



Design Specification

DocQuest

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Problem Statement

A major problem in the US healthcare system is the language barrier between patients and healthcare providers. A common example of this is that the use of professional language versus plain language creates a gap between the patients and doctors. A recent report by the Institute of Medicine (IOM) shows that there's a significant mismatch between expressing from doctors and receiving to patients the medical instructions (Ross). This miscommunication can be very dangerous to the patients, and it can affect the professionalism of the health care provider.

This problem is enhanced by the fact that many patients may have only limited language proficiency. Research shows that 1 in 5 households in the US speaks a non-English language (Camarota). The biggest immigration group speaks Spanish, followed by Chinese and Russian (Camarota). Unfortunately, less than 5 percent of the nurses in the US are identified as Hispanic or Latino (McMenamin). In addition, an interpreter was no use in 46 percent of all emergency medical cases where a limited English proficiency patient was involved (Flores). The insufficiency of bilingual or multilingual healthcare provider can decrease the satisfaction of the patients as well as the efficiency of the treatment.

As this is a problem within the sensitive healthcare world, these barriers can produce *dire* consequences. Rates of hospitalization and drug complications are higher for patients with language barriers, and these patients are less likely to have a regular source of medical care as well (Flores). Even for immigrants who learned English as adults, their level of English might decrease as the brain ages. Some elderly patients might even lose their ability to communicate in English.



Causes

Language barriers exist in healthcare for several reasons:

- 1.) Medical professionals and patients do not speak the same language.
- 2.) Bilingual professionals are not available.
- 3.) Monolingual medical professionals choose not to use interpreters due to cost (Li 2015).
- 4.) Non-professional interpreters (i.e. a patient's family member) can inaccurately translate information.
- 5.) There are cultural differences for specific words and, depending on the level of English proficiency, the understanding of words in general (Li 2015) (Saha).
- 6.) Professional interpreters make mistakes as well; they may not speak the same dialect or may not be from the same cultural background (Li 2015).
- 7.) Medical professionals are not given the training to work with interpreters (Saha).

The overarching cause that leads to language barriers in health care is the lack of quality professional translators who speak the same dialect and are from the same cultural background as the patient. In an ideal healthcare experience for a non-English speaking patient, the hospital would have available translators that fit these qualifications, yet this is not always the case (Li

2015). The expense and the lack of availability of these specific translators still pose a problem. The cost of translation services for an outpatient care setting varies depending on what type of translator service is desired and can “range from \$4 to \$150 per hour for an in-person translator, \$1.25 to \$3.00 per minute for a telephone translator, and \$1.95 to \$3.49 per minute for a video remote interpreter” (Jacobs 2018). For the most part, it is not an issue for patients to pay for interpreters, since most of the expense can be paid through insurance. Instead, the clinics are responsible at the beginning stages to pay the interpreter services, and then get reimbursed through the state's program at a later period (Jacobs 2018). This process is likely one major reason for the lack of translator usage by medical professionals. This points to an overall lack of incentive and resources to make interpreters available in the healthcare world (Saha).

To illustrate the consequence of using a non-professional translator, in other words, a health professional who is bilingual yet is not proficient in a language or a relative, there is one story about a young Hispanic boy who is a bilingual and was the translator for communicating his mother's concerns for his health. While translating his mother's health concerns, he interpreted the phrase “You were like dizzy, like pale” to “Like I was like paralyzed, something like that” (Flores 2006). This is a significant change in wording that led to a miscommunication and thus diagnosis and treatment.

All these causes of language barriers in health care can lead to detrimental consequences for both the patient and professionals, such as misdiagnosis, issues with treatment, economic consequences, and increased inefficiency. In healthcare, consequences can prove to be fatal. For example, one study found that in the pediatric realm, Spanish-speaking patients with familial language barriers have a *significantly* increased risk for “serious medical events” during hospitalization, compared to patients whose families do not have language barriers (Cohen et al.).



Existing Solutions

The language barrier in health care is a huge problem with multiple causes as listed above, one way of tackling the lack of professional translators in the medical field is attempting to find ways to alleviate the need for translators in general. One way of doing this is by connecting individuals to medical professionals who do speak the same languages as the patients. There are several solutions and search engines to currently discover medical professionals so.

One existing solution is Zocdoc, a mobile and web application that allows users to search for doctors near them. What this site does well is that it successfully allows users to search for specific kinds of doctors near them, and allows for advanced searches based on criteria like availability and languages spoken. However, this does not solve the problem at hand because it produces very minimal results when filtering by language (as it is not the main focus of the application), and the language feature is hidden in a separate page from the main search..

Another web application allowing users to search for doctors is the WebMD Physician Directory webpage. This page contains a large directory of doctors to search from, and is comprehensive

regarding contact information for these doctors. However, there is no information about what languages the doctors may speak.

Word-of-mouth is yet another existing solution for discovering doctors. This allows users to gain information from trusted sources: those in the life that inform them. However, this is not a shared resource, and the information is greatly dependent on who someone may know.



For our project

We will address the lack of access to bilingual professionals. Ease of access to bilingual medical information, including in an emergency situation, will solve the main language barrier problem making the aforementioned causes no longer be an issue.



Solution

Our solution that addresses this problem is a mobile application that helps people find medical professionals who also speak their native language. While you may be unable to plan who treats you in an emergency situation, our solution tackles situations in which you *are* able to choose who treats you. The resource will have a listing of all the medical professionals in the Seattle area including information about where they are located and the languages they speak. This information would be provided by medical professionals signing up online inputting their own information as well as the Zocdoc API. Additionally, there would be reviews made by previous patients about the quality of the treatment the medical professional provided.

