Software & Design Requirements Specification

for

MedMeet Software Application

Version 1.2

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COEN 285

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Revision History

Name	Date	Reason For Changes	Version
Jonathan Laroco	11/13/16	Initial Document	1.1
Troy Pandhumsoporn	11/13/16	Miscellaneous Sections(working on)	1.1
Josh Ding	11/18/16	User Interface development/analysis	1.1
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Troy Pandhumsoporn	12/11/16	Final review and sign off	1.2

1. Introduction

1.1 Purpose

The MedMeet online web application will facilitate the doctor's visit virtually, allowing doctors (which shall also be referred to as practitioners) and patients to communicate via text messaging and video conferencing.

In addition to facilitating the virtual doctor's visit, MedMeet will help patients and doctors manage appointments, medical diagnoses, and medical records.

The purpose of this document is to describe all of the software and design requirements of MedMeet's functionalities in detail.

1.2 Intended Audience and Reading Suggestions

The intended audience of the document are individuals such as developers, project managers and quality assurance engineers. This document contains requirements research & analysis, software design analysis and testing analysis in order to ensure a successful product.

The suggested reading varies from the user's; software and user requirements are described in Sections 1, 2 and 3, while the design and analysis of the application are described in Sections 3, 4, and 5. Testing scenarios are described in Appendix C and under Section 6 .

User reading will fall into three sections user/software requirements (Project Managers/Developers), design analysis (Project Managers/Developers) and testing analysis (Quality Assurance Engineers/Project Managers).

1.3 Product Scope

The intent of this product is to provide a highly available, easily accessible platform through which practitioners and patients may connect. Extensions of this requirements include requirements for video conferencing, appointment scheduling and management, medical records management, and user account management. In addition, this product will increase the efficiency of managing non-life-threatening emergencies by minimizing the time that practitioners and patients spend within the process.

Although the MedMeet application follows the same processes as a normal doctor's visit, the application is not designed to handle life-threatening emergency requests, examples including but

not limited to heart attacks, hemorrhages, seizures, broken bones, trauma wounds, etc. A patient is advised to contact emergency services if he or she is undergoing those types of emergencies.

In addition, MedMeet does not provide any hardware or software means to facilitate advanced imaging--examples of which include but are not limited to CAT scans, X-Rays, thermal imaging, microscopic imaging, etc. The application will only interface with auxiliary webcams and cameras integrated in laptops and other mobile devices.

MedMeet also does not provide any means to facilitate specimen tests of biological samples--examples which include but not limited to samples taken from hair, skin, blood, urine, saliva, etc.

As such, if a patient requires the advanced imaging services or biological specimen tests, his or her practitioner may provide a referral to secondary clinics that offer these services.

During the initial implementation, MedMeet will not automatically send drug prescriptions to pharmacies. While practitioners may create prescriptions orders and send them to patients, it is up to the patient to print and deliver the prescription to the pharmacy.

Disclaimers and Non-Disclosure Agreements will be used to communicate the intended purpose of the MedMeet application for all users.

2. Overall Description

2.1 Product Perspective

MedMeet is a standalone software program that will be implemented initially as a web application utilizing a combination of the Bootstrap framework, HTML, CSS, JavaScript, and PHP.

This idea was inspired by other mobile applications and online resources like ZocDoc and WebMD; however, the development team found several functionality gaps in the existing products, particularly those in facilitating practitioner/patient communications and expert medical diagnoses.

Future releases and variations of the product are planned to be developed using the MEAN Stack (MongoDB, Express.js, Angular.js, and Node.js) to enhance scalability and further improve availability.

See Context Diagram in Appendix A, Figure 1.2 (show major components of overall system, subsystem interconnections, and external interfaces, use case diagrams alternatively).

2.2 Product Functions

The MedMeet application will focus on the following four main software functionality groups:

- **User account management:** a capability to facilitate logins, registrations, password changes, and profile information updates for both patients and practitioners.
- **Online video conferencing:** a capability to facilitate a virtual doctor's office visit.
- **Appointment scheduling/management:** a function to help practitioners manage their upcoming (virtual and in-person) appointments, and for patients to schedule and manage their (virtual and in-person) visits with doctors.
- **Medical Information Management:** a capability to help patients centralize and manage their medical history as well as easily submit their medical history prior to a consultation with a practitioner; practitioners will be able to indirectly update a patient's medical history with diagnoses and appointment notes after a consultation.

User account management functionalities are common across most major software applications that handle confidential or personal information; the remaining three functionalities are key components in the doctor's visit process (online video conferencing is a virtual manifestation of a patient's physical in-person consultation with a practitioner).

This document will describe the main functionalities in detail as well as provide descriptions of their sub-functionalities.

Figures 1 & 2 show the functional block diagrams that describe the functionalities both the patient and doctors users will be allowed to perform.

2.3 User Classes and Characteristics

Within the MedMeet online application software program, there will be two distinct user classes distinguished by the doctor appointment process: practitioners and patients.

The main functionalities provided to the patient will be an intuitive dashboard interface to view his/her medical records, as well as schedule and view appointments with practitioners. In addition, the application offers video conferencing to virtually connect a patient with a practitioner. A patient will also be able to submit his or her medical history prior to a consultation with a practitioner.

The second user class is the practitioner user; these users will have access to the same functionalities as patient users with the exception that practitioners will be indirectly updating a patient's medical history with appointment notes, diagnoses, and drug prescriptions. Additionally, practitioners will utilize a virtual lobby to admit patients into a video conferencing session.

2.4 Operating Environment

The initial operating environment will be a web application developed using a combination of the Bootstrap framework, HTML, CSS, JavaScript, and PHP. This application will be run on an Apache 2.4.23 web server and hosted on four separate Amazon Web Services (AWS) EC2 Linux virtual

machines in the cloud. User access requests will be distributed across all servers by an AWS Elastic Load Balancer to prevent overload on any one server. In addition, the application will write to and read from two separate Oracle SQL Databases hosted on AWS RDS instances.

The application will integrate with the VSee Telehealth Platform API to facilitate the online video conferencing and Google Maps API to facilitate location-based services. Moreover, this application can be accessed via desktop computers, laptops, and other mobile devices to ensure maximum availability and accessibility.

2.5 Design and Implementation Constraints

During the design and implementation of the MedMeet application, the development team noted the following constraints:

1) The application is not intended to serve patients experiencing life-threatening emergencies.
2) The application does not offer advanced imaging solutions nor does it offer biological specimen testing solutions.
3) MedMeet and its development team do not assume responsibility of any medical malpractice/inappropriate user behavior that occurs on the application. Users are expected to self-police the community.
4) The application will make use of open-source software programs, libraries, development-kits, and API's to keep capital expenses at a minimum.
5) The application will be hosted in the cloud to reduce infrastructure overhead. As a result, resolution of all infrastructure and hardware-related issues are dependent on the vendor providing the service which may increase the lead time for resolving the outages.
6) The software development process selected to build the application determines the workflow organization of the development team. Meeting deadlines, time constraints of tasks, concurrency objectives, software design, and software architecture will hinge on the proper selection of the development process.
7) Specific Web Frameworks, programming languages, and coding styles (i.e. Google, Lockheed, UNIX-style, the development team's default style) will drive the flow of the software development process as well as impact software design and architecture decisions.
8) The initial system will be implemented on a LAMP (Linux, Apache, MySQL, PHP) software stack; this implementation will present scalability issues. Therefore, the initial system will not be able to service more than 100,000 users.
9) The application will only be available for users within the United States of America for its initial implementation.
10) The application makes use of video conferencing software VSee to remain in compliance with HIPAA (Health Insurance Portability and Accountability Act). More popular videoconferencing software such as FaceTime and Skype are not HIPAA-compliant, and thus barred from use within the application.

2.6 User Documentation

MedMeet will provide the following documentation to better educate patients and practitioners on the use of the application. **Table 2.1** lays out the current planned documentation to be provided to users.

Documentation Type	Description of Documentation
Release Notes	Documents summarizing added functionalities, removed/discontinued features, usually called update/version X.Y.Z, around a one month to three month cycle.
Quick Start Manual	An abridged version of the user manual to familiarize the users with minimal time investment.
*User Manual	Full length document identifying the specific properties and glossary of terms reference for understanding certain features and functions.
Tutorials	Short (3-5 page) documents in PDF (or alternatively, WebCasts and Webinars) that are provided as on/off-line help. A new standard for end-user documentation combines video, screenshots, and text.

Figure 2.1: Table providing a list of documentation that will be supplied to MedMeet users

**The need for extensive end-user documentation (user manual) is quickly disappearing as software becomes more intuitive due to more emphasis on user interface and user experience. Screencasts are prefered over user manuals nowadays [1].*

2.7 Assumptions and Dependencies

2.7.1 Assumptions

When setting the initial project scope, we (the development team) determined that the MedMeet application would not be available for use during life-threatening emergencies. In these instances, a patient is assumed to understand that he or she must contact emergency services for medical assistance.

As a basis for accessing the application, all users are assumed to have access to a laptop/PC, smartphone, and/or tablet; all of these devices are assumed to have cameras to facilitate video conferencing. In addition, patients are assumed to have basic measurement devices, including weight scales, thermometers, stopwatches, and rulers. Alternatively, patients can be assumed to know their weight and height.

All users who register for the application are assumed to be registering in good faith - that is, they are assumed to be registering with authentic information (and not personal information acquired via identity theft or fabricated information).

All registered users are expected to comply with any legal regulations, behave appropriately, and use the application as the development team intended for MedMeet to be used.

In addition, all registered users are assumed to have the proper materials for account setup (insurance and payment information for patients, and medical licenses for practitioners).

The MedMeet application will also integrate with the Google Maps API and VSee Teleconferencing API. Since the MedMeet development team does not own the source code to these dependent applications, it is assumed that the developers of the aforementioned applications will keep them in good working order.

2.7.2 Dependencies

It should be noted that MedMeet does not take responsibility for any malpractice that may occur; MedMeet will screen and ensure are practitioners are properly licensed and in good standing with federally and internationally recognized governing bodies, MedMeet will not act as one of these governing bodies. Instead, it will be up to the users to monitor the MedMeet community by rating practitioners/users and reporting potential violations or instances of malpractice.

When a practitioner registers with the MedMeet system, MedMeet will validate the legitimacy of the practitioner's credentials, validity of his/her medical license, and the history of his/her practice by referencing government databases. Therefore, it is crucial that these databases are kept in good-standing to offer maximum protection for patients using the application.

The MedMeet application will also integrate with the Google Maps API and VSee Teleconferencing API. Since the MedMeet development team does not own the source code to these dependent applications, it is assumed that the developers of the aforementioned applications will keep them in good working order.

2.8 User Requirements

Based on the data analysis, we have come up with four main user requirements categories: Online Video Conferencing, Doctor Appointment Management and Medical Information Management. Within these we have some sub-requirements that make up the overall user requirement for each product feature.

From this point forward, all requirements denoted with a ".PR" suffix shall denote a requirement pertaining strictly to practitioners, and those requirements denoted with a ".PA" suffix shall denote requirements pertaining strictly to patients.

2.8.1 User Account Management

2.8.1.1.PA Patient Registration

A. A non-existing patient shall be able to register for application access with his or her email address, password of choice, and security questions and responses.

B. Upon registration, a confirmation email shall be sent to the patient's designated email address. After the patient confirms his/her registration via the email, he/she shall be provisioned for application access.

C. If a patient inputs any incorrect/improperly formatted information during registration, he/she shall receive an error message and shall be prompted to correct the information.

2.8.1.2.PA Patient Login

A. A registered patient shall be able to access the application using his or her login credentials (email address and password provided during the registration process).

B. If a patient inputs any incorrect/improperly formatted information during login, he/she shall receive an error message and shall be prompted to correct the information.

2.8.1.3.PA Account Recovery

A. In the event a patient forgets his or her login credentials, the user shall be able to request new login credentials provided he or she correctly passes the security checks including but not limited to captchas, security questions, and SSN (Social Security Number) verification.

B. If a patient inputs any incorrect/improperly formatted information during account recovery, he/she shall receive an error message and shall be prompted to correct the information.

2.8.1.4.PA Updating Account Information

A. A patient shall be able to change/edit the following fields through the application:

   a. **Contact information including** name, phone number, email address, and physical address.
   b. **Login credentials** including email address, password, SSN, security questions, and security question responses.
   c. **Payment information** including insurance information and preferred method of personal payment (i.e. credit card, debit card, PayPal, etc.).

B. If a patient inputs any incorrect/improperly formatted information when updating account information, he/she shall receive an error message and shall be prompted to correct the information.

2.8.1.1.PR Practitioner Registration

A. A non-existing practitioner shall be able to register for application access with his or her email address, password of choice, security questions, security question responses, and medical license information.

B. Upon registration, a confirmation email shall be sent to the practitioner's designated email address. After the practitioner confirms his/her registration via the email, he/she shall be provisioned for application access.

C. If a practitioner inputs any incorrect/improperly formatted information during registration, he/she shall receive an error message and shall be prompted to correct the information.

2.8.1.2.PR Practitioner Login

A. A registered practitioner shall be able to access the application using his or her login credentials (email address and password provided during the registration process).

B. If a practitioner inputs any incorrect/improperly formatted information during login, he/she shall receive an error message and shall be prompted to correct the information.

2.8.1.3.PR Account Recovery

A. In the event a practitioner forgets his or her login credentials, the user shall be able to request new login credentials provided he or she correctly passes the security checks including but not limited to captchas, security questions, and SSN (Social Security Number) verification.

B. If a practitioner inputs any incorrect/improperly formatted information during account recovery, he/she shall receive an error message and shall be prompted to correct the information.

2.8.1.4.PR Updating Account Information

A. A practitioner shall be able to change/edit the following fields through the application:

   a. **Contact information including** name, phone number, email address, and physical address.
   b. **Proof of authorized medical practice** including certifications, licenses, accreditations, and career history.
   c. **Login credentials** including email address, password, SSN, security questions, and security question responses.

d. **Payment information** including insurance information and preferred method of personal payment (i.e. credit card, debit card, PayPal, etc.).

B. If a practitioner inputs any incorrect/improperly formatted information when updating account information, he/she shall receive an error message and shall be prompted to correct the information.

2.8.2 Online Video Conferencing

2.8.2.1.PA Submission of Medical History

A. Prior to establishing a video conferencing session with a practitioner, a patient shall be able to submit his/her Medical History (2.8.4.2.PA) to the practitioner for review.

B. The submission shall be facilitated automatically when a patient Establishes a Consultation Session (2.8.2.7.PA) with a practitioner.

2.8.2.2.PA Submission of Symptoms

A. For non-scheduled consultations:

a. Prior to Establishing a Consultation Session (2.8.2.7.PA) with a practitioner, a patient shall be able to submit a description of his/her symptoms and/or reason for initiating a consultation.
b. If a patient attempts to establish a video-conferencing session without a Submission of Symptoms, he/she shall be presented with an error message prompting him/her to complete the Submission of Symptoms.
c. The patient shall not be admitted into the Virtual Lobby (2.8.2.4.PA) prior to the Submission of Symptoms.

2.8.2.3.PA Choosing a Practitioner

A. For non-scheduled consultations:

a. The patient shall be presented with a list of practitioners available for consultation as well as the practitioners' ETA to Establishing a Consultation Session (2.8.2.7.PA), the practitioner's online status (Available, Away, Busy, or Offline), the practitioner's physical location, and the practitioners' satisfaction rating. Order of practitioner ranking shall be displayed by proximity to the patient's physical location (closer proximity ranks higher), practitioner online status, and the practitioner satisfaction ratings.
b. Once the patient selects a practitioner, he/she shall be prompted to complete the Submission of Symptoms 2.8.2.2.PA).

B. For consultations Scheduled via an Appointment (2.8.3.1.PA), the patient shall be able to select his/her Primary Healthcare Physician.

2.8.2.4.PA Virtual Lobby

A. For non-scheduled consultations:

   a. After the patient has completed the Submission of Medical History (2.8.2.1.PA) and Submission of Symptoms (2.8.2.2.PA), he/she shall be placed into a Virtual Lobby to await consultation with a practitioner.
   b. The patient shall be presented with an ETA to Establishing a Consultation Session (2.8.2.6.PA), the chosen practitioner's online status (Available, Away, Busy, or Offline), the chosen practitioner's physical location, and the chosen practitioner's satisfaction rating.

B. For consultations Scheduled via an Appointment (2.8.3.1.PA)

   a. After the patient has completed the Submission of Medical History (2.8.2.1.PA), he/she shall be placed into a Virtual Lobby to await consultation with his/her Primary Healthcare Physician.
   b. The patient shall be presented with an ETA to Establishing a Consultation Session (2.8.2.6.PA), the chosen practitioner's online status (Available, Away, Busy, or Offline), the chosen practitioner's physical location, and the chosen practitioner's satisfaction rating.

2.8.2.5.PA Audio and Video Check

At any point during the use of the application, a patient shall be able to ensure the proper function of audio and video devices necessary to facilitate a consultation with a practitioner.

2.8.2.6.PA Accepting/Declining Request for Consultation

A. If a patient initiates a consultation session, he/she shall wait to be admitted into the video conference.

B. If a practitioner initiates a consultation session, then the patient shall have two (2) minutes to accept or decline the consultation.

2.8.2.7.PA Establishing a Consultation Session

If a patient accepts a request for consultation with a practitioner, or the practitioner accepts a patient's request for consultation, then the patient shall be placed into the video-conference, thus commencing the consultation session.

2.8.2.8.PA Terminating a Consultation Session

A. At any point during the consultation, a patient shall be able to terminate the consultation session.

B. Once the session has been terminated, the patient shall be presented with an option to return to his/her Main Dashboard (2.8.4.1.PA) or the Virtual Lobby (2.8.2.4.PA).

C. Upon session termination, an automatic billing charge shall be placed against the patient's insurance and/or preferred payment method.

2.8.2.9.PA Post-Consultation Actions

A. At any point following the conclusion of the consultation, the patient shall be able to follow up with the practitioner consulted via text-based messaging.

B. The patient shall also be able to view the details of the consultation including prescriptions for medication, the practitioners' notes, and activity logs related to the consultation.

2.8.2.1.PR Examination of Medical History

A. Prior to establishing a videoconferencing session with a patient, a practitioner shall be able to examine the patient's medical history.

B. The patient's medical history shall be automatically submitted to the practitioner prior to Establishing a Consultation Session (2.8.2.6.PR).

2.8.2.2.PR Examination of Symptoms

For non-scheduled appointments, prior to Establishing a Consultation Session (2.8.2.6.PR) with a patient, a practitioner shall be able to examine a description of the patient's symptoms and/or reason for initiating a consultation.

2.8.2.3.PR Virtual Lobby

A. For non-scheduled appointments, the practitioner shall be able to view a list of patients waiting in the virtual lobby and use his/her discretion as to which patient to admit first based on the Examination of Symptoms (2.8.2.2.PR), the Examination of Medical History (2.8.2.1.PR), and the system-indicated time for which the patient has been waiting in the Virtual Lobby.

B. For consultations Scheduled via an Appointment (2.8.3.1.PR), the practitioner shall be Notified of a Pending Appointment (2.8.3.2.PR)

2.8.2.4.PR Audio and Video Check

At any point during the use of the application, a practitioner shall be able to ensure the proper function of audio and video devices necessary to facilitate a consultation with a patient.

2.8.2.5.PR Accepting/Declining Request for Consultation

A. If a practitioner initiates a consultation session, he/she shall wait to be admitted into the video conference.

B. If a patient initiates a consultation session, then the practitioner shall have two (2) minutes to accept or decline the consultation.

2.8.2.6.PR Establishing a Consultation Session

If a practitioner accepts a request for consultation with patient, or the patient accepts a practitioner's request for consultation, then the practitioner shall be placed into the video-conference, thus commencing the consultation session.

2.8.2.7.PR Conducting a Consultation Session

A. During the consultation, the practitioner shall be able to take notes and memos pertaining to the consultation.

B. Notes and memos shall be taken either within the application, or offline (which can then be scanned, uploaded, photographed, or any combination thereof).

C. In addition, during the consultation, the practitioner's online status shall appear as "Busy", which shall prevent any other patients from joining the consultation session.

2.8.2.8.PR Terminating a Consultation Session

A. At any point during the consultation, a practitioner shall be able to terminate the consultation session. Once the session has been terminated, the practitioner shall be notified to complete the Post-Consultation Actions (2.8.2.9.PR).

B. Upon termination of a session, the patient's insurance will be billed and the patient's preferred payment method will be charged.

2.8.2.9.PR Post-Consultation Actions

A. Upon Terminating a Consultation Session (2.8.2.8.PR), the practitioner will be provided an option to

    a. Return to the Main Dashboard (2.8.4.1.PR) of the application
    b. Return to the Virtual Lobby (2.8.2.3.PR)
    c. Prescribe the Patient Medication (2.8.2.10.PR)
    d. Provide a referral to a Secondary Clinic (2.8.2.11.PR)
    e. Submit a Summary of the Consultation (2.8.2.12.PR) session

B. At any point following the conclusion of the consultation, the practitioner shall be able to follow-up with a patient via text-based messaging within the application.

2.8.2.10.PR Prescribing the Patient Medication

A. At any point after conclusion of a consultation, the practitioner shall be able to prescribe medication to the patient.

B. Prescriptions shall be written directly in the application and authorized with an electronic signature, or hand-written and then subsequently scanned, uploaded, photographed, or any combination thereof and then sent to the patient via the MedMeet application.

C. Any medication prescribed shall be automatically updated to the patient's Medical History (2.8.4.2.PA)

2.8.2.11.PR Referral to a Secondary Clinic

A. At any point after conclusion of a consultation, if the patient requires advanced imaging services or biological specimen test services, the practitioner shall provide a referral to secondary clinics which offer those services.

B. Referrals shall be written directly in the application and authorized with an electronic signature, or hand-written and then subsequently scanned, uploaded, photographed, or any combination thereof and then sent to the patient via the MedMeet application.

2.8.2.12.PR Submitting a Summary of the Consultation

A. At any point after conclusion of a consultation, the practitioner shall be able to draft a summary of the consultation session with the patient.

B. Summaries shall be written directly in the application and authorized with an electronic signature, or hand-written and then subsequently scanned, uploaded, photographed, or any combination thereof and then updated to the patient's Medical History (2.8.4.2.PA) along with the consultation notes/memos.

2.8.3 Appointment Management

2.8.3.1.PA Scheduling via an Appointment

A. A patient shall schedule an appointment with his/her Primary Healthcare Physician or a practitioner of his/her choice. If the patient has no previous Primary Healthcare Physician, then the practitioner that the patient chooses to meet with will be saved as a relationship in the patient's Medical History (2.8.4.2.PA).

B. Once the appointment is scheduled and confirmed, a meeting item shall appear on the patient's Calendar of Appointments (2.8.3.4.PA), and a notification shall be sent to the user.

2.8.3.2.PA Notification of a Pending Appointment

A. The patient shall have the option of being notified of a pending appointment at designated time intervals of his/her choosing.

B. Notifications shall provide patients with the option of dismissing the notification, snoozing the notification (which will temporarily mute the notification for a certain period of time), or entering the Virtual Lobby (2.8.2.4.PA).

2.8.3.3.PA Cancellation of an Appointment

A. At any point up until the point of Establishing a Consultation Session (2.8.2.7.PA), the patient shall have the option of cancelling the appointment.

