Resolution by ResMed

Process Book
IXDS2 Spring 2020

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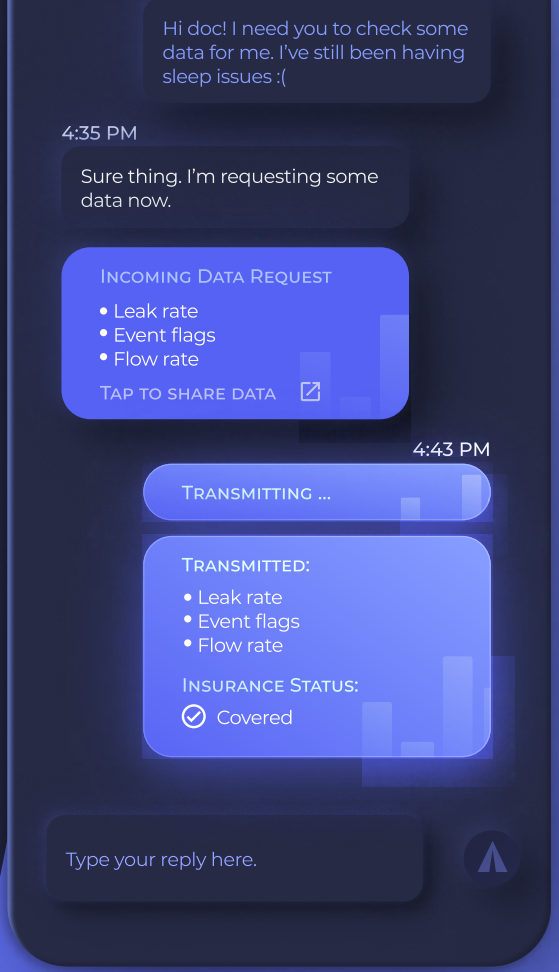
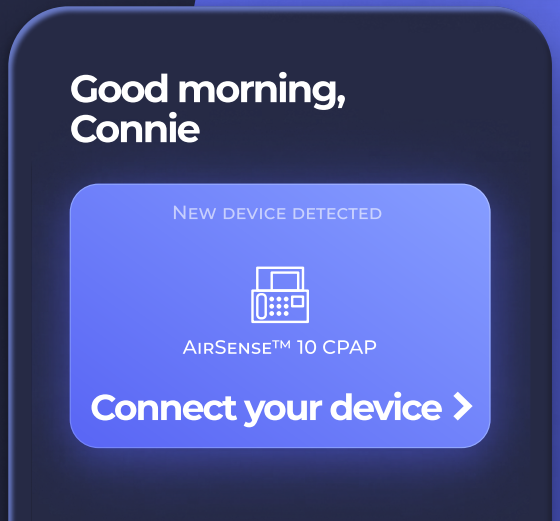
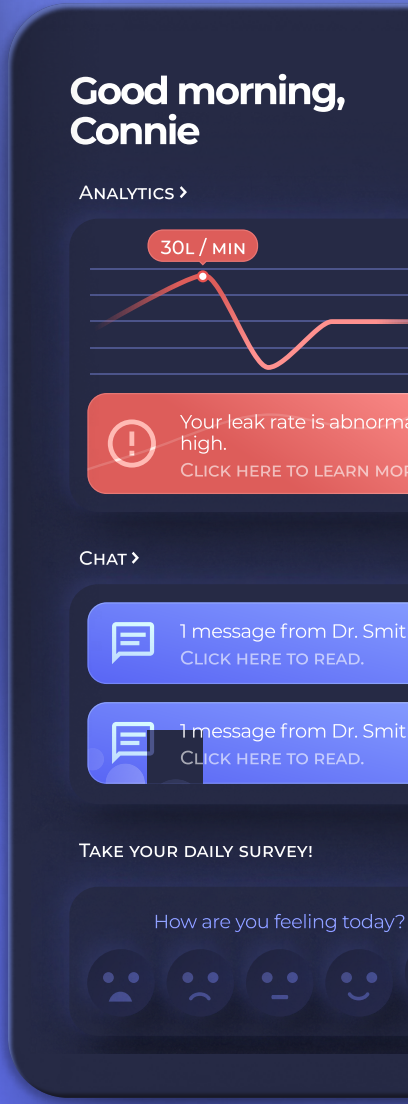
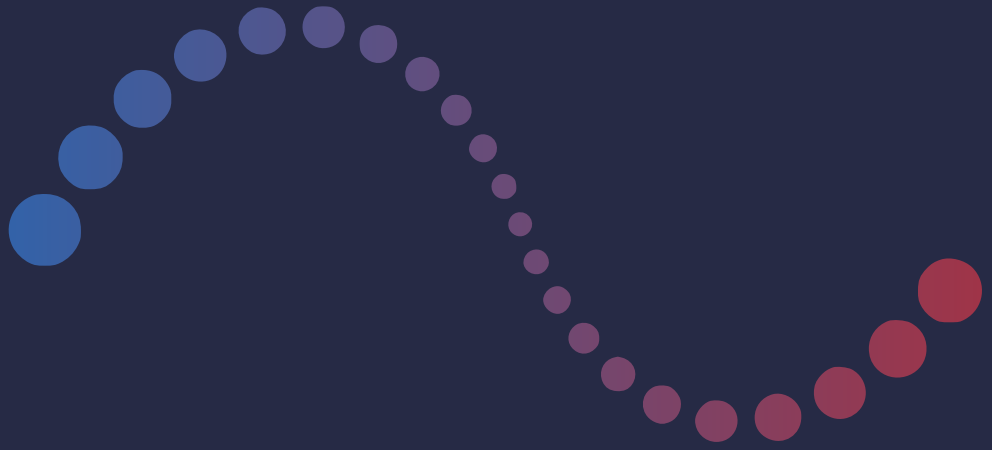




