

Health Care Accessibility for LEP Patients

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LEP Healthcare Assistant

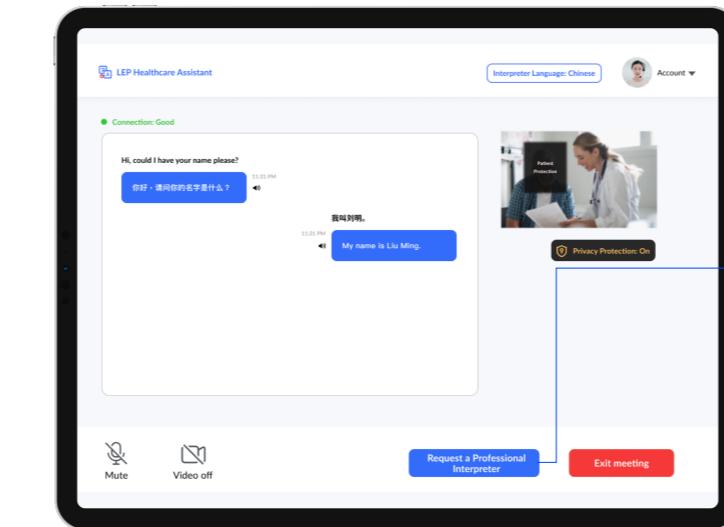
LEP patients have been suffering from low accessibility to health care service due to the shortage of in-person interpreters. As a solution, we designed **a digital platform which utilizes crowdsourcing and AI for real-time translation.**

The product allows LEP patients to have an end-to-end experience from booking appointments to reviewing reports after visit all in their native language. More importantly, it guarantees a highly accurate translation process by AI double checking and optimizing the translated outcome from multiple crowdsourcing contributors.

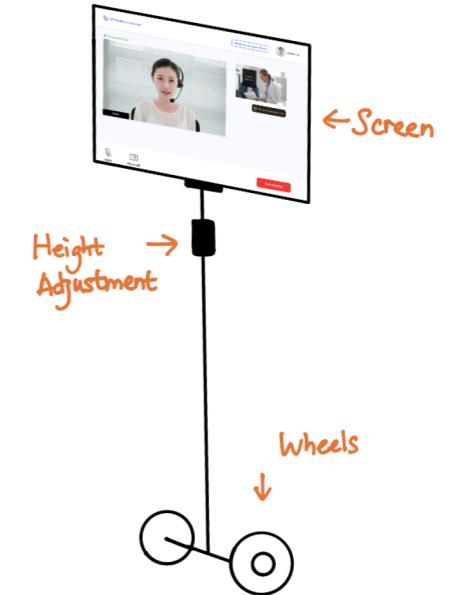
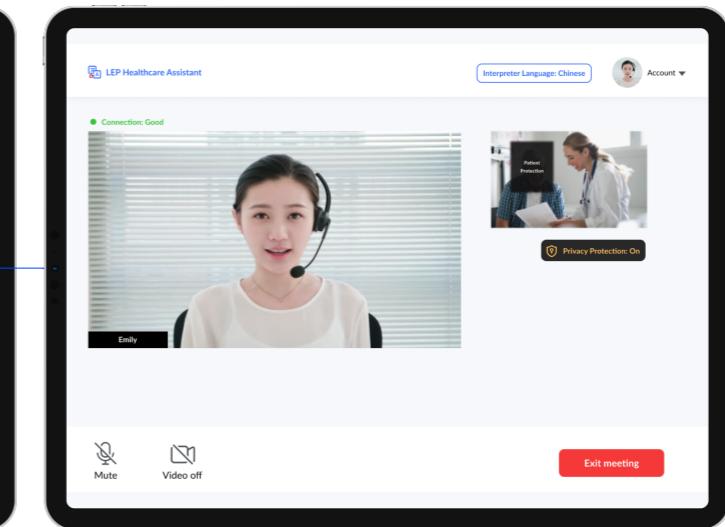
[See how we get here ->](#)

- End-to-end treatment process all in patients' native language
- High mobility with movable stand and height adjustment options
- Assigning translation tasks based on complexity
 - Professional interpreter - Complex cases
 - Crowdsourcing + AI - Simple cases

Crowdsourcing



Request a professional interpreter



Improving the Accessibility of Medical Resources for Under-served Communities with Technology

With "*Making the World more Just and Equitable*" as our high-level target, our team chose to tackle the problem of **health care disparity** with a creative technology solution, in order to improve the accessibility of medical resources for under-served population.

Why is this problem important?

Our problem space focuses on the concerns of under-served communities not getting equal health care accessibility as advantaged population. Key factors to healthcare disparities include race, medical insurance, education, transportation limitations, and language barrier, which would ultimately affect patient's chances to receive proper treatment and the quality of healthcare services.

Taking language barrier as an example: It's reported that patients with limited English proficiency widely suffered from long waiting time and high medical error rate caused by miscommunication which could even lead to their death.

Therefore, we hope to design a solution which could effectively improve the accessibility of healthcare services for less advantaged groups with technology that could be applied in realistic settings, which would largely assist under-served community to receive better treatment.

CORONAVIRUS

Hospitals Have Left Many COVID-19 Patients Who Don't Speak English Alone, Confused and Without Proper Care

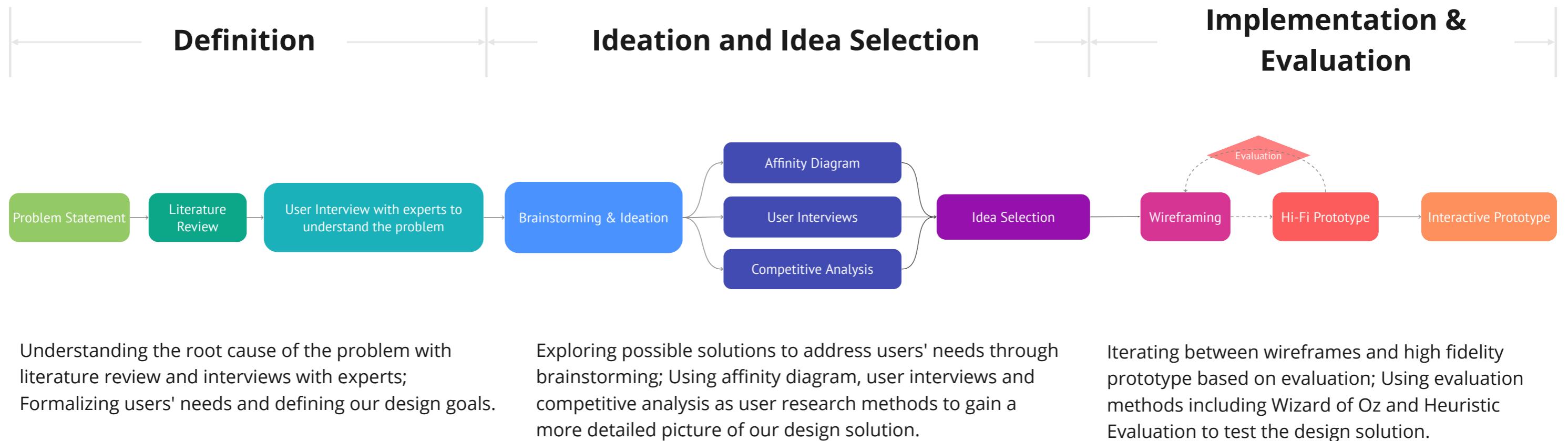
One medical worker told us: "It takes 10 minutes of sitting on the phone to get an interpreter, and that's valuable time when you're inundated. So this utilitarian calculus kicks in. And the patients that are most mainstream get the best care."

by Joshua Kaplan, March 31, 4:57 p.m. EDT



<https://www.propublica.org/article/hospitals-have-left-many-covid19-patients-who-dont-speak-english-alone-confused-and-without-proper-care>

Project Timeline



Literature Review

Exploring the problem and current solutions

Research Goals

Our initial problem space focused on the concerns of under-served communities not getting equal healthcare resources. To explore the problem, our first plan is to understand the reasons behind the problem and the limitations of the individuals, medical organizations, and communities. Starting from this broad population and problem scope, we hope to choose a design direction that needs help the most and can effectively solve the problem.

In order to understand the root causes of the disparity, we reviewed literature on this topic and conducted interviews with experts in this field, including researchers as well as local healthcare providers.

First, not all differences in health status between groups are considered to be disparities, but rather only differences which systematically and negatively impact less advantaged groups are considered disparities. Many of the current research are focused on the unequal health treatment because of **racial and ethnic disparities** in the community (Dehlendorf et al, 2010). For example, Hispanics in the United States are more likely to be uninsured than Whites, and the issue of provider bias and cultural and linguistic barriers to patient-provider communication are also important factors contributing to the issue (Artiga et al, 2020). Some other important factors to health disparities we found include **food insecurity, limited access to transportation, housing instability, lack of insurance coverage, and cultural linguistic barriers** (AAMC, 2019). When caring for the under-served community, an important theme is the **inadequate patient resources and provider resources**. It might be difficult for patients to access educational materials and especially non-English materials (Bluementhal, 2020). In order to help the under-served communities to get more information and better healthcare, there are many local organizations targeted to specific racial groups or to specific issues. However, a large portion of these material is information-based and is inefficient to use.

We also explored some current solutions, for example ClickMedix. **ClickMedix** is a health platform that provides health services to underserved populations. It helps reduce the specialists costs and operational costs via tele-consultation and improve patient quality fo care by giving better diagnosis and less wait time. One drawback of this product is that the medical resources provided through this app is only effective for a certain group of the underserved population within the United States.

Narrowing down the problem scope

After the initial research, we narrowed down the topic to **improve the hospital service for patients with limited English proficiency**. After we narrowed down our problem statement and target population, we conducted more literature review to gain a better understanding of the existing solutions and technology used. Currently, some issues around the language barrier for patients in hospital are that the hospitals do not routinely monitor medical errors for patients with limited English proficiency (LEP), and it is hard for hospitals to identify the language the patient speaks.

When using in-person interpreters, the translation has higher accuracy, but there is usually a long waiting time and there is not enough interpreters especially for uncommon languages. Medical error rate increases when LEP patients use video conferences with healthcare providers, and communication boards could not be used for complex cases. (<https://www.ahrq.gov/health-literacy/professional-training/lepguide/index.html>)

MARTTI is an interpretation app that can be used on any device. It allows video remote interpreting for both over the phone and in-person interpreting (Michelle Brubaker, 2014). It is easy to use and easily connects you to a team of the most qualified interpreters in the market. One drawback of using Martti is that interpreter use may compromise certain aspects of communication. The perceived quality of interpreter is strongly associated with patients' assessments of quality of care overall (Green et al, 2005).



Current technology and solution

Technologically, It is possible to obtain **high quality translations** from **crowdsourcing non-professional translators**, and the **cost is cheaper** than professional translation.

Crowdsourcing can play a pivotal role in future efforts to create parallel translation datasets, and it provides access to languages that currently fall outside the scope of statistical machine translation research. By soliciting multiple translations and redundantly editing them then selecting the best of the bunch, it is possible to get high quality translations without professional medical translation (Zaidan et al, 2011).

Comparing **crowdsourcing translation and machine translation**, they each have their benefits and pitfalls. The advantages and challenges of crowdsourcing are related to the high quality, quick translation speed, and low cost (Anastasiou & Gupta, 2011). Machine translation is an older technology and has many limitations. For example, machine translation can only be accurate when the text has been understood in an appropriate sense by the machine. Although the direct narration of the content can be very precise, there are still limitations in the expressions of meaning (Wilks, 1979).



Reference

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[Samantha Artiga](#) , [Kendal Orgera](#) , [Olivia Pham](#). Disparities in Health and Health Care: Five Key Questions and Answers. KFF, Mar 04, 2020. <https://www.kff.org/racial-equity-and-health-policy/issue-brief/disparities-in-health-and-health-care-five-key-questions-and-answers/>

Van Veen, TaraBinz, SophiaMuminovic, MeriChaudhry, KaleemRose, KatieCalo, SeanRammal, Jo-AnnFrance, JohnMiller, Joseph B. (2019). Potential of Mobile Health Technology to Reduce Health Disparities in Underserved Communities. *Western Journal of Emergency Medicine*. Vol.20, No.5. <https://doi.org/10.5811/westjem.2019.6.41911>

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Wilson C. C. (2013). Patient safety and healthcare quality: the case for language access. *International journal of health policy and management*, 1(4), 251–253. <https://doi.org/10.15171/ijhpm.2013.53>

Zaidan, Omar F. And Callison-Burch, Chris. Crowdsourcing Translation: Professional Quality from Non-Professionals. *Proceedings of the 49th Annual Meeting of the Association for Computational Linguistics*, Pages 1220-1229. Portland, Oregon, June 2011.