Another essential feature within the application is a discussion forum, where individuals would post their medical issues in which certified medical professionals from around the world would respond in the individual's native language. This crowd sourcing feature gives users/patients a resource focused on medical help. The forum is an alternative or an additional medical professional opinion in which people can access to freely. The incentive for medical professionals to become active participants in the forum is that it may advertise their clinic for future patients.



Technical Information

Because our application is meant to be quick and easy to access for general users, we don't store any data about them when the application loads. When the user first starts the application, their preferred language for the application is stored locally on their browser or phone and remembered the next time the application is opened. For anonymity sake, the user does not have any of their information stored on servers.

A doctor, on the other hand, will be required to log in to start answering questions. In a database, we would store information about the doctor for authorization as well as identification

with verification. This would include things like the doctor's name, their office address, credentials, phone number, and what their specialty is.

When a user posts a question to the application, the question would be sent to the database and stored there, and a user's identification is never attached to this post. The user will be able to save the post to their app main page, but this is again stored locally in cookies.

All of these methods of data storage are meant to separate the user from the data as much as possible so their information remains anonymous and secure. We do not collect or store any more data than is necessary.



Design Rationale

Overall Project

Our overall project design, as aforementioned, is a mobile application that connects patients to doctors that speak the same language to them.

For this design, our general rationale is that non-English speakers in the U.S. face barriers to accessing medical help. Patients with language barriers are not only less likely to have a “usual source” of medical care, but also less likely to return for follow-up appointments, higher risk of hospitalization, and increased risk of drug complications (Flores, 2006).

While interpreters may be thought of as a solution to this issue, there are also barriers to obtaining these language services. In our research, we interviewed nurses who stated that while they use interpreters, they are not always available for patients. In our interview with a pharmacist, this sentiment was echoed, and our interviewee added that specific dialects may not be covered by interpreters.

Thus, a focus on connecting patients with doctors that speak the same language can address these language barriers, and provides a potential long-term way for patients to address their medical care needs.

Doctor List

Studies have shown that many Asian Americans that are not proficient in English experience barriers when seeking help (Jones, Chow, & Gatz, 2006). In terms of health care, researches prove that only 23 percent of U.S hospitals offer training for their staffs on working with medical interpreters (Flores). One of the nurses we interviewed also affirms the existence of language barrier, saying that it is difficult to overcome this barrier especially at night shifts, since most of the interpreters do not work at night. Instead of solving the language barrier problem through translating, we decided to take a more direct approach: enable the patient to find a doctor who speaks the same language with them, and then start a conversation using the language they are both fluent at. In this way information transferring will be efficient and accurate. In other words, our application allows users to find the best-matched doctor based on their language.

Another major element we would include in our design is the doctor list interface. On this interface, users would be able to input the language that they want the doctors to be fluent in as

a searching keyword. After clicking on the search button, the lists of qualified doctors (with specific language fluency) will be shown with the top one being the closest to that user. Additionally, there will be a map visualization of this data showing the locations of all the doctors. The users will also be able to leave a comment and rate their health care experience. These reviews will be shown on the doctor's information page, serving as a reliable source to help subsequent users decide which doctor to choose.

Ideally, medical professionals' information will be generated after signing up. Besides some basic information, doctors will also be required to list their language fluency as well as their affiliated clinics. Later on, we might try to cooperate with ZocDoc and use its API which stored variety of doctors' data to enrich our existing doctor list.

Discussion Medical Board

The discussion board is where the patients and doctors communicate online about any inquiries and concerns. Since the participants can come from many different backgrounds and speak different languages, the discussions will be available in multiple languages. The users will be able to select a preferred language when they sign up. In order to participate, both parties have to sign up for an account.

The medical professionals are required to fill out basic information like name, education, occupation, specialty, location, and language skills. Background checks will also be included to ensure the reliabilities of these professionals. They will also be asked to upload a diploma of their medical education and proof of language skills. The amount of work medical professionals have to go through is to assure patients their experience with seeing doctors online is safe and effective.

As for patients, the steps will be very different from medical professionals. It's important to give patients plenty of control over the discussion board, thus a designated patient sign up page is implemented. Besides basic information like name and location, they will have the option to choose preferred languages, describe symptoms, ask questions about previous diagnoses, and choose medical divisions.

The layout of the discussion board will be fairly simple. The patients will be able to search for medical professionals based on their needs of language, specialty, and experiences. Then the patients can choose the medical professionals they're interested in talking to. They can set up an appointment with them. Since this discussion board includes sensitive personal information, it will be kept private.

The rationale for this discussion board is that individuals with English not as their first language, when they *are* able to connect to a healthcare professional, face barriers to adequately explaining their medical problems. In a survey we distributed to students, 62 percent of respondents with English not as their first language found it moderately difficult to explain their medical concerns to a doctor, while **all** respondents with English not as their first language indicated at least some difficulty explaining their medical concerns. This points to a clear need for clear, comfortable communication about medical concerns in a familiar language.

The patients are very likely to be connected with medical professionals from around the world. This provides an opportunity for professionals to help people who needed their skills and the patients a better and safer experience.

UI

Another key feature of our mobile application will be the option to change the application into the language the user is most comfortable with. This is an important part of our design because there not only exists a barrier in communicating with medical professionals, but also finding them in the first place. In the survey we distributed, answered by 57 students, around 95 percent of respondents with English not as their first language indicated some level of difficulty in seeking help for their medical needs. In addition, over 50 percent of these same group of respondents found it at least moderately (3 out of 5 on a scale) difficult to seek help.

Thus, while our mobile application gives user the ability to find doctors that speak the same language as them, this would be in vain if they could not understand how to navigate the mobile application itself.