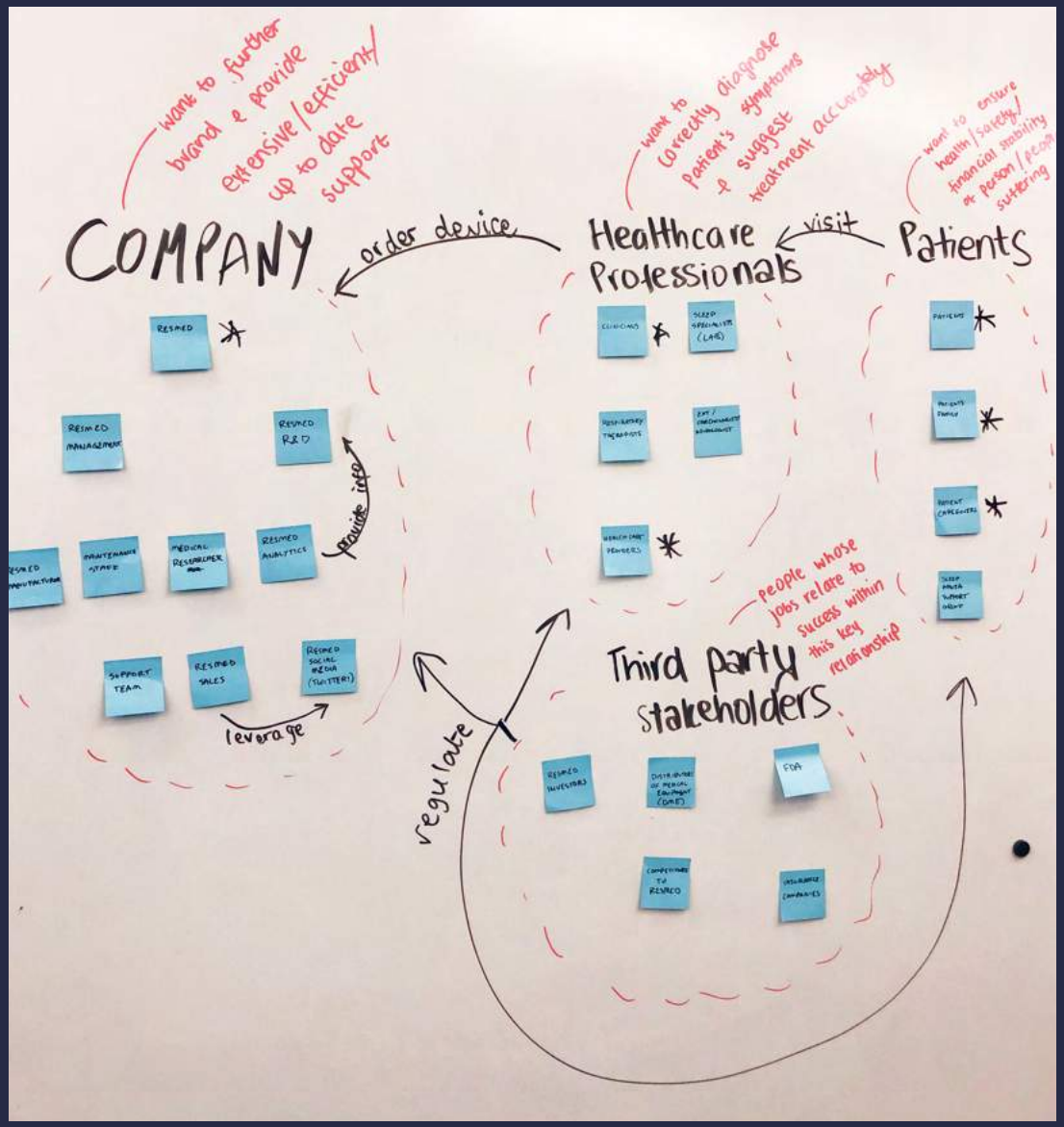




ResMed

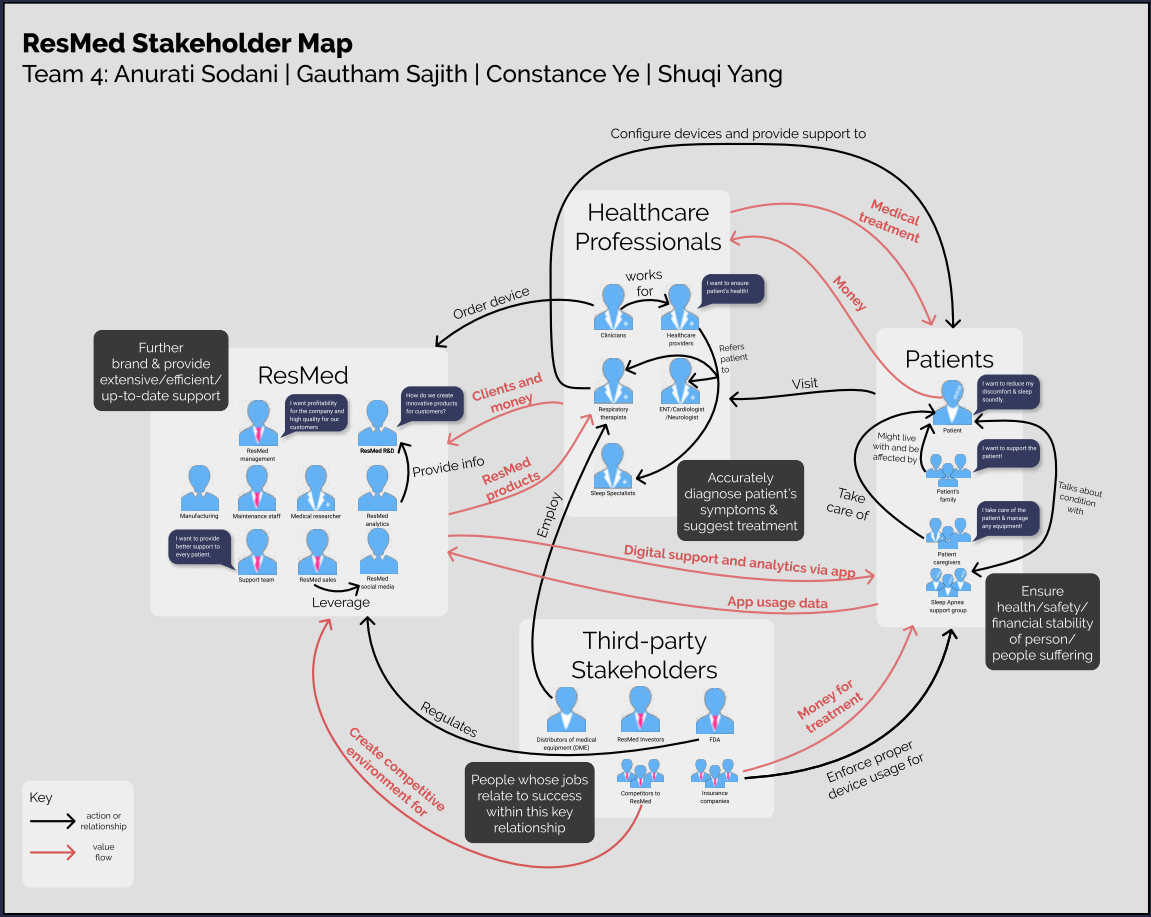
This project is associated with Interaction Design Studio 2 at Carnegie Mellon University. Our project was to be an internal UX team at a designated company and create an application that brought a new form of service to customers and the company. The application had to be mobile-based. Our project is for ResMed. ResMed is a medical device company that creates devices for people who are battling sleep apnea. The project included several phases of research and the final product is a hi-fidelity prototype that created a solution derived from our research.

Stakeholder Map v1



Our first task was to formulate a stakeholder map to help us better understand the problem space as well as the major players within it. Based on our initial prompt and our preliminary secondary research, we listed and grouped as many stakeholders as we could think of. We outlined interactions between these groups, as well as overarching goals of each group.

Stakeholder Map v2



After conducting further secondary research, we built a digital draft of our stakeholder map. Major groups in this map included:

- healthcare professionals
- patients
- third-party stakeholders
- ResMed internal stakeholders

We overlayed both actions/relationships as well as value flow onto this map. One major insight we drew from this stakeholder map which would go on to influence the direction of our project is that there is little direct interaction between ResMed and the patients. There are usually intermediaries in the way of healthcare professionals, distributors of medical equipment (DMEs), and more.

Stakeholder Map v3

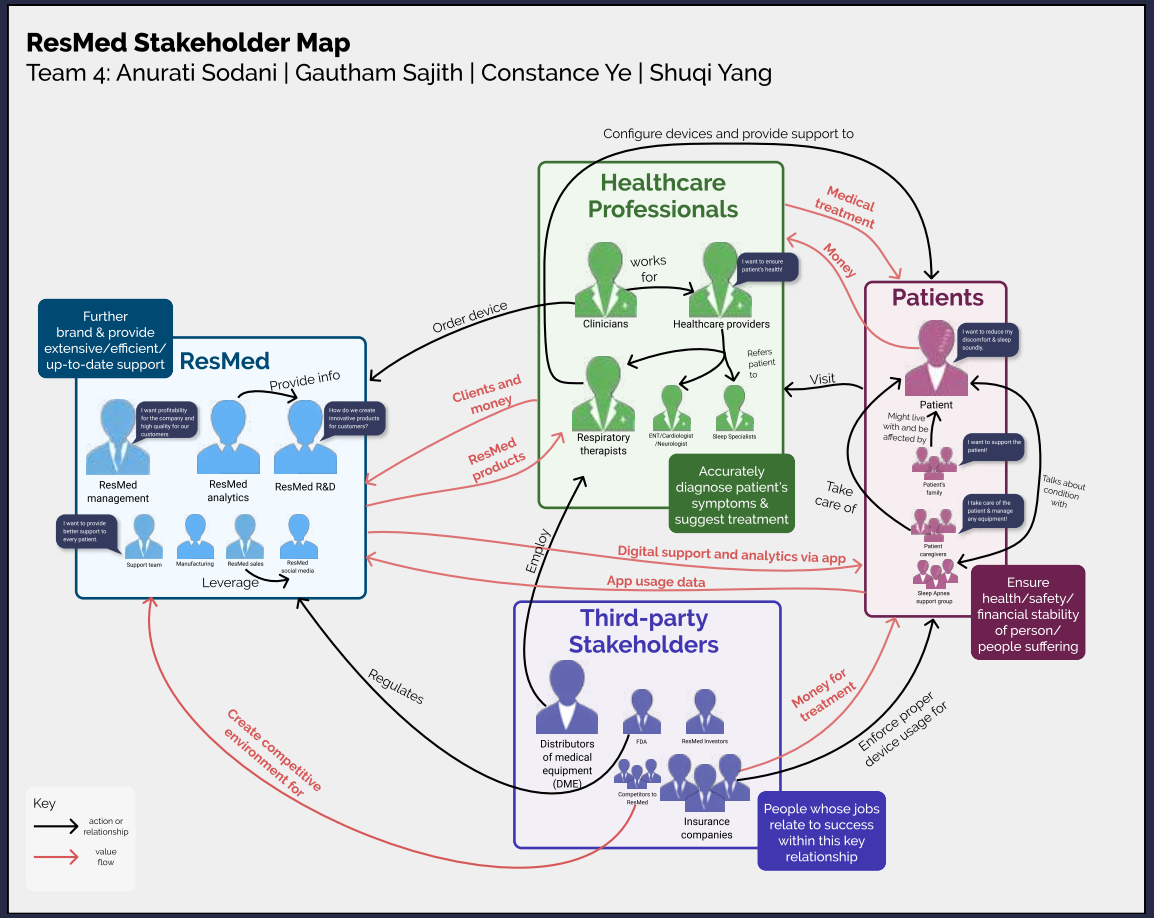
We presented our draft stakeholder map in class, along with a verbal explanation of our insights from this map as described on the previous page.