Analysis

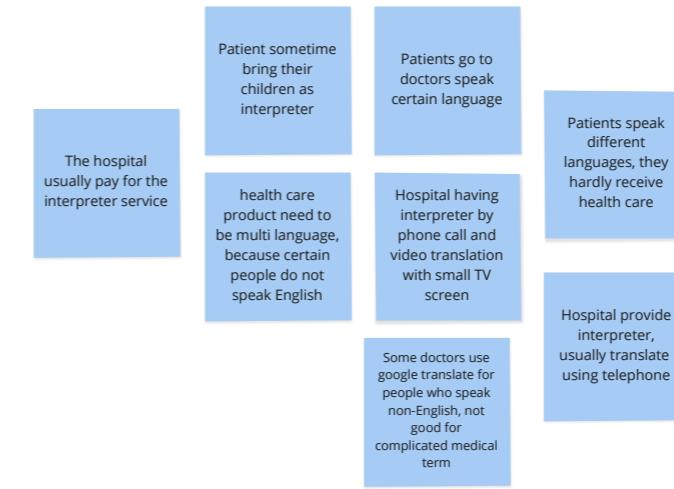
In addition to literature research, **we conducted four interviews with researchers and experts from Cornell Center of Health Equity**. With all the valuable notes we collected during our interview, we use affinity diagram to further analyze our findings.

From our understanding of the affinity diagram results combined with our findings from the research paper, we found that language issues are of great concern to hospitals, doctors, and patients. The number of immigrants and non-English native speakers is huge; however, the number of interpreters was limited. Most of the translation services are connected by phone, which lacks accuracy when the interpreter tries to understand the patient's problems.

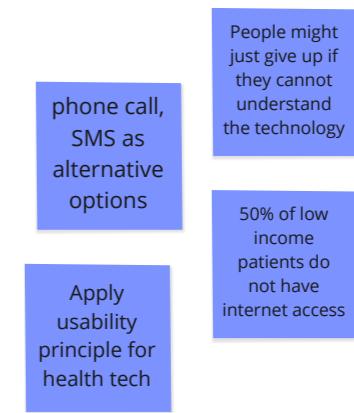
So in our design, there are several problems we were trying to solve.

First, solve the problem of insufficient translators; second, decrease medical error rate related to language limitations; third, provide multi-language technology service while having alternative options including text message and phone call for patients with limited internet access; forth, protect privacy and build trust for patients and healthcare providers.

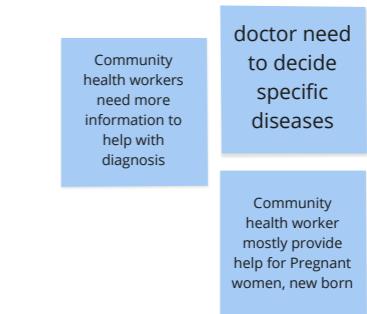
Language Differences



Usability and Restrictions



Accuracy of diagnosis



Receiving Health Insurance



Data Collection



Goals

- Reduce the waiting time caused by insufficient professional interpreters.**
- Decrease medical error rate related to language limitations.**
- Provide multi-language technology service while having alternative options including text message and phone call for patients with limited internet access.**
- Protect privacy and build trust for patients and healthcare providers.**

Initial Exploration

In our first phase of the wireframing (low fidelity) design process, we carried out design considerations from four main stakeholders: **LEP patients, health workers, professional interpreters, and the volunteer staff.**

We hope to solve the shortage of translators by **recruiting volunteers and through appointment arrangements to increase translation staff's work efficiency.** At the same time, we arrange a professional translator and a volunteer in each translation work to supervise the translation results and quality of each other to ensure the accuracy of the translation.

The primary function includes that patients can make appointments online, by telephone or SMS. Doctors can view the content of the appointment and request the participation of translators and volunteers. Translators and volunteers can agree to join the meeting. The most crucial function design is the interface design during the meeting phase. We designed a search function to facilitate interpreters and volunteers to confirm some professional medical terms further. We also include a function for volunteers to record relevant diagnostic results and prescriptions. This information will be sent to the patient after the meeting.

Patient

This wireframe section for patients includes three main components: 1) A "I'm a .." dropdown with options Patient, Doctor, Interpreter, and Volunteer. 2) A "Which language are you using?" dropdown with English, 中文 (Chinese), and Deutsch (German). 3) A "In which way do you prefer receiving message" dropdown with Online, Phone, and SMS. To the right, there is a "Book an appointment" sidebar with a search bar and a list of scheduled appointments for the day, each with "View Info" and "Start Meeting" buttons.

Doctor + Interpreter

This section shows two views: one for the Doctor and one for the Interpreter. Both views feature "My appointments" sections for different dates, each with a list of scheduled meetings and "View Info" and "Start Meeting" buttons. Below these are "Diagnosis" and "Prescription" summary cards. The Interpreter's view includes a "Medical Term Search" section for "Pharyngitis".

Volunteer

This wireframe for volunteers is similar to the Doctor and Interpreter versions, featuring "My appointments" for different dates and "View Info" and "Start Meeting" buttons. It also includes a "Medical Term Search" section for "Pharyngitis" and "Prescription" summary cards.

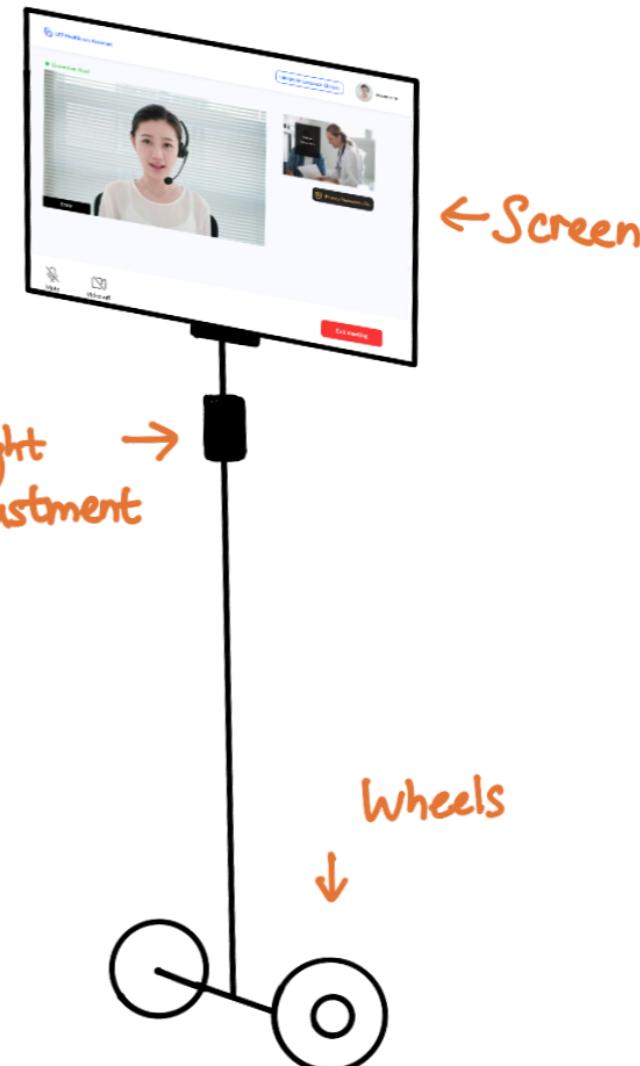
Refining Concept based on Feedback

Before we start working on our high-fidelity prototype, we gathered some feedback from experts, some of them are professional healthcare workers and some are Cornell health equity researchers.

First of all, we will not be able to keep the number of volunteers to participate in the meetings. In addition, having both a professional interpreter and a volunteer join in a meeting does not solve the problem of insufficient translators to a large extent, but slows down the interaction.

Based on the above feedback and after consulting with professor, we consider **further integrating AI translation and crowdsourcing resources into the design**.

Some other refinement include adding a movable stand to increase mobility, allowing a smarter work distribution based on case complexity (simple cases go to crowdsourcing + AI; complexed cases go to professional interpreters), and reducing unnecessary interactions.



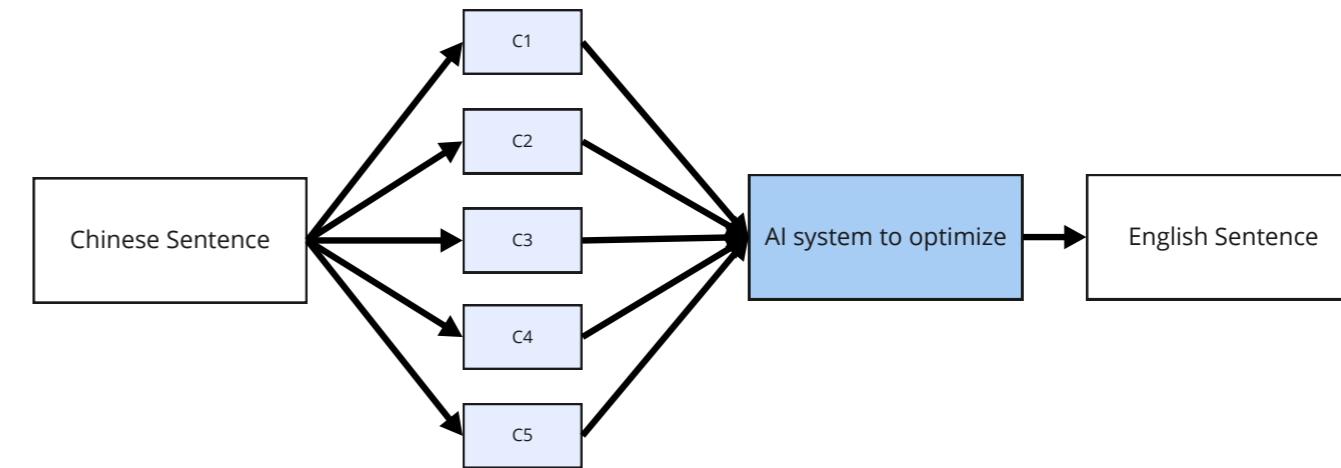
Logic behind Design

We included several innovation points in our design.

First, we **realized product mobility by adding a movable base**, which allows the product to fit a more diverse situation and more convenient for doctors and patients to use.

Second, we **combined crowdsourcing with AI translation**. By including these two resources in our product, we mainly solve the problem of not having enough interpreters because it is possible to obtain high-quality translations from non-professional translators. The cost is an order of magnitude cheaper than professional translation (Zaidan et al, 2011)

Also, the combination of crowdsourcing and AI checking increases accuracy. In our design, **we expect five crowdsourcing staff to work together when doing the text translation and have AI automatically check the translation quality**. In this case, we minimized the possibility that translation errors were caused by individuals.



Third, we also focus on **privacy protection**. In our interviews, several experts mentioned that privacy and safety are large concerns in designing the technology solution for patients and doctors. Based on this requirement, we have strengthened the privacy protection methods of the original video call. In the original video process, patients can only choose to turn their videos on or off, but this will also affect the accuracy of the translation at certain times. We took this into consideration and **added a design that allows patients to mosaic their faces**. This not only protects the privacy of patients but also allows translators to receive their physical expressions better.

Finally, we provide an end-to-end service that our product is not only a platform to provide video connection between patients, doctors, and translators. **We also include designs for LEP patients to make an appointment and send the patients their health records with information about the diagnosis results and the prescriptions based on their primary language.**

Advantages

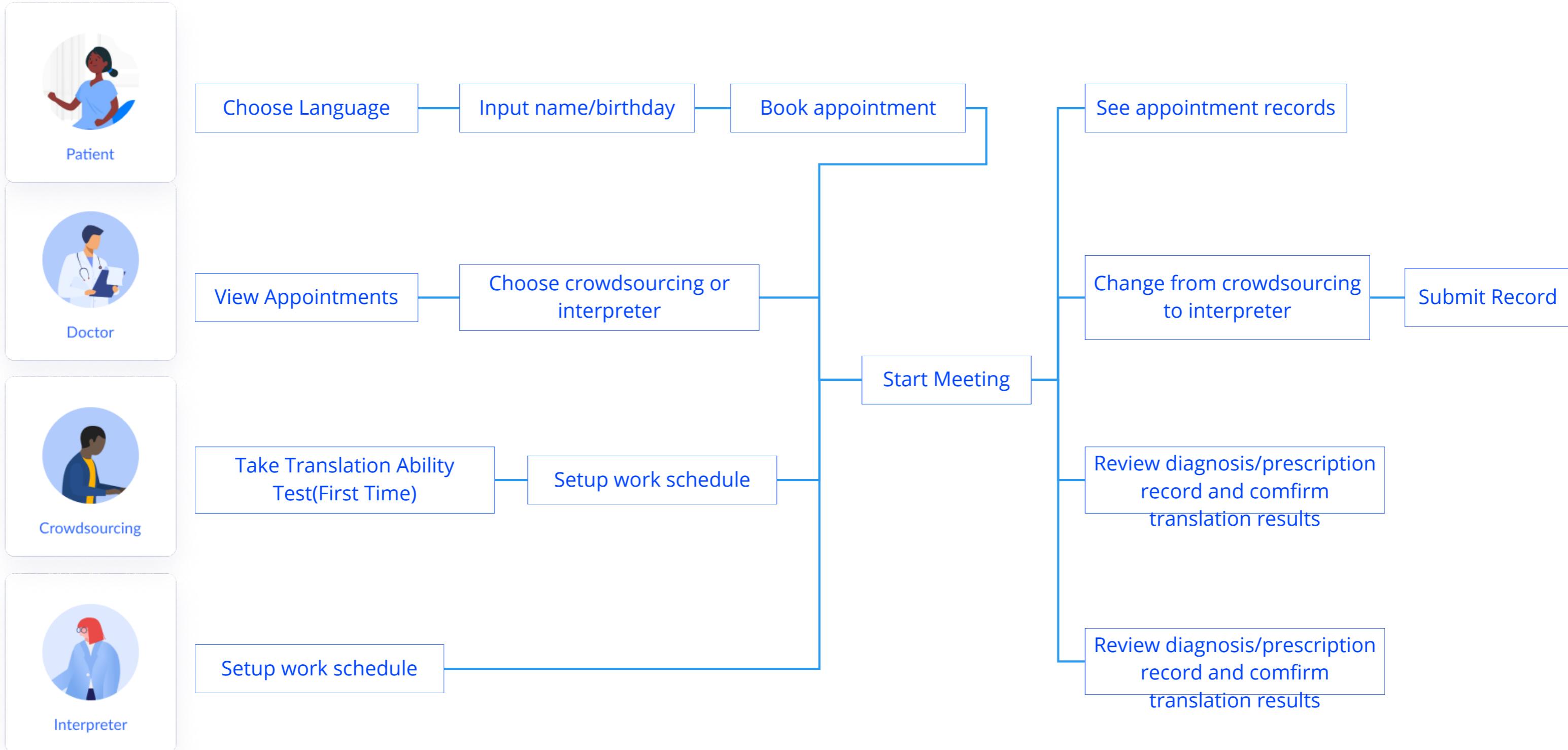
By including those innovation points, our design has several advantages.