User Personas

Based upon our research of the problem and our user tests, we created four user personas to better inform our decision making process for the high-fidelity prototype. With these user personas, we were able to better direct the focus of our solution, *who* it would actually be serving and *how* it would be serving them.



Name: Seol Eun Jung
Age: 42 yo **Proficient Languages:** Korean

Background: Immigrated to the United States with her husband and 12 year old son from Seoul due to her husband's job relocation knows little to none English

Goal: Find a family doctor who speaks fluent Korean for diabetic issues and son's asthma

Technical Skills: Low

Personality: Shy, Quiet; tends to figure things on own; protective of her family; not risk taking



Name: Mason Keling
Age: 58 yo **Proficient Languages:** English, Spanish

Background: Graduated from University of Washington as a certified pediatrician; in the field for almost 30 years; recently opened an outpatient clinic

Goal: Advertise his outpatient clinic and help those in lower income regions

Technical Skills: Moderate

Personality: Patient, Stern; Enjoys reading novels in his free time; not a risk taker; Slow learner, but once learned is pretty good; far-sighted



Name: Jeff Hernandez

Age: 10 yo Proficient Languages: Spanish, English

Bio: First generation Mexican American child of parents who's english are of limited proficiency and whos technical skills are limited to watching videos on their smartphone

Goal: **Help non-English speaking parents find a dentist within 15 miles from their house**

Technical Skills: High

Personality:
Outgoing, loud; fast learner -- plays around with things to learn; takes several risk



Name: Annabelle White

Age: 20 yo Proficient Languages: French, English

Bio: Born and raised Paris, France; Attending college in the States; Fluent in English, yet would like to find a medical professional who speaks both English and French

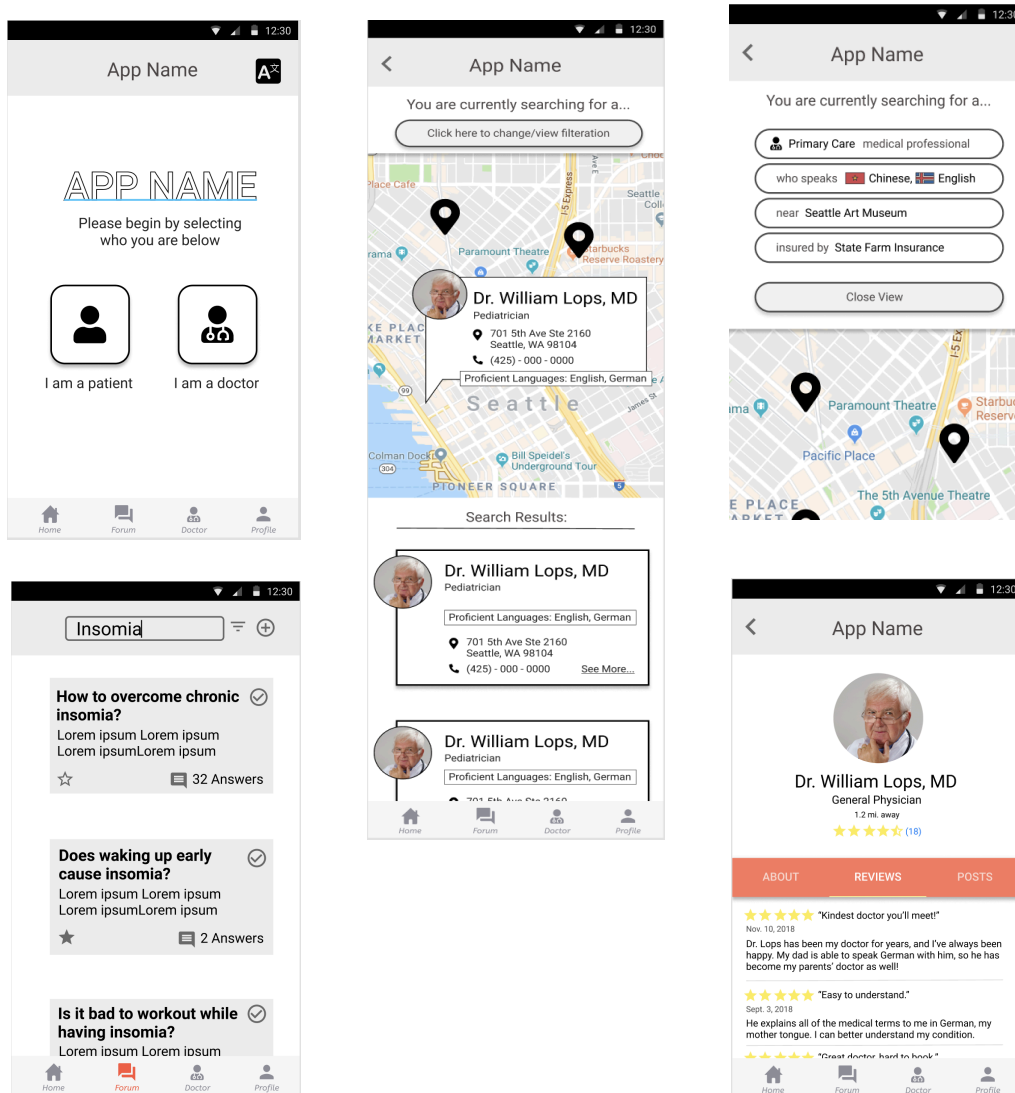
Goal: **Find a doctor for a one-time check up for a medical condition she is worried about**

Technical Skills: High

Personality:
Keeps to self, Assertive, anti-social; slow learner; risk taker; learns best hands-on

Initial Draft: Wireframes

Below are a few screens of our first prototype, which we did user testing on.