Some of the critiques from our presentation were:

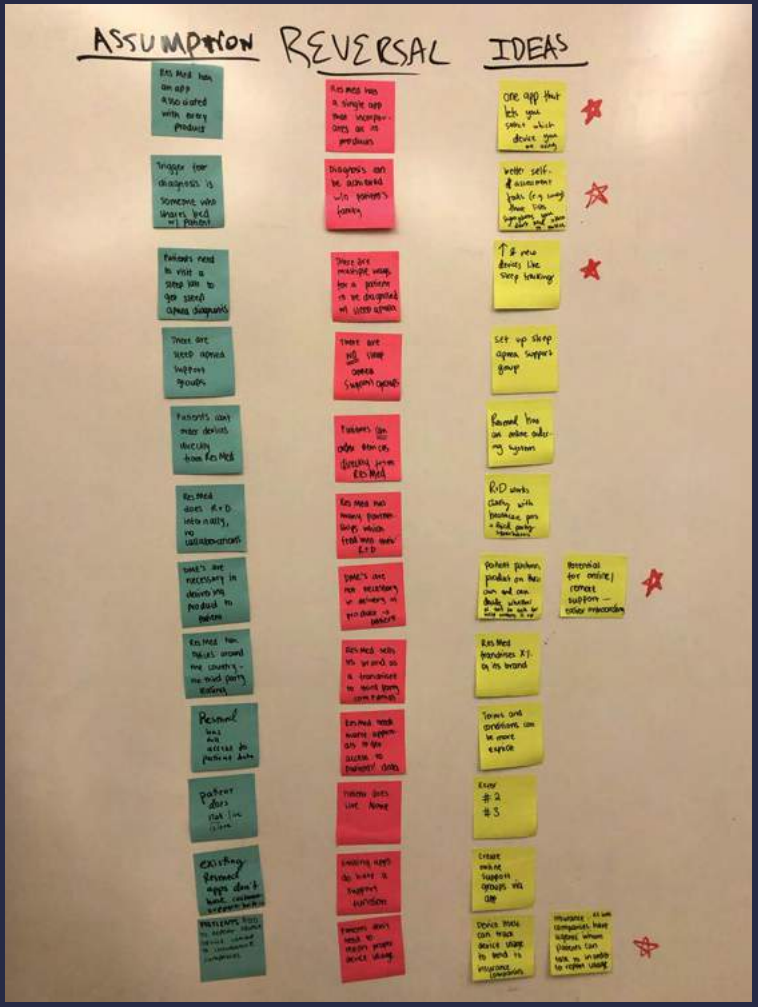
- It was difficult to distinguish stakeholder groups
- There was no hierarchy to the stakeholders to identify which ones were important to pay attention to
- There were many stakeholders with no goals or arrows

Based on this critique, we created a revised version of our stakeholder map, shown to the right. We grouped stakeholders more distinctly, and used color as a signal to differentiate them. We also removed extraneous stakeholders who did not play a key role in the narrative of our stakeholder map. Lastly, we increased the size of key stakeholders within each group as a form of visual hierarchy within groups.

While our insights from this stakeholder map remain the same as before, this process led to a stakeholder map which was much easier to parse visually.



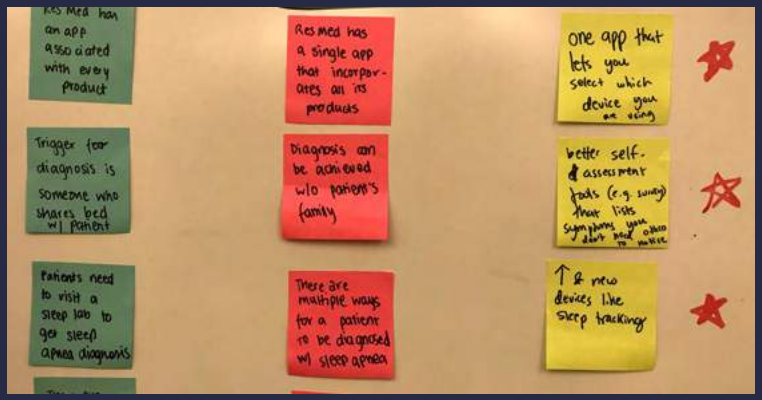
Reverse Assumptions

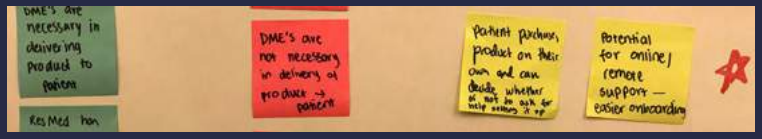


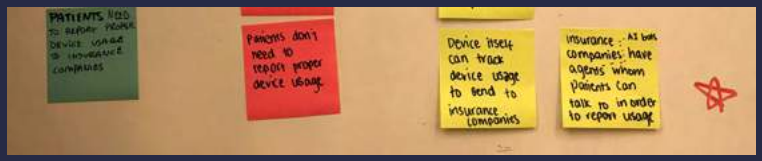
In order to move our research forward past the stakeholder map, we used a technique called reverse assumptions. This activity was conducted after the first presentation of our stakeholder map. First, we wrote down any assumptions we were making -- these can be about very specific items or it can be about overall assumptions in the business model.

This technique is used to make us as a team question what thoughts we may have had going into the project that may not be fully fleshed out, necessarily relevant to our project, or that we may have missed out on entirely. After writing down assumptions, we reversed them. While this seems extreme, it forces us to think in a completely different way. After reversing the assumptions, our team came up with ideas on how to make that reversed assumption a possibility.

Three Possible Directions







Self-Diagnosis

Direct-to-patient sales and support

Data transparency and advanced data collection

Based on the reversed assumptions activity, we identified three potential directions to take our project.

1. **Self-Diagnosis**: Sleep apnea patients usually find out about their condition from sharing a bed with a family member or partner who notices they stop breathing in their sleep. We considered ways to provide self-diagnosis tools for people who sleep alone.

2. **Direct-to-patient sales and support**: Since there is no open-ended support on the existing app, when patients need help with their device they are unable to get help in a timely way.

3. **Transparency and advanced data collection**: Patients have to bring their device's SD card into the doctor every 6 months so that the data can be transferred to an insurance company, for insurance compliance reasons. If the device and app can track the data automatically, it will make the patients try the treatment more often since it is less of a hassle.

Informal Report

Our next step was to conduct deeper secondary research, specifically digging into the goals and needs of our stakeholders, information about ResMed, and information about the medical technology domain.

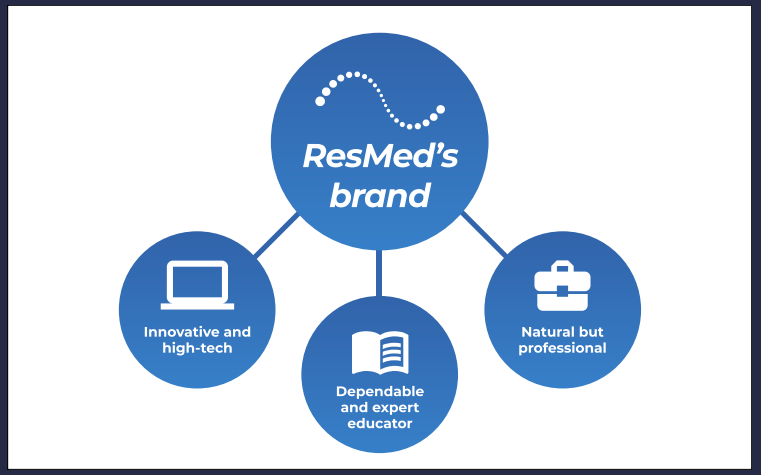
We were asked to frame our stakeholder goals in the context of the Harvard Business Review "Jobs To Be Done" article. For each stakeholder, we identified goals, needs, preferences (high-level phrases which reflect the stakeholder's wants, e.g. "collaborative teams"), and key attributes (e.g. "effective leadership", "compassion").

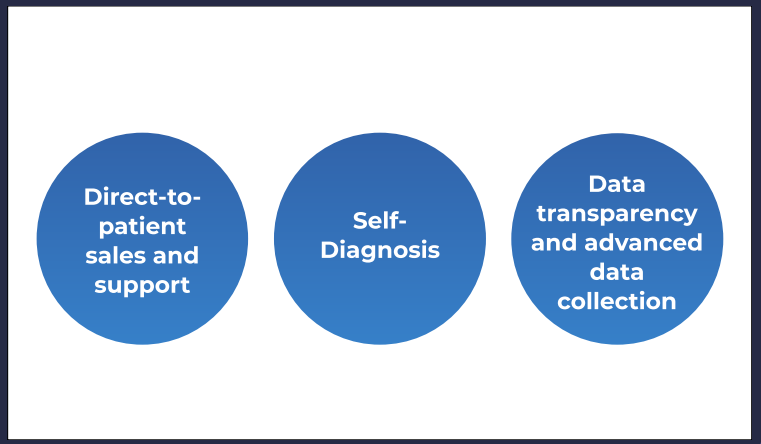
For the company and domain report, we discussed ResMed's:

- Organization and operations
- Company history
- Company goals
- Branding and marketing
- Competitive landscape
- Customer (and their need for ResMed's product)
- Product constraints