First, the design does not require hospitals to purchase additional electronic products. The product can be implemented in phones, tablets, computers, or any screen products.

Moreover, LEP patients have more access to our product because patients are not required to have internet access to access our product; they can make an appointment and receive records by text, phone call, or online.

Most importantly, we provide a flexible response to the needs of patients and doctors. Users can switch their language selection in the language setting at any time. Doctors can switch from crowdsourcing translation to have a professional interpreter join the video call anytime based on the doctor's needs.

User Flow

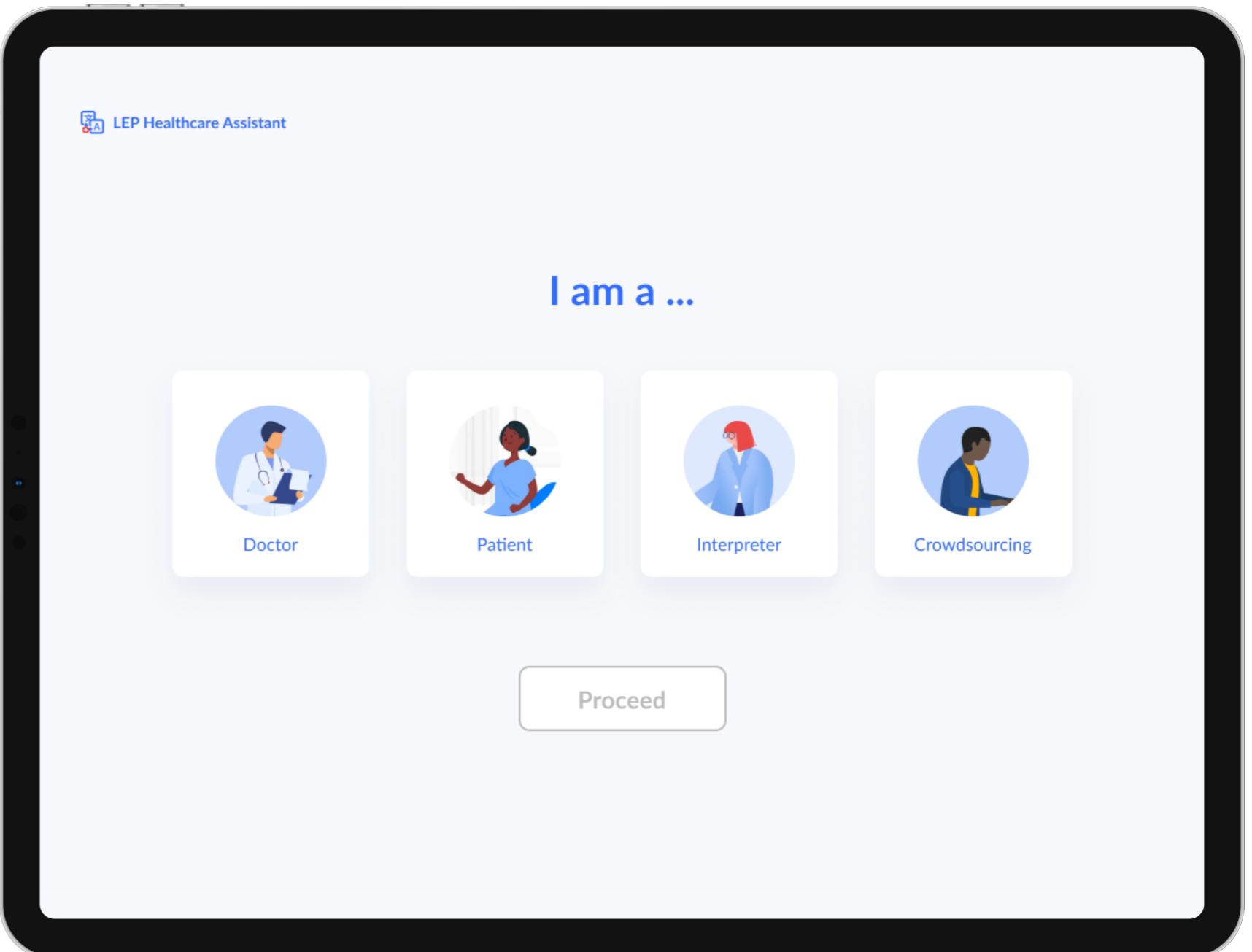


Prototype

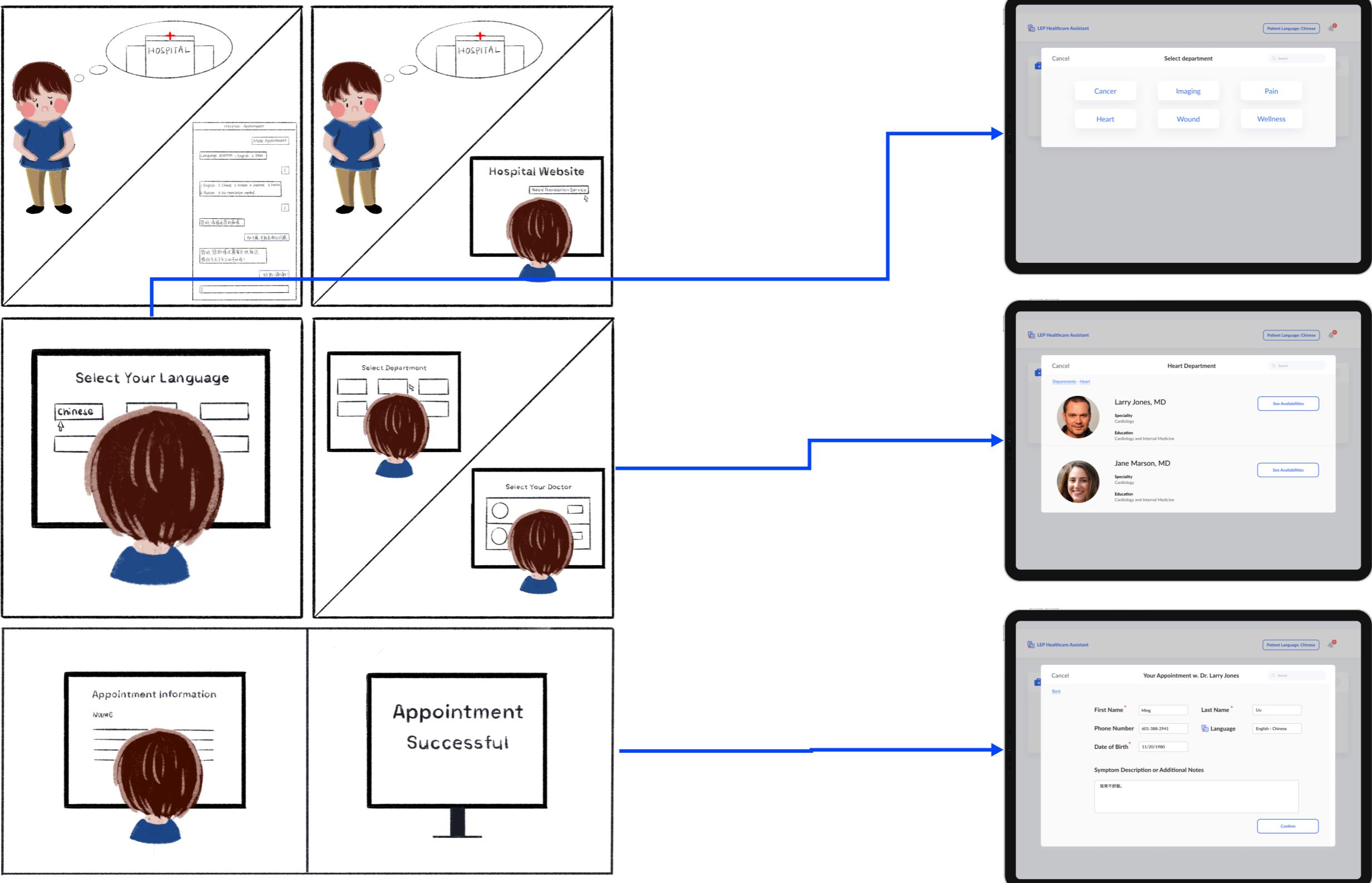
In our final prototype, our software will be available to four types of people: **patients, doctors, interpreters, and crowdsourcing staff**. Each type of user will use different functions.

In the initial interface, users will choose their language to ensure that they will not be unable to use the software due to language problems.

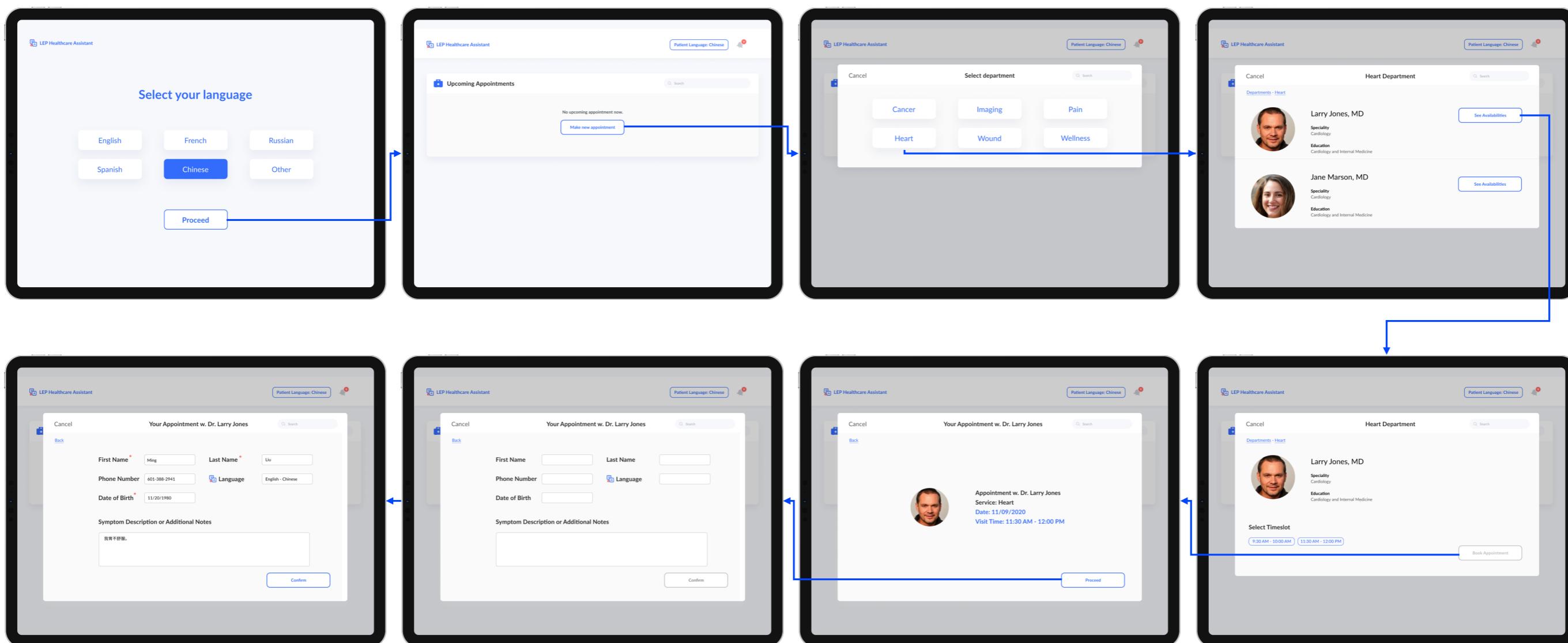
In use case in reality, our stakeholders would have different entry points (as shown in the user flow before), however, we decided to show their entry points on the same page in our prototype for better showcasing.