B. Upon cancellation of the appointment, the meeting item shall be automatically deleted from the patient's Calendar of Appointments (2.8.3.4.PA).

2.8.3.4.PA Calendar of Appointments

A. A patient shall have access to a calendar within the MedMeet application, which shall display all upcoming scheduled appointments with practitioners.

B. A patient shall also have the ability to access any specific appointment within the calendar, and enter the Virtual Lobby (2.8.2.4.PA) for that appointment.

C. In addition, when Scheduling an Appointment (2.8.3.1.PA), a patient shall be able to see what times the practitioner of his/her choice is available from within the calendar.

2.8.3.5.PA Rescheduling of Appointments

If a patient's request for an appointment is rejected, or if a patient misses an appointment, he/she shall be able to reschedule the appointment for a later time.

2.8.3.1.PR Scheduling via an Appointment

A. A practitioner shall be able to entertain patient requests for consultations via pre-scheduled appointments and create appointments on the patient's behalf.

B. In addition, a practitioner shall be able to suggest alternate meeting times if the patient's appointment request is not in agreeance with the practitioner's schedule.

2.8.3.2.PR Notification of a Pending Appointment

A. The practitioner shall have the option of being notified of a pending appointment at designated time intervals of his/her choosing.

B. Notifications shall provide practitioners with the option of dismissing the notification, snoozing the notification (which will temporarily mute the notification for a certain period of time), or entering the Virtual Lobby (2.8.2.3.PR).

2.8.3.3.PA Management of Appointment Requests

A. Practitioners shall have the ability to either accept or decline patients' requests for pre-scheduled appointment consultations.

B. According notifications will be sent to the patients depending on the practitioners' acceptance/rejection of the appointment request.

2.8.3.4.PA Calendar of Appointments

A. A practitioner shall have access to a calendar within the MedMeet application, which shall display all upcoming scheduled appointments with practitioners.

B. A practitioner shall also have the ability to access any specific appointment within the calendar, and enter the Virtual Lobby (2.8.2.2.PR) for that appointment.

C. In addition, when Scheduling an Appointment (2.8.3.1.PR), a practitioner shall be able to see what times he/she is available from within the calendar.

2.8.3.5.PA Rescheduling of Appointments

If a practitioner's scheduled appointment time is rejected by the patient, or if a practitioner misses an appointment, he/she shall be able to reschedule the appointment for a later time.

2.8.4 Medical Information Management

2.8.4.1.PA Main Dashboard

A patient shall have access to a main dashboard or homepage within the application, which will provide an overview of recent activity including any recent consultations with practitioners, recent prescriptions received, and any updates to medical history.

2.8.4.2.PA Medical History

A patient shall have access to his/her complete medical history, including but not limited to any illnesses diagnosed by practitioners, preexisting conditions, medications/supplements taken, surgeries/operations, etc.

2.8.4.3.PA Practitioner History

A. A patient shall have access to a complete history of his/her practitioners consulted.

B. A patient shall also be able to review a practitioner's performance by a numerical grading scale and free-response text.

2.8.4.4.PA Insurance and Payment Information

A. A patient shall be able to update his/her insurance information as well as submit insurance claims via the application.

B. A patient shall also be able to update his/her information regarding the preferred payment method (i.e. debit card, credit card, bank account, PayPal, etc.).

2.8.4.5.PA Activity Log

A patient shall have access to his or her complete activity log including but not limited to any consultations, information updates, medications prescribed, etc.

2.8.4.1.PR Main Dashboard

A practitioner shall have which will provide an overview of recent activity including any recent consultations with patients, recent prescriptions received, and any updates made to patients' medical history.

A practitioner shall also have the ability to see his/her performance metrics including but not limited to average patients wait times, average patient consultation time, consultation frequency, patient reviews, etc.

2.8.4.2.PR Medical History

A. A practitioner shall have access to the patient's complete medical history prior to a consultation.

B. A practitioner shall also be able to update a patient's medical history upon conclusion of a consultation.

2.8.4.3.PR Patient History

A practitioner shall have access to his/her complete patient history.

2.8.4.4.PR Activity Log

A practitioner shall have access to his or her complete activity log including but not limited to any consultations, information updates, medications prescribed, etc.

3. Data Collection Analysis

As the MedMeet application is intended to be a general mass-consumer product, the team elected to survey potential application users and perform ethnographic studies to collect data points. The team distributed a set of three surveys; two of these surveys were sent to patient users and the third survey was disseminated to practitioner users. Additionally, the team members participated in the ethnographic study by providing journals on their own experiences when visiting a doctor's office.

The intent of the surveys was to validate the market for the MedMeet application as well as identify a clear need for simplifying/expediting the process of the doctor's visit.

Graphical interpretations of the survey results can be see in Appendix F.

3.1 Patient Surveys

The objective of this survey was to determine if there was any correlation between wait times in hospital/distance from a respondent's residence to the nearest hospital and his/her willingness to visit said hospital. If we can determine that the longer the wait time and/or distance to a hospital is adversely impacting a patient's willingness to visit the hospital, we have validated a need for a

product that can drastically eliminate wait times and distance by virtually connecting a patient with a doctor.

This survey saw ten respondents, six male and four female, with average ages ranging between 21.4 years old to 32.3 years old. The mode age group was 19 to 25 years old (five respondents), with the minimum age group being 0 to 18 years old (one respondent), and the maximum being 61+ years old (no respondents). All of these respondents stated that they were healthy.

Of these respondents, five stated that their wait times in the hospital ranged from 21 to 40 minutes (this was the mode); of these five respondents, only one was female. The minimum range was 0 to 9 minutes (one respondent), and the maximum was over 40 minutes (zero respondents). The average range of wait times range from 14.5 to 28.9 minutes.

The average distance between a respondent's residence and the nearest hospital was tied between range six to ten miles (four respondents) and 11 to 20 miles (four respondents). The minimum range was zero to five miles (one respondent), and the maximum range was over 21 miles (no respondents). The average distance between a respondent's residence and his/her nearest hospital was determined to be between 6.8 and 13 miles.

Of all the respondents, eight stated that the wait times and hospital proximity would definitely impact their willingness to visit a hospital. The remaining two respondents who were not impacted by wait times or proximity stated ten to 20 minutes and zero to five miles, and ten to 20 minutes and six to ten miles. It should also be noted that a respondent that stated a wait time of under ten minutes and proximity between zero to five miles indicated that wait times and proximity would impact his willingness to visit a hospital. Therefore, we can conclude that there is a negative correlation between longer wait times/longer distance to a patient's willingness to visit a hospital.

Three of these respondents were able to provide a list of household items that would assist in a virtual diagnosis of an ailment. All three of these respondents had at least a smartphone; two of these respondents had additional items such as stopwatches, thermometers, rulers, weight scales, and smartwatches to supplement the diagnosis.

3.2 Patient Surveys for Web Tools

The second survey conducted was an extension of the first – this survey attempts to measure the effectiveness of existing online medical tools for diagnosing ailments (WebMD). Six of the ten respondents from the previous survey completed the second survey.

When asked how comfortable the respondent was in sending confidential medical information to the tool if required (on a scale of 1 to 10, with 1 being least and 10 being most), the average comfort level was determined to be 7.833, with a low of 6 and a high of 10 and a standard deviation of 1.722. Two of the respondents marked this field with a 10, three marked this field with a 7, and one marked this field with a 6. Of those respondents who responded with less than a 10, the results

show that the respondents did not believe that there could be a 100% secure online tool. Given any past history of insurance companies being hacked, we expected the respondents to have reservations with sending data through online means.

In this group, on average, the respondents would consult the online resource up between 45.833% and 70.833% of the time when they were ill. Three respondents stated that they would use this resource up to between 75% to 100% of the time, two stated that they would use the resource between 25% and 50% of the time, and one stated that he/she would use this resource up to 25% of the time.

When asked how trustworthy the online resource was in providing a correct diagnosis (1 being the least and 10 being the most), the average trust level was determined to be 6.333. The standard deviation was 1.506, with the low being a 4 and the high being an 8; three respondents stated a trust level of 7 (the mode). The respondent with the lowest usage of the resource (up to 25% of the time) had the highest trust level of the group (with a trust level of 8).

When asked how often they would have to visit a doctor in person after performing the self-diagnosis, on average, a patient would still have to visit an actual doctor between 37.5% and 62.5% of the time. However, the results of this question were very polarized, with three respondents stating that they would have to visit the doctor up to 25% of the time, and the other three respondents stating that they would have to visit between 75% to 100% of the time. One interesting correlation to note here is that the three respondents who used an online resource 75% to 100% of the time to diagnose an ailment all stated that they still had to visit a doctor's after their self-diagnosis 75% to 100% of the time.

On average, the respondents stated that the online resource would correctly diagnose their ailment 25% to 45.833% of the time, with three respondents stating that the resource would correctly diagnose up to 25% of the time, two stating between 75% and 100% of the time, and one stating the resource would never diagnose an ailment correctly (it should be noted that this respondent also uses the resource 75% to 100% of the time when he/she is ill). It should also be noted that the respondents who stated that the resource would diagnose correctly 75% to 100% of the time also used the resource 75% to 100% of the time. Aside from the respondent who stated a diagnosis precision of 0, the percentage of correct diagnosis correlates exactly with how often the respondents frequented the site.

When queried about the effectiveness of the non-prescription medication advocated by the diagnosis of the online resource, the respondents gave an average effectiveness of 3.667; the low was a 1 (mode of 3 respondents), and the high was an 8, with a standard deviation of 3.077. Those who responded with a 1 provided a reasoning the more serious ailments like bacterial infections still required a doctor's prescription of antibiotics to cure. The respondent who provided the highest effectiveness level also stated that thus far, prescription medications were enough to alleviate his/her ailments. Another interesting point to note is that the respondents who frequented the site the most were also the same three respondents who rated the effectiveness levels of the mediation

as 1. The respondent who frequented the site the least also happened to provide the highest effectiveness level. The two respondents who frequented the site 25% to 50% of the time stated effectiveness levels of 5 and 6.

On average, the online resource prescribed the correct remedy around 33.333% and 58.333% of the time. The results were split evenly for 0% to 25% of the time, 25% to 50% of the time, and 75% to 100% of the time. Two of the most frequent users gave the two highest ratings in this category, however; there seemed to be no other correlation between frequency of resource usage and correctness of prescription.

Finally, the respondents were asked of how they would advise the online resource to be used. Four respondents stated that it was a tool for self-diagnosis, but NOT a complete replacement for a doctor (the mode), one claimed it as a supplement to an in-person doctor's visit, and one claimed it as a complete replacement for a doctor. There is no apparent correlation among any of the other categories and how the respondents advised this resource to be used.

3.3 Doctor Surveys

In addition to regular patients, we also consulted the advice of three doctors (general practitioners) to provide their input on patient behavior and patterns. All three doctors stated on having the average patient being age 61 years old and over. Two of these doctors stated that the best age group to use a self-diagnosis medical app would be between 41 - 60 years old, and the third doctor responded that the app would be useful for all ages. All three doctors concurred that it would still be important for a patient to schedule an in-person appointment with a medical professional, regardless of the results of the patient's self-diagnosis. Two of the doctors provided additional reasoning that they would need to validate the diagnosis, or provide immediate attention for a more serious situation. On a scale of 1 (least) to 10 (most), all three doctors stated an importance level of 10 when asked if a patient should schedule a follow-up after receiving a consultation and prescription. When asked how often a patient should schedule a visit, one doctor responded with "once every three months", one responded with once a year, and one provided a response of "on average, how often does a patient visit you" which we will take as a sarcastic response. All doctors believed the capability to directly text/message a practitioner would encourage patients to more freely communicate with medical professionals and get immediate help for any issues. One doctor even reasoned that the convenience and accessibility would definitely help facilitate more conversation. Two of the doctors stated that their patients visit them once a year on average, and the third doctor stated that on average, their patients would visit them at least half a year.

3.4 Survey Conclusions

There are several key general conclusions that we can draw from the results of these surveys.

1) Long wait times and longer distances to a hospital may discourage a patient from seeking professional medical help.

2) Patients are fairly comfortable submitting medical information online, provided that the submission is facilitated through a very secure connection.
3) Doctors agree that the convenience and availability of a patient directly texting/messaging a medical professional will help facilitate communications, and that it is important for an ill patient to consult a doctor even if the patient's self-diagnosis is correct.
4) For the general patient survey, we have yet to obtain data from patients that are disabled (Handicapped or Deaf) found under the Health category. More inferences can be made on understanding the need for the application.
5) More general diagnostics tools such as blood glucose devices, pulse oximeters, and blood pressure monitors may be bought from a general pharmacy for bulk discount using a large client order. The tools that the patients had on hand may be insufficient to cover other basic diagnostics that happen during a doctor's visit.

In regards to patients using online tools (WebMD), only the most frequent (and presumably most experienced) users were able to achieve the highest diagnosis precision. For the average patient, it would be irresponsible to use the resource, as it cannot guarantee a 100% correct diagnosis. By taking a look at the most frequent users, we can also determine that patients will run into illnesses that can only be treated by prescription medication; thus, the online resource is still ultimately useless as the patient would still have to consult a medical professional. As a result, we can qualitatively describe the results as the following:

1) The online resource is not very effective at correctly diagnosing an ailment for patients.
2) Patients do not trust the online resource with full confidence.
3) Even if an online resource does correctly diagnose an illness, the application still cannot prescribe prescription medication to treat more serious conditions.
4) The over-the-counter medication alternatives that the online resource provides are not very effective at treating the illness.
5) Even after performing a self-diagnosis, a patient will still have to visit a doctor's office somewhat frequently.

Therefore, we can determine that our application would need to be available to access at all times, handle electronic medical records with stringent security measures, provide the capability to virtually connect doctors and patients to eliminate wait time and travel time, and enable a doctor to electronically prescribe prescription medication for a patient.

3.5 Survey Data Trends

While performing quantitative analysis of the survey results, the team observed the following trends:

1) 72.73% of respondents think that long wait times and a long drive to a hospital will discourage them from visiting.

2) 83% of respondents believe that online tools can only be useful for self-diagnosis (and not a replacement for a doctor's visit).
3) The average effectiveness of a remedy obtained from an online diagnosis is 3.667 out of 10 (not very high).
4) On average, current online resources diagnose an ailment correctly up to 45.83% (not very confidence-inspiring)
5) On average, a patient will still have to visit a hospital up to 62.5% of the time even after they've performed a self-diagnosis.
6) 100% of all doctors surveyed state that it is preferable if a patient still confers a doctor even though the patient may have already used an online resource (i.e. WebMD) to obtain a diagnosis

3.6 Ethnographic Studies Conclusions

All three members of the MedMeet team were required to write about their experiences in regards to the doctor appointment process. The data points extracted from the journals would provide valuable insight into the process flow of the doctor's visit as well as identify shortcomings in the status quo that the MedMeet application may address. The team identified the following areas to focus analysis on the time required to travel to the doctor's office and the overall experience during the visit.

It was determine that the average time required to travel to a doctor's office was 26 minutes, with two of the journal entries expressing about a 18 to 22 minute travel time, while one member experienced a 40 minute travel time. It should be noted that all three team members expressed that a lack of traffic significantly reduced the travel time when compared to a similar commute during rush hour. There was also a comment about the need to travel with a serious discomfort based on the illness symptoms. The environment setting was varies from journal entry; two members described a non-emergency doctor's visit, and one described the settings of an ER visit. The two doctor's office also had very different settings, while one had no waiting patients the other had a room full causing the participant to be cautious about their surroundings. The overall tone from the journals indicated a that the participants we experiencing great discomfort during the process. The team believes the source of this discomfort is because the participants would rather eliminate the travel/doctor wait times and replace it with rest from the comfort of their own homes.

In conclusion, these studies validated the market for the MedMeet application and demonstrated that there is a legitimate need to improve the doctor's visit process by promoting efficiency of time and user-friendliness.

With an average of 2 to 2.5 hours to complete the entire current doctor's visit process, the development team plans on eliminating 88% of the process by providing the ability for a patient and practitioner to hold a 30 minute consultation session via the application.

4. External Interface Requirements

The MedMeet UI was developed using modern community standards, including Responsive Web Design and mobile optimization. It uses a combination of the Bootstrap HTML/CSS/JS library and custom-written HTML/CSS/JS.

A common element across all UI views (except for the user registration and user login views) include a fixed navigation bar, which scrolls with the view. This way, a user can quickly access the sliding hamburger menu (hidden by default, shown when the user clicks on the hamburger icon on the right of the navigation bar) wherever he or she may be within the view.

4.1 User Interfaces for Patients

In this section, the term “user” will refer to strictly as patient users. Practitioners are excluded from the user group in this section.

User Login Portal - User provides a correct email address and password login and presses the submit button to navigate to the home page. If a user input incorrect information, a popup error message will appear, prompting the user to re-input his or her information.

Home Page - The user is redirected to the main home/hub page where he/she can view recent updates, recent activities, and drug prescriptions.

Meet with a Doctor - The user selects an appropriate doctor from the the list of available doctors. Doctors’ statuses are shown as “offline” or “available” for conferencing. After designating the doctor, the user selects the “Meet Now” button to move forward with the conference. This view will also show the closest doctors (by distance), or by availability (doctors with lower wait times before admittance will be shown first).

Profile Page - The user’s personal account information is presented/viewed here. Users can change email address and password, update their residential address and phone number, or change their insurance provider and health insurance details (or alternatively, payment information via credit card or debit card) in the event a charge needs to be made against the insurance. Should a user decide to change any of the information within this view and inputs his or her information incorrectly, a popup error message will appear, prompting the user to re-input his or her information.

Registration - The user creates a new account by inputting his/her first and last name, email, and password. An e-mail verification notification is sent to the email address provided. The user checks his/her e-mail and clicks a link with some security implementations to verify the user’s authenticity

(e.g. CAPTCHAs, image CAPTCHAs, last four digits of SSN) and a success message to approve the profile creation.

Patient Records - The user's personal medical information is recorded here, including recent prescriptions, recent consultations/visits with medical practitioners, as well as general health information including but not limited to height, weight, gender, and preexisting conditions. The user will be able to update his or her general health information at any time.

Messages - The user will be able to contact practitioners he or she has recently visited/consulted. They may also respond to follow up messages regarding recent visits/consultations as well.

4.2 User Interfaces for Practitioners

In this section, the term "user" will refer to strictly as practitioner users. Patients are excluded from the user group in this section.

User Login Portal - User provides a correct email address and password login and presses the submit button to navigate to the home page. If a user input incorrect information, a popup error message will appear, prompting the user to re-input his or her information.

Home Page - The user is redirected to the main home/hub page where he/she can view recent updates, recent activities, and prescriptions. The home page will also provide the user with basic metrics, including patient satisfaction with the user's visits/consultations, average wait time before admittance, as well as percentage of patients who choose the user as the practitioner of choice.

Virtual Lobby - The Virtual Lobby shows the user a list of patients who are requesting medical consultation. The list of patients will be prioritized by wait time (the patients who have been waiting longest will be at the top of the list). After a user accepts a patient, a video-conferencing session will automatically initiate and the medical consultation will ensue.

Patient History - The Patient List shows the user a complete list of patients that he/she has provided consultation for. The practitioner may submit notes/memos and prescriptions following consultations directly to the patient's medical history through this UI View.

Profile Page - The user's personal account information is presented/viewed here. Users can change email address and password, update their residential address and phone number, or change their accreditations, licenses, and specializations. Should a user incorrectly input information into any of the fields, a popup error message will appear, prompting the user to re-input his or her information

Registration - The user creates a new account by inputting his/her first and last name, email, and password. An e-mail verification notification is sent to the email address provided. The user checks his/her e-mail and clicks a link with some security implementations to verify the user's authenticity

(e.g. CAPTCHAs, image CAPTCHAs, last four digits of SSN) and a success message to approve the profile creation. Should a user incorrectly input information into any of the fields, a popup error message will appear, prompting the user to re-input his or her information.

Messages - The user will be able to contact patients he or she as recently advised as a means to follow up on a treatment or diagnosis.

4.3 Hardware Interfaces

The user logs into the application using a PC through a home router (usually LAN/WLAN), which connects to an Internet provider's systems of routers/network switches, and forwards the request/query to healthcare network system (Ethernet LAN, WLAN).

The complete MedMeet hardware systems include:

- Web Servers to host the application
- Load Balancers to ensure system availability and maximize application uptime
- Firewalls to maximize system security when users transmit confidential information (i.e. medical records, insurance information, payment information) through the application
- Databases to hold information for user accounts

4.3.1 Web Servers

For initial implementation, MedMeet will utilize a total of seven Linux machines all running Apache web servers. The breakdown of servers and their respective environments will be as follows:

- 1 server for a DEV (development) environment
- 2 servers for a STAGE (staging) environment
- 4 servers for a PROD (production) environment

4.3.2 Load Balancer

For initial implementation, MedMeet will utilize a single load balancer to distribute requests to the 4 servers.

4.3.3 Load Balancer

For initial implementation, MedMeet will utilize a FireEye Enterprise Firewall system to guard its webservers and databases to mitigate any risk of hackers gaining access to confidential user information.

4.3.4 Database

For initial implementation, MedMeet will utilize two Oracle SQL databases. One database will contain tables which shall hold information for

- User Login information (email and password)
- User Account Information (payment and insurance information)
- User activity

The second database will be used to hold strictly medical history and medical records. The rationale behind this architecture decision was to reduce the risk of a total security breach; in the event that the system is unable to prevent unauthorized access into the database, the unauthorized user will not be able to extract a complete set of information from any particular database.

4.4 Software Interfaces

The MedMeet application will integrate with VSee API's and SDK's to facilitate the online video conferencing feature.

In addition, to facilitate location-based services, the MedMeet application will integrate with Google Maps API's and SDK's.

4.5 Communications Interfaces

The team has identified the following communications interfaces required for proper application functionality:

- Client-Server System to facilitate video conferencing via the VSee API's and SDK's
- HTTP for normal processing of web queries and requests from the user (client) to the application (hosted by a web/database server).
- HTTPS using AES-128 Encryption for payment transactions and submissions.
- SFTP for submitting forms/information within the application.
- TCP/IP protocol for reliable transport of data and messages being routed through a network.
- UDP as the transport protocol used for voice transmissions during teleconferencing.
- WiFi (802.11b) link as the network standard for wireless routers, computers, and phones

5. System Features

The MedMeet application will focus on the following four main software functionality groups:

- **User account management** to facilitate logins, registrations, password changes, and profile information updates for both patients and practitioners.
- **Online video conferencing** to facilitate a virtual doctor's office visit.
- **Appointment scheduling/management** to help practitioners manage their upcoming (virtual and in-person) appointments, and for patients to schedule and manage their (virtual and in-person) visits with doctors.

- **Medical Information Management** to help patients centralize and manage their medical history as well as easily submit their medical history prior to a consultation with a practitioner; practitioners will be able to indirectly update a patient's medical history with diagnoses and appointment notes after a consultation.

5.1 User Account Management

5.1.1 Description and Priority

The User Account Management functionality group encompasses all login and registration functionality.

5.1.2 Stimulus/Response Sequences

Upon launching the MedMeet application, a user will be presented with an option to Login or Register. The input fields for the Login option are expanded by default. If a user chooses to Register, he/she shall be taken to the registration page. All users must agree to Terms and Conditions before registering for use of the application.

