að það mun mögulega hafa áhrip á það hvernig þú munt sofa í nót og vilt því hafa það skráð niður. Notaðu kerfið til þess að skrá það inn.

11. Þú varst smá þreyttur en geispaðir líka mikið og fannst fyrir frekar mikilli syfju. Notaðu kerfið til þess að skrá það inn. Það gekk vel í vinnunni, þú varst ekkert stressaður og varst líka í frekar góðu skapi – sérstaklega eftir klukkutíma morgunæfinguna þína. Notaðu kerfið til þess að skrá það inn.

12. Stillingar

13. Spjall

14. Minn svefn
15. Þú vilt bera saman svefninn þinn fyrir þessa vikuna og svo vikuna 5 - 11 apríl og þar með sjá muninn á hversu lengi þú ert að sofa


17. Þú hefur mikinn áhuga á að sjá mismunandi tölfraði tengda þér og þínun svefni. Þú vilt ssamt aðeins sjá hversu lengi þú ert að sofa að meðaltali, hvenær þú ert yfirleitt að fara upp í rúm á kvöldin og hversu langan tíma það er að taka þig að sofna að meðaltali. Notaðu kerfið til að sækja þessar upplýsingar.

18. Nú hefur þú klárað allt sem þú ætlaðir þér að gera og vilt því skrá þig út. Notaðu kerfið til þess

**Verkefni fyrir sérfræðinga – sýn heilbrigðisstarfsmanna**

**Innskráning**

1. Þú ert heilbrigðisstarfsmaður á vegum svefn byltingarinnar og þig langar að skoða upplýsingar um ákvæða sjúklinga. Þú ætlaðir að skrá þig inn á síðuna með netfanginu sigrunjohe@gmail.com og lykilorðinu hr12345. Notaðu kerfið til þess að gera það.

**Skoða einstakling**

2. Nú ert þú skráð/ur inn á síðuna og getur hafist handa við að sinna verkefnum dagsins. Notaðu kerfið til þess að finna lista yfir einstaklinga sem þurfa sérstaka eftirfylgni, og skoðaðu þann sem er í mesta forganginum,

3. Nú ert þú inni á síðunni hjá þeim einstaklingi sem er í mestum forgang og þú villt finna út hver greiningin hans er ásamt þeim lyfjum sem hann er á núna.


5. Þú ert komin/n inn á síðuna hjá henni Ónnu. Þú ætlaðir að byrja á því finna út hversu langt er síðan að það var síðast haft samband við hana, notaðu kerfið til þess að finna útúr því.
6. Þig langar að sjá hversu lengi Anna hefur verið að sofa síðastliðna viku, notaðu kerfið til þess að finna út ðví

7. Þú vilt sjá hversu lengi hún er að sofa þessa viku samanborið við vikuna 5 - 11 apríl, þar sem hún var að skipa um svefnlyf og þú vilt því sjá muninn á svefnmynstrinu hennar. Notaðu kerfið til þess að skoða þetta

8. Þú vilt sjá hvenær Anna er að fara upp í rúm og hversu reglulega hún er að sofa. Notaðu kerfið til þess að sjá klukkan hvað hún var sofandi súðausti þriðjudag.

9. Þú hefur mikinn áhuga á að sjá mismunandi tölfraði tengdar Önnu og svefninum hennar. Þú vilt samt aðeins sjá hversu lengi hún ert að sofa að meðalalti, hvenær hún er yfirleitt að fara upp í rúm á kvöldin og hversu langan tíma það er að taka hana að sofna að meðalalti. Notaðu kerfið til að sækja þessar upplýsingar.

Spjall


Leita eftir góp


Verkefni fyrir sérfræðinga – sýn rannsakenda

Innskráning

1. Þú eftir rannsakandi á vegum svefn byltingarinnar og þig langar að skoða upplýsingar um ákveðna sjúklinga. Þú áætla að skrá þig inn á síðuna með netfanginu sigrunjohe@gmail.com og lykilorðinu hr12345. Notaðu kerfið til þess að gera það.