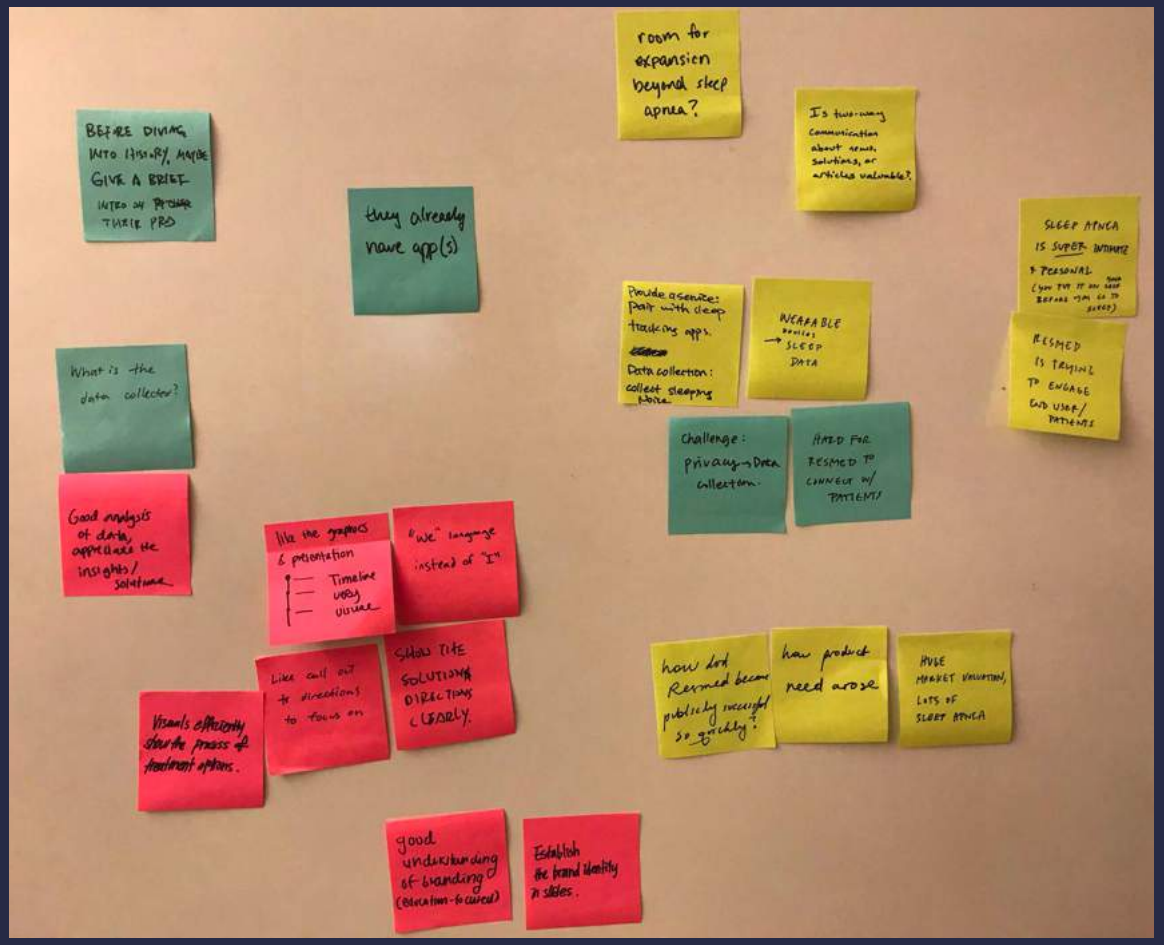
Along with this research, we found a Vice article named "Hacking Sleep Apnea Devices", about a practice in which sleep apnea patients use a third-party software called Sleepyhead to "hack" their machines and unveil an abundance of informative data that is collected on the devices but hidden from the user.

We then presented our research findings, along with our three potential project directions from the reverse assumptions activity.





Informal Report Presentation



We received feedback from class of our report presentation of the company and our solution directions. This feedback was in the “Rose, Bud, and Thorn” format.

The roses (pink notes) represent things we did well. This included the graphics and the presentations style, a clear and focused understanding of the branding, and clear solution directions.

The buds (green notes) represent opportunities. These included the potential for wearable device connectivity, more info about the device and treatment that ResMad offers, and further analysis of how Resmed became successful so quickly.

The thorns (blue notes) represent challenges we could face. These included that ResMed already has a suite of apps, that data collection and privacy is a difficult and sensitive issue, and that legal issues might prevent us from connecting ResMed with patients.

Choosing a Direction

Based on the Rose, Bud, and Thorn feedback we identified "**direct to patient support**" and "**data transparency**" as the two most promising options. We ultimately decided to go in the direction of data transparency, compelled by the article about Sleepyhead and also existing Resmed app reviews on the Google Play Store and the Apple App Store that showed how users loved being able to see their data, but were frustrated by the lack of information being given to them. Specifically, Resmed's apps tended to use opaque numbers and composite scores rather than more transparent data visualizations, and they provided only a fraction of the information that was available through Sleepyhead.

We did more research on Sleepyhead, and found it was a common tool among medical researchers, doctors and patients for tracking trends. It was also a common topic on sleep apnea forums and on Reddit; many people would post screenshots of their Sleepyhead view and ask for assistance from the community in interpreting the data. We realized that having a tool to track all of their data was important to some members of the sleep apnea community because it allowed them to feel comfortable making changes to their settings and taking control of their own medical information in a way that existing apps by Resmed did not

Example of a patient sharing their Sleepyhead data with the community

"oh - by the way, I love sleepyhead! It helps me know how well my treatment is serving me from an objective standard. I can correlate the subjective how do i feel and my doc and I can come to a more tailored program for me."

- user on MyApnea.org

"I think the various software reports and results are written for doctors more than patients, but its great for a person like me that likes to read numbers and understand what is going on. I have never seen the website that talks about what all the data means. I can empathise with some of the feedback that it is a bit overwhelming how much info you get."

- user on MyApnea.org

Sleepyhead and Resmed

Because we would be creating a synthesis of Resmed apps and Sleepyhead features, we studied existing app reviews and forum posts to identify what the key weaknesses for each were.

Resmed

Resmed apps use a composite score for most statistics, leading to user frustration.

"Functionality is a single number without details in several categories. Not very useful even in comparison historically."

Resmed devices don't properly report usage details to insurance if the user is using a different device for travel.

"If you own a Resmed travel CPAP machine and register them both with Resmed, you'd resonably expect Resmed to combine the data of both together for insurance purposes... Resmed doesn't even report the travel device's data to my doctor!"

Sleepyhead

Sleephead provided data, but no information about what the complicated terms meant.

"It would be great Sleepyhead had some kind of automated tool for making suggestions based on your data." -myApnea.org

"there's a large gap between seeing that data and knowing how to interpret it."-myApnea.org

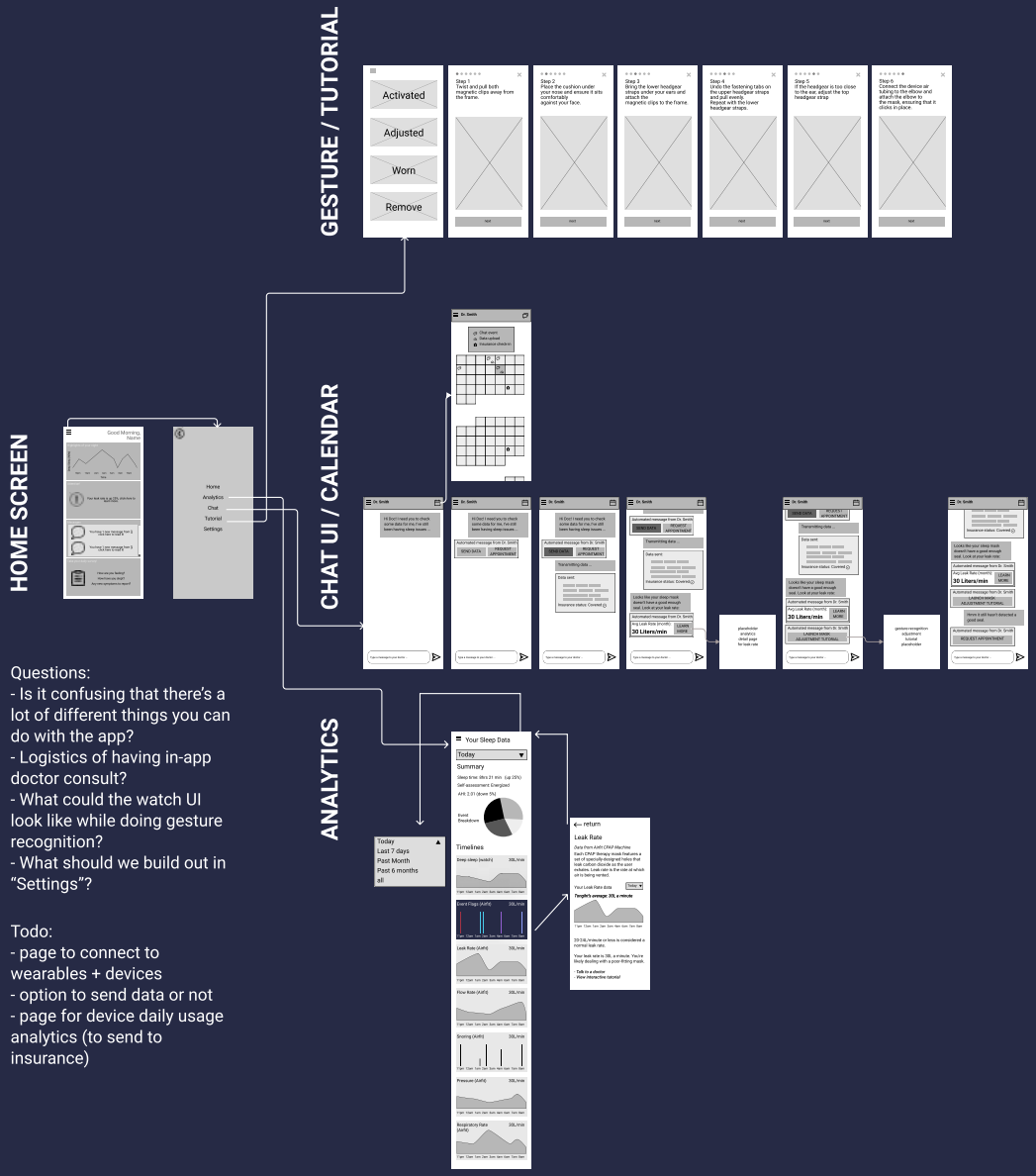
Users had to remove their SD card from their CPAP machines in order to read data into Sleepyhead each time.