5.1.2.1 Login

To login, a user will be presented with two inputs fields: one for an email address and one for the password. Once the user correctly inputs the login credentials and submits them, he/she will be taken to his/her Main Dashboard.

If a user submits incorrect information, an error message will appear on the login page, prompting the user to re-enter the login credentials.

5.1.2.2 Registration

To register, a user must first choose if he/she is intending to use the application as a patient or practitioner.

The initial input fields area:

- The user's First Name
- The user's Last Name
- The user's Email Address
- Confirmation of the user's Email Address
- The user's desired Password
- Confirmation of the user's Desired Password

Upon submission of the information, a confirmation email will be sent to the user's indicated email address. The user must click on the hyperlink within the email in order for the account to be activated. The activation link is valid for 24 hours, and the user may request a new link after it has expired by either clicking on the expired link or attempting to log on with their credentials.

Any incorrect submissions will result in an error message showing on the registration page, prompting users to correct the mistakes.

Upon account activation, patients and practitioners will be presented with two different experiences.

A. A patient will be prompted to set up security measures including selecting a set of three security questions, his/her SSN, insurance information, and preferred payment method. Additionally, the patient will be prompted to input his/her physical location/address. Authorization checks will be performed immediately to ensure that all information is invalid. If any information provided is invalid, the user will be presented with an error message prompting him/her to make the necessary corrections. Upon submission, a patient will be taken to his/her Main Dashboard.

B. A practitioner will be prompted to set up security measures including selecting a set of three security questions, his/her SSN, medical license information, career history, accreditations, and certifications. Additionally, the practitioner will be prompted to input his/her physical location/address. Authorization checks will be performed immediately to ensure that all information is invalid. If any information provided is invalid, the user will be presented with an error message prompting him/her to make the necessary corrections. Upon submission, a practitioner will be taken to his/her Main Dashboard.

5.1.2.3 Account Information

All users may access their Account Information page from the left-navigation menu by clicking on the sandwich/hamburger icon at the top right of the navigation bar (always located at the top of the window). All information supplied during registration will appear on the Account Information page; users may choose to change the information at any time. If a user does choose to update the information on this page, a popup will appear, prompting the user to authenticate the update with his/her login credentials as well as supply a response to a captcha.

5.1.3 Functional Requirements

A complete list of Functional Requirements for the User Account Management functionality group are documented in Section 2.8.1.

In addition, the application shall function in all browsers over a standard internet connection.

5.2 Online Video Conferencing

5.2.1 Description and Priority

The Online Video Conferencing Functionality group facilitates virtual communications between the patient and practitioner. Within the functionality group is a Virtual Lobby, which is a virtual waiting room in which patients will be placed on hold before being admitted to the video conferencing session. Practitioners may use their discretion as to which patients he/she admits within the virtual lobby depending on appointment time, time elapsed in the lobby, and patient medical history/symptoms.

5.2.2 Stimulus/Response Sequences

5.2.2.1 Patients Consulting a Practitioner without a Scheduled Appointment

The patient will expand the left-navigation menu by clicking on the sandwich/hamburger icon at the top right of the navigation bar (always located at the top of the window). Once the patient clicks on “Meet with a Doctor”, he/she will be taken to a page showing a list of practitioners as well as his/her Primary Care Physician. The following information is shown with each practitioner displayed in the list:

- The practitioner’s name
- The practitioner’s rating
- The practitioner’s physical location
- The practitioner’s online status (Available, Busy, Away, or Offline)
- The practitioner’s ETA to availability (if the practitioner’s status is not set as “Available”)

Results are automatically sorted based on the practitioner’s rating, physical location, online status, and ETA to availability.

The patient may choose which practitioner he/she wishes to meet with by clicking on “Meet Now”. Once the patient clicks on “Meet Now,” he/she will be prompted to fill out a form of the patient’s symptoms as well as the patient’s medical history. If these are not completed, the patient will be presented with an error message prompting him/her to complete the fields. Additionally, a validation check will be performed on the patient’s insurance and payment methods to ensure validity of the information. If the validation check does not pass, and error message will appear and the patient will be prompted to correct the fields.

Once all necessary information is submitted, the patient is placed into the Virtual Lobby. When the patient is selected for consultation, he/she will be placed in the one-on-one video conferencing

session with the practitioner. At any point during the session, the patient may choose to terminate the consultation by ending the call, which will return them to his/her Main Dashboard.

5.2.2.2 Patients Consulting a Practitioner with a Scheduled Appointment

A notification will pop up at certain time intervals reminding the patient of a pending appointment (information displayed will include the practitioner with whom the patient will be meeting with, the time of the appointment, and the subject of the appointment); this popup will appear on any UI View within the application. At any point, the patient may choose to start the video-conferencing session ("Meet Now"), snooze the notification ("Snooze"), or dismiss the notification ("Dismiss").

- Meet Now
    - He/she will be prompted to fill out a form of the patient's medical history. If these are not completed, the patient will be presented with an error message prompting him/her to complete the fields. Additionally, a validation check will be performed on the patient's insurance and payment methods to ensure validity of the information. If the validation check does not pass, and error message will appear and the patient will be prompted to correct the fields. Once all necessary information is submitted, the patient is placed into the Virtual Lobby. When the patient is selected for consultation, he/she will be placed in the one-on-one video conferencing session with the practitioner. At any point during the session, the patient may choose to terminate the consultation by ending the call, which will return them to his/her Main Dashboard.
- Snooze
    - The patient may snooze the notification, choosing the time interval for which the notification will be muted. At the end of the selected time interval, the popup will appear again.
- Dismiss
    - The patient will permanently mute the notification when selection this option.

If a practitioner initiates a video-conferencing session, the patient will be notified with a popup with the option of accepting or declining the session. If no action is taken within two minutes, the application will automatically interpret the "no-action" decision as a rejection and will not initiate the video-conferencing session.

5.2.2.3 Practitioners Entering the Virtual Lobby with Unscheduled Consultations

The practitioner will expand the left-navigation menu by clicking on the sandwich/hamburger icon at the top right of the navigation bar (always located at the top of the window). Once the patient clicks on “Virtual Lobby”, he/she will be taken to a page showing a list of patients waiting to be admitted into video conferencing sessions. Order of patients are ranked by time elapsed within the Virtual Lobby, symptoms and medical history, and physical location. If a patient has a pending appointment due within ten minutes of the scheduled appointment, that patient will rank at the top of the list.

Once the practitioner clicks on “Meet Now,” he/she will initiate the video-conferencing session and receive a copy of the patient’s medical history and description of symptoms. During the consultation session, the practitioner may take notes directly into the application and write prescriptions directly into the application. Alternatively, the practitioner may scan, take photos of, and/or upload hand-written and/or printed prescriptions, notes, and memos into the application.

At any point during the consultation, the practitioner may elect to terminate the session. Upon termination, the practitioner will be prompted to upload and/or send notes, memos, and/or prescriptions into the applications. The practitioner may choose to “Send,” “Snooze,” or “Dismiss.”

- Send
    - The practitioner will be taken to a form prompting him/her to complete the consultation notes (a text input field with the option to upload files or take a photo). The form will also contain a dropdown menu asking if any medications will be prescribed to the patient; if the practitioner chooses “Yes,” an additional text input field will appear (with options of uploading a file or taking a photo), asking the practitioner to complete the form. If the practitioner selects “No,” no further action is required. If any of the fields are left in their default state, the practitioner will be presented with an error message, prompting him/her to complete the fields.
- Snooze
    - The practitioner may snooze the notification, choosing the time interval for which the notification will be muted. At the end of the selected time interval, the popup will appear again.
- Dismiss
    - The patient will permanently mute the notification when selection this option.

5.2.2.4 Practitioners Entering the Virtual Lobby with a Scheduled Consultations

A notification will pop up at certain time intervals reminding the practitioner of a pending appointment (information displayed will include the patient with whom the practitioner will be meeting with, the time of the appointment, and the subject of the appointment); this popup will appear on any UI View within the application. At any point, the practitioner may choose to start the

video-conferencing session (“Meet Now”), snooze the notification (“Snooze”), or dismiss the notification (“Dismiss”).

- Meet Now
    - The practitioner will be presented with the patient’s medical history and will be placed into the video conferencing session.
- Snooze
    - The practitioner may snooze the notification, choosing the time interval for which the notification will be muted. At the end of the selected time interval, the popup will appear again.
- Dismiss
    - The practitioner will permanently mute the notification when selection this option.

If a patient initiates a video-conferencing session, the practitioner will be notified with a popup with the option of accepting or declining the session. If no action is taken within two minutes, the application will automatically interpret the “no-action” decision as a rejection and will not initiate the video-conferencing session.

5.2.3 Functional Requirements

A complete list of Functional Requirements for the Online Video Conferencing functionality group are documented in Section 2.8.2.

In addition, the application shall function in all browsers over a standard internet connection.

The first functional requirement would be to pass through all of the checks including, audio/video, insurance, and emergency check. Since the user will be on a website, the web server will be able to handle the video conference through a web application API. The main requirements include a web browser, a audio mic, and a web camera.

5.3 Doctor Appointment Management

5.3.1 Description and Priority

The Doctor Appointment Management functionality group will help users handle both online and offline doctor’s appointments. Once a patient has successfully scheduled a meeting with a practitioner, a timeslot will be reserved on the practitioner’s calendar, locking the timeslot from other reservation requests; patients will be presented with timeslots that are available for the practitioner chosen.

5.3.2 Stimulus/Response Sequences

5.3.2.1 Patients

The patient will expand the left-navigation menu by clicking on the sandwich/hamburger icon at the top right of the navigation bar (always located at the top of the window). Once the patient clicks on “Meet with a Doctor”, he/she will be taken to a page showing a list of practitioners as well as his/her Primary Care Physician.

For each practitioner that is shown within the list, the patient will have an option to schedule an appointment with the practitioner, whether it be in-office or virtual. Once scheduling is initiated, a form will appear, prompting users to choose whether the appointment will be virtual or in-person; additionally, the practitioner’s available time slots will be shown to the patient, and the patient may select appointment times based on the available slots. When a time is selected the patient will be notified if the practitioner accepts the proposed time; if rejected, the appointment will be deleted and a the patient will receive a message to reschedule the appointment. The patient may also access a calendar which displays all upcoming appointments; by clicking on a calendar item, the patient may jump directly into the Virtual Lobby. The patient may cancel an appointment at any time, request a reschedule, and/or propose a new meeting time.

5.3.2.2 Practitioners

Practitioners will receive notifications for meeting requests, and will have access to a calendar showing all pending/upcoming appointments. For each appointment, the practitioner will be able to see which patient they are meeting with, where the meeting will take place (online or in-office), and when the meeting will take place. Accepted meetings will be marked as green on the calendar; meetings that are pending practitioner approvals are marked with yellow. For all meetings, the practitioner may accept the request, cancel the meeting, reschedule the meeting, and/or propose a new meeting.

5.3.3 Functional Requirements

A complete list of Functional Requirements for the Doctor Appointment Management functionality group are documented in Section 2.8.3.

In addition, the application shall function in all browsers over a standard internet connection.

5.4 Medical Information Management

5.4.1 Description and Priority

The Medical Information Management functionality group allows both patients and practitioners to view his/her complete medical history and acts as a repository; patients may view and update their personal health records while practitioners may view all consultations performed as well as all medications prescribed to various patients.

5.4.2 Stimulus/Response Sequences

5.4.1.2 Patients

Upon logging into the application, patients will be taken to the Main Dashboard, which provides information regarding recent activity, recent medications prescribed, as well as recent consultation with practitioners. By clicking on “Patient Records” in the left-navigation, the patient will be taken to the Patient Records page, where he/she will be able to review notes written by practitioners and have a record of their consultations with practitioners as well as their personal health records. The Patient Records page has two input sources; patient-added data and practitioner-added data. Practitioners may submit data to a patient's medical record by providing detailed notes taken from the medical consultations; patients are required to complete a Medical History form during registration, which documents any medication/supplements taken, pre-existing conditions, past diagnoses, and any surgeries/operations performed. This form will be submitted to the practitioner during each consultation session.

The Patient Records page will also display any recent consultations with practitioners, as well as any notes/memos and prescriptions that resulted from those consultations.

In addition, patients will be able to view a recent activity log, which provides patients a non-detailed descriptions of their activities on the application.

5.4.1.2 Practitioners

Upon logging into the application, practitioners will be taken to the Main Dashboard, which provides information regarding recent activity, recent medications prescribed, as well as recent consultation with patients. In addition, the Main Dashboard will provide the practitioner with performance metrics including the the number of times the practitioner has been consulted, the average patient wait time for the practitioner, the practitioner’s performance rating, and the average consultation time.

At the end of each consultation, the practitioner may update the patient’s medical history by submitting any notes/memos taken during the consultation as well as any medications that were prescribed as a result of the session.

In addition, practitioners will be able to view a recent activity log, which provides practitioners a non-detailed descriptions of their activities on the application.

5.4.3 Functional Requirements

A complete list of Functional Requirements for the Medical Information Management functionality group are documented in Section 2.8.4.

In addition, the application shall function in all browsers over a standard internet connection.

6. Other Nonfunctional Requirements

6.1 Performance Requirements

Response Time for Normal Request Queries - The application should run fluidly--processing normal web queries and navigation of web pages [2].

Load Testing Requirement - The application must address the concern on how it behaves during heavy traffic periods-- that is when several users are active/frequently at one time and the capability of servicing users without loss in performance [2].

Stress Test Requirement - The application should work at all times of the day or times when doctors are available. Users (patients and doctors) should be able to login without any qualms of the application crashing [2].

Recovery Test Requirement - The application and system should be able to recover from hardware failures, software crashes, and disastrous errors.

Regression Test Requirement - The application should still perform normally when new software patches, updates, enhancements, configuration changes are applied (from the most recently tested, working software version).

6.2 Safety Requirements

To prevent any improper use of the application, the application will provide users with disclaimer statements notifying users that the web/mobile application is not emergency care for life-threatening injuries or emergency incidents.

All healthcare-related products are subject to Health Insurance Portability and Accountability Act **(**HIPAA) Compliance, which requires safeguards for the confidentiality and security of healthcare information (when using the web application). To remain in compliance with HIPAA, MedMeet makes use of an integration with VSee, which is a HIPAA-compliant video conferencing platform [3].

Online Video Conferencing functionality is to facilitate a consultation session between a patient and a practitioner as well as provide a video feed to document general symptoms; users should not send/broadcast anything unwarranted or unrelated to conducting a medical consultation.

6.3 Security Requirements

Standard Account Login Protection for patients' medical information: Aside from username and password, there are additional functionalities such as security questions, SSN verification, multi-factor authentication, visual CAPTCHAs, and device-locked (only allow a single device to login) functionalities.

Network Security for Server/Database Management of Patient Records: The application can choose from either or a combination of options: Secure Shell (SSH) Key Authentication, Firewalls, VPN (virtual private networking), Service and File Auditing, Intrusion Detection Systems, Isolated Execution Environments. [4]

Payment Processing Protections: The application will make use of security certificates during the payment phase (available with a Paypal API); the application can use public key infrastructure and SSL/TLS encryption during "Enter Payment Information Stage during co-pay [4].

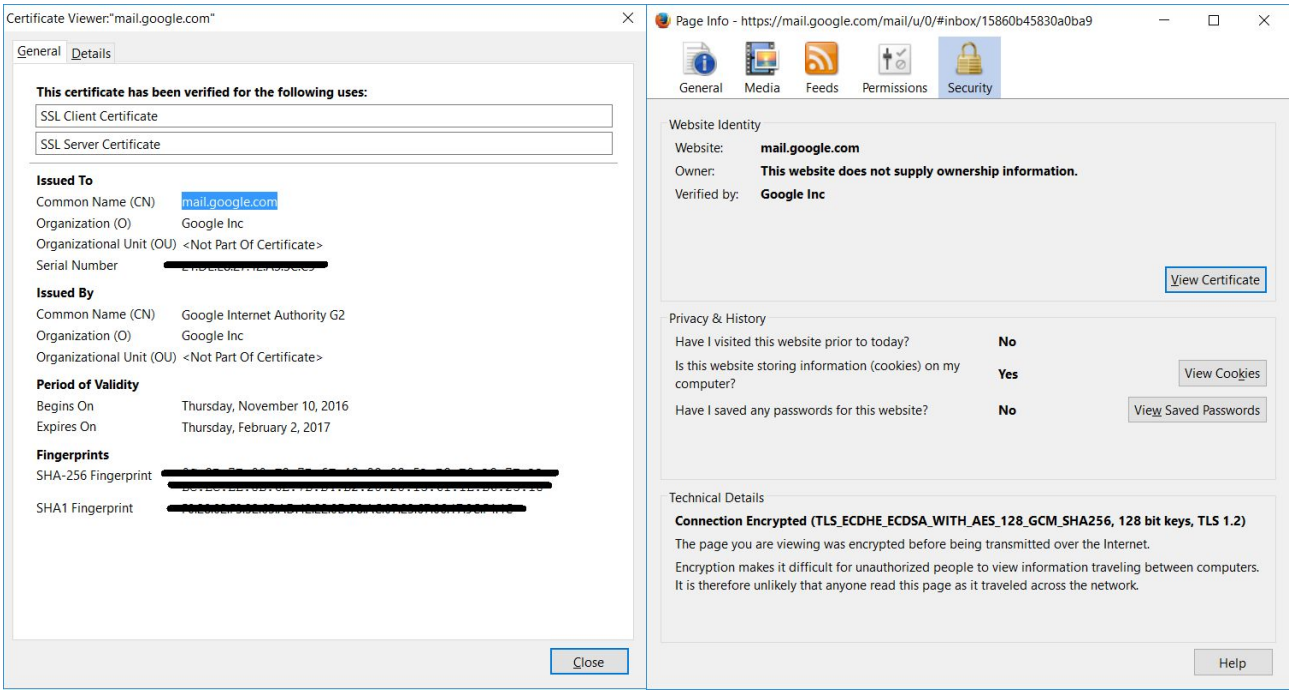


Figure 1: Security Certificate Details with Hashing Algorithm (left), Connection Encryption Algorithm (right)

6.4 Software Quality Attributes

Availability: Patients must be able to log into the online portal to meet a doctor at any time/any reasonable hours set by the application. A doctor must be available to service patients using the

application (may require rotation shifts). Therefore, it is crucial that the application remains running 24/7/365.

Extensibility: Future releases of the application are expected to integrate with API's and SDK's of wearable devices including FitBits and Apple Watches. By expanding the compatibility with more devices, patients will presented with more options when conducting consultation session with practitioners. Such devices may also aid in taking heart rates and body temperature, which will provide the consulting practitioner vital and accurate information about the patient.

Interoperability: The application will need to offer multi-browser support, and run seamlessly on all major web browsers; all software integrations need to mesh without critical issues (bugs, errors, and design issues).

Portability: For a mobile application, the application must function on all smartphones' operatings systems. For a web application, the software development framework and environment are key for responsiveness.

Reliability: The application must operate free of any major bugs/defects, as such bugs and defects may cause serious disruptions during crucial consultation sessions. Any bugs and defects that are found should be automatically reported by the application to the development team; a bug report should include any error codes that are triggered by the application as well as a thread dump to help the development team determine the root cause of the issue.

Reusability: Patients must be able to have their account information saved to reduce the need of having to fill in the same details on online health forms.

Robustness: The application must be able to handle heavy traffic/workloads (number of users) and remain functional at all times (have a backup version available during maintenance).

Scalability: The application is expected to meet increasing performance demands from a single client-server system to a larger systems that supports a larger client base (more regions, states, territories, and countries) [5].

6.5 Business Rules

Business partners, customers (patients), doctors, and/or unmentioned stakeholders contribute feedback to the product. Stakeholders must agree/find consensus with decisions [6]

Designers and marketers should understand what customer/business needs are to be met by a proposed solution.

Stakeholders should provide input on the next phase for the project.

Management makes the call if work groups cannot make a fast decision.

Employees should attack problems aggressively and pool ideas from different perspectives. Concentrate on the issues and facts, rather than personalities or positions [6].

7. Other Requirements

Legal Requirements: Patient & Doctor Confidentiality Agreement for health issues is a critical requirement. End User Agreement and e-Signature (Digital Signature) required on submitted forms/information (e.g. “I profess that I am the person with this associated name and the information that I provided is correct, and held accountable for any inaccuracies”). In addition, the application must remain in compliance with HIPAA regulations.

Database Requirements: The servers should have optimal encryption software to safeguard access to patient records (from being exposed through use). In addition, all databases should be safeguarded behind firewalls; only a select list of IP addresses (web servers and administrators) should be authorized to access the the databases.

Internationalization Requirements: By default, the English language version of the software is supported first, then languages with the most popular demographic (Spanish, Mandarin/Cantonese) alternate/regional translation are to be added at an unspecified future date.