Patient - Before the Appointment

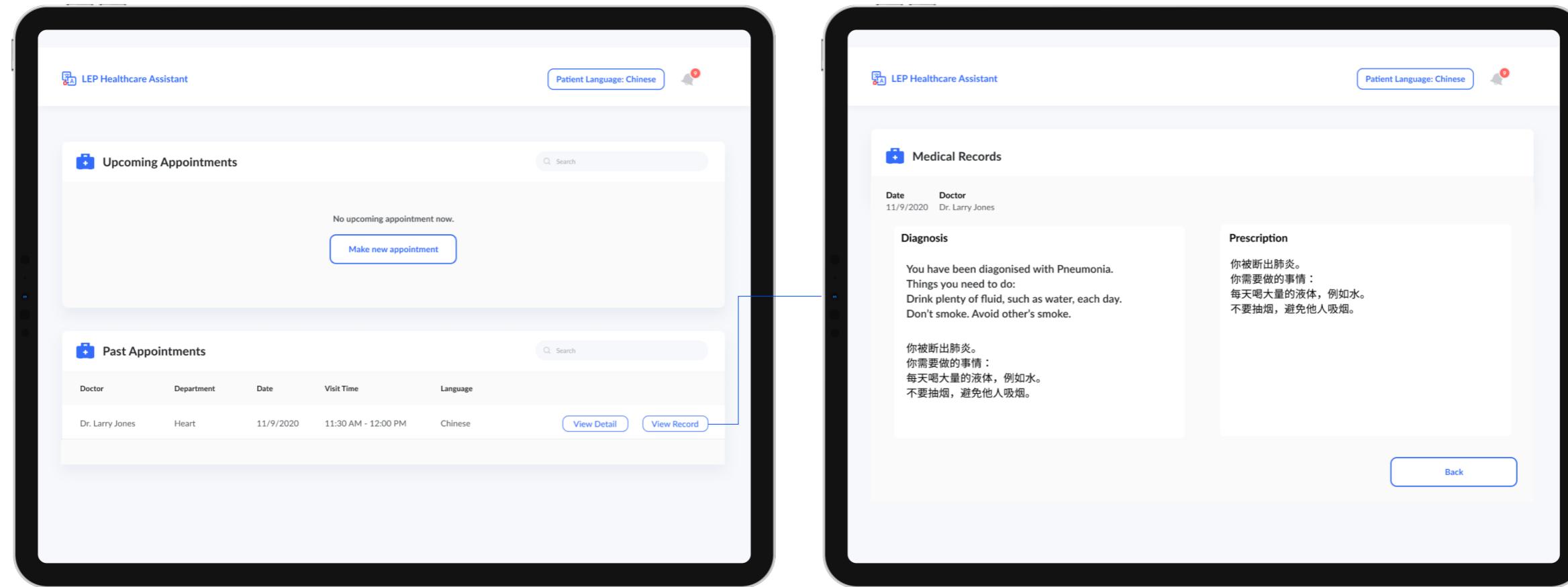


The patient can use this software to make an appointment with the doctor. According to his condition's prediction, he can choose the most suitable doctor by looking at different doctors' detailed information in different departments. When making an appointment, he needs to fill in his detailed information, including his name, birthday, phone number, and language used. Besides, he also needs to describe his condition so that the doctor can predict. In the whole process, the patient does not need to use any English. All the interfaces he sees will be **translated into the language of his choice**, and the **content he filled in will be automatically translated into English**.

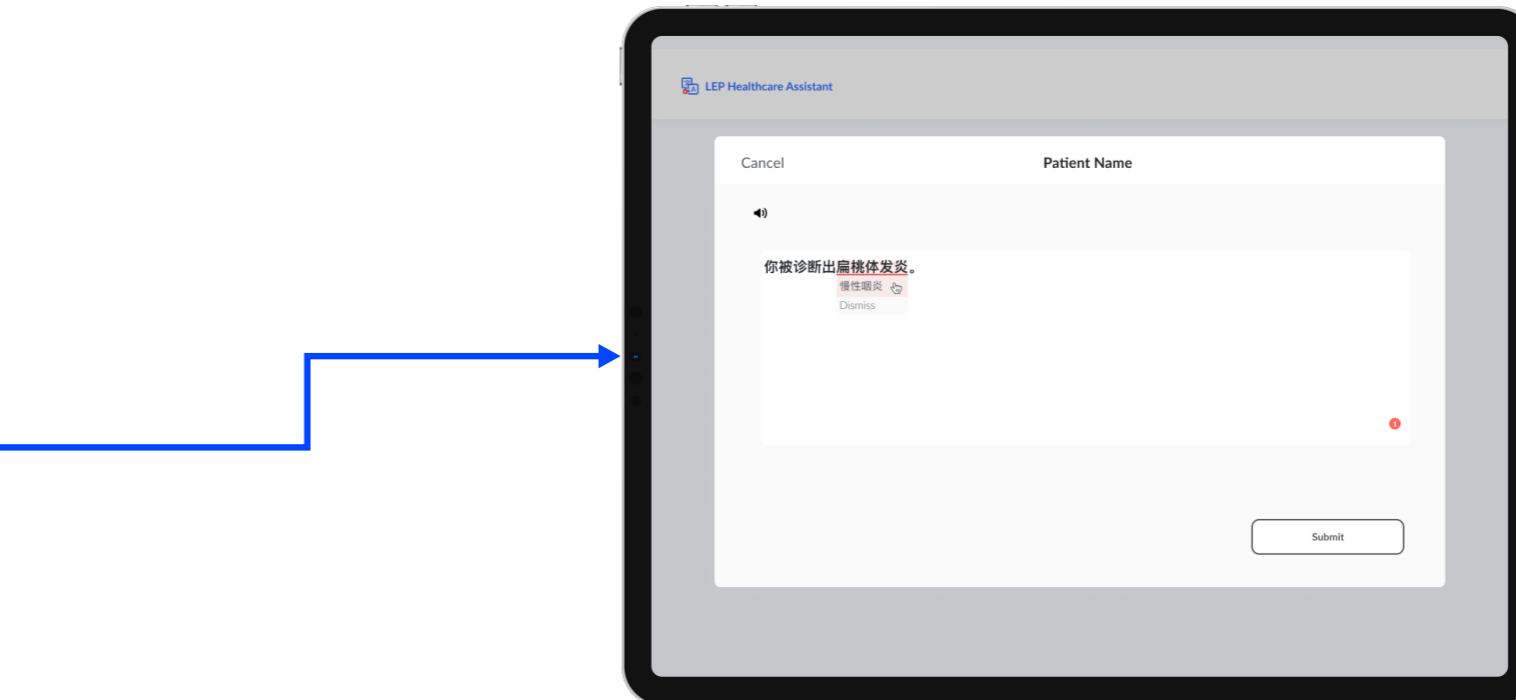
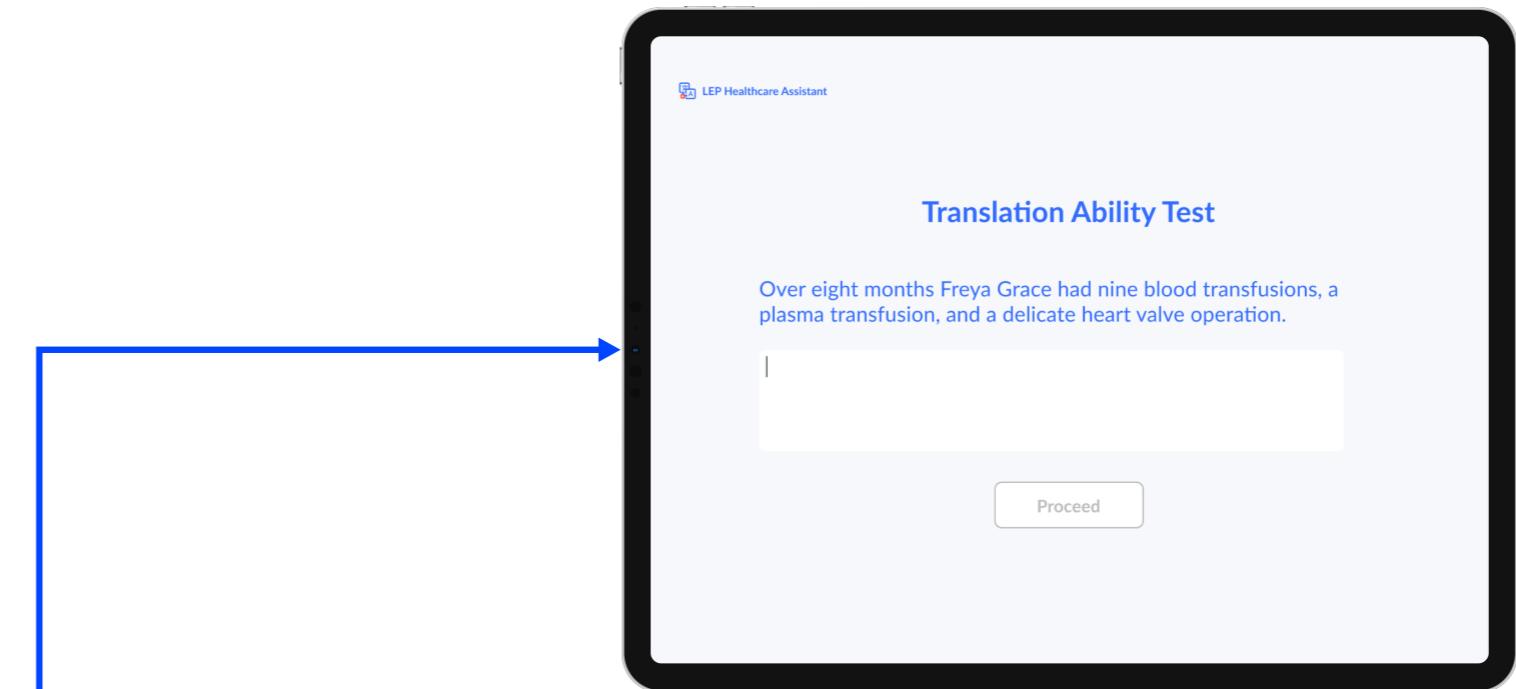
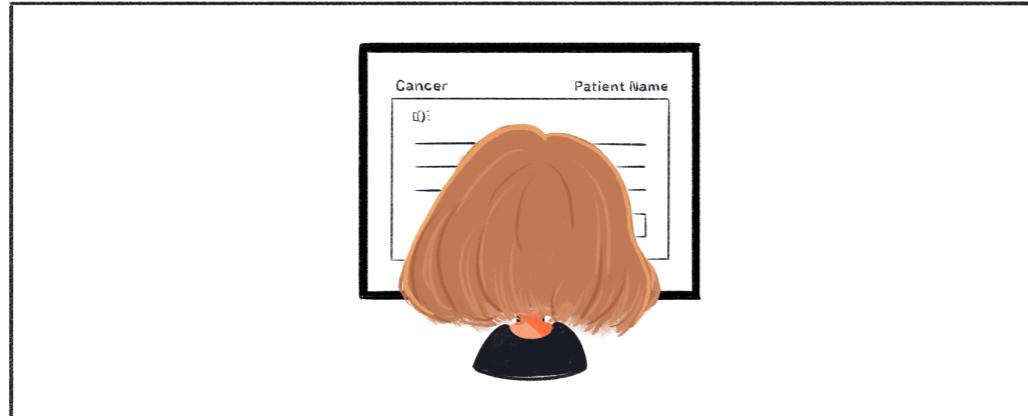
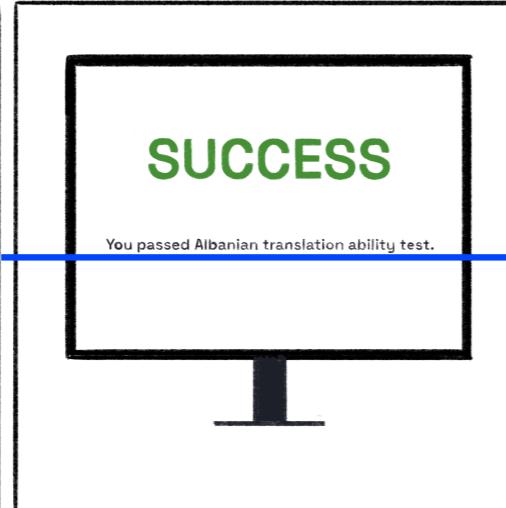
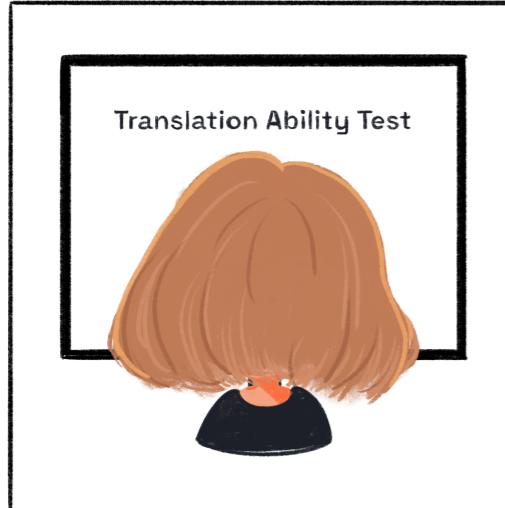
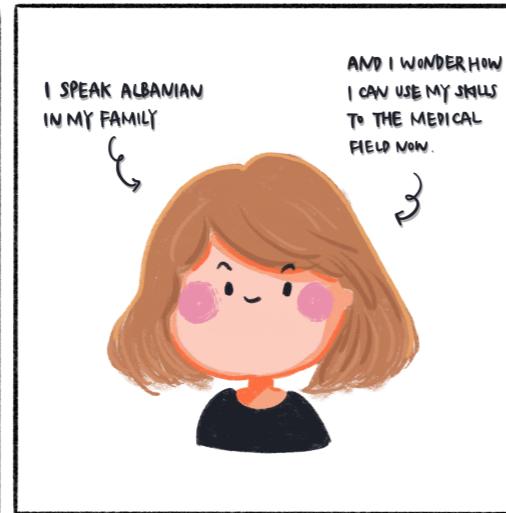
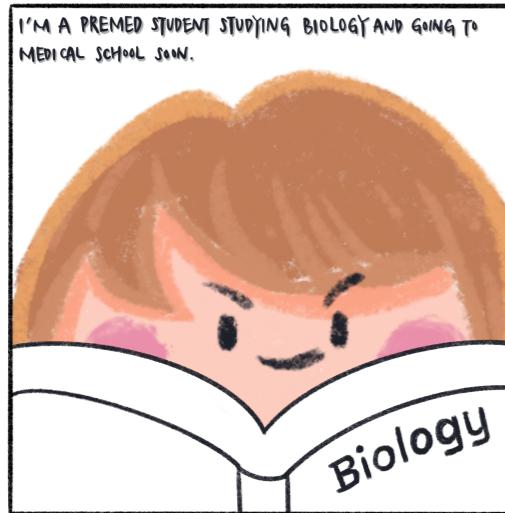