Evaluation

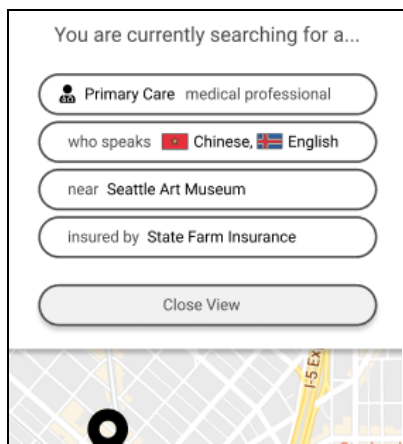
User Testing

In order to assess the quality of our initial design, we conducted usability tests with various users. The five initial user tests we did consisted of two immigrant adults, two international students, and one domestic student with English as a first language. After assuring the users that we are not testing their ability and instead testing the application, we asked them to try to use our current prototype to complete four tasks: 1) changing the application language from

English to Chinese, 2) asking a question on the medical forum, 3) finding a doctor who speaks both Chinese and English, and 4) viewing the reviews of the aforementioned doctor.

This user testing process has provided us with valuable feedback to act upon moving forward. There seems to be confusion with our language selectors: both for changing the app's display language and to filter through doctors by languages spoken.

There was a moderate amount of confusion about the process of changing the app's display language. Users found the button initially unintuitive, but eventually understood its purpose. This points to the fact that perhaps the icon we have chosen to change the display language is not as clear as we thought. Another example of a potentially confusing icon is the "plus" button that allows users to ask a new question. Both users that were not proficient in technology had difficulty understanding what this "plus" meant.



Three out of the four users that attempted to find a doctor that spoke both Chinese and English experienced difficulties. This illustrates an issue in our "find a doctor" interfaces. Users found it difficult to filter for doctors that spoke English and Chinese because there were two screens where the option to filter by languages spoken was given. Moving forward, we will aim to make this process much clearer by better organizing the language selection process.

The image **above** shows the icon we used for changing the interface language. The image to the **left** shows the interface that the user interacted with to refine their search for a doctor, which three out of four users found difficult.

Overall, these evaluations of our design informed us that we had to update a few elements of our design to better communicate with the user: whether that be visually, or using explanatory text.

High Fidelity Prototypes ([link](#))

Based on the feedback we received from our initial user tests, we updated our wireframes and made the following final prototypes. Below we are including some key screens of our high-fidelity prototype, and brief explanations of their functions.

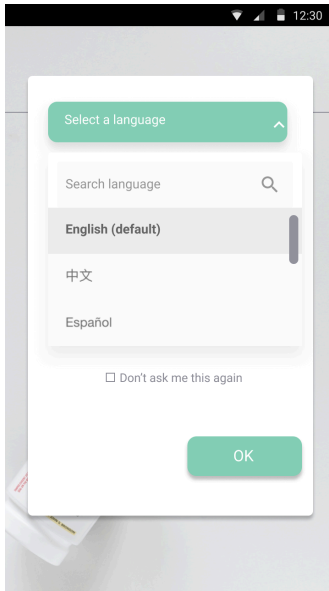


Figure 1

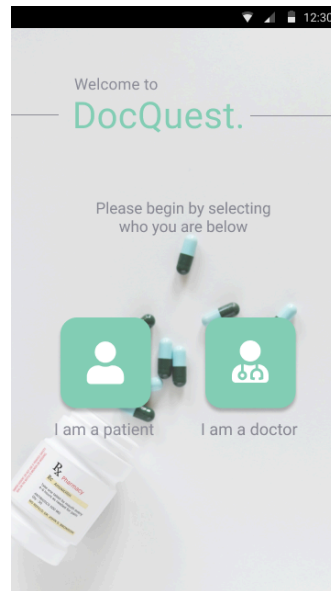


Figure 2

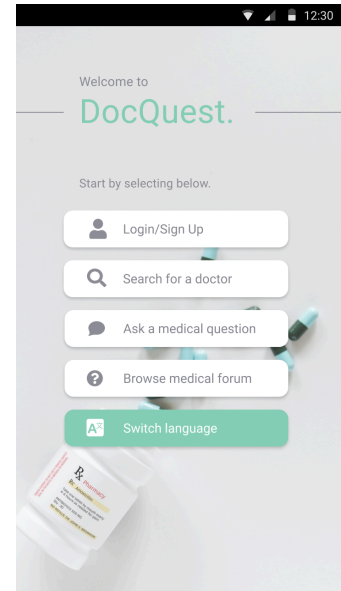


Figure 3

In the initial landing page (Figure 1), users will firstly be asked to select the system language. After that they will be able to continue as either a patient or a doctor (Figure 2). If they choose the patient option, they will soon enter the patient landing page (Figure 3) which shows major functions including log in/sign up, search for a doctor, ask a medical question, browse medical forum and switch system language. Ideally a doctor will be able to sign up and answer the questions posted in the medical forum, we may incorporate those in the future but currently we will mainly focus on developing our app from the patient's view.