"but I don't use it all that often, mainly due to limitations outside of the software's control. For example, it's a pain to have to take the SD card out of my CPAP to read it" - myApnea.org

Because Sleephead is open-source software created and maintained by one developer who relies on donations, the developer was unable to keep up with the new feature requests of the community, which created a conflict that eventually led to the shutdown of the Sleepyhead project.

The community then duplicated the code and now maintains a new project called OSCR, which is almost identical to Sleepyhead. Clearly, there is a strong need for the software, and we thought it was the perfect opportunity for Resmed, which had many prior apps that were unsuccessful (bad ratings), to give users what they wanted, especially because Resmed had the resources and hardware integration capabilities to fix the previously mentioned key flaws.

Low-Fi & Wireframe



Questions:
- Is it confusing that there's a lot of different things you can do with the app?
- Logistics of having in-app doctor consult?
- What could the watch UI look like while doing gesture recognition?
- What should we build out in "Settings"?

Todo:
- page to connect to wearables + devices
- option to send data or not
- page for device daily usage analytics (to send to insurance)

After settling on a solution direction, we created wireframes to establish the flow of our mobile service and the basic structure of every screen.

For our low-fidelity prototype and wireframes, there are four main features :

- home page,

- tutorial with gesture recognition,

- chat with doctor

- data analytics screens

We also listed our questions and todo tasks for our next steps.

Building the low-fidelity wireframes helped us quickly establish a shared understanding of the features of our application, and helped us get the app in front of critiquers quickly to get our questions answered.

Mid-Fi & Feedback

For our mid-fidelity prototype , we added more detail to our screens and began to move towards color. Working on our wireframes and based on our discussion as a group, we added more detail into the analytics page and changed the chat feature to make it more interactive.

We used inspiration from existing applications to create our colour palette. We also thought through a user's interaction with our application and added some detail into our features. We had a few questions regarding whether our app has too much going on or whether it isn't clear how the user's journey would proceed.

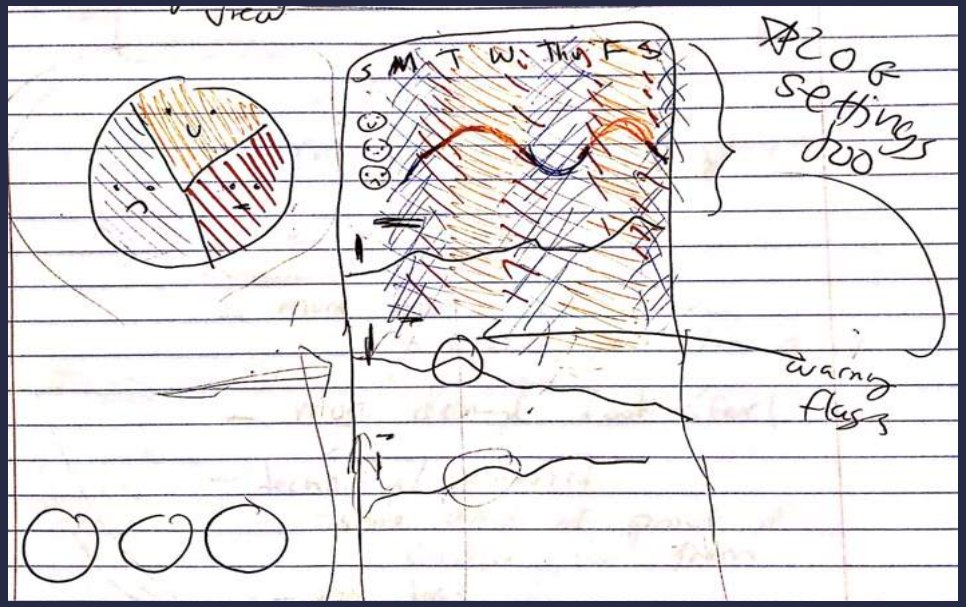
We received very useful feedback for our mid-fidelity prototypes.

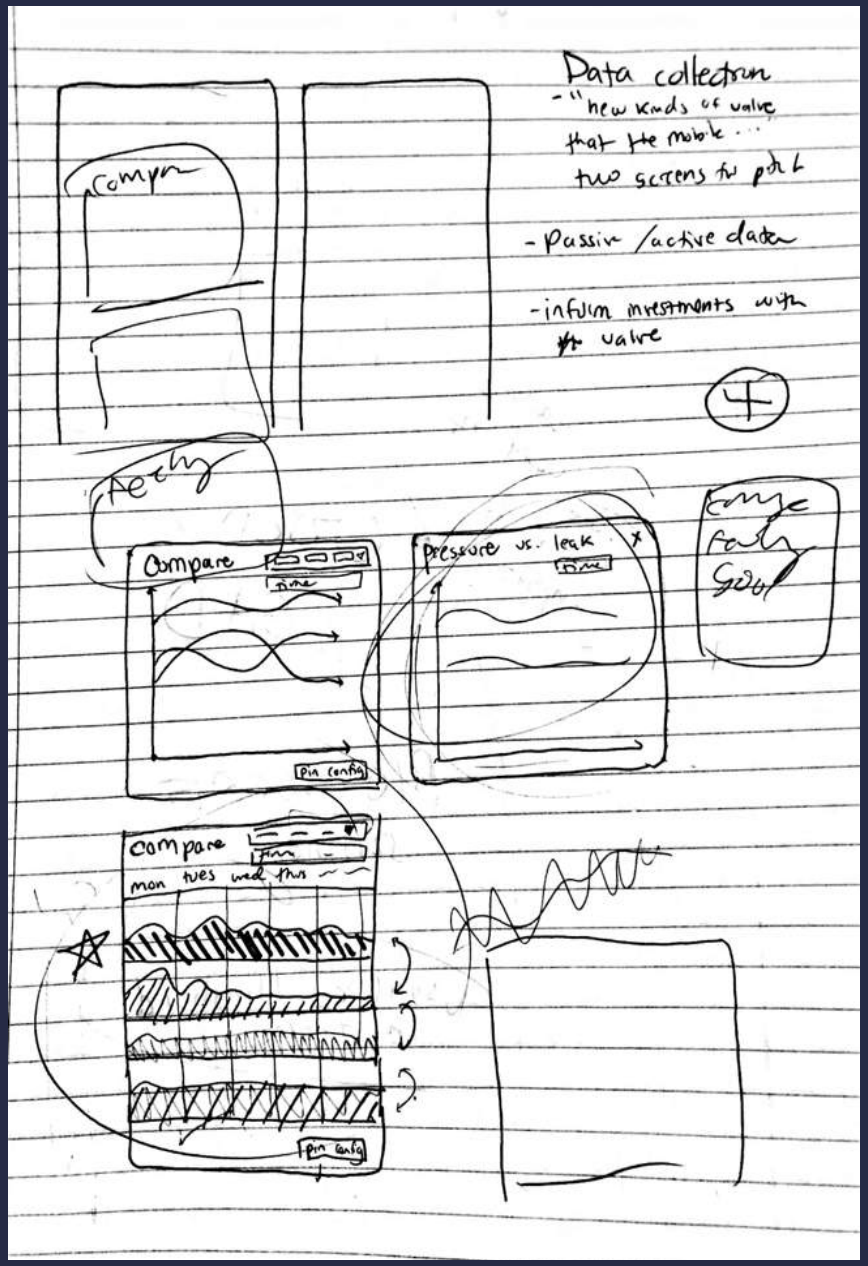
Some of the feedback that we received included:
- What data is device specific and what data is about the patient?
- How often are users using the application?
- How will the daily survey be visualized given that there is a lot of qualitative information?
- Usability in terms of necessity of the hamburger menu and whether it is redundant or necessary
- How to create a user journey rather than a list of features that users may feel overwhelmed by?
- Who is talking in the chat -- is it a doctor, nurse, representative, respiratory therapist?

Mid-Fi & Feedback cont.

We asked our professor, Sara Blumenstein, for some help with tackling the challenge of data visualization and analysis tools. She suggested thinking about methods of categorization, such as "what went well/what didn't go well", a big score summary, and more. She also suggested that we think about what different levels of users would want, which was really helpful advice that ultimately formed the summary screen that leads to the rest of the data pages.

We also asked her about her opinion on our overall focus, and we were told that our direction makes sense as long as we pitch it correctly, and that to be efficient about our time, we could choose areas to highlight and focus on.





Sketches of comparative analysis tools

Data Collection

We listed and classified all the different types of data that our mobile service application is going to collect:

- sleep and usage analytics data
- messaging data between doctors and patients
- patients personal info data
- other devices connected data

We included wearable devices, such as the Apple watch, in our mobile service, as an additional data collector and sensing apparatus. It can track more usage and health data that can support our data analytics. The sensors in the Apple Watch would also help recognize gestures that the patients make, using the gyroscope.

Since we collect lots of data from patients, we provide options about what kinds of data they want to share, and who they want to share it with. We also provide our data policy when patients log in to our mobile service, so they will be able to see what data is shared to whom if they are concerned about their data privacy.

Team 4: Resmed

Types of data collected by our app

Analytics:

Data from the CPAP device that our user is using.