Patient - After the Appointment

After the entire treatment and diagnosis process is over, the patient can read the detailed report by viewing past appointments, including symptoms and treatment plans, and all the content will be displayed in bilingual form.



Crowdsourcing

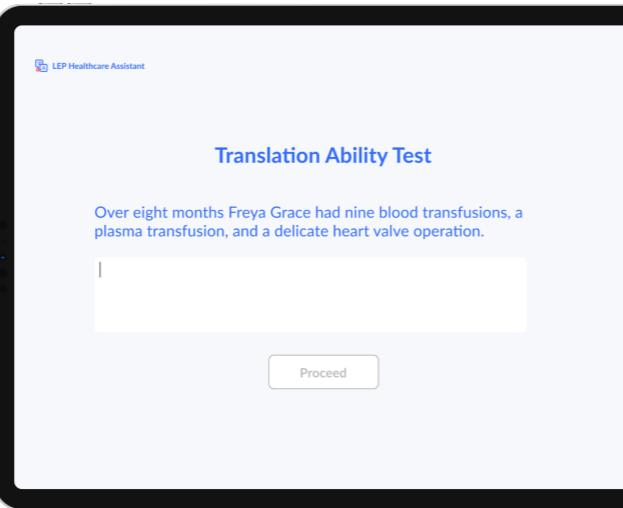


Crowdsourcing

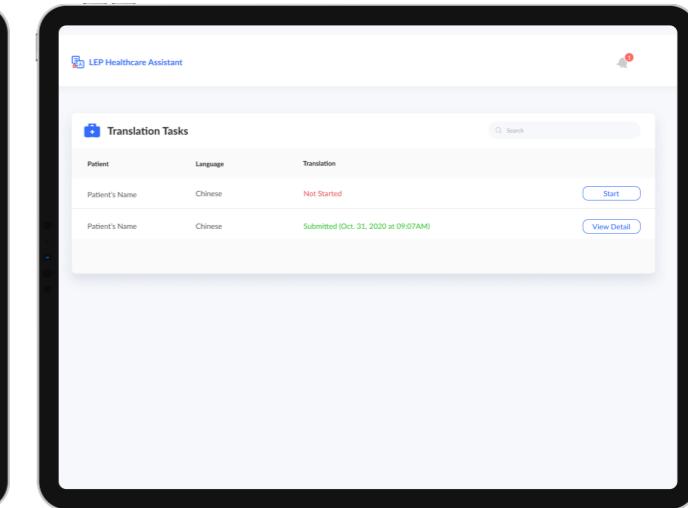
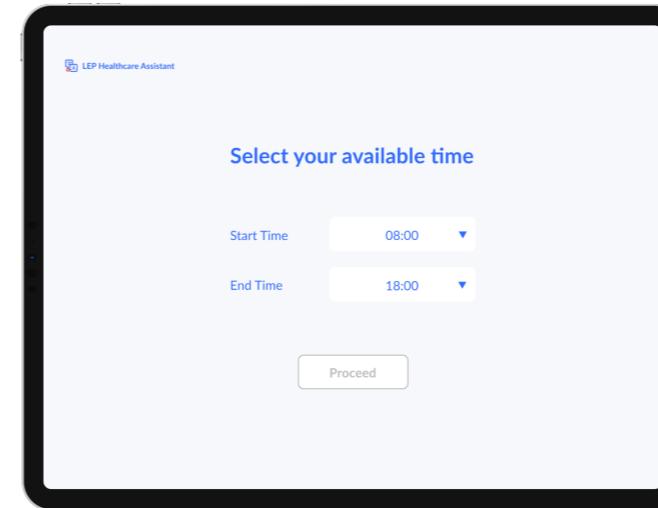
Crowdsourcing staff will have to provide education or particular certification. Besides, crowdsourcing staff will receive some translation test before participating in the translation service. After that, crowdsourcing staff can set up the schedule to work.

During the staff's work time, crowdsourcing staff will translate the patients' and doctors' words by typing them out. The AI will check the translation quality. After comparing the crowdsourcing staff's translation results, the AI will send the translated text with audio. After the appointment, the professional interpreter will check if the AI translated records according to the conversation and further confirm it.

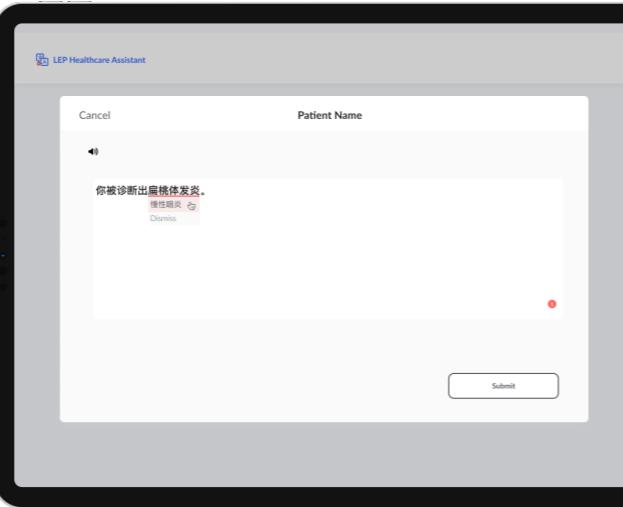
Translation Ability Test



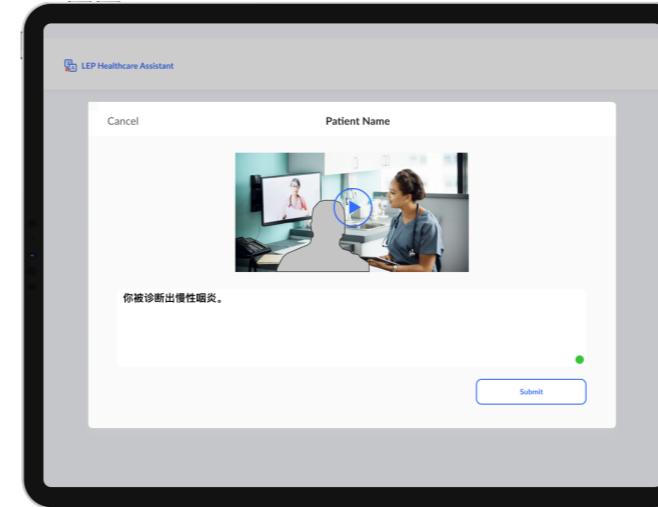
Set available time



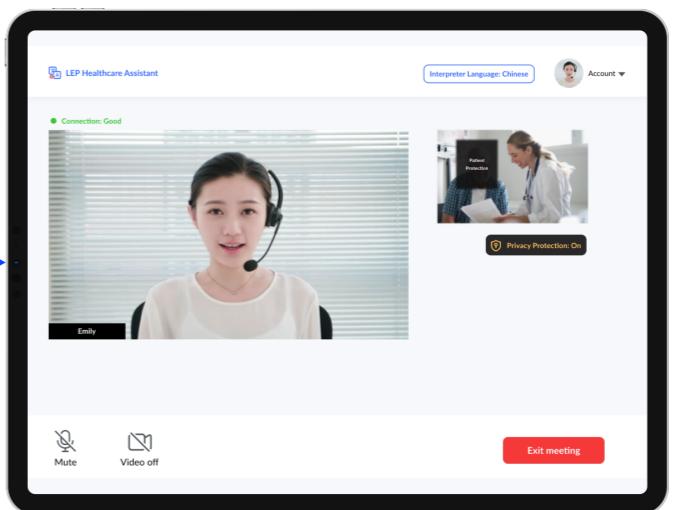
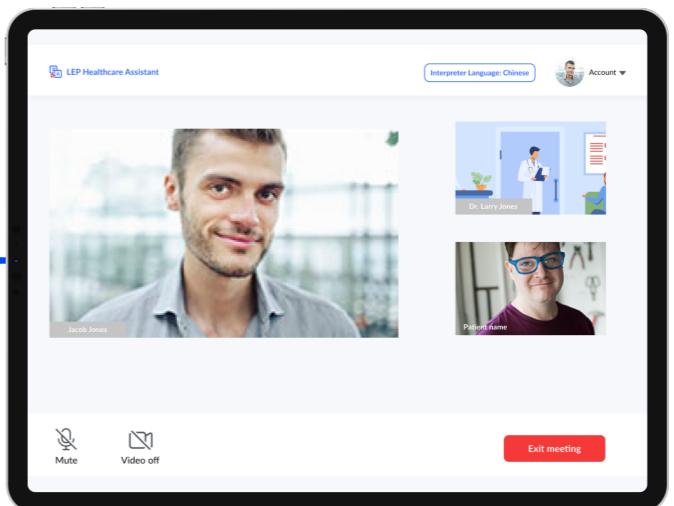
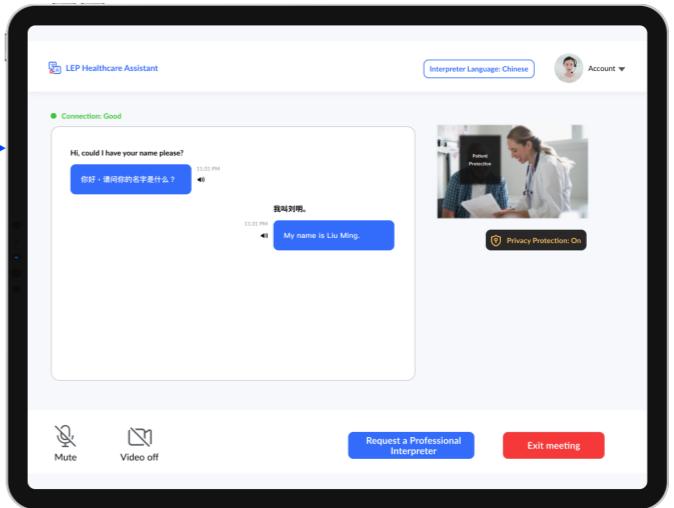
Audio Translation