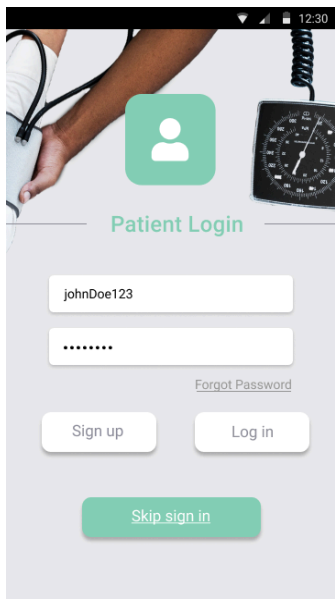


Figure 4

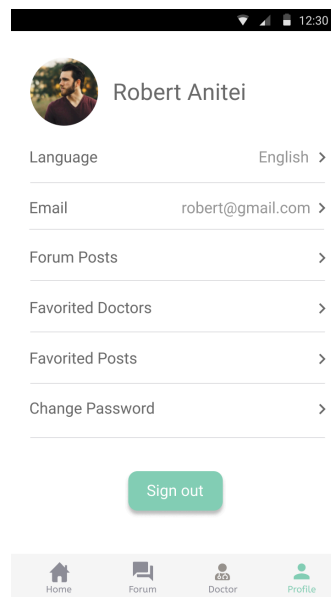


Figure 5

On the user login page (Figure 4), we also provide the option of “skip sign in”. After signing up, users will be able to get access to their profile page(Figure 5) and see the lists of their favorited doctors, favorited posts, as well as the posts they have submitted into the forum.

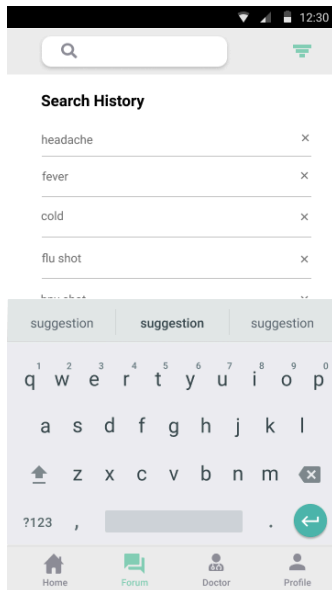


Figure 6

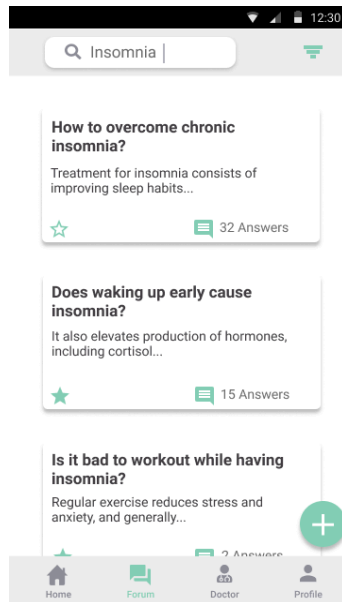


Figure 7

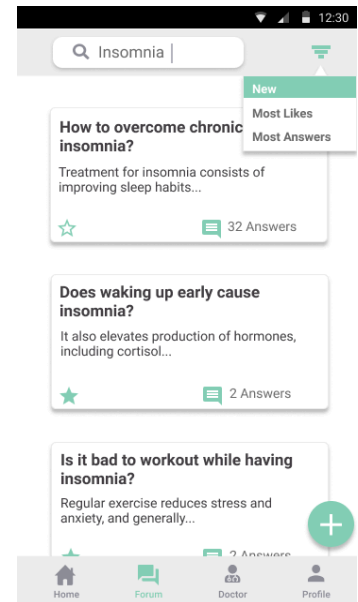


Figure 8

By clicking on the forum tab on the bottom navigation bar, users will be able to access the medical forum, where users can search a health issue they concern about (Figure 6). To protect users' privacy as well as to provide an environment where users feel comfortable and safe to

communicate, their identity will not appear in the forum, in other words, users will be able to post health relevant questions anonymously (Figure 7). Users can also favorite any questions by clicking on the star button on the bottom left of each question card so that review them later. Meanwhile, the answers icon on the bottom right of each question card shows how many certified doctors have answered this question. By clicking on the filter icon on the right side of the search bar (Figure 8), users will be able to customize the display sequence of the searching results, and in this way they can quickly find questions being posted most recently , questions with most likes, and questions with most answers.

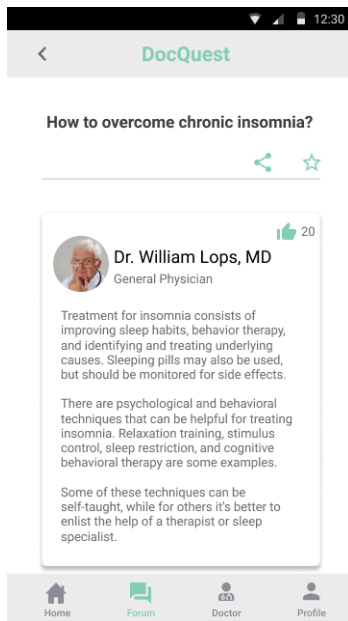


Figure 9

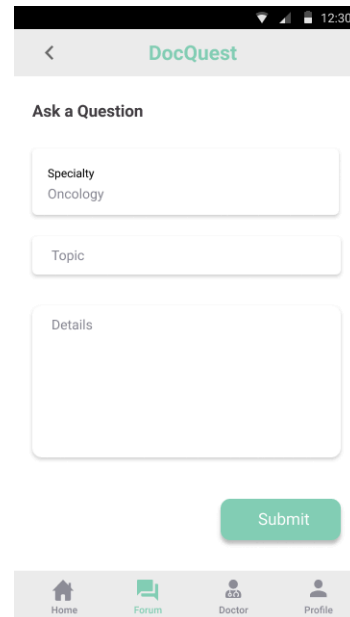


Figure 10

Once the users click on certain card with the question they want to learn more about, our app will direct them to the interface that contains the details of various answers (Figure 9). If the users find one answer to be helpful, they could click on the thumb icon on the top right corner of that answer card, as we believe this function can help users determine whether certain answer is reliable.