1. Pressure
   a. Passive data
   b. Explicit data
2. Flow Rate
   a. Passive data
   b. Explicit data
3. Mask on/off times
   a. Passive
   b. Explicit data
4. Mask usage hours
   a. Passive
   b. Explicit data
5. Leak Rate
   a. Passive data
   b. Explicit data
6. Snore
   a. Passive data
   b. Explicit data
7. Event Flags
   a. Passive data
   b. Explicit data
8. Respiratory Rate (breaths per minute)
   a. Passive data
   b. Explicit data
9. deep sleep/light sleep
   a. Passive data
   b. Active data
10. Personal feeling
    a. Active data
    b. Explicit data
11. Apenas
    a. Passive data
    b. Explicit data
12. Hypopneas
    a. Passive data
    b. Explicit data
13. AHI
    a. Passive data
    b. Implicit data
14. Perceived quality of sleep
    a. Passive data
    b. Implicit data
15. Hours slept
    a. Passive data
    b. Implicit data

Messaging info

Data from the messages between the user and the doctors and insurance companies.

1. All of the messages that are sent and received
   a. Active data
   b. Explicit data

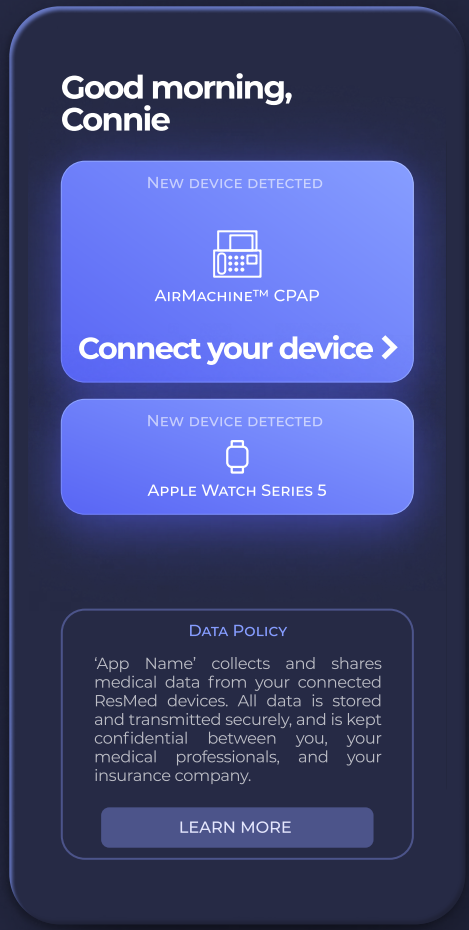
Patient info

Minimal information about the patient

1. Nickname
   a. Active data
   b. Explicit data
2. Email address
   a. Active data
   b. Explicit data
3. Password
   a. Active data
   b. Explicit data

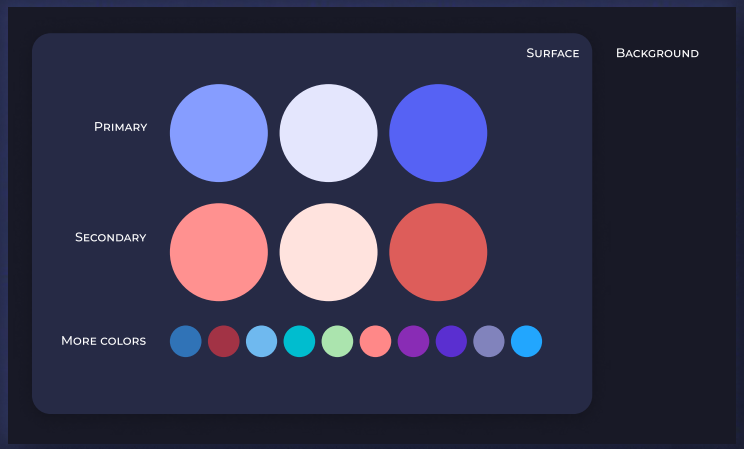
Other Data

1. Devices connected
   a. Passive data
   b. Explicit data



Branding and Design for Final Prototype

Based on the feedback from our mid-fidelity prototype, as well as an analysis of our problem space and intended product branding, we formulated a succinct design system for our product. This design system would help speed up development of the high-fidelity prototype by serving as the vocabulary through which all of us could build high-fidelity screens.



First, we settled on a color scheme for our application. We modified the pre-existing ResMed brand colors (a dark blue and a deep red, along with various whites and greys) and combined them with dark background and surface colors to arrive at our color scheme.

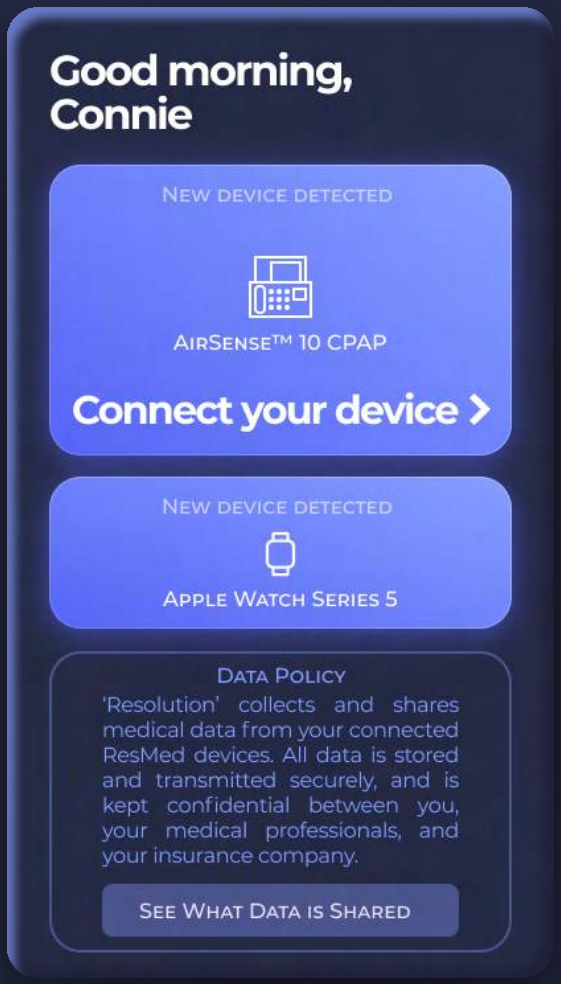
We chose a dark theme for our application because this app would likely be used by patients in the morning or at night, and we did not want to have bright white screens causing them eye strain.

We also created a set of reusable Figma components for UI elements which would be commonly used throughout our application. The Figma component system enables a master-child relationship between components, in which making changes to the master component will reflect that change on all child components. This system allowed us to quickly make modifications to the look and feel of our application if we were dissatisfied with our UI.

Hi-Fi Home Page

Onboarding screen

When the user onboards our app, we allow them to connect their CPAP machine and other devices like Apple Watches and Fitbits. We also explicitly explain what our data policy is.



Home screen

On the home screen, users can access all three primary features: **analytics**, **chat** and **tutorial**. Each card displays what is most important for that day.

We also provide a one-click daily survey, which is important for the user to track their progress from a subjective point of view. It was important that it was on the homepage so that it is easy to access and fill out. Our data policy is on the page so that it is clear we value users' privacy preferences and that they can change the settings and who has control over their data at any time.

Data Visualization

← Sleep Data Analytics Home Page

The user is given an easy to digest summary of their data from the previous night.

In the highlights section, it will summarize what went well and what did not, based on guidelines set by sleep apnea professionals.

Complete Data Page →

Furthermore, we also provide the ability to view all of the data in depth, with different time ranges. All of the data shown is modeled after what Sleepyhead shows the user; we show exactly the same information, but in a more readable format.

If a device like an Apple Watch is connected to the app, we also synthesize sleep data, such as sleep quality, from that device.

← Settings Tracking

We imagine that when they tap on a part of the graph, it will tell them what the settings were at that point in time, so they can compare how the settings, which is the only part they have control over, compare to the trends.

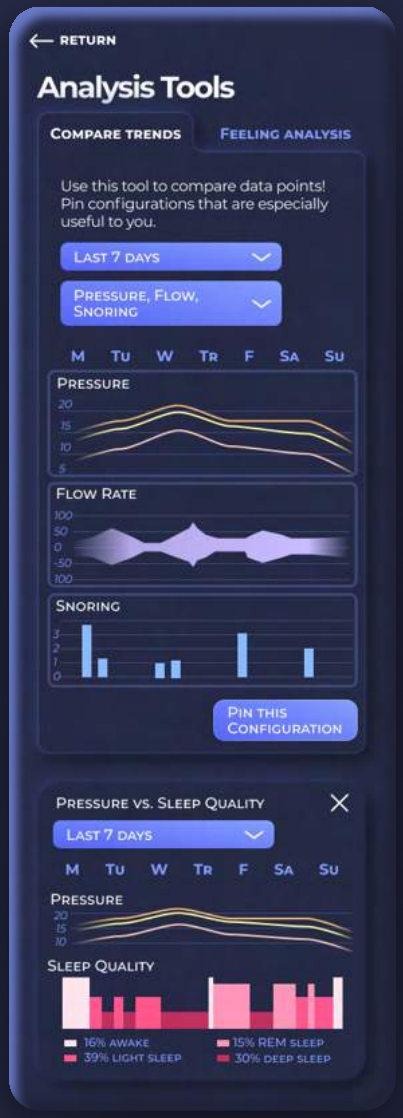
SETTINGS
Min pressure: 5
Max pressure: 10
Mode: APAP

↑ Details Page

One pain point that we identified was that many users might not have the medical vocabulary to understand all the data. To address this, we created a details page for each type of data that describes what it means and how it applies to the user. If they might be having difficulties in this area, we provide suggestions for improvement.

