

Project Deliverable #5: Evaluation Plan

1. Research Questions

- a. Will the doctor/researcher find the sonifications distracting during appointments?
 - i. This question is relevant, as it ensures the usability and acceptance of the system by doctors. If the sonifications are distracting, it could hinder the effectiveness of the telemedicine tool. Addressing this question helps in refining the sonification design to be informative without causing distractions, ensuring that doctors can focus on the patient's conditions during appointments.
- b. Can doctors accurately interpret patient conditions through audio cues from the product?
 - i. This question is relevant, since accurate interpretation is fundamental to the product's success. If doctors can effectively interpret patient conditions through audio cues, the system's ability to convey essential information may be more accurate. This question assesses the system's core functionality, ensuring doctors can make proper and informed decisions remotely.
- c. Will the sonifications positively affect doctors' prescriptions and decision-making during these remote appointments?
 - i. This question is relevant because the impact of sonifications on doctors' decision-making processes is vital. Positive influence on prescriptions and decision-making implies that sonifications are not only informative, but also aid doctors in providing appropriate treatments remotely. This question essentially evaluates the practical impact of sonification on medical decisions.
- d. Will the alerts be effective enough to get the doctor's attention?
 - i. This question basically makes sure that the product is effective. While core functionality is important, so is making sure the doctors act upon cues from the product. If the alerts are not seen by the doctor, important issues might be missed, compromising patient safety. Addressing this question ensures that the alert system is robust and can successfully capture the doctor's attention when immediate action is needed.
- e. Does the use of sonification enhance doctor-patient communication and satisfaction during remote consultations?
 - i. This question is relevant, since effective communication and satisfaction are extremely important in healthcare interactions. If sonifications enhance communication, that will strengthen the doctor-patient relationship, ensuring a more empathetic and engaging remote consultation. This

question assesses the impact of sonification on the human aspect of healthcare. One of the primary motivations behind creating this product is to improve patient satisfaction, so this question will address if this product does actually accomplish that.

- f. Are patients okay with extra audio monitoring during general doctor's appointments?
 - i. This question addresses the fact that patient acceptance is key to the success of the telemedicine system. If patients are comfortable with the additional audio monitoring, it indicates that the system's monitoring methods are non-intrusive and acceptable; however, if patients are not okay with the extra monitoring, the product will end up lowering patient satisfaction, something the doctor/researcher doesn't want. Understanding patient comfort ensures the system respects patient privacy and promotes a positive healthcare experience.
 - g. Do doctors and patients feel more engaged and connected during appointments with this audio-based product?
 - i. This question is relevant because engagement and connection are vital for effective healthcare delivery. If both doctors and patients feel more engaged and connected, it indicates that the audio-based interface successfully bridges the gap between physical distance, enhancing the overall telemedicine experience. Again, one of the primary motivations behind the creation of this product is to improve patient satisfaction, and therefore, this question is paramount to achieving that. Enhanced engagement can lead to better patient-doctor relationships and, as a result, better healthcare outcomes.
2. Participants and Recruiting
- a. In this scenario, we will need to recruit mock doctors and patients, as there are two sides to this product. The doctors will need to test whether the system gives accurate responses, reports the data in an understandable way, and that the signals are readable. On the other hand, the patients need to be able to be monitored properly by the system, and the patients need to know how to use the product without getting the information output.
 - b. Limiting patient demographics by product will improve efficacy, since certain products will be specifically tailored for certain problems present more in that demographic. Therefore, this product will best serve patients between the ages 18 and 30. Patients within that age bracket should be familiar with operating simple technology, will be able to consent for themselves, and might be the age bracket most willing to test this product out.
 - c. On the other hand, the doctors will need to be practicing doctors, legally allowed to practice. They should preferably have at least 5 years in the industry, be

familiar with operating basic technology (phones, laptops, etc.), and be located either in a hospital or in a separate clinic.