During our first round of user tests, several users found it difficult to find the add button next to the search bar while they were asked to add a new question to the forum. We decided to move the add button on the bottom right corner of the forum interface (Figure 7), and made the surrounding circle it solid-filled with the theme color green, in this way the button can become more intuitive to the users. Once the users click on the add button, they will be able to specify the health question and then ask the question anonymously.

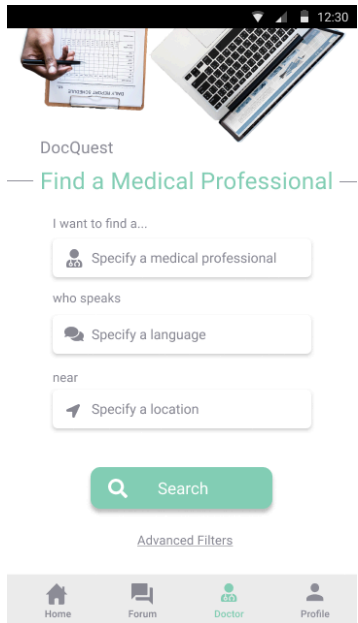


Figure 11

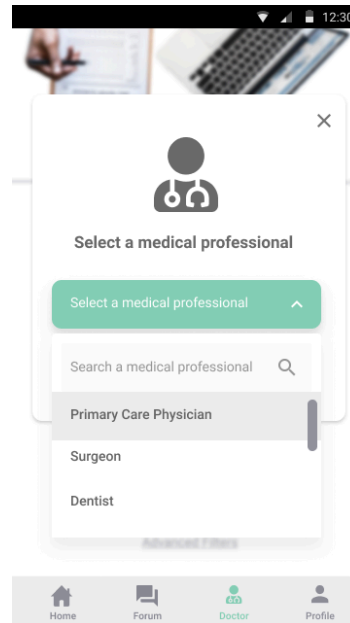


Figure 12

By clicking on the doctor icon on the bottom navigation bar, users will get access to the landing page that allows them to find a medical professional (Figure 11). First of all, users can easily specify a certain medical professional they are looking for (Figure 12).

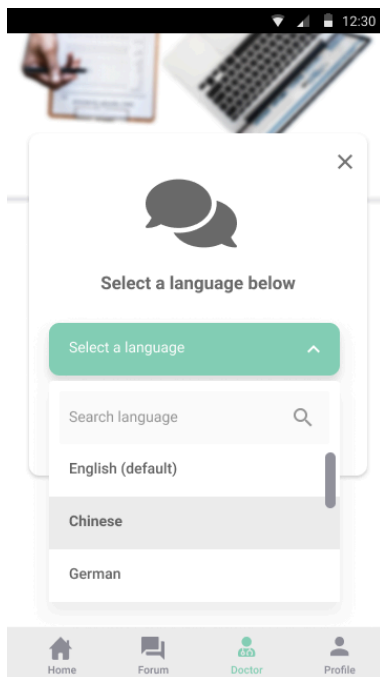


Figure 13

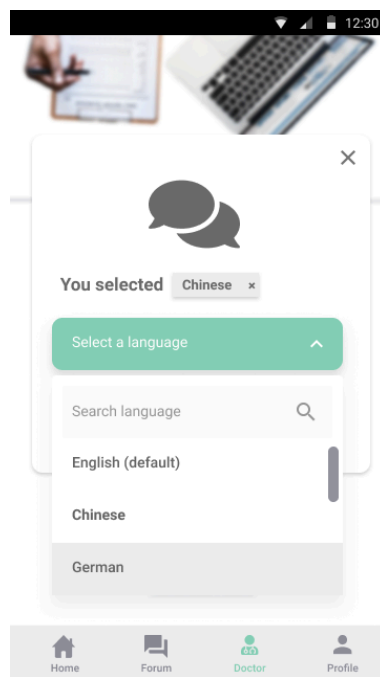


Figure 14

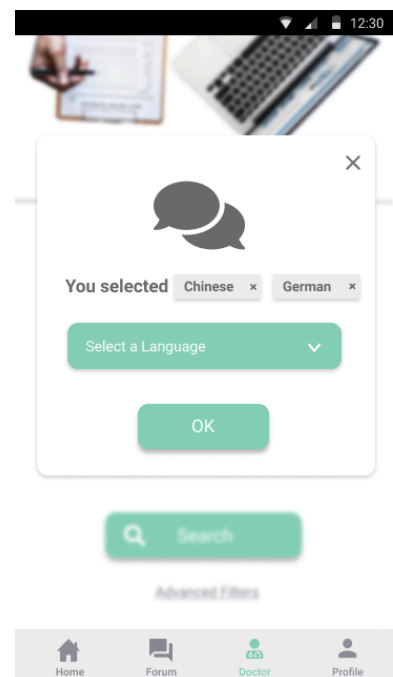


Figure 15

In addition, we also allow the users to specify certain languages they want the doctor to be able to speak. As our first round of user tests reflect several users found it somewhat difficult to accomplish the task of finding a doctor who speaks both Chinese and English. So we fixed this filter in a way that it becomes clear for the users that they can choose one or more languages at the same time (Figure 14, Figure 15).