Data Analysis

None of the existing products that we looked at during our secondary research phase provided in-depth analysis tools, but we think this is critical for a super-user who already understands their data but wants to see how they can leverage it to improve their health.



← Compare Trends

The first tool we provide is for streamlined comparison. On the previous "See your complete data" page, data trends are styled apart from each other and comparison requires continuous scrolling up and down. In this tool, users can choose which items they want to compare along any time range, and can also pin them to repeat the analysis in the future.

← Feeling and Setting Analysis

The other tool is called feeling analysis. We noticed from forum posts that users like comparing their subjective feeling to the day-to-day raw data. This tool tries to make this easier by displaying the feeling from the daily surveys over time. The background is colored according to the feeling during that time frame, so users can easily compare how they felt at that time to what the data looks like at that time.

Furthermore, because the goal of these comparisons is to identify what settings made the user feel best, they can scrub through the timeframe to see past settings to understand how the settings affect the trends and feelings.

Messages

One of the main selling-points of our mobile service is an integrated chat with a ResMed-certified doctor via a telemedicine feature. The chat allows you to ask questions of your doctor, allows them to transparently request and receive information collected by your device, and lets them inform you of any potential issues with your device usage.

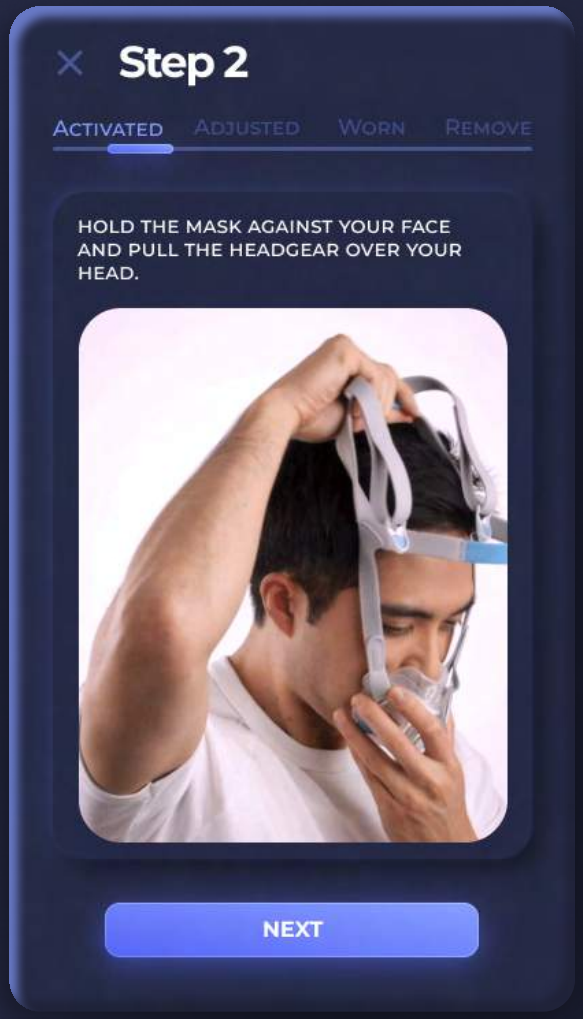
One of the key insights we gained from our secondary research was that sleep apnea patients felt that their in-person consults with doctors were rushed and impersonal, and that doctors were checking their data only for insurance compliance purposes rather than for their well-being.

Having this in-app consult feature allows doctors to respond to patients asynchronously on their own time, and the app automates many of the annoying parts of a doctor-patient chat (e.g. sharing data, demonstrating proper usage, scheduling appointments) so that doctors can focus on patients' well-being.

Tutorial

We built out a high-fidelity version of one step in our tutorial flow. This screen also includes a custom-built illustrated animation showing how to adjust your headgear (shown on the right) for our gesture recognition feature.

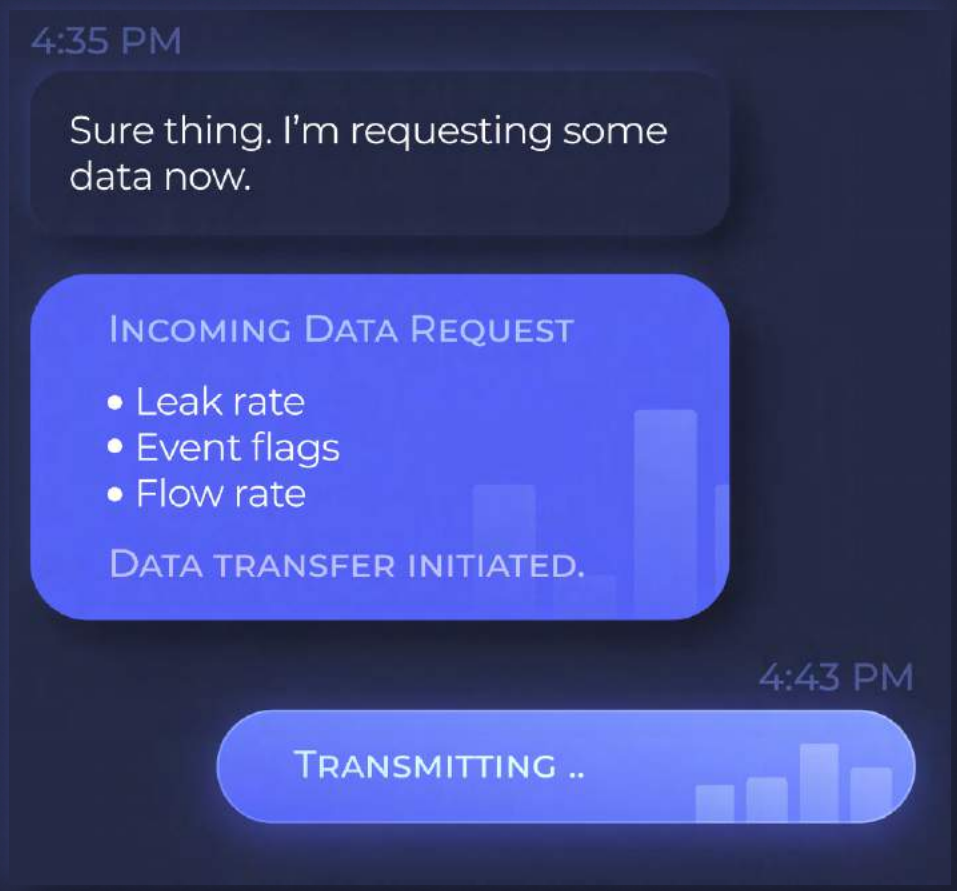
The gesture recognition flow activates when the app has a wearable device such as an Apple Watch connected. Our app will make use of some machine learning models for gesture recognition to indicate to the patient whether they are performing the mask adjustment gesture properly, based on gyroscope data from the watch. This gives the patients some assurance that what they're doing is correct, beyond what a simple tutorial could give them.



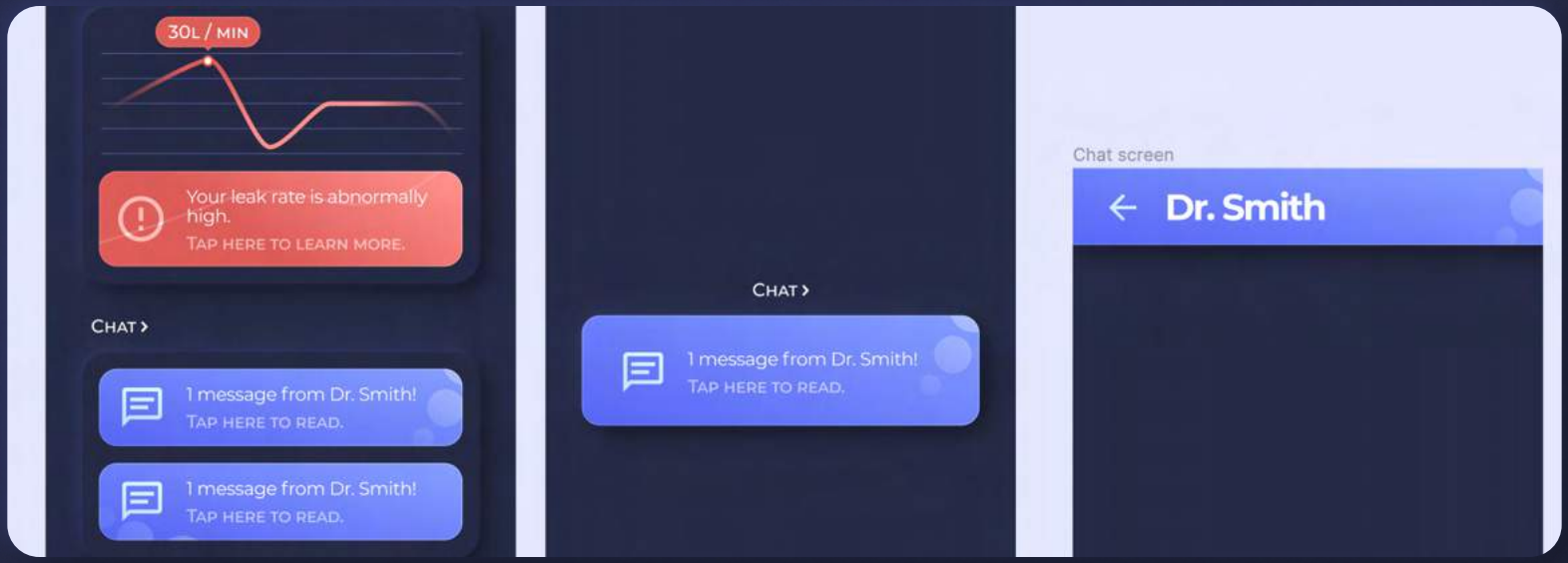
Microinteractions

We used the Figma prototyping tool to build a few crucial microinteractions into our product. For our purposes, the microinteractions give a feeling of visual delight to the user, alleviate waiting during background processing, and give an indication to the underlying navigational structure of the application.