Video Translation

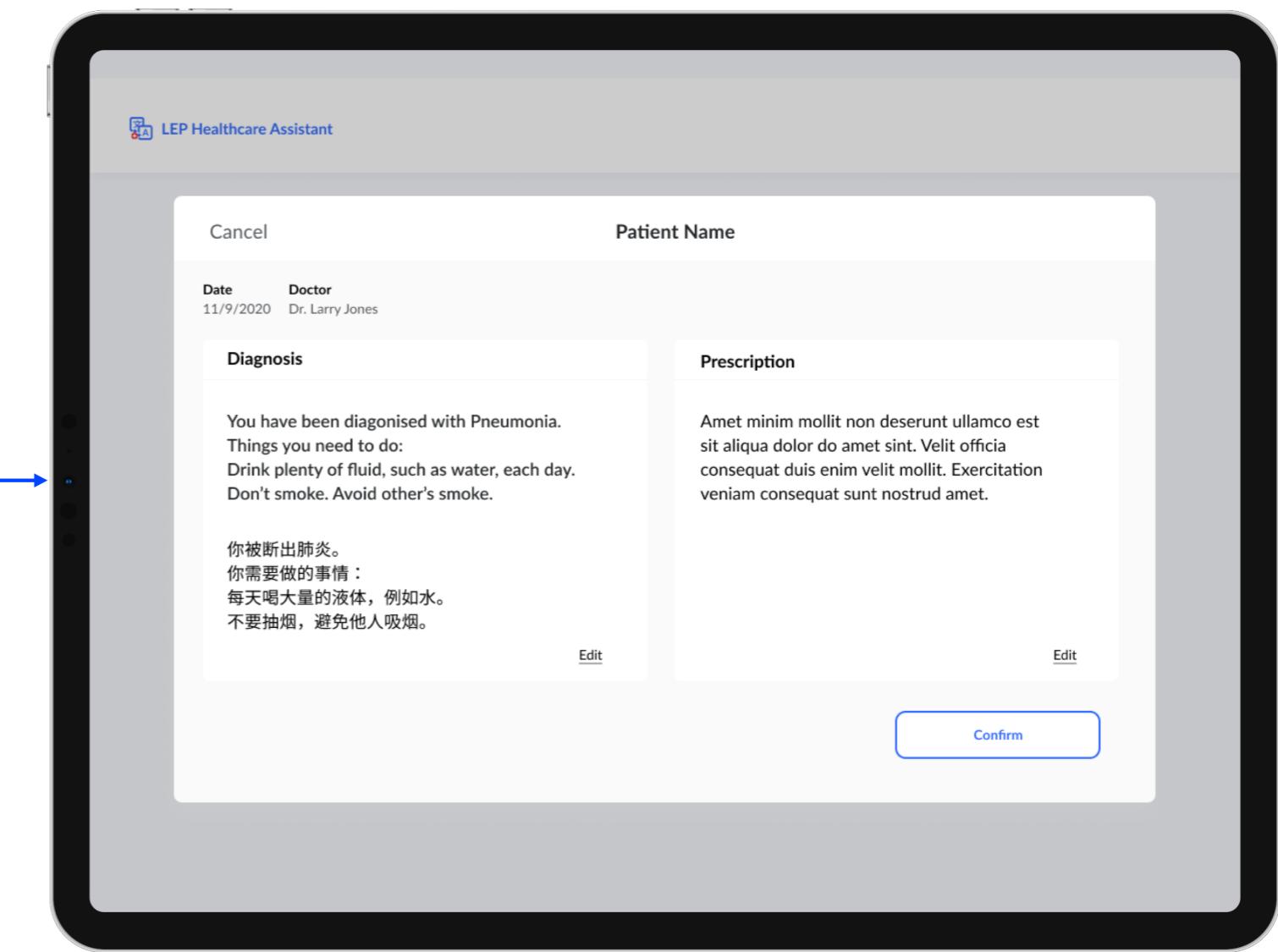
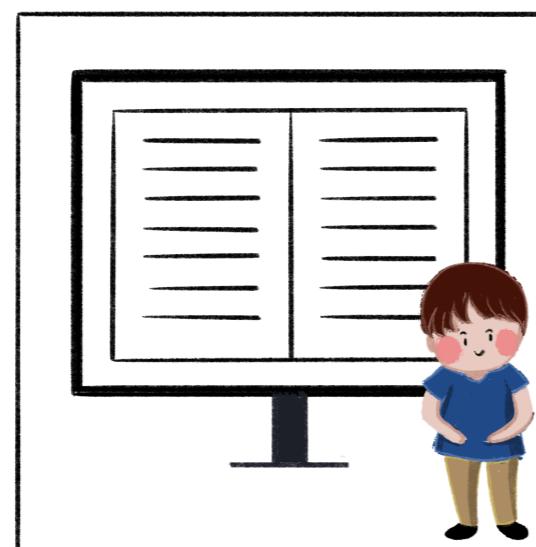
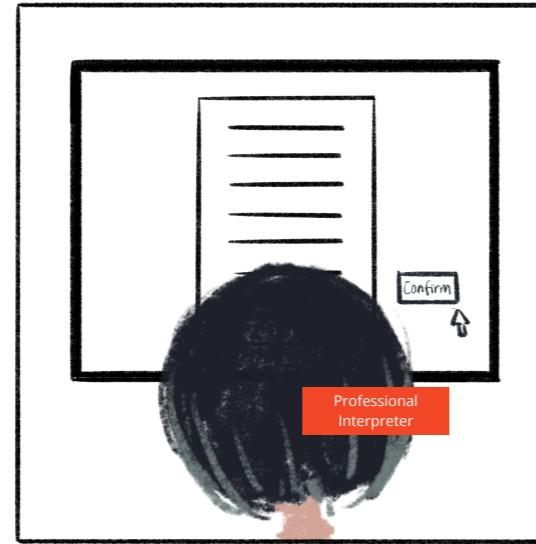
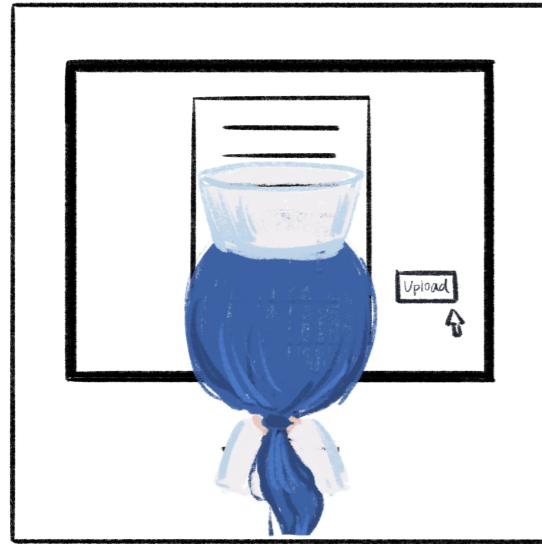


During the appointment



If doctors believe that the patient's symptoms are more severe than he/she thought before the meeting or doctors consider the case, they need high accuracy in understanding the patient's situation. The doctor can request a professional interpreter immediately.

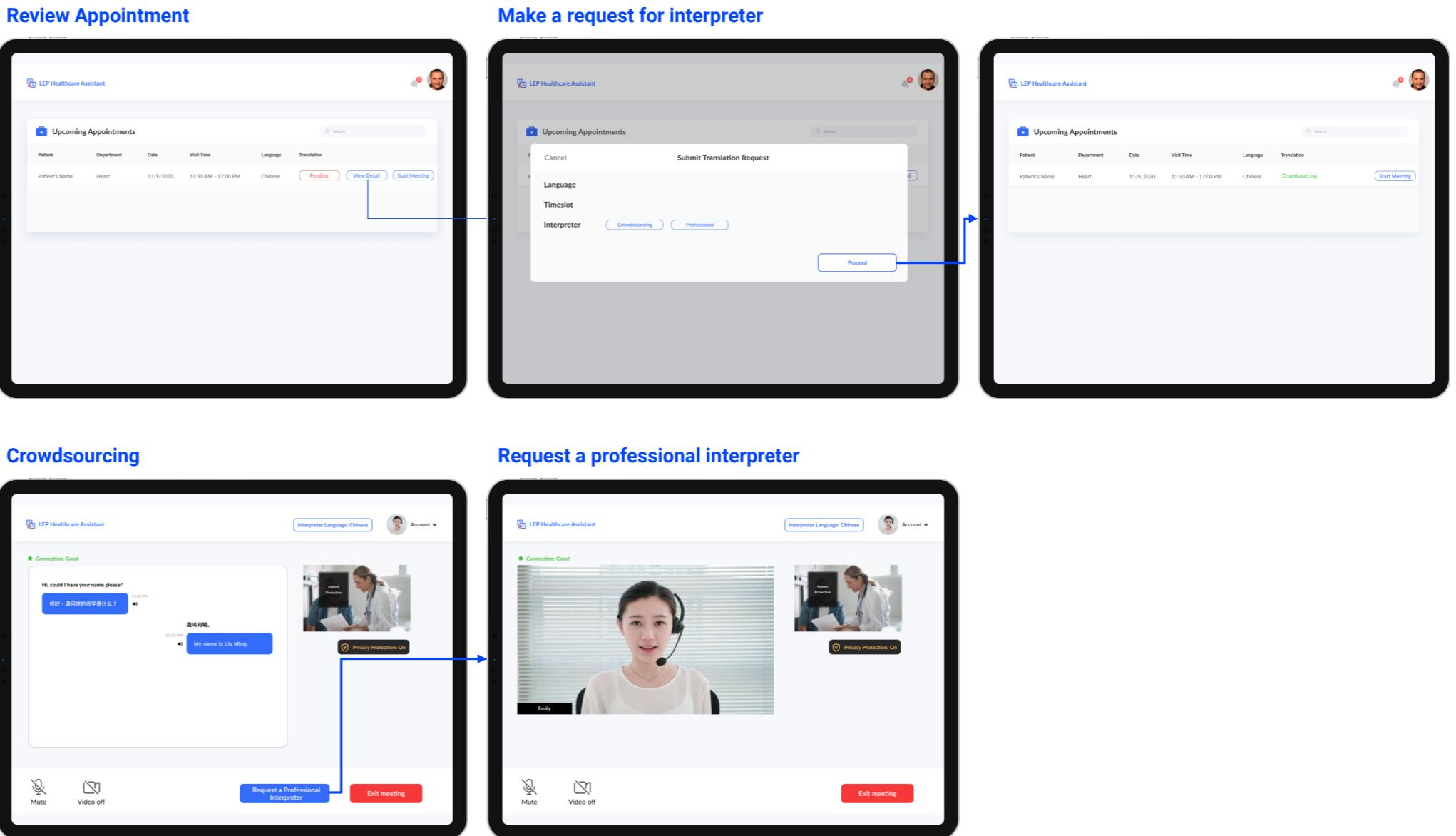
After the appointment



Doctors submit the records about diagnosis and prescriptions. The AI will do a auto-translation. Our professional Interpreter here (can be crowdsourcing staff if no professional interpreter involved in the meeting) will confirm the translation results. After that, patients can view their records with translated results.