Appendix A: Glossary of Terms

Audio/Video check: *A check done by the system prior to the online doctor's appointment, checks whether the user has adequate hardware and software required for a video conference.*

Doctor communication check: *A check done by the system prior to the online doctor's appointment, checks whether doctor communication is needed and provides a friendly suggestion that doctor communication isn't needed to diagnose the illness/symptom.*

Doctor Users: *Users specified as doctor professionals, these include general practitioners and other experts of the medical field. The requirements of the user includes a doctor of medicine degree from a 4 year medical program, 3 years of residency training and a state license to practice medicine unsupervised [7]. The functionalities of a doctor user includes management of patients, communicate online with patients and doctor office/schedule management.*

Emergency check: *A check done by the system prior to the online doctor's appointment, checks whether the symptom described by the patient user requires immediate assistance, the system will provide a suggestion to contact 911 for serious life-threatening emergencies.*

HIPAA: Health Insurance Portability and Accountability Act, which is a regulation that requires safeguards for the confidentiality and security of healthcare information

In office check: *A check done by the system prior to the online doctor's appointment, checks whether the symptom described by the patient user requires an in-office doctor visit in addition to an online video communication doctor visit.*

Patient Users: *These patient users are specified as general MedMeet users. These include users who will use the application to schedule doctor appointments, communicate online with doctors and review appointment notes/medical records.*

Practitioner Users: *See* ***Doctor Users***

Primary Healthcare Physician: *This is a patient's default practitioner*

Secondary Clinic: *This is a clinic/facility that provides advanced imaging services and biological specimen testing services*

SSN: *Social Security Number*

Appendix B: Analysis Models

Figure 1: Concept System Context Diagram

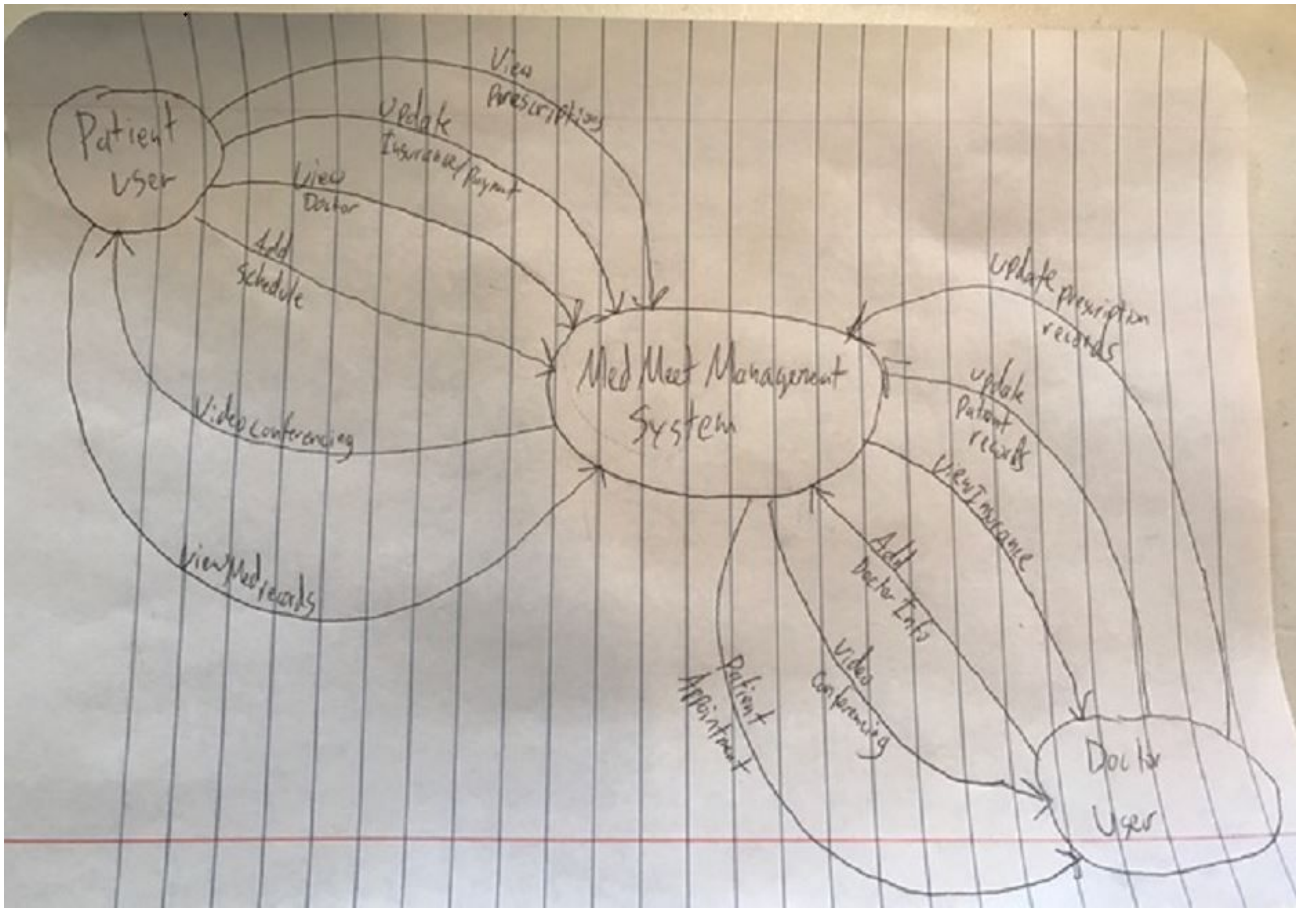


Figure 1.1: Context Diagram Interpretation

User Type	***Import/Export system***	***Functionality***
Patient User	*Export From System*	*Video Conferencing*
Patient User	*Import To System*	*Schedule Appointment*
Patient User	*Export From System*	*View Doctor Information*
Patient User	*Import To System*	*Update Insurance/Payment*
Patient User	*Export From System*	*View Medical Records*
Patient User	*Export From System*	*View Prescriptions*
Doctor User	*Export From System*	*Video Conferencing*
Doctor User	*Export From System*	*View Patient Appointments*
Doctor User	*Import To System*	*Update Office Information*
Doctor User	*Export From System*	*View Insurance/Payment*
Doctor User	*Import To System*	*Write Patient Med. Records*
Doctor User	*Import To System*	*Write Prescriptions*