3. Measures

a. Quantitative Measures

i. Response time (of the doctors)

1. This is the average time it takes the doctors to read and respond to the alerts, starting from when the alert is displayed on screen. This helps the researchers determine how effective the alerts are in getting doctors' attention.

ii. Patient satisfaction of the appointment

1. Patient satisfaction with the appointment is one of the key reasons this product is being created. We can use a small numeric survey/questionnaire for patients to rate their satisfaction with the appointment to check if the product is helpful.

iii. Doctor rating of product

1. The doctor also needs to be satisfied with the efficacy of the product for it to be successful. The doctor needs to want to use it to improve their remote appointments, and gauging this can also happen via a short numeric survey.

iv. Error rates

1. We will record any errors or inaccuracies in diagnosis or response made by doctors. Lower error rates indicate that the system is relatively reliable.

b. Qualitative Measures

i. Product usability (by the doctor)

1. The doctor can be asked what they thought of the product in terms of the product. Rather than this being numeric data, the doctor can use descriptive words to explain how they felt about the appointment using the product.

ii. User engagement

1. Asking about user engagement allows us to improve the product for the better. We can see what parts of the product worked, what didn't, what can be done better, etc. from a small survey where the user (the doctor) can pick between "good," "bad," and "can be improved" for various aspects of the product and the appointment

iii. Alert effectiveness

1. By asking whether the doctor thought the alerts were noticeable and worded clearly enough for them to accurately respond, the product can be improved and the research questions can be answered.

- iv. Doctor understanding of sonification
 - 1. The doctors can be asked (on the supplemental survey) whether or not they were able to understand the various sonifications coming from the product.
- c. Subjective Measures
 - i. Patient comments
 - 1. The patients can be asked to leave comments and feedback for what they liked about the product and appointment, as well as what they didn't like and what can be improved and how. These comments can help answer our research questions, and improve the product for future usage.
 - ii. Doctor's ability to use and interpret the product's output
 - 1. The doctor can write comments on the supplemental survey describing what they thought of both the product and the appointment as a whole. These comments can be used to both answer the research questions, and help improve the product for users in the future.

4. Protocol

- a. Introduction and Consent
 - i. There will be online consent forms that the participants can mark that they have consented to be a part of this study. They will only be given to people over the age of 18.
 - ii. The consent form will have a basic overview of the study, and what the participant will be asked to do. There will be two versions (one for the doctor, and another for the patient), as shown below:
 - 1. Doctor Version
 - a. Thank you for your interest in participating in this study!
 - b. In this study, you will act as a doctor, and be tasked with monitoring a "patient" through a video interface, with an additional audio product. The goal of the simulation is to test whether this audio sonification product will augment the overall experience of the appointment. After the 5-minute appointment is over, you will be asked to complete an anonymous short survey so that we can improve the product and experience for the future.
 - c. Do you consent to being a part of this study? (checkbox)
 - d. Please type out your full name in lieu of a signature.
 - e. _____
 - 2. Patient Version
 - a. Thank you for your interest in participating in this study!

- b. In this study, you will attend a remote doctor's appointment as a "patient." You will interact with a "doctor" through a video interface, and will be monitored using an additional audio sonification device. After the 5-minute appointment is over, you will be asked to complete an anonymous short survey so that we can improve the product and experience for the future.
- c. Do you consent to being a part of this study? (checkbox)
- d. Please type out your full name in lieu of a signature.
- e. _____

b. Training

- i. Rather than having formal training, right before the appointment, I will give both participants a short document detailing what they need to do and be aware of. The instructions will be something like this:

1. Doctor

- a. This appointment will be a 5-minute long video consultation with another person acting as your patient. During the appointment, you will not only be running the video, but you will also be in charge of monitoring the patient's audio using the audio product running in processing. You will interact with the patient by asking normal day-to-day questions and talking to the patient. Throughout the appointment, you may manipulate the sliders and buttons on the simulation to better hear certain parts of the patient's audio. If you hear or see certain out-of-the ordinary behaviors, alert the patient and take appropriate action. After the appointment is over, you will take a short survey about the product and your experience.

2. Patient

- a. This appointment will be a 5-minute long video consultation with another person acting as your doctor. During the appointment, you will interact with the doctor as if this was a real remote appointment. During the appointment, you will enact two scenarios at different times: breathing really hard, and continuously tapping your fingers on the table. Keep track of how the doctor responds. After the appointment is over, you will take a short survey about the product and your experience.