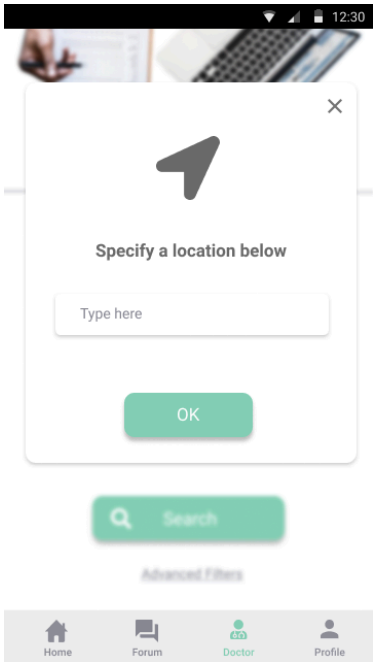


Figure 16

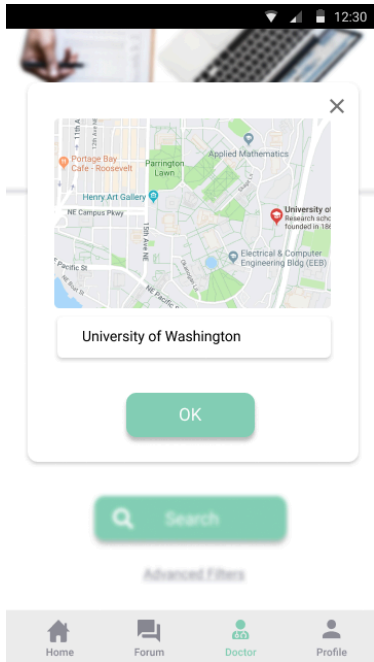
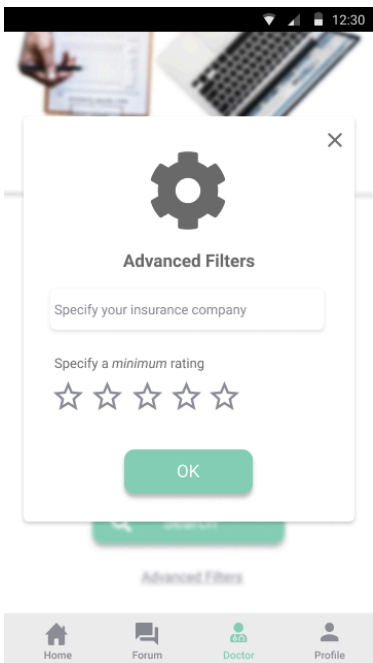


Figure 17

Furthermore, users are also able to specify certain location they want the doctor’s clinic to be close to (Figure 16, Figure 17)



(left) Figure 18

We also incorporate the advanced filters feature in order to help users find the best-match doctor. Users not only can filter out results based on specific professional, language and location, but also can filter out results based on the specific insurance company they want the clinic to support and the a minimum rating of the doctor.

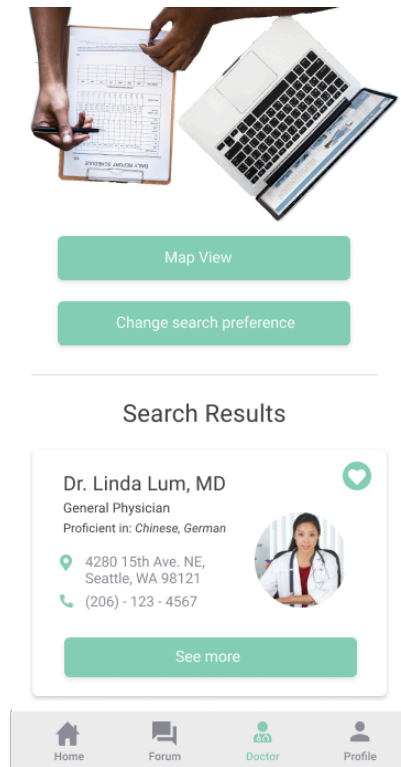


Figure 19

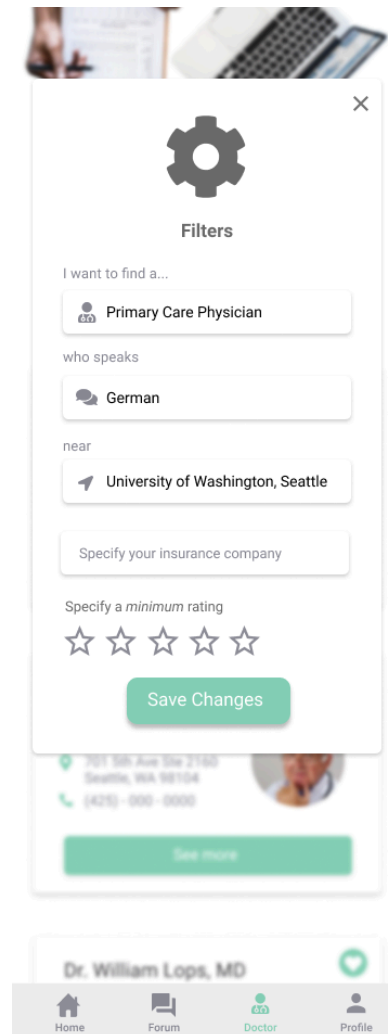


Figure 20

After all the filters have been applied, qualified doctors will show up in the format of a list (Figure 19), where the users will be able to scroll down to see more doctors . We also allow the users to reset their search preference (Figure 20) if they want to search for a different doctor.