One of the key microinteractions in our application is an animation which plays in the chat window while data is being transmitted to the doctor. The “Transmitting...” card flashes, and the data bars animate up and down. This gives the user an indication that something is happening in the background (i.e. data transfer), and makes their wait time more pleasurable.



Microinteractions cont.



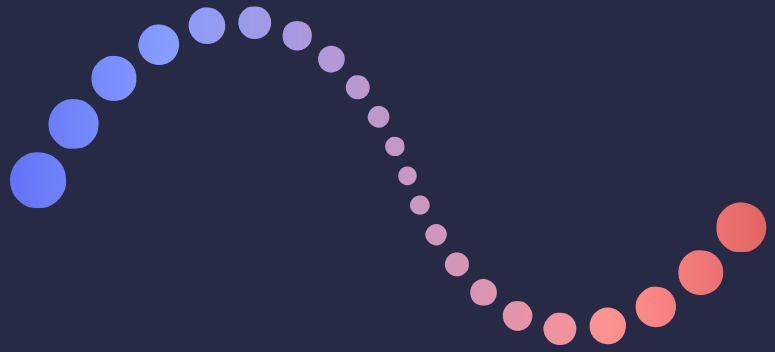
Another prominent microinteraction, which occurs at multiple points throughout our application, is the inter-screen transition. These are more easily visualized in a live demonstration. When the user taps a card, there is a 2-step transition in which the card is first isolated on the screen while the remainder of the screen objects animate away. Then, the card grows and morphs to become the next screen the user navigated to. This microinteraction gives the application a feel of fluidity and continuity, and informs the user of the underlying navigational structure of our application.

Implementing these micro-interactions gives our product a polished and intentionally designed feeling. As we discussed during lecture, microinteractions are a crucial part of how a user experiences your application and can make using your application feel more pleasurable.

Co-Creation of Value

While creating our app, we kept co-creation of value in mind.

Mock Pitch



Resolution
by ResMed

In class, we were given the opportunity to run through our pitch that we would be presenting to executives later. This run-through was very helpful in that it helped trim down our pitch to focus on the important sections.

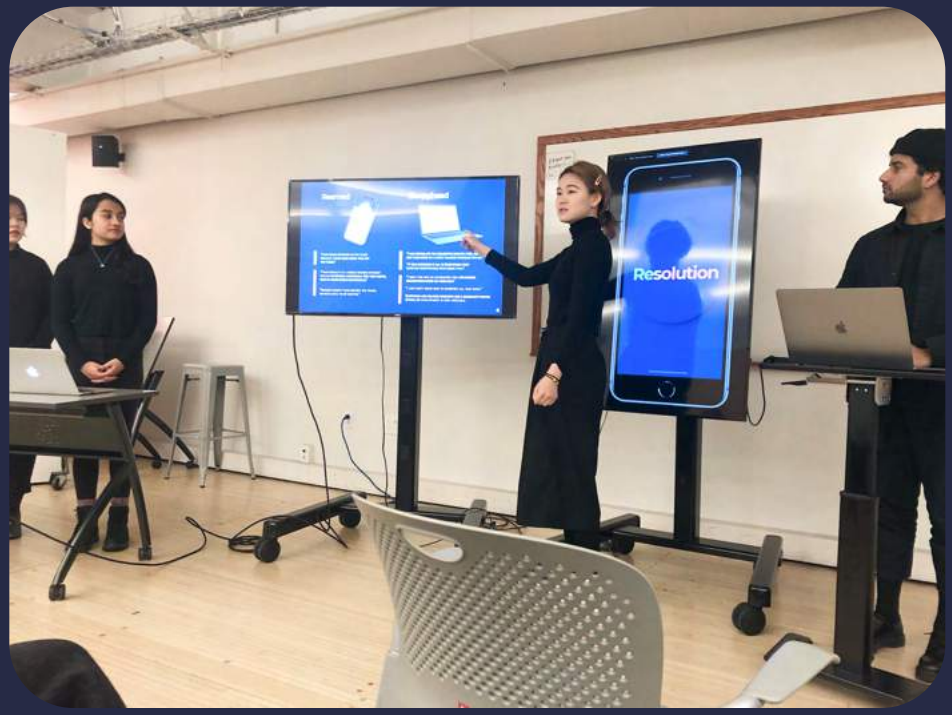
When writing the pitch, it gave our team a chance to reflect and highlighted the need for our application. It also made us reflect on the process and understand what steps led us to create the application. The sections that were more difficult to write were the competitive analysis as we didn't want to speak poorly about another application or ResMed's existing applications, given that we were pitching to the company itself.

The main point of feedback we received from this initial run through is that we were spending too much time talking about the process of how we got to the application and very little time on the application and the demo. The other point of feedback we got is that one of the risks we identified didn't have a very good solution so it is best to not mention it or come up with a more feasible solution that is not generic or implied.

Final Pitch

For our pitch, we wanted to focus on how our app could be a successor to all of Resmed's many poorly-performing apps. We showed that we had done extensive research and had found a compelling area where Resmed's user base had a need that we could address better.

We first talked about the existing ecosystem of apps and problems identified with them. We then used evidence from app store reviews and online sleep apnea forums to support our claims and show that Sleepyhead is an existing competitor and a big opportunity. We then explained the app's three primary features and displayed the prototype on the second screen. After this, we explained the value of the app for all of the stakeholders. We then addressed the primary risks we imagined would be associated with the app, along with some future directions for growth. We then ended the pitch with a Q&A.

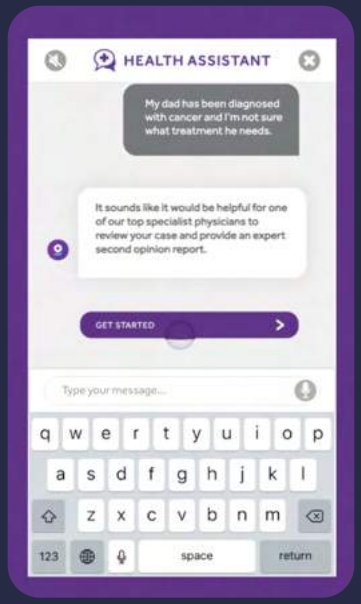


Pitch Feedback

- *It might not be realistic to have real doctors in the chat feature due to regulatory laws and time constraints.*

A simple Google search reveals an abundance of online doctor services. We believe that if we were to have next steps, we can do further research and modify our messaging service to mimic theirs, especially because we have found several examples of apps that function almost identically to how we proposed ours to work. More research might be needed to see if text-based messaging is HIPAA compliant, but there are prior examples, and if this proves too difficult, we can switch to a balance of text where it is legal, and phone calls for the rest. While messaging will not be as instantaneous as in our demo, it will still be much faster and more accessible than setting up an appointment and traveling to a doctor's office.

MDLive app



Teledoc app

- *It is possible to do more personalized suggestions based on apnea type and equipment type.*

We think this was a great suggestion, and one we might have missed without the help of the guest critic, who has worked in the medical field before. Because there are three different types of apnea (Obstructive, Central and Complex), that all display different patterns of sleep disturbances, this would be really helpful for personalizing how we interpret their data.

Furthermore, because we can track the trends, it is possible that our app could be used to detect possible misdiagnoses if the data for the patient matches the patterns for another type of apnea more closely. Because we are just comparing plots of numbers, this type of analysis could most likely be accomplished with machine learning.

We can also modify the tutorial to be specialized for the machine type.

Pitch Feedback cont.

- *Doctors will want to see a diary feature and will want to analyze the data in their own software.*

  This was also a great suggestion from Dan Rosenberg! Data from the app could easily be made available for the doctor by exporting it into their software wirelessly. We could work with the software company to encode this data in a proper format for export and import. For the diary feature, it can easily be implemented along with our existing daily survey. Below is an example of what that might look like.

- *Our design might not be visually acessible due to smaller font sizes or low contrast.*

  This is a great point; while we modeled our design to be gentle on the eyes in times with low lighting (early morning, night), we would love to add an accessibility toggle feature that would turn up contrast and other factors.

Conclusion

We accomplished a lot in this project and we want to outline some of our learnings as we wrap up. These included:

The network associated with sleep apnea involves many stakeholders and it is important to understand how even the smallest stakeholder plays a part in order to make a successful user experience.

Having more features is not always the priority if there is one feature that is more fleshed out and meets the main user need/gap in the market.

When designing an application, there are several different types of users you have to think about and some features will have to be designed for the high frequency users that may not be beneficial to low frequency users.

A big difficulty we faced was having to rapidly learn about sleep apnea and the vocabulary and legal regulations surrounding it. This was critical for us to design an app that was actually useful and would be realistic to create. However, a lot of the information that we needed was something that we could only find general information about on the internet, but would only be able to learn more specific information about by consulting with a real healthcare professional and others in the industry. Thus, we learned how to work through these challenges and how to dive deep into a research space.

Ultimately, we grew as researchers and designers during this project; we're really grateful for the feedback from our professors and peers, and look forward to applying what we learned to future projects!