c. Evaluation Tasks

- i. During the appointment, the doctor will be tasked with monitoring the patient as if it were a general checkup by asking a series of questions and talking to them normally. The patient will then enact the two scenarios at different times, and the doctor will have to use the audio product and respond accordingly. There will be a third outside researcher monitoring the doctor's behavior and tracking the doctor's response time.
- d. Scenarios
 - i. The patient, at two separate points during the appointment, will breathe heavily, and continuously tap their fingers on the table to see if the doctor notices.
- e. Procedure when running the evaluation
 - i. First, situate the "patient" and "doctor" in two different places separated by at least a wall, where they can't hear or see each other in real time without some sort of video/audio connection.
 - ii. Next, both participants will be given their individual instructions, and asked to read it and ask any questions they may have to an outside researcher.
 - iii. Once both participants have read and understood the instructions, the researcher will set up the interface, where the doctor is able to monitor the patient's audio and see and hear the device output, while the patient is not able to see or hear the device output.
 - iv. The researcher will set a timer for 5 minutes, and the "doctor's appointment" will start. The doctor will converse with the patient throughout the duration of the appointment, asking them questions.
 - v. At two separate points in time during the appointment, the patient will enact the two scenarios: breathing heavily, and tapping their fingers on the table.
 - vi. Both the patient and the researcher will monitor the doctor's reactions, and the researcher will note the reaction time of the doctor to take appropriate action and ask the patient what is going on.
 - vii. After the 5 minutes are up, the researcher will end the appointment, stop the video and audio, and will give the doctor and patient the anonymous survey to take separately, and after those have been completed, the simulation is complete.
- f. Post-Study Assessments and Interviews
 - i. Both the doctor and the patient will receive post-study surveys to fill out. The purpose of these surveys is to answer the research questions, and improve the product for future use.
 - ii. Doctor Survey

1. On a scale from 1-10, with 1 being the worst and 10 being the best, rate the product in terms of usability.
2. Would you describe your overall experience with this product (as a doctor) as good, bad, or needs improvement?
3. Were you able to understand the sonifications on the audio product?
4. Were you able to use the product effectively?
5. Any other comments, questions, concerns, or feedback for us?
6. Thank you. Your help is extremely appreciated.

iii. Patient Survey

1. On a scale from 1-10, with 1 being the worst and 10 being the best, rate your overall appointment experience in terms of quality and your satisfaction.
2. Would you describe your interactions with the doctor as good, bad, or needs improvement?
3. Do you think the audio product improved your satisfaction with the appointment?
4. Do you think the doctor responded properly and adequately to the example scenarios?
5. Any other comments, questions, concerns, or feedback for us?
6. Thank you. Your help is extremely appreciated.

5. Analysis

a. Response Time (of the doctors):

- i. I will calculate the average response time of doctors to alerts, and come up with what can be done to minimize the average response time. I can analyze the data, write out specific statistics (mean, median, mode, range, etc.), and construct a box plot or histogram to effectively visualize and communicate the data.

b. Patient Satisfaction:

- i. I will compute the average patient satisfaction score, and analyze variations in satisfaction scores concerning different aspects of the appointment, and determine what can be done to maximize patient satisfaction with the appointment. Like the response time, I can analyze the data, write out specific statistics (mean, median, mode, range, etc.), and construct a box plot or histogram to effectively visualize and communicate the data.

c. Doctor Rating of Product:

- i. I will determine the average rating given by doctors to the product. Then, using the doctors' feedback, I will identify specific features or aspects of the product that received lower ratings, and determine what can be done to

fix that. Like the other two pieces of quantitative feedback, I can analyze the data, write out specific statistics (mean, median, mode, range, etc.), and construct a box plot or histogram to effectively visualize and communicate the data.

- d. Product Usability (by the doctor):
 - i. To analyze this data, I will categorize the qualitative feedback from doctors regarding product usability. After that, I will identify common themes in positive and negative feedback, and use them to come up with ideas to make the product more user-friendly.
- e. User Engagement:
 - i. I will analyze responses regarding user engagement, and identify which aspects of the product received positive feedback and areas that need improvement.
- f. Alert Effectiveness:
 - i. I will categorize doctors' opinions on the effectiveness of alerts, identify specific situations where alerts were effective or ineffective, and list out what can be done to make the alerts more effective for the doctor.
- g. Doctor Understanding of Sonification:
 - i. I will analyze qualitative responses regarding the doctors' understanding of sonifications, and identify any challenges faced by doctors in interpreting sonifications. Then, I will decide what can be done to mitigate those and make the product more understandable.
- h. Patient Comments:
 - i. As for the patient comments, I will read the patient feedback, and identify recurring themes in patient feedback, both positive and negative. I will use these to improve the product in the future.
- i. Doctor's Ability to Use and Interpret the Product's Output:
 - i. Finally, I will analyze the doctors' comments on their ability to use and interpret the product, identify challenges faced by doctors in using the product effectively, and make a plan to make the product better based on that feedback.