Figure 1.2: Computer-Generated Context Diagram

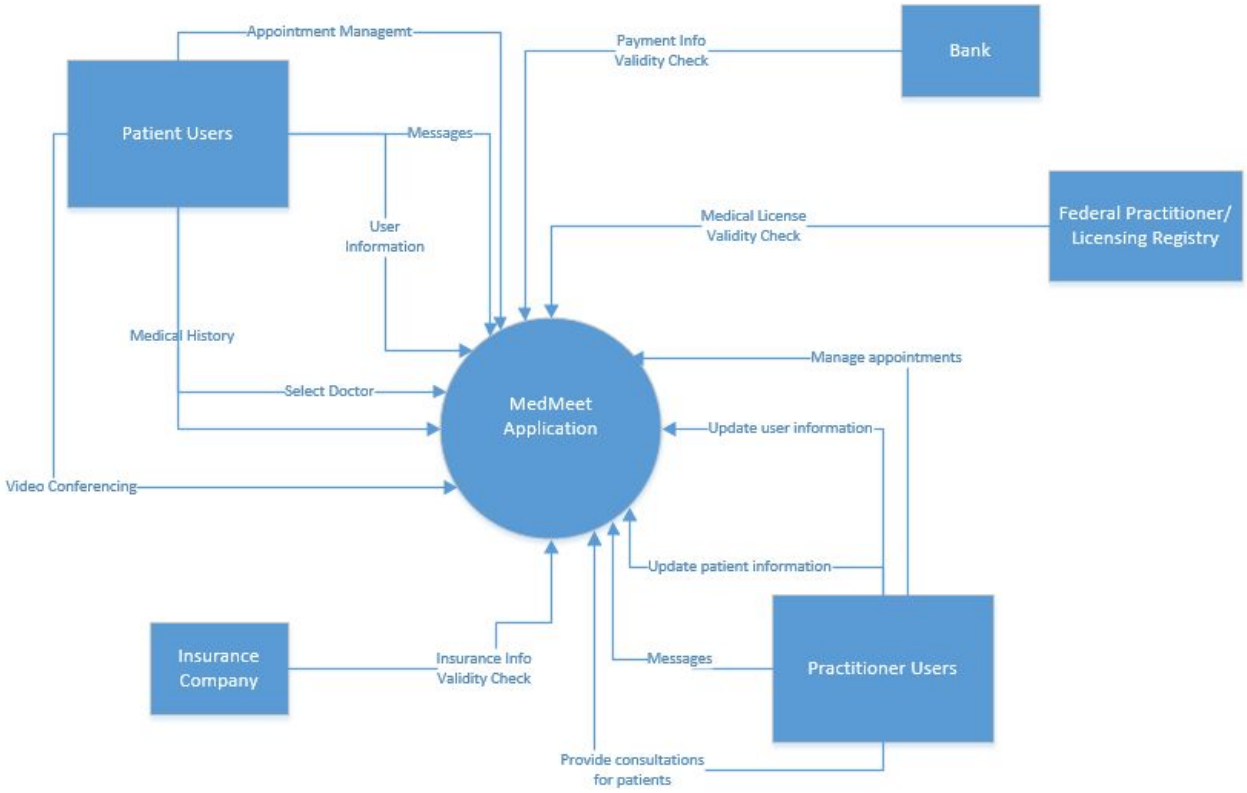


Figure 2: Scheduling Use Case Diagram

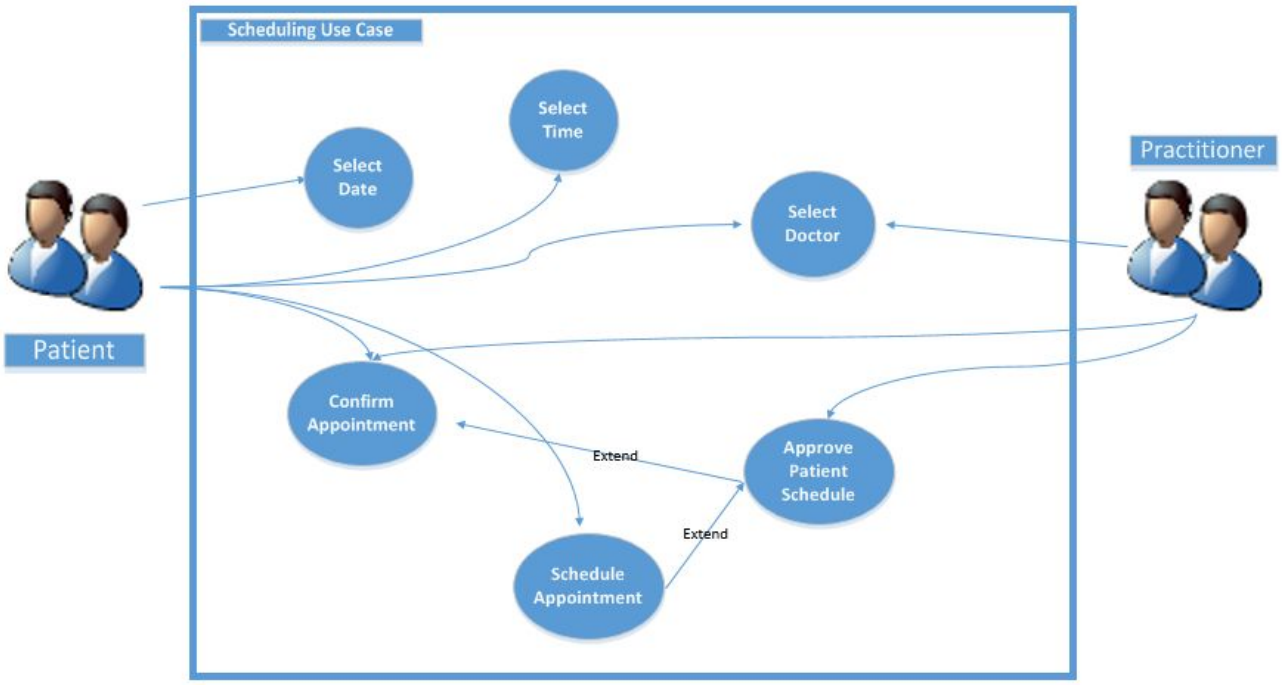


Figure 3: Medical Record Management Use Case Diagram

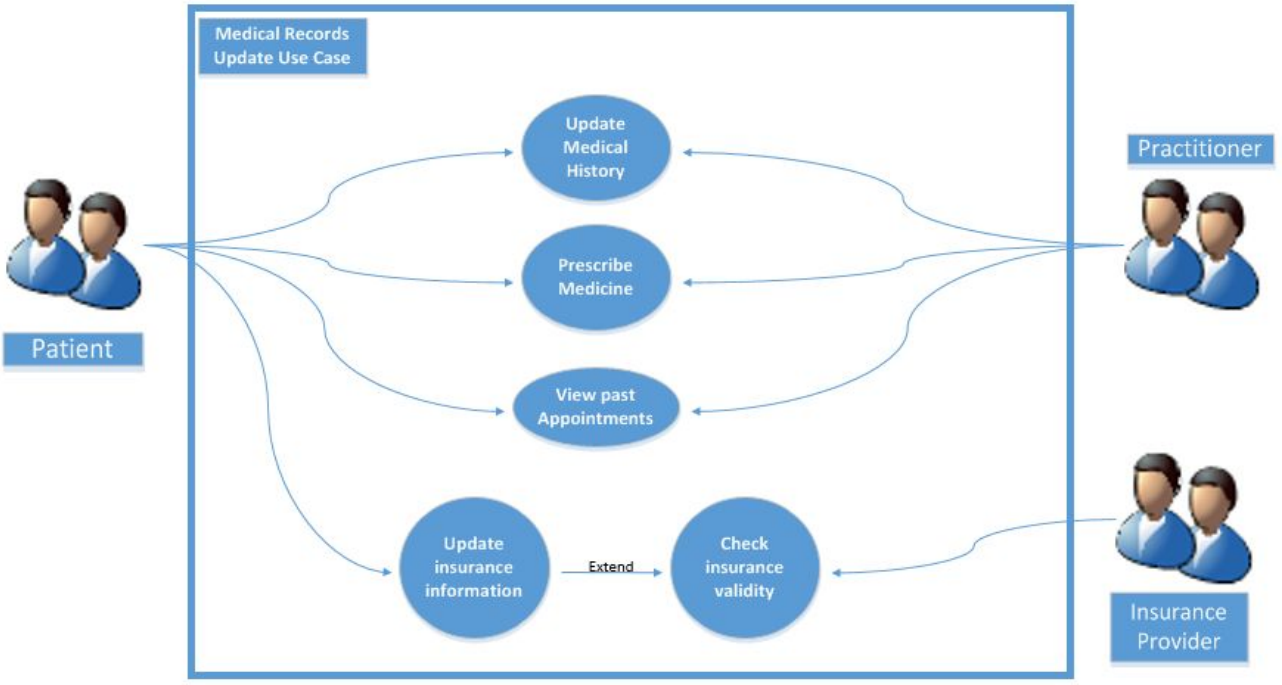


Figure 4: Online Video Conference Use Case Diagram

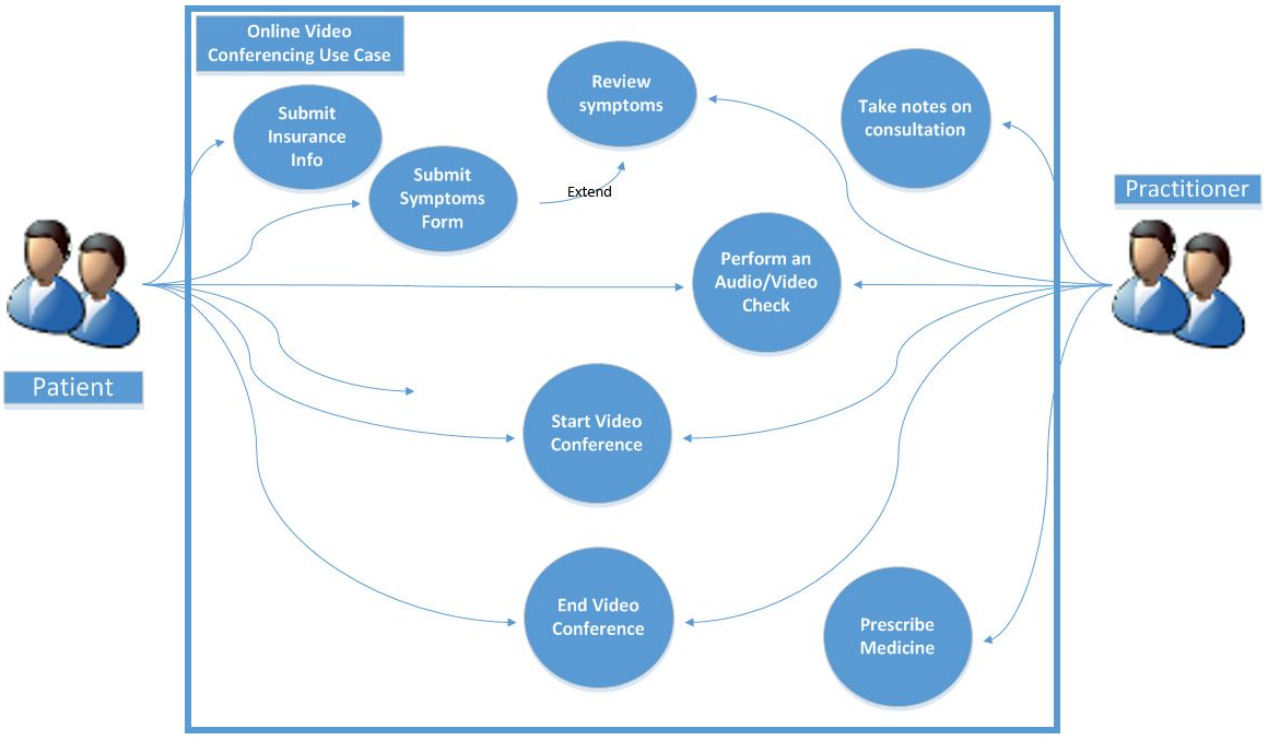


Figure 5: Patient Functional Diagram

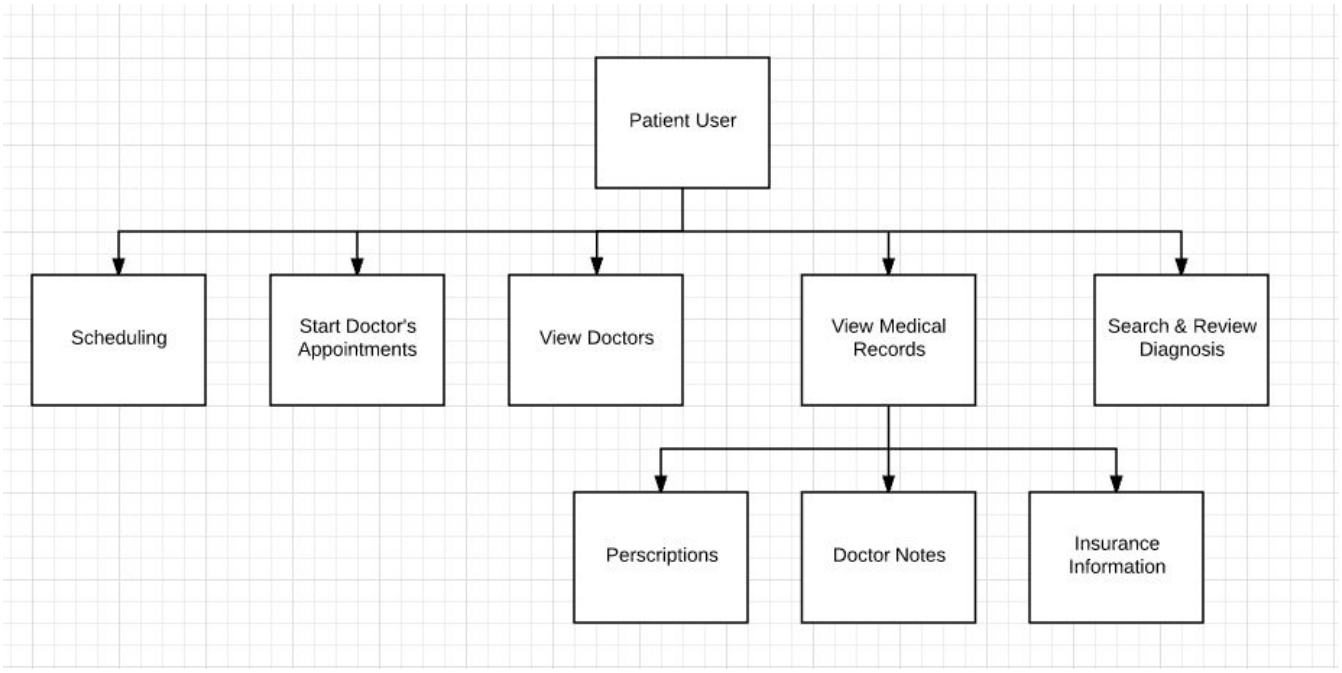


Figure 6: Doctor Functional Diagram

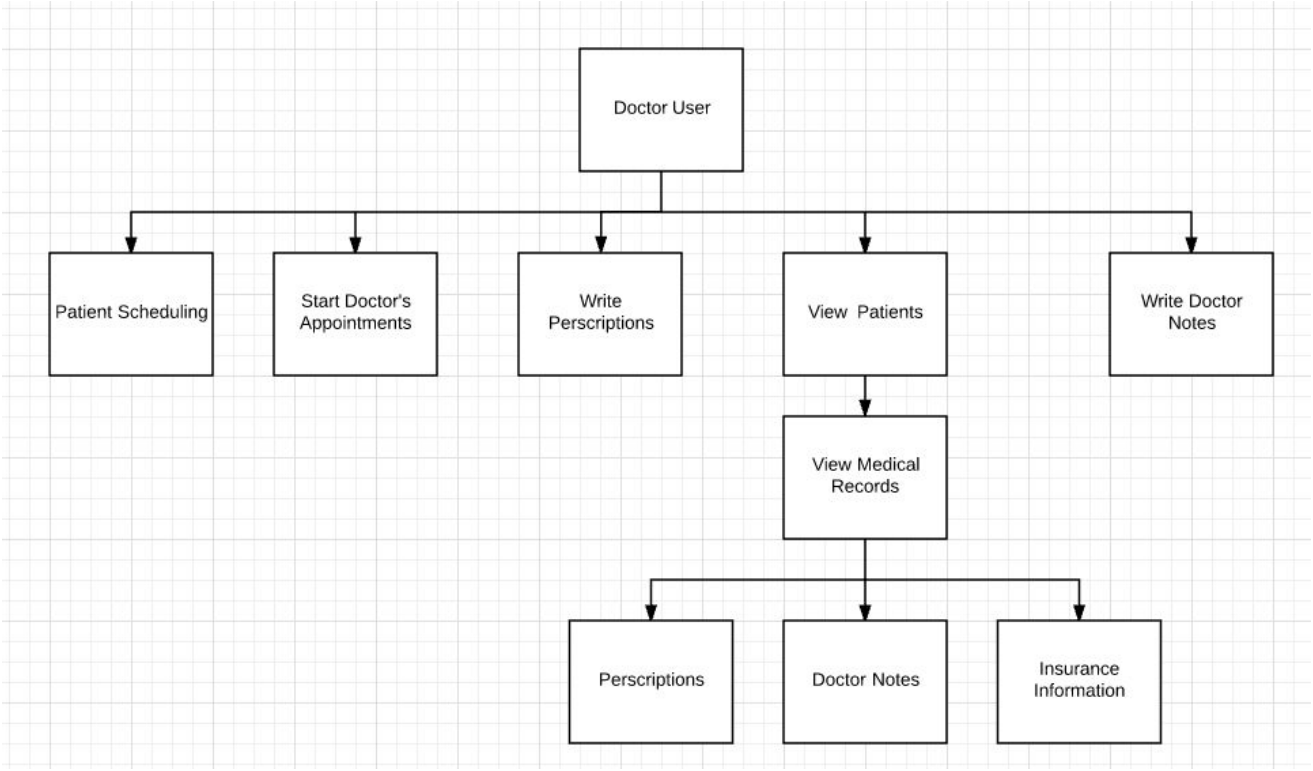


Figure 7: Doctor Activity Diagram

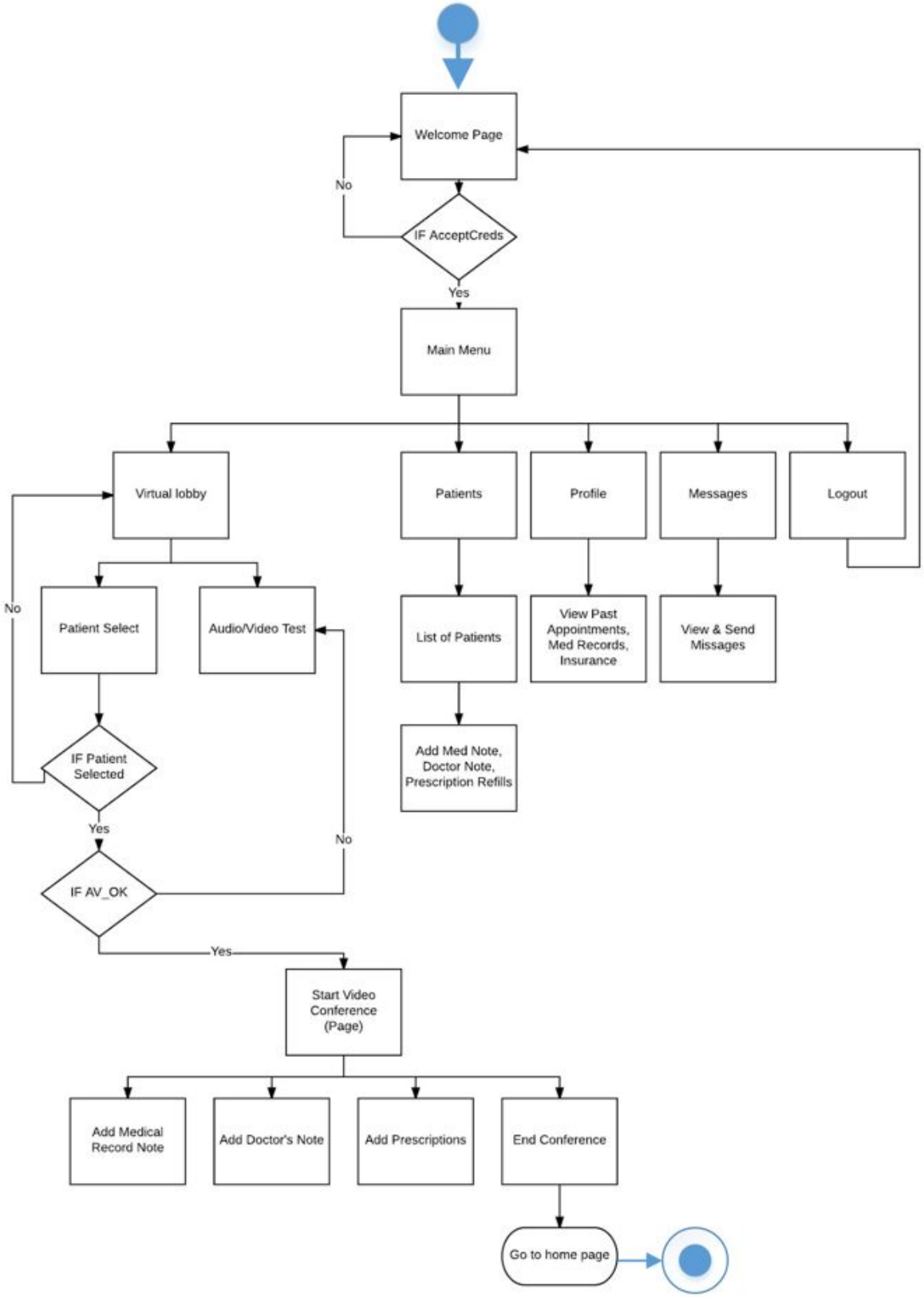


Figure 8: Patient Activity Diagram

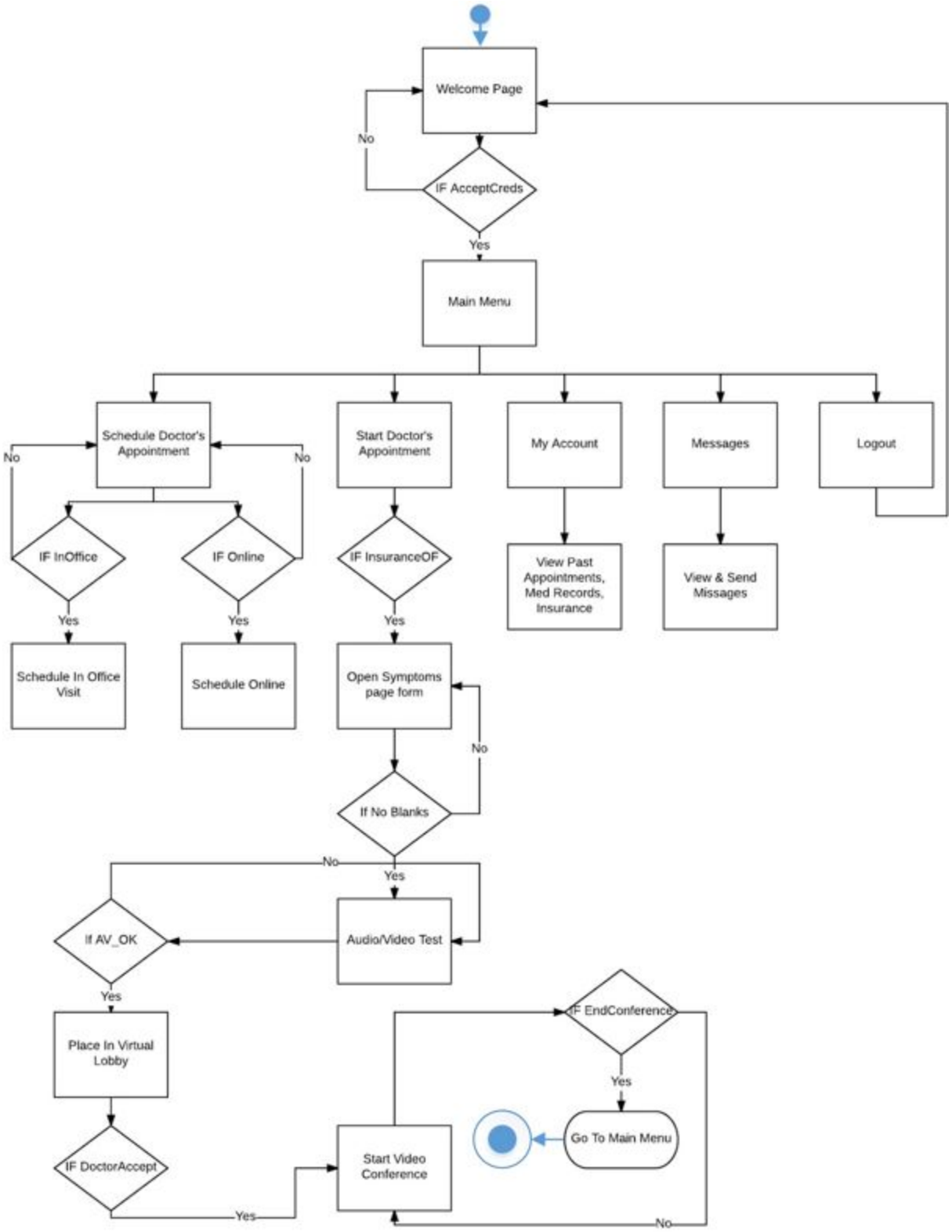


Figure 9: Entity-Relationship Diagram

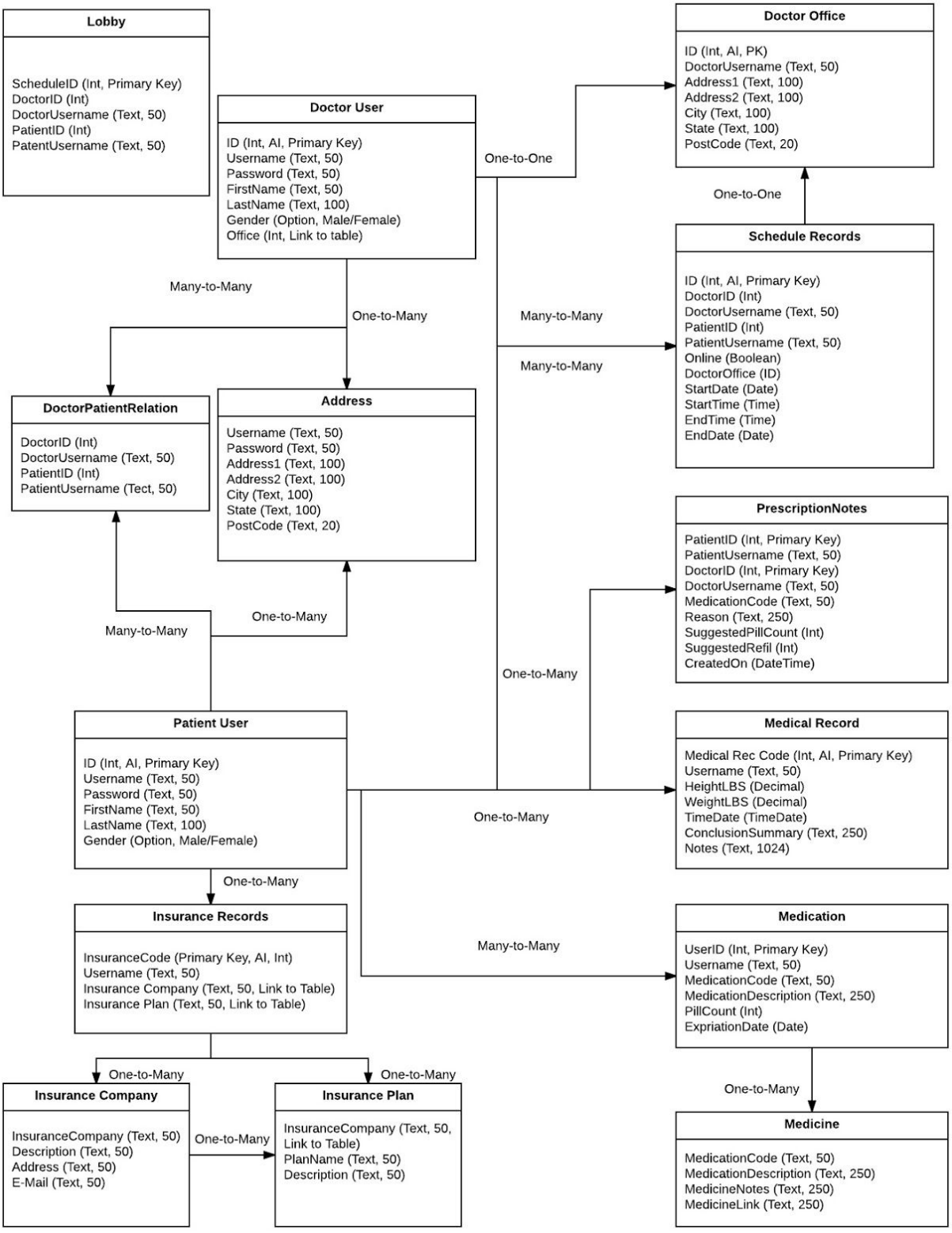


Figure 10: System Architecture Physical Block Diagram

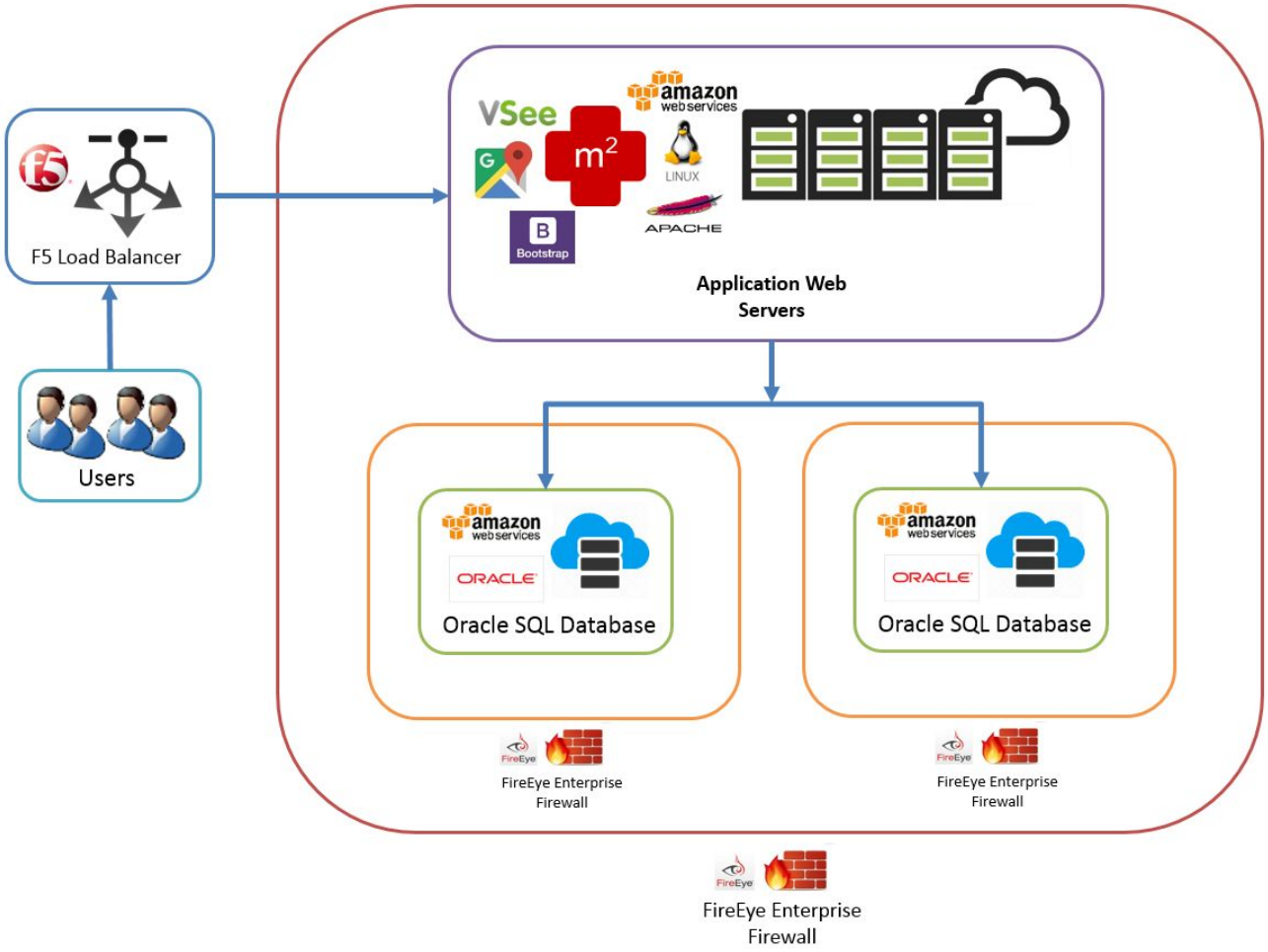


Figure 11: Requirements/Features Traceability Matrix (Patients)

Requirement ID		UI Views/Features						
		Registration	Login	Homepage	User Profile	Medical Records	Meet with Doctor	Messages
2.8.1		X	X					
	2.8.1.1.PA	X						
	2.8.1.2.PA		X					
	2.8.1.3.PA		X					
	2.8.1.4.PA				X			
2.8.2				X		X	X	X
	2.8.2.1.PA					X		
	2.8.2.2.PA						X	
	2.8.2.3.PA						X	
	2.8.2.4.PA						X	
	2.8.2.5.PA						X	
	2.8.2.6.PA						X	
	2.8.2.7.PA						X	
	2.8.2.8.PA						X	
	2.8.2.9.PA			X		X	X	X
2.8.3				X	X	X	X	X
	2.8.3.1.PA			X	X	X	X	X
	2.8.3.2.PA						X	
	2.8.3.3.PA						X	
	2.8.3.4.PA						X	
	2.8.3.5.PA						X	

2.8.4				X		X		
	2.8.4.1.PA			X				
	2.8.4.2.PA					X		
	2.8.4.3.PA					X		
	2.8.4.4.PA					X		
	2.8.4.5.PA			X		X		

Figure 12: Requirements/Features Traceability Matrix (Practitioners)

Requirement ID		UI Features/Views						
		Registration	Login	Homepage	User Profile	Patient List	Virtual Lobby	Messages
2.8.1		X	X					
	2.8.1.1.PR	X						
	2.8.1.2.PR		X					
	2.8.1.3.PR		X					
	2.8.1.4.PR				X			
2.8.2				X		X	X	X
	2.8.2.1.PR					X	X	
	2.8.2.2.PR						X	
	2.8.2.3.PR						X	
	2.8.2.4.PR						X	
	2.8.2.5.PR						X	
	2.8.2.6.PR						X	
	2.8.2.7.PR						X	
	2.8.2.8.PR						X	
	2.8.2.9.PR					X	X	X
	2.8.2.10.PR			X		X	X	

	2.8.2.11.PR			X		X	X	X
	2.8.2.12.PR			X		X	X	
2.8.3				X	X	X	X	X
	2.8.3.1.PR						X	
	2.8.3.2.PR			X	X	X	X	X
	2.8.3.3.PR						X	
	2.8.3.4.PR						X	
	2.8.3.5.PR						X	
2.8.4				X	X	X		
	2.8.4.1.PR			X		X		
	2.8.4.2.PR					X		
	2.8.4.3.PR					X		
	2.8.4.4.PR				X			

Appendix C: Scenarios/Test Analysis

Scenario 1 (Patient user wants to schedule in office appointment):

Patient A wants to schedule an in office appointment with the MedMeet application. After creating a new MedMeet user application, Patient A will be directed to an insurance information page where they will need to fill out. Patient A will then be redirected to the welcome page, where he or she will have the ability to view available timeslots and schedule in office appointments. Upon completion a email confirmation will be sent to the user confirming appointment and a form will be issued giving the user an option to provide further illness symptoms related specifically to the doctor visit. The doctor will then provide notes and diagnosis analysis, a document archiving system will be used to place such documents. Patient A will then have the ability to view historical records related to that visit.

Scenario 2 (Patient user wants to schedule online appointment):

Patient B wants to schedule an online appointment using the MedMeet application. When the user goes through the login process, he or she will be presented to schedule an online appointment immediately or to schedule for an advanced date. If Patient B schedules immediately, they will be asked whether they want a specific doctor or "next available doctor". The system will place the user in a queue based on doctor preferences. If Patient B select "advanced date" the user will be directed to a online scheduling system, the process will be similar to process described in scenario 1. When an "immediate appointment" is requested from Patient B, the user will be presented a form asking what symptoms they are experiencing. The following conditions must be true in order to advance to an online appointment: the illness does not require emergency medical assistance, the illness does not require a face to face doctor visit to further diagnose, the illness is not simple enough to be validated as a self-treatment meaning users do not need face-to-face doctor assistance. If these three conditions are true then Patient B will be redirected to a audio and video check. The audio and video assistant will help Patient B with any audio or video assistance before talking with a doctor, once completed they will be redirected to a virtual lobby in which the doctor will "knock" to start the video conference. When a doctor is ready the patient will be asked if it "is okay to start the conference", once confirmed the video conference will start. Upon completion, the patient will be able to view records and (if applicable) online prescriptions provided by the doctor these will be described in scenario 3.

Scenario 3 (Patient user wants to view medical records):

Patient C wants to view medical records based on data inserted from both doctors and patient users. After Patient C logs into the MedMeet application they will see a button called "My Account". When selected the user will be able to see information including: doctor's notes, previous appointment diagnosis documents, medical prescription notes and other medical records related to the patient user. The user interface will provide a easy to use navigation to be able to provide excellent usability for the user.

Scenario 4 (Doctor user wants to manage/view upcoming schedules):

Doctor A wants to view and manage upcoming schedules that are booked in the MedMeet application. When logging in, the doctor is presented a user interface that details in schedule in "online appointment" and "in-office appointments". From here doctors can view appointments in measurements of days, weeks and months. In addition, they can provide scheduling information such as days in office and vacation days which communicates with the patient users when scheduling appointments.

Scenario 5 (Doctor user wants to start online appointment):

Doctor B is scheduled for an upcoming online appointment and wants to start the appointment using the MedMeet application. The user logs into the MedMeet application and views all upcoming appointments. Doctor B then chooses an appointment and elects to start the appointment. Once started the doctor will be placed in a video conference with the patient. While interviewing and diagnosing the patient, Doctor B will have a place to take notes and provide patient analysis. After the video conference is completed, Doctor B will have time to finish up notes as well as provide specialist suggestions and prescription notes. These scenarios will be discussed in scenario 6.

Scenario 6 (Doctor wants to add additional medical notes to patient record):

Doctor C wants to add additional medical information to a patient using the online doctor appointment application. Doctor C will have the ability to add medical information, for a patient user record, two different ways. The first way is after the doctor and patient end their online video conference, from here the doctor will be redirected to the user record page, this list the user record as well as many different medical information related to the user. Doctors will have the ability to add appointment notes, doctor specialization suggestions and prescription notes for the user to print and download. Additionally Doctor C will have the ability to log into the MedMeet application and perform the same document requests. The second approach will be primarily used for doctor visits performed in office.

Scenario 7 (Doctor and Patient want to sign up for the MedMeet application):

Both Doctor D and Patient D want to sign up for the MedMeet application. Each different user will be presented with a user interface illustrated in both the Login UI (Doctor & Patient) sections of this document. Both the doctor and patient will be presented with a form that allows them to create a new account, and link and email to the application. The procedure will follow standard software processes including login creation and credential management. From here the Doctor D will have the opportunity to set a in-office schedule as well as an online schedule, after both schedules are created patient users will be able to see Doctor D as a doctor available to take online or in office patients. In addition, Doctor D will have the ability to request "patients" in which this allows already establish doctor/patient relationships to create a link between the doctor and

patient. This is based on the patient user acceptance. On the other side, Patient D will be presented a form that allows users to upload and create medical record documents. These documents will be used for doctors, authorized by the patient, to review. In addition the scheduling process will start, asking the user if they want to create a new doctor appointment, with the scenario described in scenario 1 & 2.