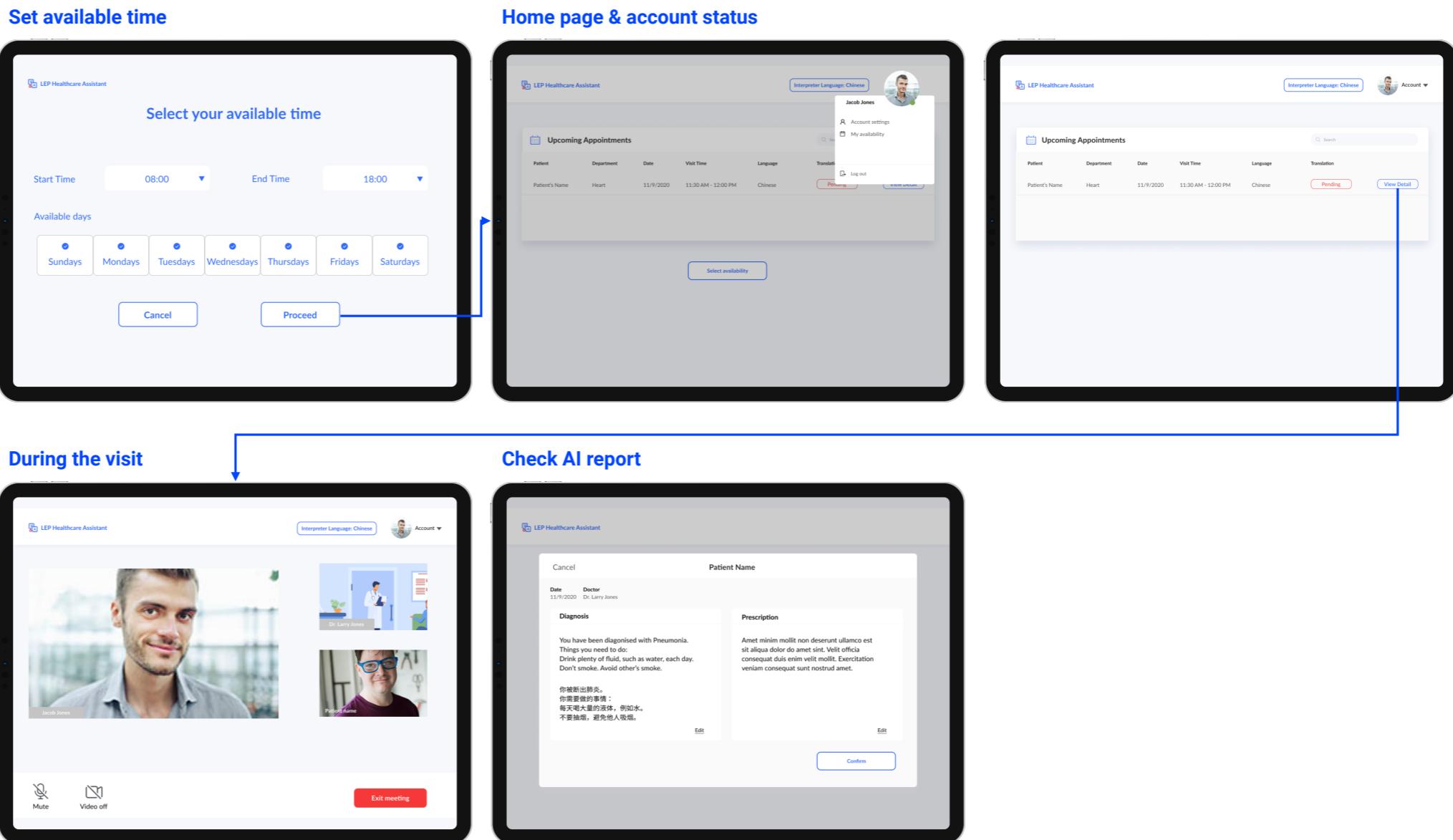
Doctor

Doctors can view the appointment's content and request the participation of either a professional interpreter or the crowdsourcing translation service based on patients' description of his or her situation. Ideally, if the patient's problem is not too severe, the doctor will choose the crowdsourcing and ai translation. If the doctor thinks the problem is severe, the doctor can choose a professional translator to join the consultation. During the meeting, if doctors believe that the patient's symptoms are more severe than he thought or need to understand the patient's needs better. The doctor can immediately request a professional translator. Also, the doctor can help the patient to turn on the privacy protection function based on patient's need during the meeting so that patient's face will be mosaic. After the appointment, doctors can submit the records about diagnosis and prescriptions the AI translator will automatically translate the text.



Interpreter

The professional interpreter has similar functions that interpreters need to set up the work schedule and join the meeting when there is a scheduled appointment. A professional interpreter will be added to the conversation in the form of voice translation. After the appointment, the professional interpreter will check if the AI translated records according to the conversation and further confirm it.

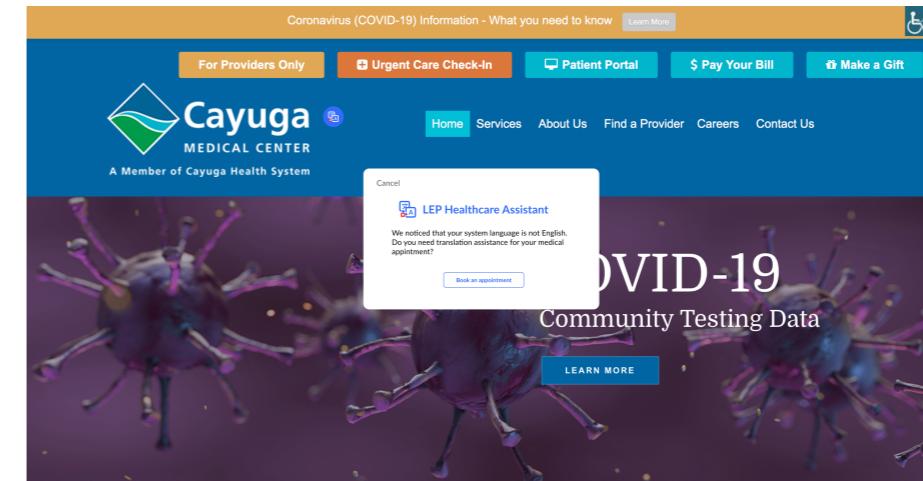
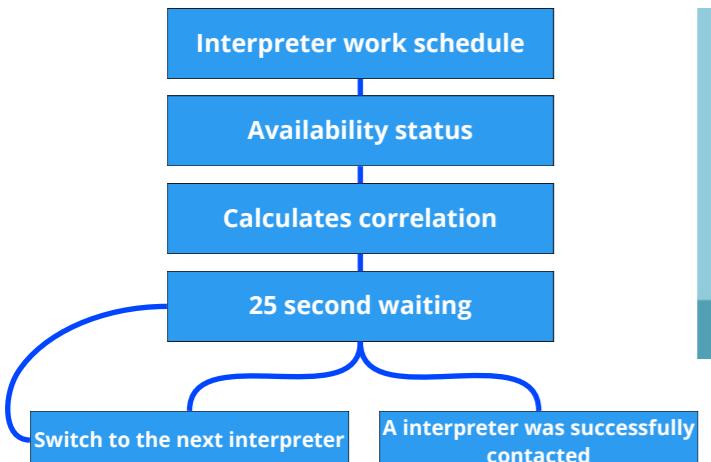


Design Challenges and Solutions

Challenge 1 - Increase Contact Efficiency with Professional Translators

The first resolution is that, cooperating with more translation companies to have more professional interpreters provide services for our platform.

From our design perspective, we tried to optimize the connection process. While connecting with the interpreters, the system will do a quick calculation based on the interpreter's work schedule , their availability status, and if the interpreter fits the patients' language needs. Based on the calculation result, there will be a list of interpreters the system is trying to connect with. For each interpreter, we will wait for 25 seconds for the interpreter to accept the translation request.



Challenge 2 - Promote Our Product

First, we will cooperate with the hospital by putting our product information on their website. One feature can be implemented is that while we found that the users' default language setting is not English, there will be a pop-up screen asking users if they need our service in their appointment. Also, we can include the service introduction in the telephone and text appointment process.

On the other hand, we will also promote the product offline by posting the product information at some medical service institutions, such as hospitals or local clinics.

Finally, We also consider setting up a product website to further introduce and explain our service content.

Translation Ability Test

Over eight months Freya Grace had nine blood transfusions, a plasma transfusion, and a delicate heart valve operation.

在过去8个月里，芙蕾娜·格蕾丝一共输了九次血、一次血浆，还做了一次心脏瓣膜手术。

Challenge 3 - Recruit qualified crowdsourcing staff

First, our staff will review the person's resume and personal information to make sure that the person has a relevant education background or translation certificates.

From the design perspective, our product will include a **translation ability test** that will give users some random medical-related sentences and ask them to finish translation in a short time and then AI will check their accuracy level. The crowdsourcing staff needs to pass this test to serve for a real case.

Proceed

Passed

Proceed

Evaluation

We used the **Wizard of Oz** as the testing technique.

In addition to the user, there will be three people participating in the interview process, one will be the doctor, one will be the interpreter and crowdsourcing staff, and the other will be a notetaker. The person acting as the doctor will face the user, who will pretend to be a patient, while the remaining two will participate remotely.

We have prepared two tasks for users to try.

The first is a milder symptom, the patient has a rash, and crowdsourcing staff will be used to translate for him throughout the process. The other is abdominal pain; the doctor underestimated the severity, so that crowdsourcing staff will be switched to professional interpreters during the diagnosis process.

1. The patient has a rash.
 - The patient makes an appointment with the doctor Larry Jones between 11:30 and 12:00.
 - The Symptom Description is “我身上起疹子了”。
 - The doctor decides to use the crowdsourcing staff.
 - Doctor: “What's wrong with you?” (T: 请问你有什么问题)
 - Patient: “我身上起疹子了。” (P: I have some rashes)
 - Doctor: “When does this happen?” (D: 什么时候开始有的)
 - Patient: “两小时前，我吃了些坚果后就开始起疹子了。”(Two hours ago, I started to have a rash after eating some nuts)
 - Doctor: “You are probably allergic to the nuts, you need to have some antihistamine cream.” (你对坚果过敏，你应该使用一些抗组胺软膏。)
2. The patient has Acute appendicitis
 - The patient makes an appointment with the doctor Larry Jones between 11:30 and 12:00.
 - The Symptom Description is “我肚子很疼”。
 - The doctor decides to use the crowdsourcing staff.
 - Doctor: “What's wrong with you?”(D: 请问你有什么问题)
 - Patient: “我肚子很疼。” (P: My stomach hurts)
 - Doctor: “When does this happen?”(D: 什么时候开始的)
 - Patient: “从一小时前就开始了。”(Started an hour ago)
 - Doctor: “Which part is painful? The upper part or the lower part?” (哪一部分疼？上腹部还是下腹部？)
 - Patient: “左下腹部疼。” (Lower left part)
 - Doctor: “This condition might be serious, we need to change to an interpreter.” (情况可能比较严重，我们需要换成专业的口译人员。)
 - Change from crowdsourcing to interpreter.
 - Doctor: “For a scale from 1-5, how painful are you right now?”(从一到五分，你现在的疼痛等级是多少)
 - Patient: “四分。” (Four)
 - Doctor: “You have acute appendicitis and must have an operation.” (你得了急性阑尾炎，并且应该尽快手术)

(Script for the tasks.)

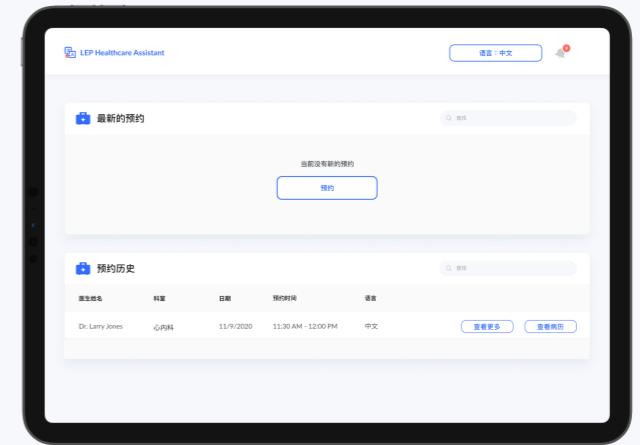
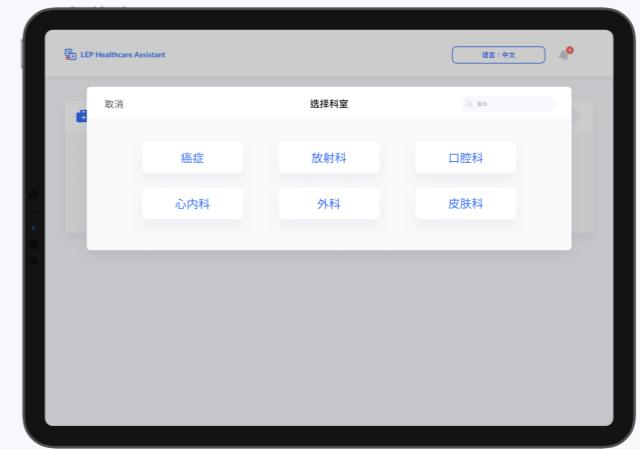
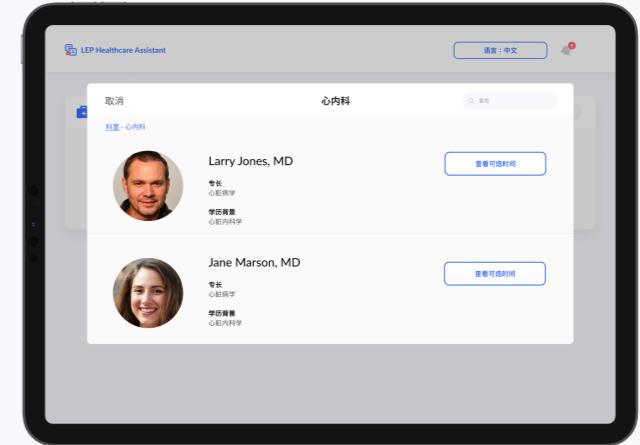
Evaluation with LEP participants

We recruited **two participants who are native Chinese speakers and do not speak or understand English well**. The two participants are between 40-50 years old who have access to mobile phones and the internet.

First, the participant pretended to be a patient and the goal was to make an appointment with interpretation service on our app. Our team evaluated the participants' performance on the on-boarding pages, and from the homepage, make an appointment. **We observed the errors and hesitations during the navigation process, and if participants could achieve the goal of the task.**

Then, in the role play scenario where the participants are seeing the doctor with crowdsourcing translation and a professional interpreter, **we observed participants' reaction to the interpretation process.**

Lastly, we asked follow up questions about their experience using the app and their suggestions in general.



We translated all the interfaces into Chinese in patient's user flow in order to simulate the realistic settings.

Evaluation with participants in medical industry

We interviewed **one participant in medical industry about her thoughts on the feasibility of our solution**, especially the process during the appointment where we assign parts of the cases to AI+crowdsourcing. After that, we conducted user testing by asking her to complete tasks in the doctor perspective.

We observed the task-completion process of the participant and collected her feedback during her experience.

Overall, she think the user flow is clear to her and she appreciates the usage of AI as double-checking tool for translation.

One question she addressed is the following:

How could we train the AI to recognize the best solution from different translations submitted by crowdsourcing contributors?