Skoða einstakling
2. Nú ert þú skráð/ur inn á síðuna og getur hafist handa við að sinna verkefnum
dagsins. Notaðu kerfið til þess að finna lista yfir einstaklinga sem þurfa sérstaka
eftirfylgni, og skoðaðu þann sem er í mesta forganginum.
3. Nú ert þú inná síðunni hjá þeim einstaklingi sem er í mestum forgangi, nú villt þú
finna út hver greiningin hans er ásamt þeim lyfjum sem hann er á núna.
4. SR20004 er einstaklingur sem þú ætlar næst að skoða. Notaðu kerfið til þess að opna
síðuna hans.
5. Þú ert komin/n inn á síðuna hjá SR19004. Þú ætlar að byrja á því finna út hversu
langt er síðan að það var síðast haft samband við hann, notaðu kerfið til þess að
finna út úr því.
6. Þig langar að sjá hversu lengi SR20004 hefur verið að sofa síðastliðna viku, notaðu
kerfið til þess að finna hversu lengi hann svaf seinasta fimmtudag.
7. Þú villt sjá hversu lengi hann er að sofa þessa viku samanborið við vikuna 5 - 11 april,
þar sem hann var að skipta um svefnlyf og þú villt því sjá muninn á svefnmynstrinu
hjá honum. Notaðu kerfið til þess að skoða þetta
8. Þú villt sjá hvænær hann er að fara upp í rúm og hversu regludega hann er að sofa.
Notaðu kerfið til þess að sjá klukkan hvað hann var sofandi síðasta þriðjudag.
9. Þú hefur mikinn áhuga á að sjá mismunandi tölfræði tengdar SR19004 og svefninum
hans. Þú villt samt sem aður aðeins sjá hversu lengi hann er að sofa að meðaltali,
hvænær SR190004 er yfirleitt að fara upp í rúm á kvöldin og hversu langan tíma það
er að taka hann að sofna að meðaltali. Notaðu kerfið til að sækja þessar upplýsingar.

Spjall
10. Þú mannst eftir því að hafa rætt við einstakling SR21005 varðandi það að hann var
alltaf að gleyma að fylla inn í svefndagbókina. Þú villt finna þessi tilteknu skilaboð,
notaðu kerfið til þess.

Leita eftir hóp
11. Síðasta verkefni dagsins er að skoða ákveðinn hóp af einstaklingum. Þú villt sjá
hvernig fólk sem er yngra en 51 árs, sem er greint með kæfisvefn og drekkur fleiri en
5 koffíndrykki á dag sefur. Notaðu kerfið til þess að gera það.
12. Nú hefur þú lokið við verkefni dagsins og vilt því skrá þig út úr kerfinu. Notaðu kerfið
til þess.
**Quick Debrief**

**Sjúklingar**
- Ef viðkomandi hefur gert svefndabók á pappír: Hvernig fannst þér að vinna þig í gegnum þetta kerfi samanbörð við það sem þú gerðir á pappír?
- Hvað líkaði þér við þetta kerfi? Hvað líkaði þér ekki?
- Myndir þú mæla með þessu kerfi við fólkið í kringum þig?
- Ef þú gætir bætt 3 hluti í þessu kerfi, hvað myndir þú bæta?
- Hvort myndir þú frekar vilja sinna svefndagbók á mögulegri vefsíðu eða á pappír?

**Sérfræðingar**
- Hvernig er þetta kerfi samanbörð við það sem þú vinnur með í dag?
- Hvað líkaði þér við þetta kerfi? Hvað líkaði þér ekki?
- Myndir þú mæla með þessu kerfi við samstarfsfólk þitt?
- Ef þú gætir bætt 3 hluti í þessu kerfi, hvað myndir þú bæta?

Í lokinn erum við með nokkrar spurningar varðandi ánægju notenda á síðunni.

### 8.7 Usability measurements

**Table 18: Time of each patient finishing each task**

<table>
<thead>
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Table 19: Time of each professional finishing each task

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Table 20: Clicks it took each patient to finish each task

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Table 21: Clicks it took each professional to finish each task

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<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
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<td><strong>100%</strong></td>
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Success rate = \( \frac{57.5}{60} = 95.8\% \)

### Table 23: Success rate for professionals

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Success rate = \( \frac{34}{36} = 73.9\% \)
Table 24: Problems each patient encountered in each task

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Table 25: Problems each professional encountered in each task

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SUS rating over all: 9,51
Precentage of strongly disagree = 0/30 = 0%
Precentage of strongly disagree = 0/30 = 0%

Table 27: SUS professionals

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SUS rating over all: 8,05
Precentage of strongly disagree = 1/60 = 1,6%
Precentage of strongly disagree = 3/60 = 5%