Test Matrix:

Test ID	Requirement	Test Case	Expected Outcome	Test Method	Pass/Fail
1	2.8.1.2.PA 2.8.1.2.PR	*The user logs into the system using his/her login credentials.*	*The user will be taken to his/her homepage*		
2	2.8.3.1.PR	*A patient schedules an appointment with a practitioner.*	*Both the patient and practitioner calendars will be updated with a new record*		
3	2.8.2.4.PA	*A patient selects a practitioner for consultation.*	*A new patient/practitioner relationship is created*		
4	2.8.1.4.PR	*Patient Views/Updates Medical Record*	*List of medical records related to the patient are presented and the patient will he able to update his/her medical records.*		
5	2.8.1.4.PR	*Patient Updates Insurance*	*A patient's medical history will reflect the updated insurance information*		
6	2.8.2.8.PA	*Patient Pays Co-Pay*	*Patient receive a confirmation of payment via the application and email*		
7	2.8.2.5.PA	*The patient initiates a consultation session via a pre-scheduled appointment.*	*Prior to starting a consultation session, the patient must perform an audio/video check*		

8	2.8.2.1.PA		*Prior to the consultation, the patient must present valid insurance and payment information*		
9	2.8.2.7.PA		*The patient is connected to the practitioner via a videoconferencing session.*		
10	2.8.2.8.PA	*The patient terminates the video-conferencing session.*	*A new patient Medical Record is created. The videoconferencing session is terminated, and the user will be presented with the option of returning to the Virtual Lobby or homepage.*		
11	2.8.2.9.PR	*A practitioner is prompted to follow up with a patient.*	*The practitioner will be taken to the Messaging page, where he/she will be presented with the option to send a text-based message to a patient.*		
12	2.8.3.4.PA	*A practitioner views his/her calendar of appointments.*	*The practitioner will be presented with his/her calendar with a list of upcoming appointments.*		

13	2.8.2.9.PR	*The practitioner submits a prescription to the patient.*	*A new medical record will be created for the patient.*		
14	2.8.2.7.PR	*The practitioner submits notes taken during a consultation session.*	*The consultation notes/memos will be updated to the patient's medical history.*		
15	2.8.2.4.PR	*The practitioner initiates a consultation session via a pre-scheduled appointment.*	*Prior to starting a consultation session, the practitioner must perform an audio/video check*		
16	2.8.2.6.PR		*Practitioner is connected with the patient via video conferencing.*		
17	2.8.2.PR	*The practitioner terminates the consultation session.*	*A new patient medical record is created, and the videoconferencing session ends.*		
18	2.8.1.4.PR	*The practitioner updates his/her office information via his/her Account Information page.*	*The Account Information page will be updated to reflect the new office information.*		

Appendix D: Survey Questions

General Questions for Patients

1. Gender of patient?
    a. Male
    b. Female
2. Age of patient?
    a. 0 - 18
    b. 19 - 25
    c. 26 - 40
    d. 41 - 60
    e. 61 and over
3. Are you impaired or disabled?
    a. Disabled (Handicapped, wheel-chair bound)
    b. Impaired (Mute or Deaf)
    c. Healthy
4. From personal experience what is the average wait time at doctor's office?
    a. Under 10 minutes
    b. 10 - 20 minutes
    c. 21 - 40 minutes
    d. Over 41 minutes
5. From personal experience how far is the doctor's office from your house?
    a. 0 - 5 miles
    b. 6 - 10 miles
    c. 11 - 20 miles
    d. Over 20 miles
6. Do wait times and distance to the office discourage you from seeing the doctor?
    a. Yes
    b. No
7. Which of the following medical tools do you have easy access to (you may select multiple options)?
    a. Weight scale
    b. Ruler adequate for measuring height
    c. Thermometer
    d. Stopwatch (for manual reading of heartrate)
    e. Smartphone
    f. Wearable device (i.e. Smart Watch, FitBit, etc.)
    g. None of the above.
    h. All of the above

Questions for Patients Using Online Resources

1. If this resource requires you to send confidential personal information through a secure means, on a scale of one (least) to ten (most), how comfortable would you be sending the confidential information?
2. If you feel ill, how often do you consult this resource as your primary means of medical help?
    a. Never
    b. Rare (up to 25% of instances)
    c. Occasional (up to 50% of instances)
    d. Frequent (up to 100% of instances)
    e. Every time (100% of instances)
3. On a scale of one (least) to ten (most), how trustworthy is this resource's diagnosis of the ailment?
4. (Follow-up to question 3) If you feel ill and perform a self-diagnosis using this resource, how often do you have to visit a physician to obtain a certified diagnosis?
    a. Never
    b. Rare (up to 25% of instances)
    c. Occasional (up to 50% of instances)
    d. Frequent (up to 100% of instances)
    e. Every time (100% of instances)
5. If you feel ill and perform a self-diagnosis using this resource, how often does this resource accurately diagnose the ailment?
    a. Never
    b. Rare (up to 25% of instances)
    c. Occasional (up to 50% of instances)
    d. Frequent (up to 100% of instances)
    e. Every time (100% of instances)
6. On a scale of 1 (least effective) to 10 (most effective), how effective are the non-prescription medication remedies recommended by this resources for your ailment?
7. As a continuation of Question 4, how often are these recommended remedies effective at all?
    a. Never
    b. Rare (up to 25% of instances)
    c. Occasional (up to 50% of instances)
    d. Frequent (up to 100% of instances)
    e. Every time (100% of instances)
8. [Open-ended question] How would you recommend this resource be used?
9. [Open-ended question] How do you use this resource?
10. [Open-ended question] When do you use this resource?
11. [Open-ended question] What do you use this resource for?
12. [Open-ended question] Do you think this resource can serve as a complete replacement for an in-clinic consultation of a physician?
13. [Multiple choice version of question 6] How would you recommend this resource be used?
    a. Complete replacement for an in-person doctor's visit
    b. As a supplement for an in-person doctor's visit
    c. As a tool for self-diagnosis (but not a complete replacement for a doctor)
    d. Other: [fill in the blank option]

Questions for Doctors

1. What is the average age of your patients?
    a. 0 - 18
    b. 19 - 25
    c. 26 - 40
    d. 41 - 60
    e. 61 and over
2. *What age group would you recommend using a self-diagnosis medical app? Select as many as you want. (Assume that the patient is alone)*
    a. 12 - 17
    b. 18 - 25
    c. 26 - 40
    d. 41 - 60
    e. 61 and over
    f. All of the above.
    g. Specify age range _____
3. Do you believe that it is necessary for the patient to schedule an appointment with you even if the patient's self-diagnosis was correct (specify the reason)?
    a. Yes _____
    b. No _____
4. On a scale of one (least) to ten (most), how important is it to schedule a follow-up with an ill patient?
5. Ideally, how often should a patient speak with a practitioner or visit a practitioner?
    a. Once a month
    b. Once every three months
    c. Once every half a year
    d. Once a year
6. On average, wow often does a patient visit you?
    a. Once a month
    b. Once every three months
    c. Once every half a year
    d. Once a year
7. Do you think facilitating visits virtually, or the ability to directly text/message a practitioner would enable patients to more frequently communicate with their practitioners (specify reason)?
    a. Yes _____
    b. No _____

Appendix E: Ethnographic Journal Entries

Teammate 1:

Date/Time: Wednesday, March 2nd, 2016 10:30 AM
Doctor: Dr. Gene Kim MD (Primary Care Doctor)
Location: 1 Shrader Street Suite 550 SF, CA 94117
Diagnosis: Flu-like symptoms

Travel Setting:
Traveling from SF's outer sunset district to the doctor's office in the richmond district. Based on my Uber receipt the total amount of time it took me to get from my house to the doctor's office was 11.70 minutes (3.72 miles). From the doctor's office to my house it took 11.38 minutes (3.65 miles). My first Uber ride time was 10:12 AM and my second ride was at 11:21 AM. That means that the whole doctor trip took me me around 80 minutes all together. Although this is ideal time to travel in SF (as everyone was at work and the streets were less crowded), during rush hour traffic I would expect the travel to be almost double (at 20 minutes). To conclude the travel time was an average weekday and during the most of convenient of times and took about 80 minutes all together.

Environment Setting:
Upon entering the doctor's office it took about 2 - 3 minutes to find the exact office (many rooms in one building), my assumption is that its San Francisco and that the environment makes it harder to find. After being greeted I was delighted to find out that no one was in front of me, this again made me think it would be a quicker doctor's appointment as I am the first in line (from what I can see). Although the doctors office was nice and comfortable, but in the current state I was in the last thing I wanted to be was outside in public. From the time of entry to the time my name was called the process took about 10 minutes It took just about 5 minutes to get seated in my room, from which my measurements including weight & height were taken. I described my symptoms to the nurse who assured me "the doctor will be in soon". About 10 minutes past from the time the nurse left to when the doctor came into the room. The doctor and I talked about my symptoms, took a few tests including body temperature and prescribed me medication. I was on my way out of the doctors office in about 20 minutes. From there I had 6 minutes to follow up with the front desk admin and schedule an uber home.

Conclusion:
Although the travel time as well as doctor's appointment was much less than I had expected for San Francisco (there has been times where the whole process was over 1.5/2 hours) a lot of the experience was designed with time in mind (wanted to get in and out as fast as possible..). The time was picked in advanced strategically, taking uber was more convenient mentally ($22.41 all together) than finding parking (expect an additional 10 - 20 minutes based parking). One thing I noticed about myself was my attitude and the feeling of being out of my house, out of my bed. Going to the doctor's office took a lot of planning including preparing mentally and physically to get

out of bed when dealing with flu like symptoms. To put in the perspective of our doctor visit application, we plan to attack the length of the process as a whole, eliminating ride (22 minutes) and doctor waiting (20 minutes) times. This significantly cuts our total time (80 minutes) in half (38 minutes).

Teammate 2:

Date/Time: Sunday, March 27th, 2016 2:30 PM
Doctor: ------
Location: El Camino Hospital, Mountain View, California
Diagnosis: Infection-like symptoms

Background:
I had been experiencing odd symptoms for about a week now, including very swollen lymph nodes and a headache that almost seemed like I had sustained a concussion. I also had a high fever, but no congestion or sore throat. Using online resources, I diagnosed this as a possible infection or cold, but over the counter medication seemed to be having no effect. By the middle of the week, I was feeling very exhausted and was almost bedridden.

Travel Setting:
It took about 20 minutes to drive from my home in Santa Clara to El Camino hospital (travelling through a mixture of surface streets and highways) in severe discomfort. In retrospect, this was not a safe decision - the headache was painful to the point where I was squinting to see properly. There was very little traffic on an Easter Sunday - with traffic, the commute would have taken about 40 minutes.

Environment Setting:
When I checked into the ER, I had to wait about 30 minutes for a nurse to take my blood pressure and basic vitals. It was physically obvious that my lymph nodes were swollen, and I described on the check-in sheet that I was experiencing severe discomfort. It took an additional 15-20 minutes for a nurse to see me and ask more detailed questions about my symptoms. After an additional 1.5 hours of waiting, I was admitted to a patient bay, where a second nurse prepped me for examination. Another 45 minutes later, I was finally able to consult a doctor, who suspected I had contracted both strep throat and Mono. To confirm that I indeed have Mono, they would need to conduct further blood test, which took an additional 30 minutes. After they made the official diagnosis of Mononucleosis, I had to proceed with a further 10 minutes of post-visit activities (billing insurance, getting prescription medication, etc).

The pharmacy that I normally use was closed, so I had to wait until Monday to get the medication.

Conclusion:

The problem start with my initial erroneous self-diagnosis of the basic cold or flu. The final diagnosis was actually more severe than what I had thought - Mono is extremely contagious and some patients infected with mono have reported being bedridden for weeks, even months.

The travel time to the hospital was not off putting, as I travel between Santa Clara and Mountain View on a fairly frequent basis. However, in hindsight, driving in severe discomfort was not a wise idea as it could have caused a severe accident and led to further complications.

The wait time in the ER was what shocked me the most - given my fairly obvious state, I'm surprised it took over 2.5 hours to consult the necessary help. From my observation, the hospital was not busy at all - there were very few people in the waiting room.

Teammate 3:

Date/Time: April 2016
Doctor: Dr. Ming-Hsien Wu
Wu (Primary Care Doctor)
Location: Fremont, CA
Diagnosis: Actual Flu Symptoms
Travel Outlook:
Traveling from my house in Fremont to the Palo Alto Medical Foundation within Fremont takes around 9-11 minutes one way, so the whole doctor's trip takes around 18-22 minutes depending on green traffic light frequency. I had an appointment around 10:30 am, left home at 10:00 am at arrived at the destination at 10:11 am (using the remaining time to find parking). This was an average weekday, so the transit time was reasonable.

Environment Setting:
I entered Building II (notified beforehand) and took the elevator to the 2nd floor reception office (where my primary care physician would be working on). I waited in line for around 2-3 minutes with other patients to check in with the receptionists (two – three were working at the time). After paying a $10 co-pay, I settled myself in the lounging area for around 10 minutes. The seating arrangement had some sick patients coughing and elderly patients holding onto a breathing tank or a cane, monitored by a family member. Some children were playing with the toys scattered on the table while the parents either watched on or read magazines. I decided to distance myself from the coughing patients when they started to move near my seated location.

The nurse called me in and directed me to the doctor's office. She started taking the usual diagnostics of weighing, proper blood pressure monitoring, and asking the purpose of my visit. She scribbled some notes and asked about symptoms all taking a process of seven to eight minutes. Around three minutes later, the doctor checked in and took note of my coughing and sneezing. He asked some more questions about how long I had these symptoms, and any behavior typical of flu symptoms like dizziness and fever. After a 10-minute exchange, along with my re-occurring eczema, he prescribed antibiotics—however, the antibiotics were a different color, blue this time,

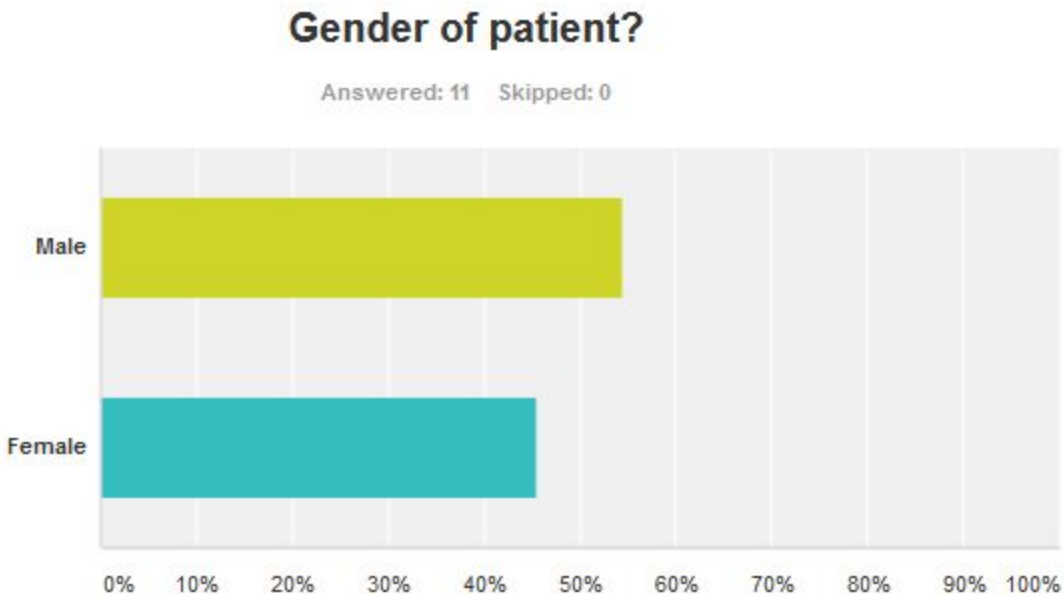
(red, white for staph infection) and strength depending on how severe the symptoms were and how long I had the flu. He also scheduled my medication to pick-up at the nearest pharmacy to my home. The drive from the doctor's office took seven minutes to the pharmacy, and another 10-15 minutes of waiting time at the pharmacy to put together the medication.

Conclusion:
The transit time was not much inconvenience for me, though the combined times of finding parking, waiting at the receptionist office, waiting at the doctor's room, and waiting at the pharmacy for the medication did add up. While I did have the flu and some of the symptoms could be easily diagnosed, I also went for dual purpose of checking up on the status of another unrelated, concurrent illness. I believe the online doctor meetup app would still do good for normal and physically disabled patients that have difficulties in longer travel time or inconvenience of having to physically visit.

Appendix F: Graphical Interpretation of Survey Results

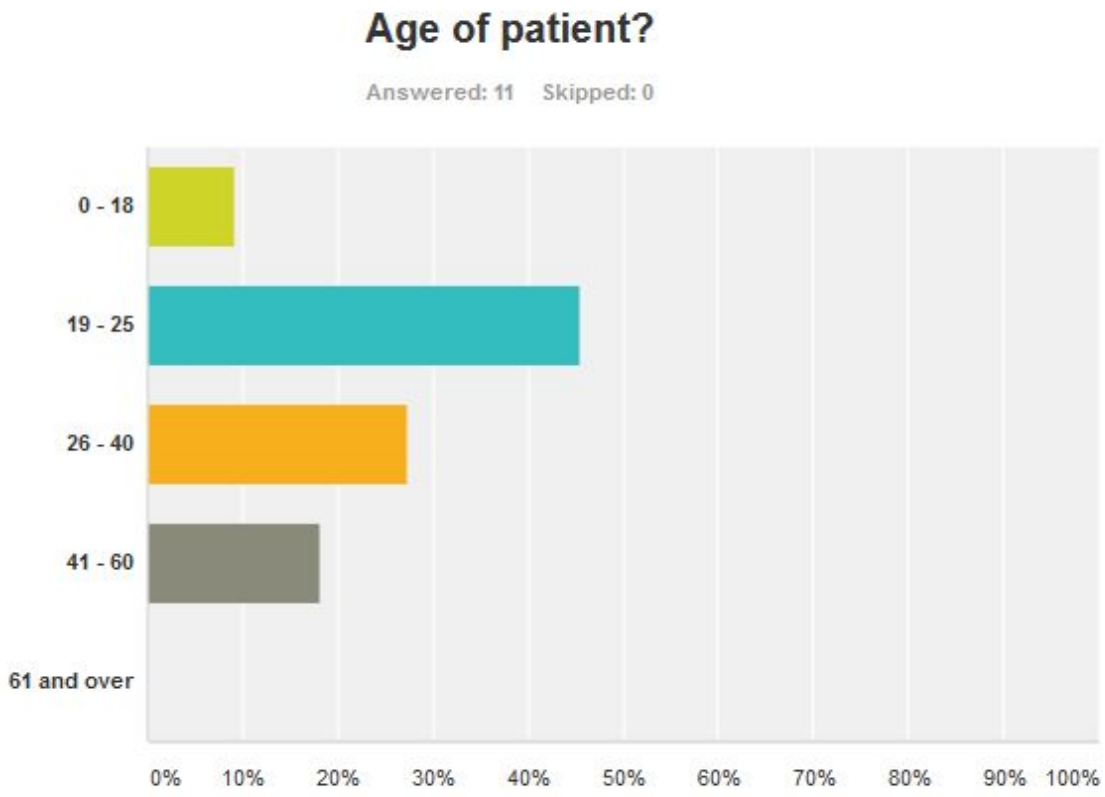
MedMeet Application: General Questions for Patients (Survey I)

Figure 1: Q1, Patient's Gender



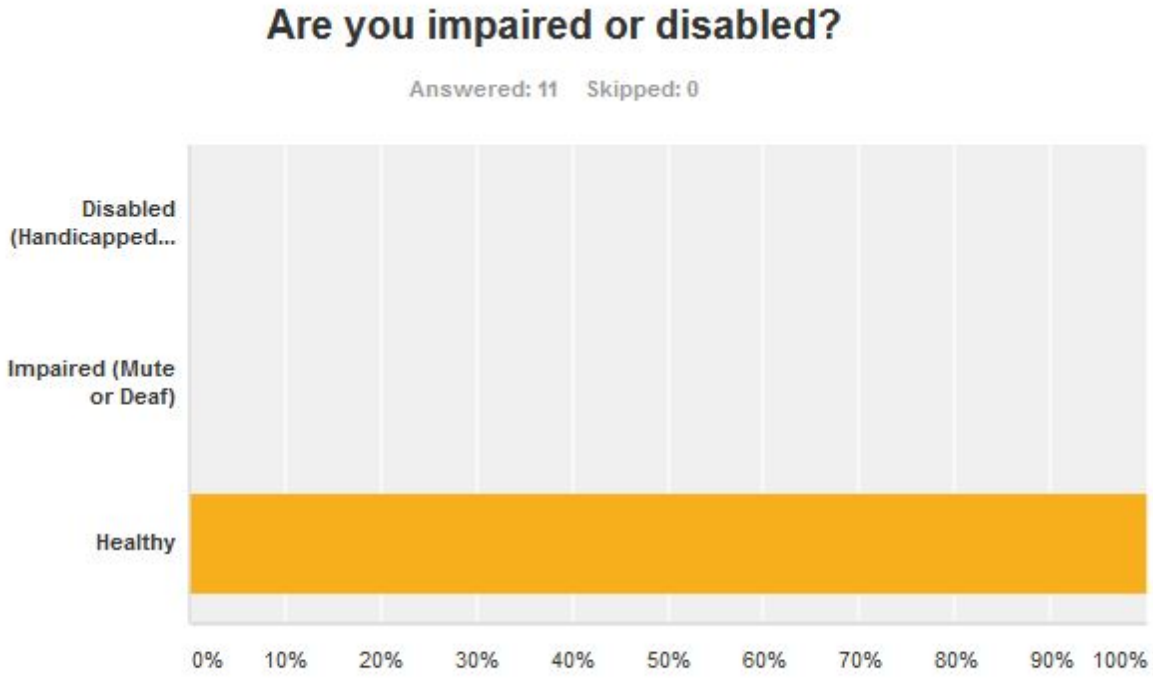
Answer Choices	Responses	
Male	54.55%	6
Female	45.45%	5
Total		11

Figure 2: Q2, Age of Patient



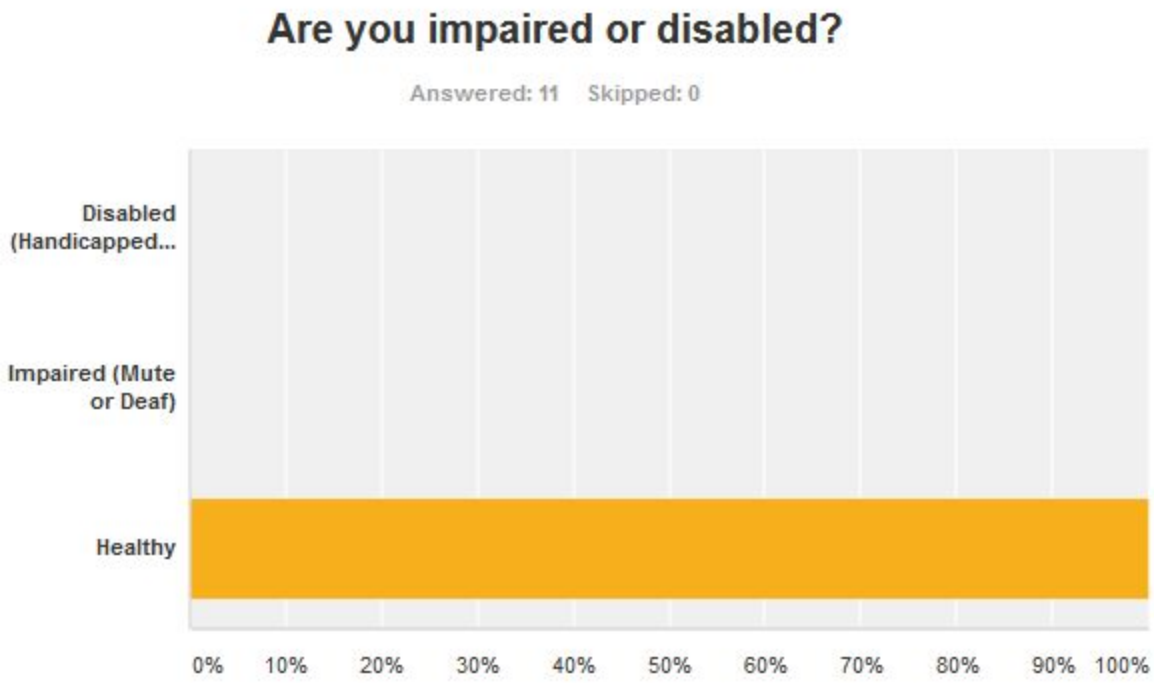
Answer Choices	Responses	
0 - 18	9.09%	1
19 - 25	45.45%	5
26 - 40	27.27%	3
41 - 60	18.18%	2
61 and over	0.00%	0
Total		11

Figure 3: Q3, Survey results assessing overall general condition the patient's health