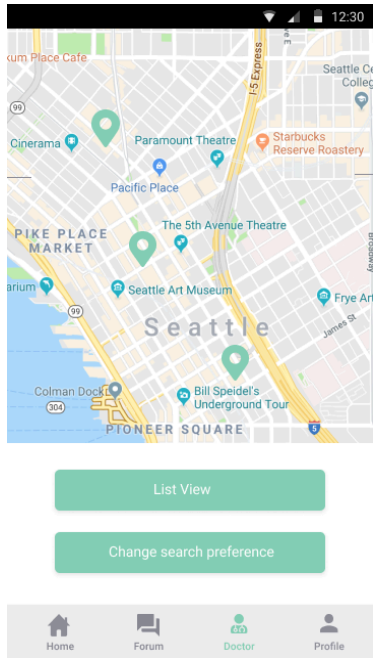


Figure 21

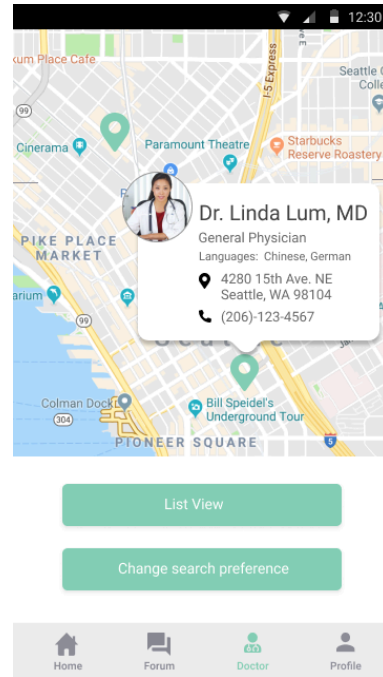


Figure 22

Users can also switch from list view to map view to see a map with the location of each doctor's clinic (Figure 21). By clicking on specific location icon on the map, users will be able to see some basic information of corresponding doctor (Figure 22).

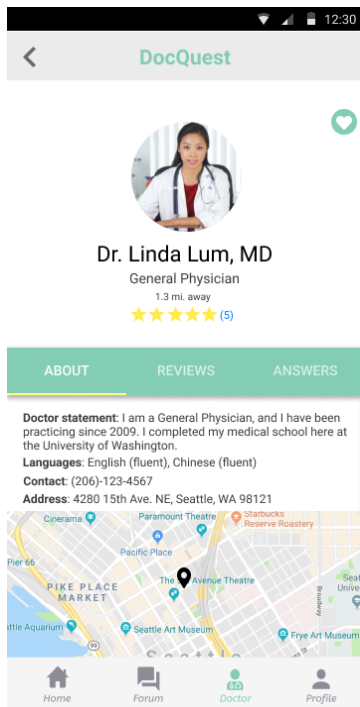


Figure 23

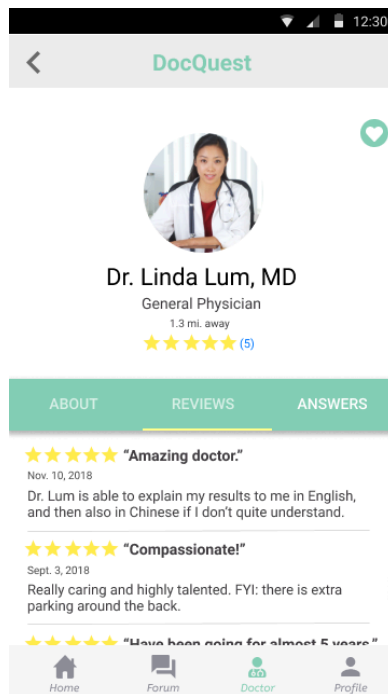


Figure 24

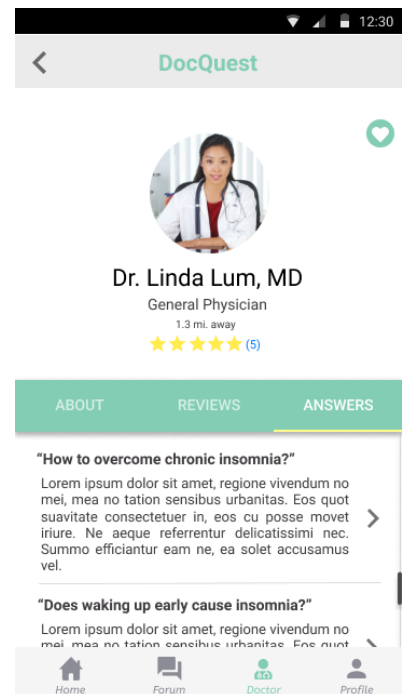


Figure 25

Selecting a specific doctor will enable the users to enter the doctor's profile page that contain more detailed information (Figure 23). The heart icon on the top right corner allows the users to mark certain doctor as favorite doctor. Users will also be able to see the reviews and rating that other patients have given to that specific doctor (Figure 24). Moreover, users can look through all the questions that the doctor has answered in the forum (Figure 25).



Limitations

Resolving the language barrier that exists in the medical field is a large and challenging problem that our solution cannot resolve alone. However, our solution addresses this problem by focusing in on connecting individuals who cannot speak English to medical professionals who can speak their native language to alleviate the need for medical translators. However, there are several assumptions that we make that limit who can use our application as well as how effective our solution can resolve this problem.

For one, we are relying on medical professionals to contribute to answering patient questions through the medical forum. Additionally, while we may be using ZocDoc's API to generate our database of medical professional information, we are also relying on medical professionals to input their own data to the application. Our applications relies heavily on medical professionals to actively use our application to help individuals. Though this expectation may not be realistic considering the lack of incentive to do so, besides promotion of their health clinic. The reliance on crowdsourcing for this mobile application is a major limitation because without medical professional participation and the overall dataset our application will be useless.

A major limitation of our application was our lack of feedback from medical professionals. In general, it was challenging to reach out to medical professionals to talk to and attain feedback about our application. While we attained a lot of information from the patient users through user testing, we did not obtain information from the medical professional perspective. Therefore a major user of our application was unable to evaluate the mobile application. In the future, we would want to have a medical professional give feedback on our application as well as have more non-English speaking individuals test our application.



References

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