Evaluation with interpreters

We interviewed **one participant who had experience translating for medical appointment** and conducted user testing by asking her to complete tasks in the crowdsourcing/professional interpreter perspective.

According to her feedback, the task flow for professional interpreter is easy to understand because it is similar to the current video-translation experience. For the crowdsourcing side, she thinks it is considerate to have privacy settings during video translation, but she thinks **it is still challenging for the crowdsourcing contributors to recognize clearly if the patient has some accent.**

Some major confusions that she addressed are the following:

Could the professional translator also complete crowdsourcing tasks if he/she is available?

Would it be helpful if patient could double-check or type out the sentence before translation so that crowdsourcing contributor would not have to listen?

Evaluation Insights

After the evaluation process, we generated the following insights:

- | When an interpreter does not follow the appointment from the beginning, the interpreter need to **quickly understand the context** to translate accurately.
- | **LEP patients need more assurance about the accuracy** of translation content, i.e. when the patient has an accent. Patients want to know that they are understood correctly by the interpreter or AI translation.
- | For cases in which crowdsourcing staff could not understand the sentence properly, he/she should **have a way to reject the task**.
- | Patients may have **various need for AI reading, including play speed, font size, gender of the AI, etc.** Since they would have a virtual depiction of person when they communicate with AI, it is important for AI to accommodate to their needs to make them feel comfortable.

Good

Users could easily understand the expected interactions on each screen. They did not hesitate to click the expected action item, which proves the high usability of our design.

Users completed the tasks without error. They showed no confusion for the translated results and expressed high satisfaction for the user experience.

Need Improvement

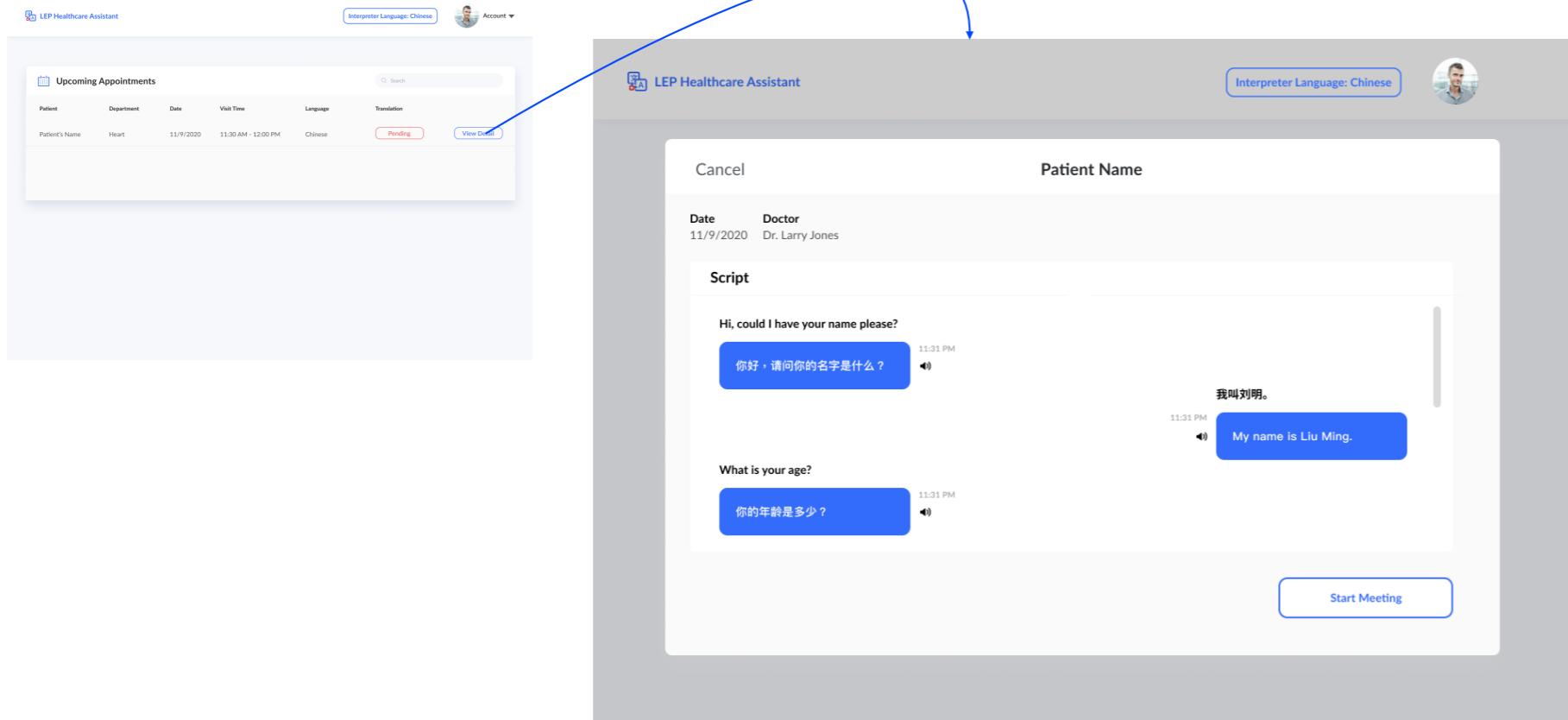
Professional interpreters need to have access to previous communication before switching to better understand the context.

Missing speed adjustment and other customization for AI reader of translated sentence. Elder patients would need slower audio play of translated sentence to better understand the meaning.

Our project need to explain better about how we train the AI to select the best solution.

Improvements after evaluation

Professional Interpreters need to know the context and discussion before switching.



Firstly, under the circumstance where the doctor need to switch from crowdsourcing mode to professional interpreter mode in the midst of the communication, professional interpreters need to have access to the content of previous discussion in order to learn the context and provide translation.

Therefore, we decided to **add detail page with script from previous discussion for the professional interpreters**, and they would be able to view the script before and during the meeting.

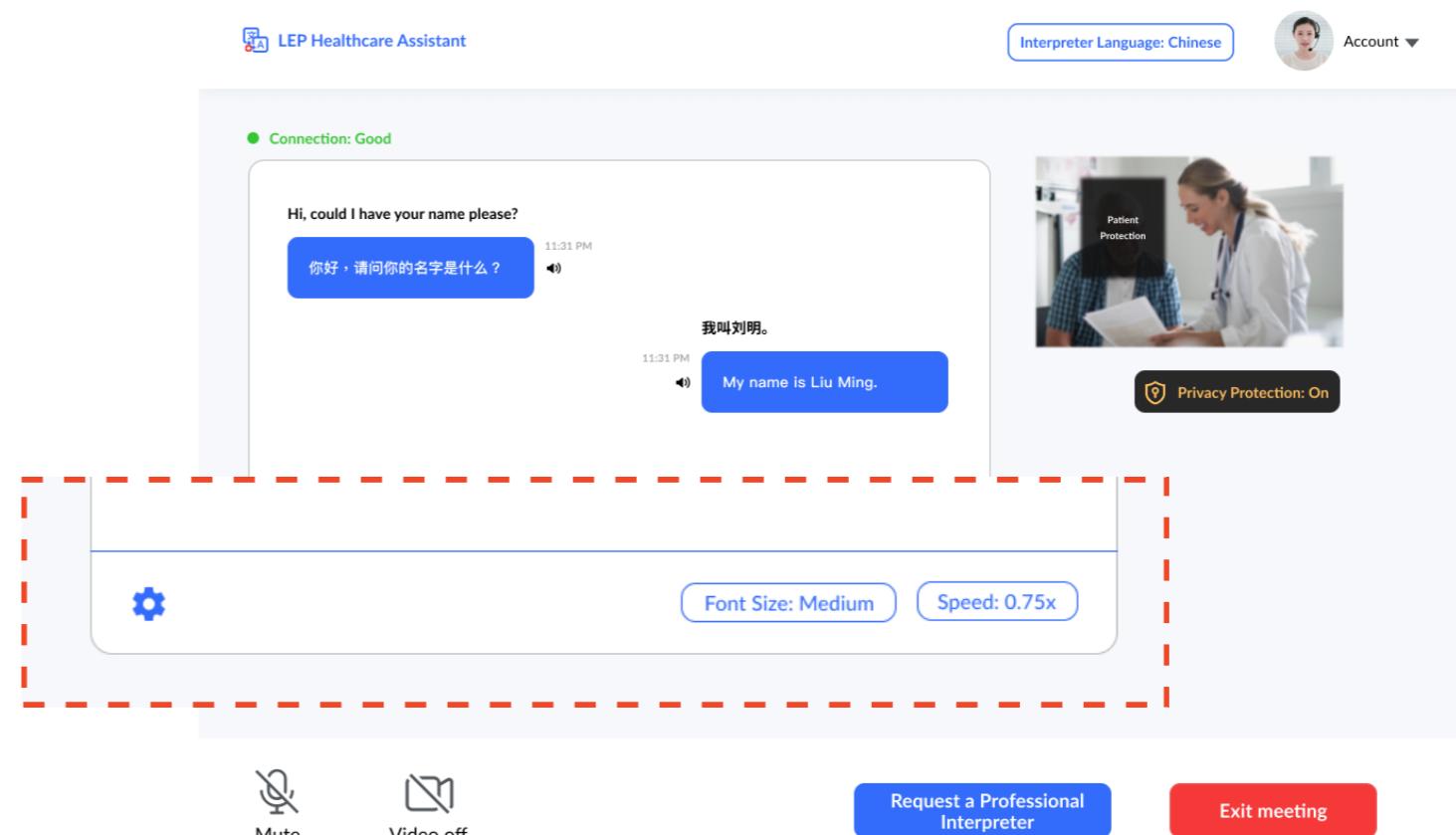
Improvements after evaluation

Secondly, based on our interviewee's feedback, we noticed that customization of the AI reader is necessary for understanding under the crowdsourcing mode. For example, Elder patients would need slower audio play of translated sentence to better understand the meaning.

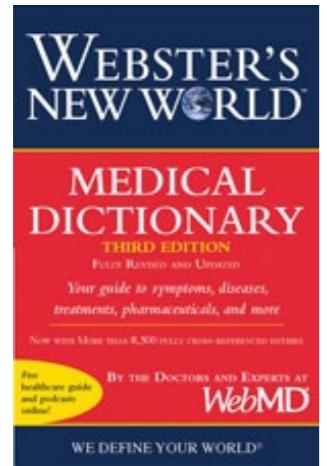
Additionally, patients may have a preference on the gender of AI to better build trust in the communication.

Therefore, we added **a setting bar at the bottom of the translation screen to allow customization in play speed, font size, gender and other aspects.**

Patients need customization to understand AI reading. (Changing speed, replay, etc.)



Improvements after evaluation



We are taking the suggestions from our participant from medical industry to have an explanation about how we could train the AI.

We expect the AI to be trained by **a series of translation script for medical cases and some databases/dictionaries containing medical terms that are frequently used.**

How to train the AI?

How to solve problems during crowdsourcing?

If the crowdsourcing contributor could not recognize the sentence or do not know the correct translation:

He/she should have option to reject the task.

If the five submitted translation for one sentence are significantly different from one another and AI could not decide on the optimal solution:

Our platform would hire certain number of experts (professional interpreters) as final decision maker, and they would receive unsolved tasks from the system under the circumstance described above and give the final solution.

If the professional translator would like to work on crowdsourcing tasks in available time.

They could turn on their availability for crowdsourcing and they would be able to receive tasks.

Discussion

Based on the evaluation outcomes and reflection on our current design solution, we think the product is implementable in real world settings because of the following reasons.

Firstly, from the perspective of technology, as stated earlier by *REAL-TIME CAPTIONING WITH THE CROWD* (<https://interactions.acm.org/archive/view/may-june-2014/real-time-captioning-with-the-crowd>), real-time translation using crowdsourcing is realizable and has been proven to be effective.

Secondly, this solution is financially practical because the crowdsourcing contributors would cost less than professional interpreters. Hospitals could pay by the service time to the platform and sign long-term contract.

Lastly, it reduces waiting time for patients and provides more convenience in the health care experience.

One concern interpreters may have is that implementing AI and crowdsourcing translation will take opportunities way from professional interpreter. However, we believe that they cannot be a complete substitute for professional interpretation. Instead, we hope to have them work together complementarily to provide the most efficient and accurate service.

What can be improved in the future?

We've made several changes according to the evaluation results, such as providing accommodations for patients based on their needs and adding speed adjustment of audio output. In the future, we wish to further improve on providing a better user experience relating to using the AI technology.

First, the sounds made by AI may make the patient feel unfriendly and untrustworthy. Some people are resistant to AI voices; no matter how we adjust our design, some users may still think that AI voices cannot be trusted.

Secondly, even if the AI output is the patient's native language, AI cannot accurately simulate different dialects because of the different accents in different regions.

In sum, in future iterations, we need a deeper understanding of our target audience, since some of them could be suffering from other inconveniences like age, disabilities, and different literacy level in technology. For example, for patients who could not even read in their primary language, we could design a fully audio treatment experience.