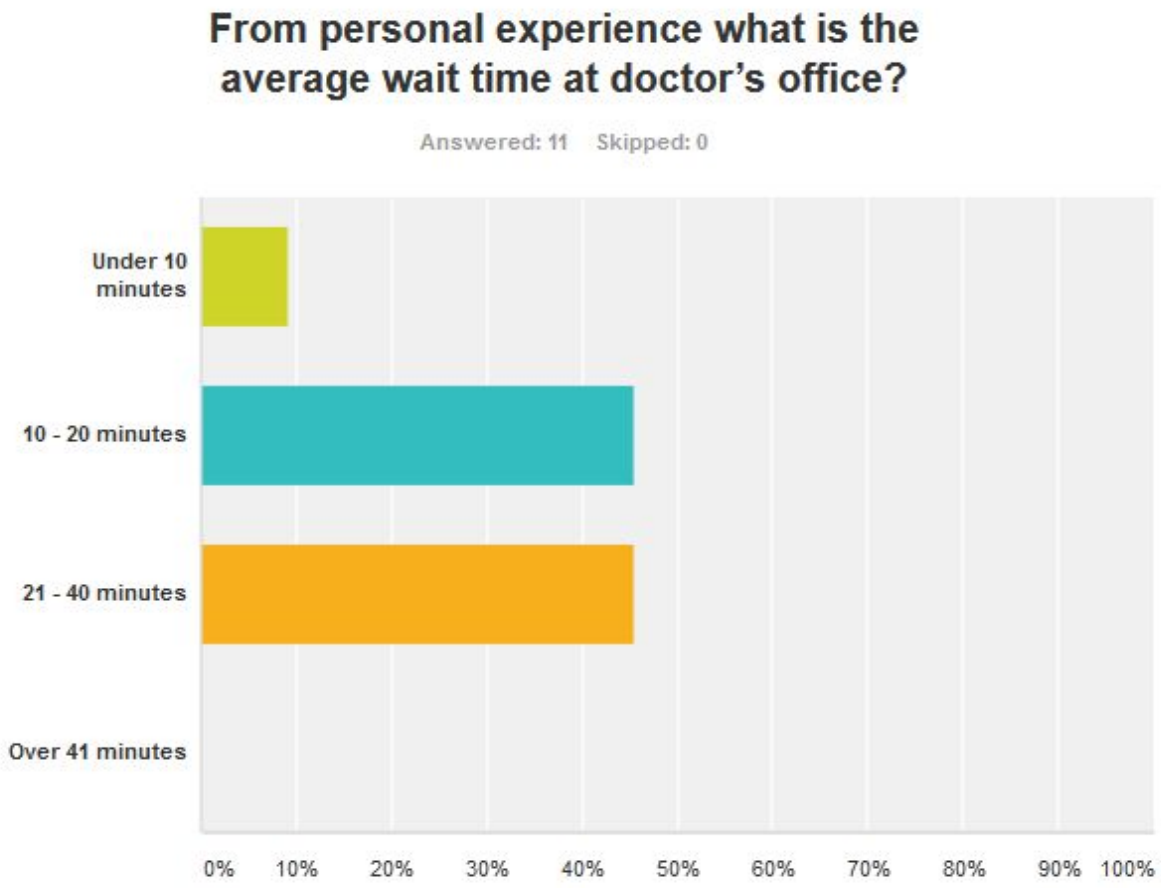
Answer Choices	Responses	
Disabled (Handicapped, wheel-chair bound)	0.00%	0
Impaired (Mute or Deaf)	0.00%	0
Healthy	100.00%	11
Total		11

Figure 4: Q4, Survey results assessing overall general condition the patient's health



Answer Choices	Responses	
Disabled (Handicapped, wheel-chair bound)	0.00%	0
Impaired (Mute or Deaf)	0.00%	0
Healthy	100.00%	11
Total		11

Figure 5: Q5, Survey results assessing average wait time at the doctor's office



Answer Choices	Responses	
Under 10 minutes	9.09%	1
10 - 20 minutes	45.45%	5
21 - 40 minutes	45.45%	5
Over 41 minutes	0.00%	0
Total		11

Figure 6: Q6, Survey results querying for impact of distance and wait times on a patient's desire to consult a practitioner in person

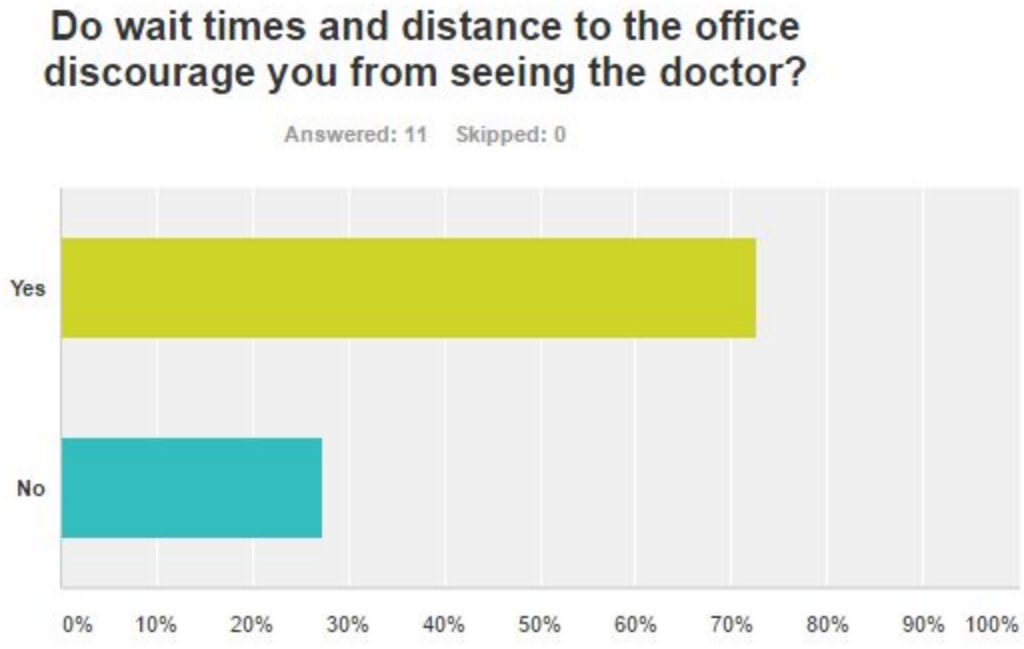
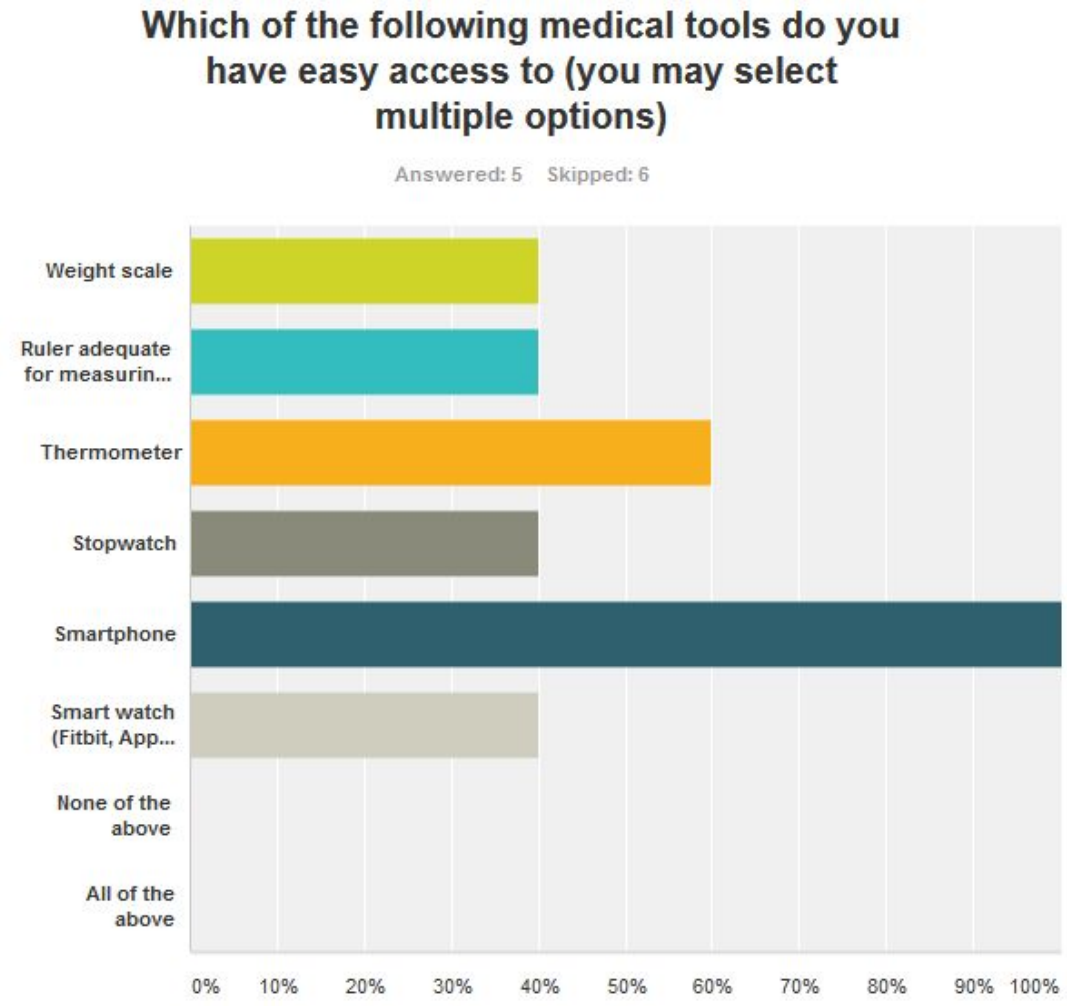


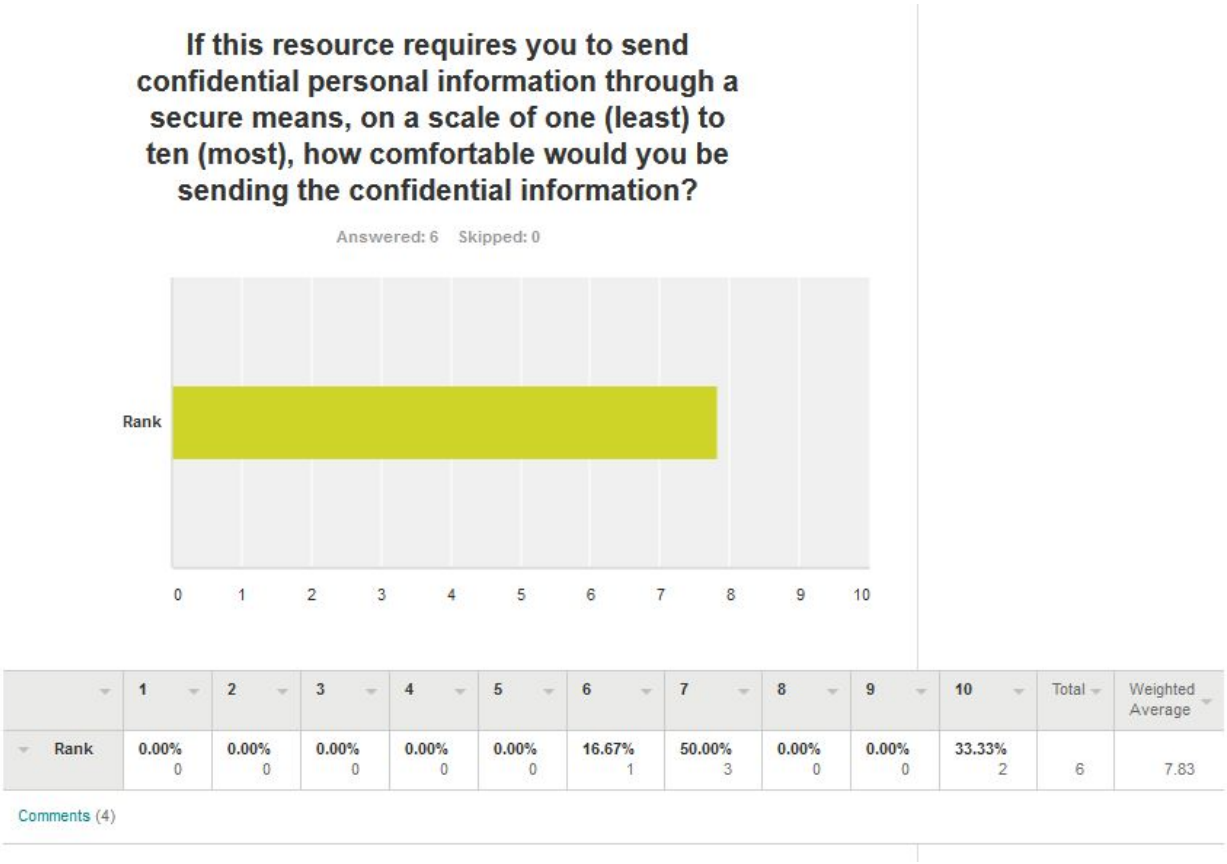
Figure 7: Q7, Survey results assessing diagnostics tools that patients are accessible to (have on hand)



Answer Choices	Responses	
Weight scale	40.00%	2
Ruler adequate for measuring height	40.00%	2
Thermometer	60.00%	3
Stopwatch	40.00%	2
Smartphone	100.00%	5
Smart watch (Fitbit, Apple Watch)	40.00%	2
None of the above	0.00%	0
All of the above	0.00%	0
Total Respondents: 5		

MedMeet: Questions for Patients Using Online Resources (Survey II)

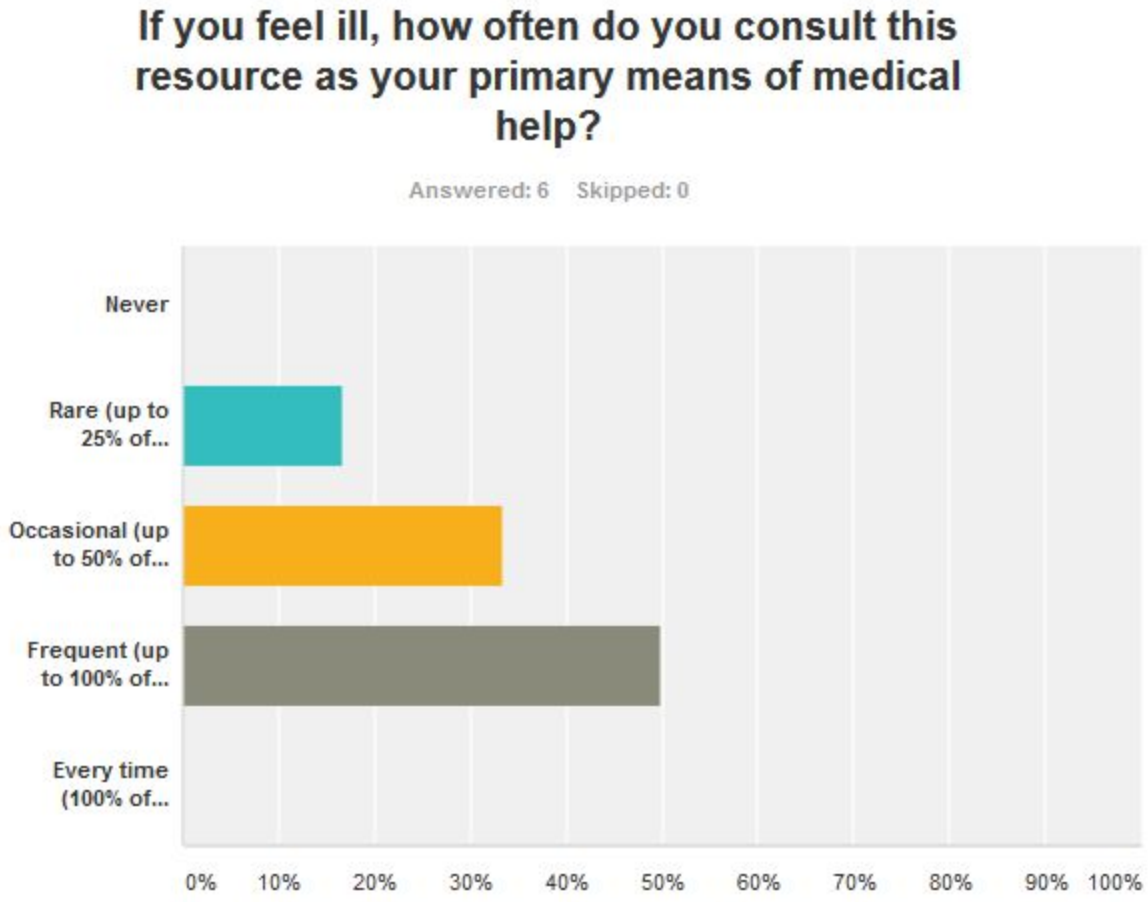
Figure 1: Q1, Survey results assessing comfortability sending confidential information through secure means.



	1	2	3	4	5	6	7	8	9	10	Total	Weighted Average
Rank	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0	16.67% 1	50.00% 3	0.00% 0	0.00% 0	33.33% 2	6	7.83

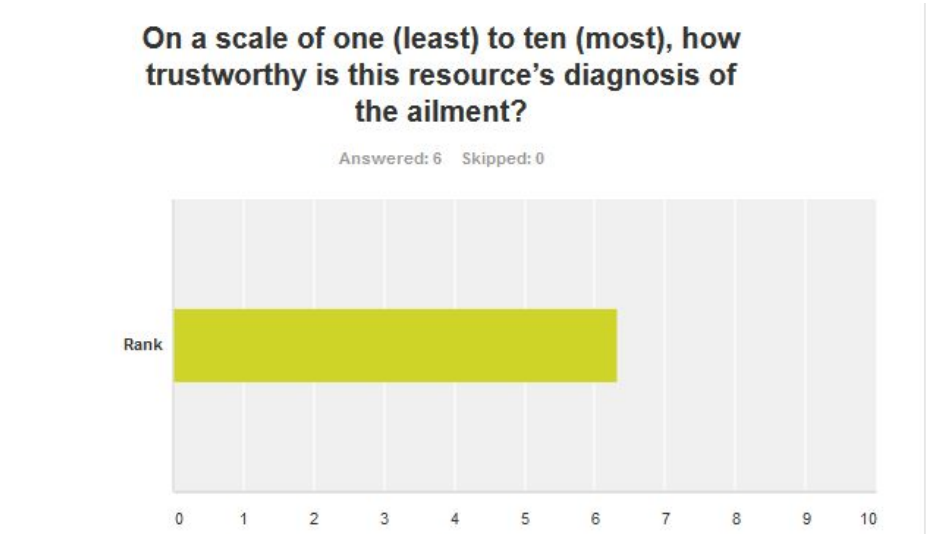
Comments (4)

Figure 2: Q2, Survey results assessing consultation of the web application as main form of medical assistance.



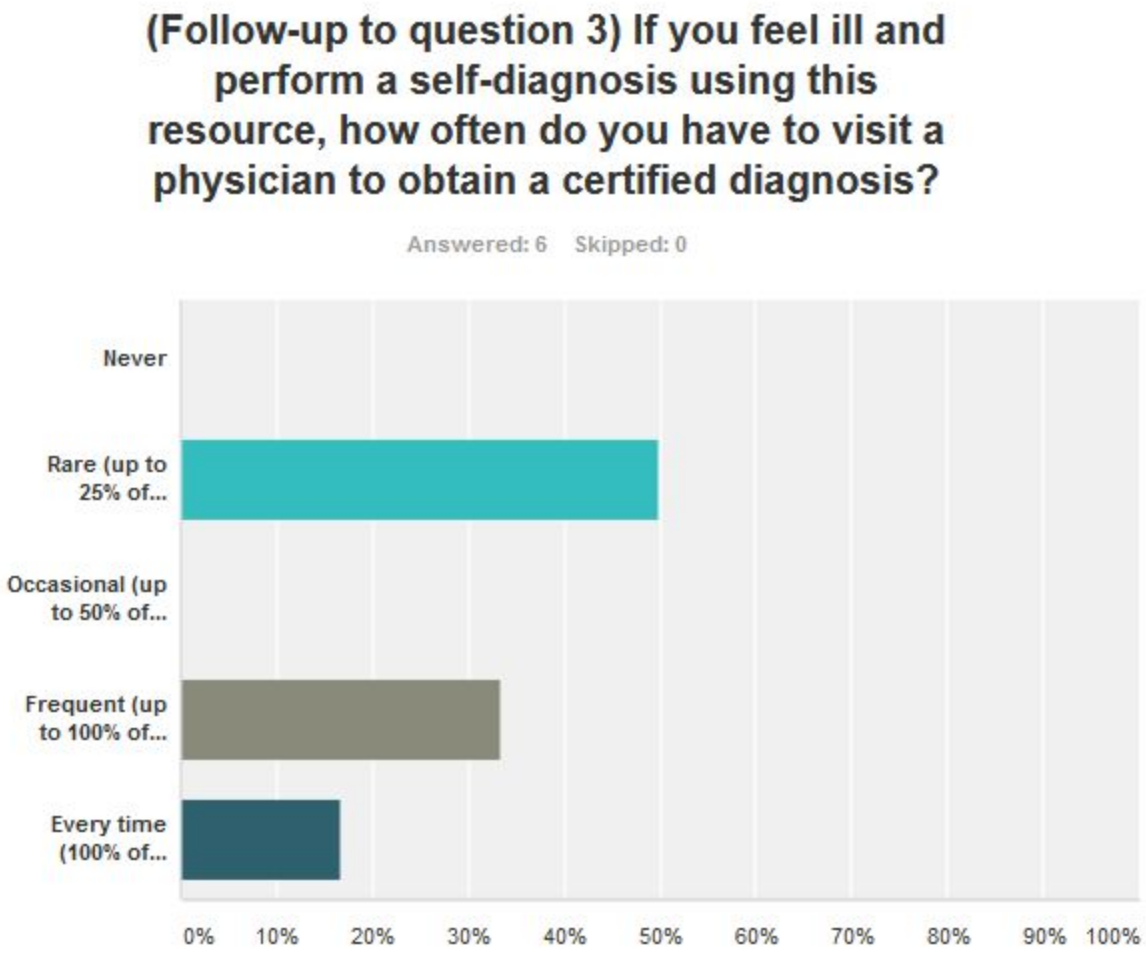
Answer Choices	Responses	
Never	0.00%	0
Rare (up to 25% of instances)	16.67%	1
Occasional (up to 50% of instances)	33.33%	2
Frequent (up to 100% of instances)	50.00%	3
Every time (100% of instances)	0.00%	0
Total		6

Figure 3: Q3, Survey results assessing trustworthiness of web application resource for self-diagnosis.



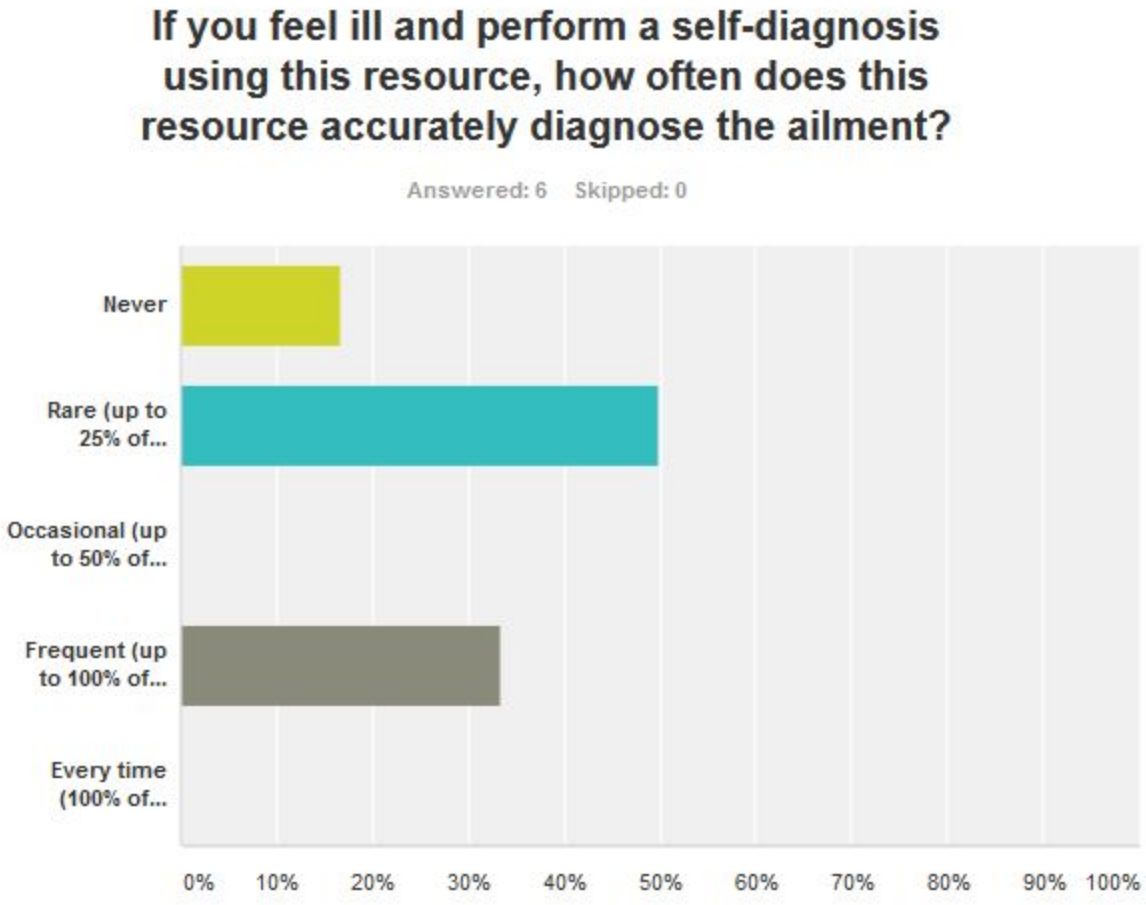
	1	2	3	4	5	6	7	8	9	10	Total	Weighted Average
Rank	0.00% 0	0.00% 0	0.00% 0	16.67% 1	16.67% 1	0.00% 0	50.00% 3	16.67% 1	0.00% 0	0.00% 0	6	6.33

Figure 4: Q4, Survey results assessing trustworthiness of web application resource for self-diagnosis.



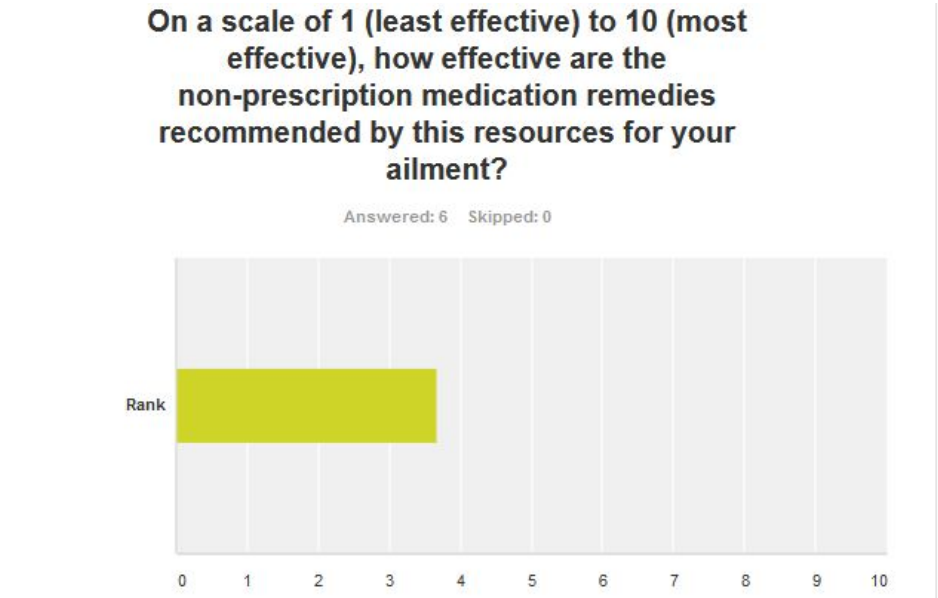
Answer Choices	Responses	
Never	0.00%	0
Rare (up to 25% of instances)	50.00%	3
Occasional (up to 50% of instances)	0.00%	0
Frequent (up to 100% of instances)	33.33%	2
Every time (100% of instances)	16.67%	1
Total		6

Figure 5: Q5, Survey results assessing trustworthiness of web application resource for self-diagnosis.



Answer Choices	Responses	
Never	16.67%	1
Rare (up to 25% of instances)	50.00%	3
Occasional (up to 50% of instances)	0.00%	0
Frequent (up to 100% of instances)	33.33%	2
Every time (100% of instances)	0.00%	0
Total		6

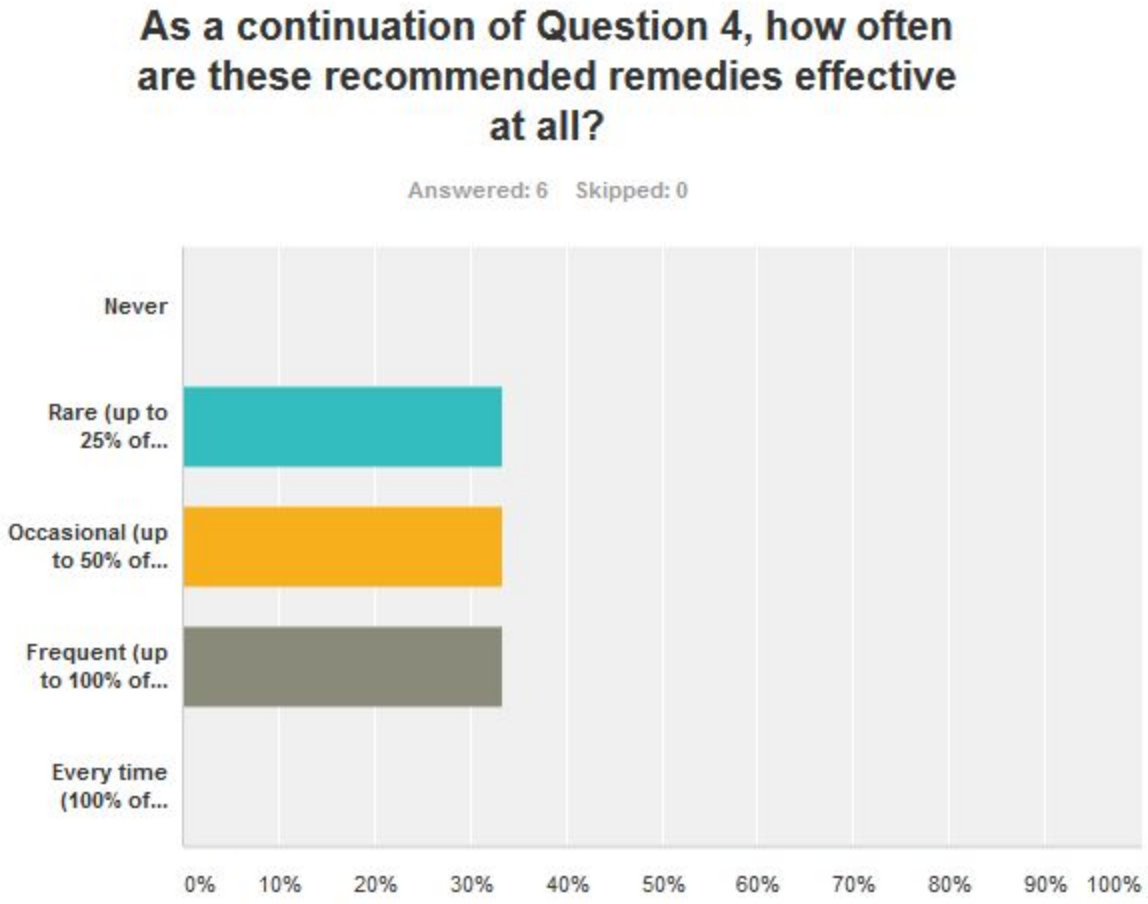
Figure 6: Q6, Survey results assessing effectiveness of "over-the-counter" medication recommended by the web app (WebMD) on illness.



	1	2	3	4	5	6	7	8	9	10	Total	Weighted Average
Rank	50.00% 3	0.00% 0	0.00% 0	0.00% 0	16.67% 1	16.67% 1	0.00% 0	16.67% 1	0.00% 0	0.00% 0	6	3.67

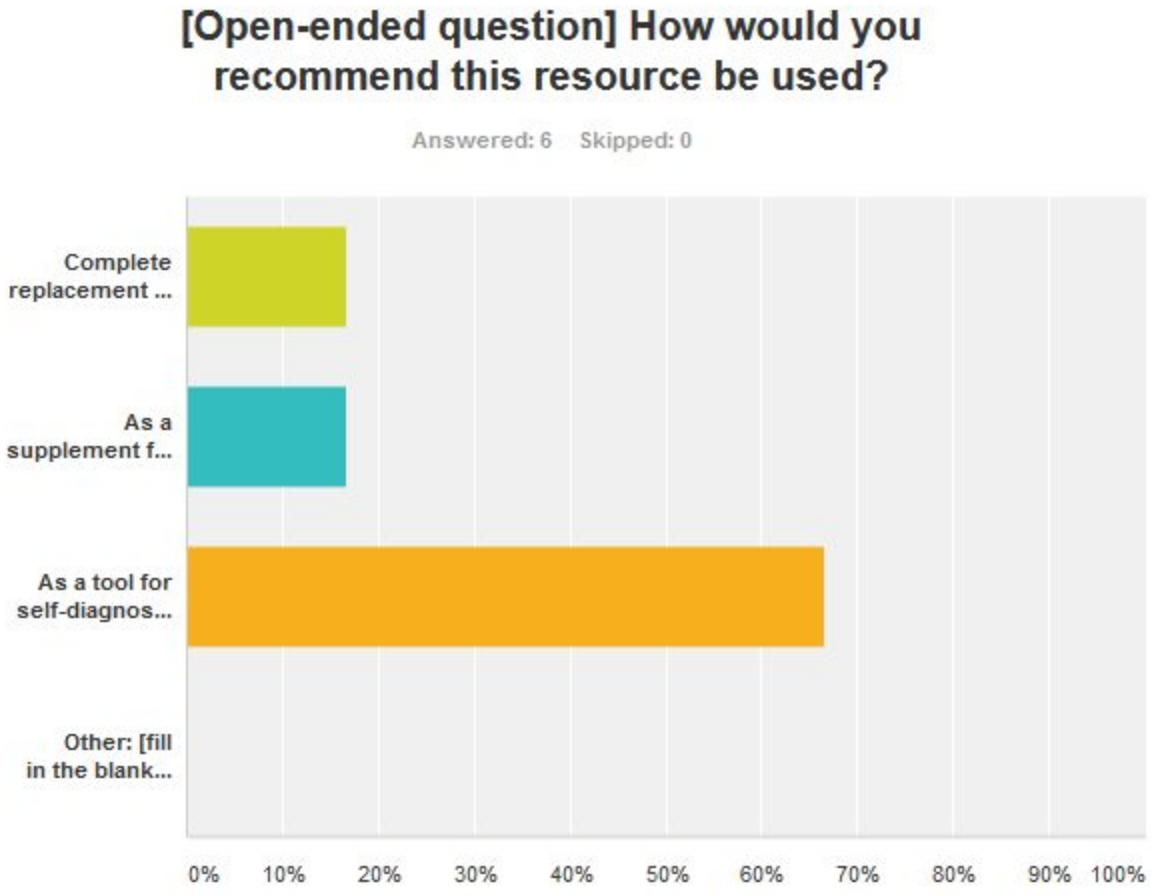
Comments (3)

Figure 7: Q7, Survey results assessing effectiveness of "over-the-counter" medication recommended by the web app (WebMD) on illness. (Rated 1 to 10)



Answer Choices	Responses	
Never	0.00%	0
Rare (up to 25% of instances)	33.33%	2
Occasional (up to 50% of instances)	33.33%	2
Frequent (up to 100% of instances)	33.33%	2
Every time (100% of instances)	0.00%	0
Total		6

Figure 8: Q8, Survey results asking patients on how the web resource should be utilized.



Answer Choices	Responses	
Complete replacement for an in-person doctor's visit	16.67%	1
As a supplement for an in-person doctor's visit	16.67%	1
As a tool for self-diagnosis (but not a complete replacement for a doctor)	66.67%	4
Other: [fill in the blank option]	0.00%	0
Total		6

Figure 9: Q9, Survey results acessing patients on what times they would use the resource

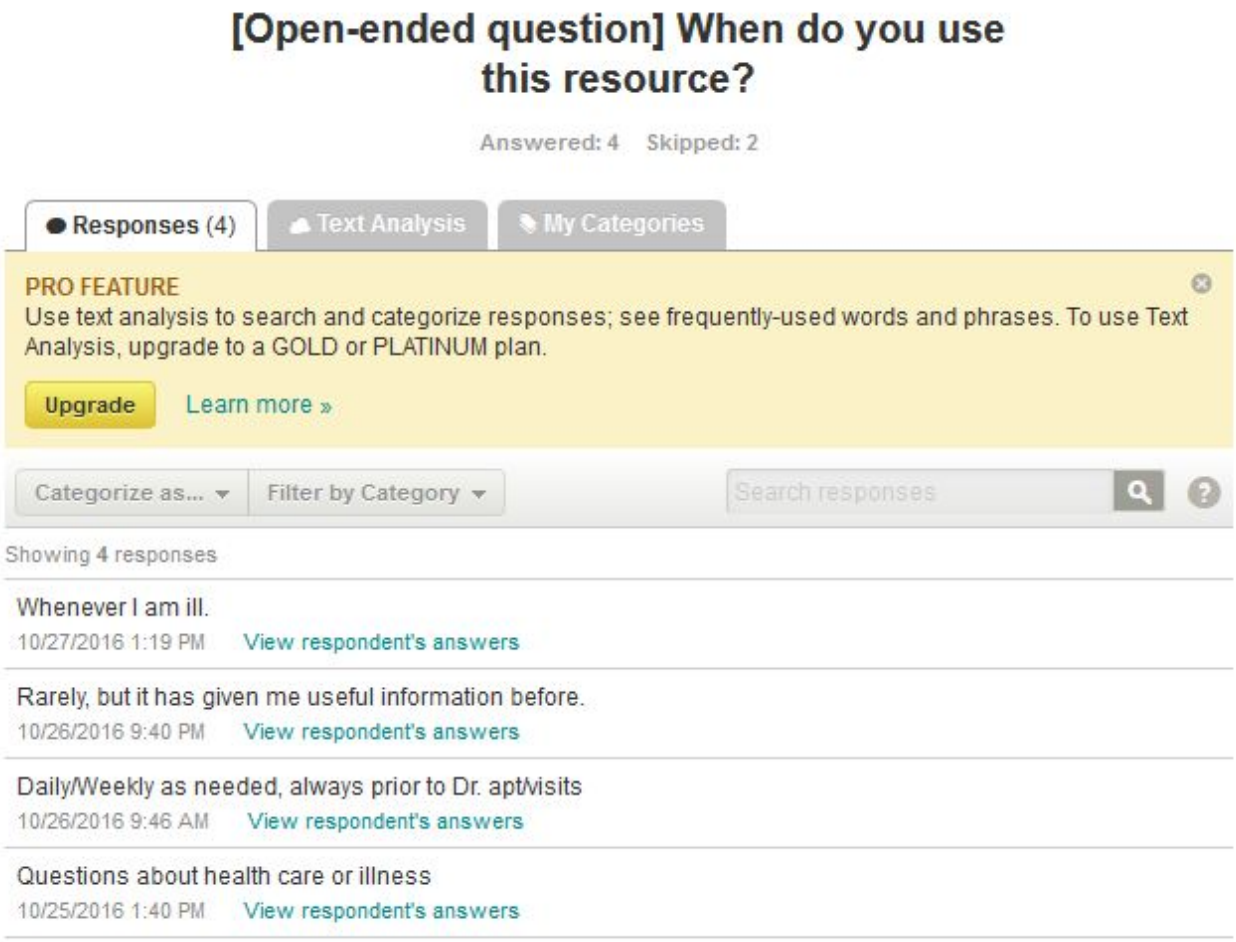
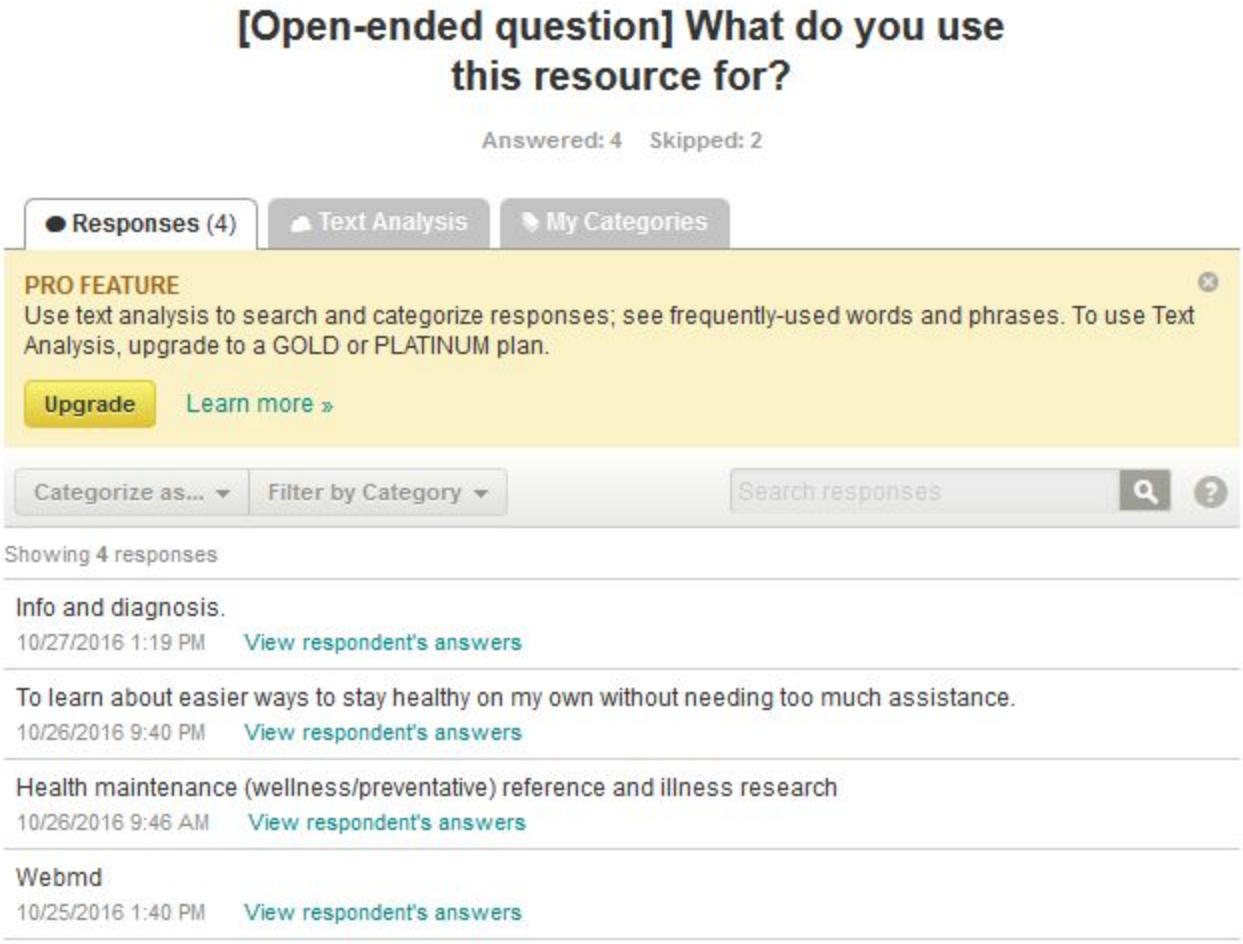
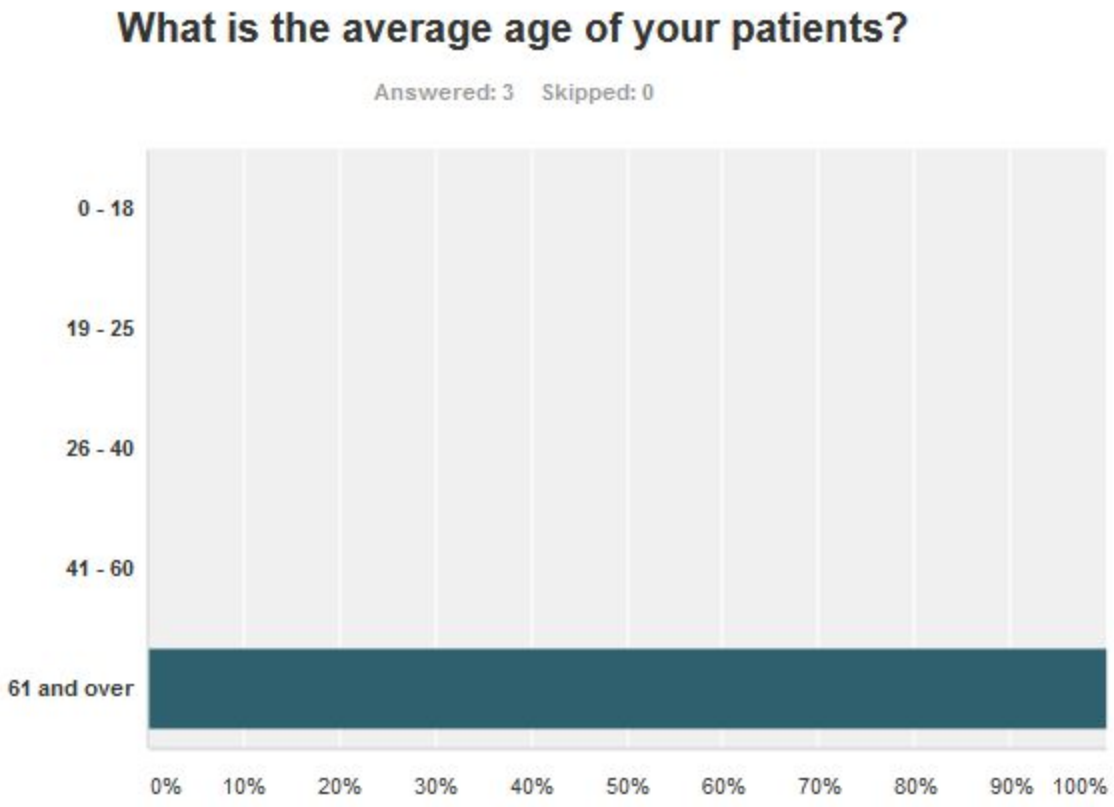


Figure 10: Q10, Survey results acessing patients on what cases/scenarios they would use the web resource.



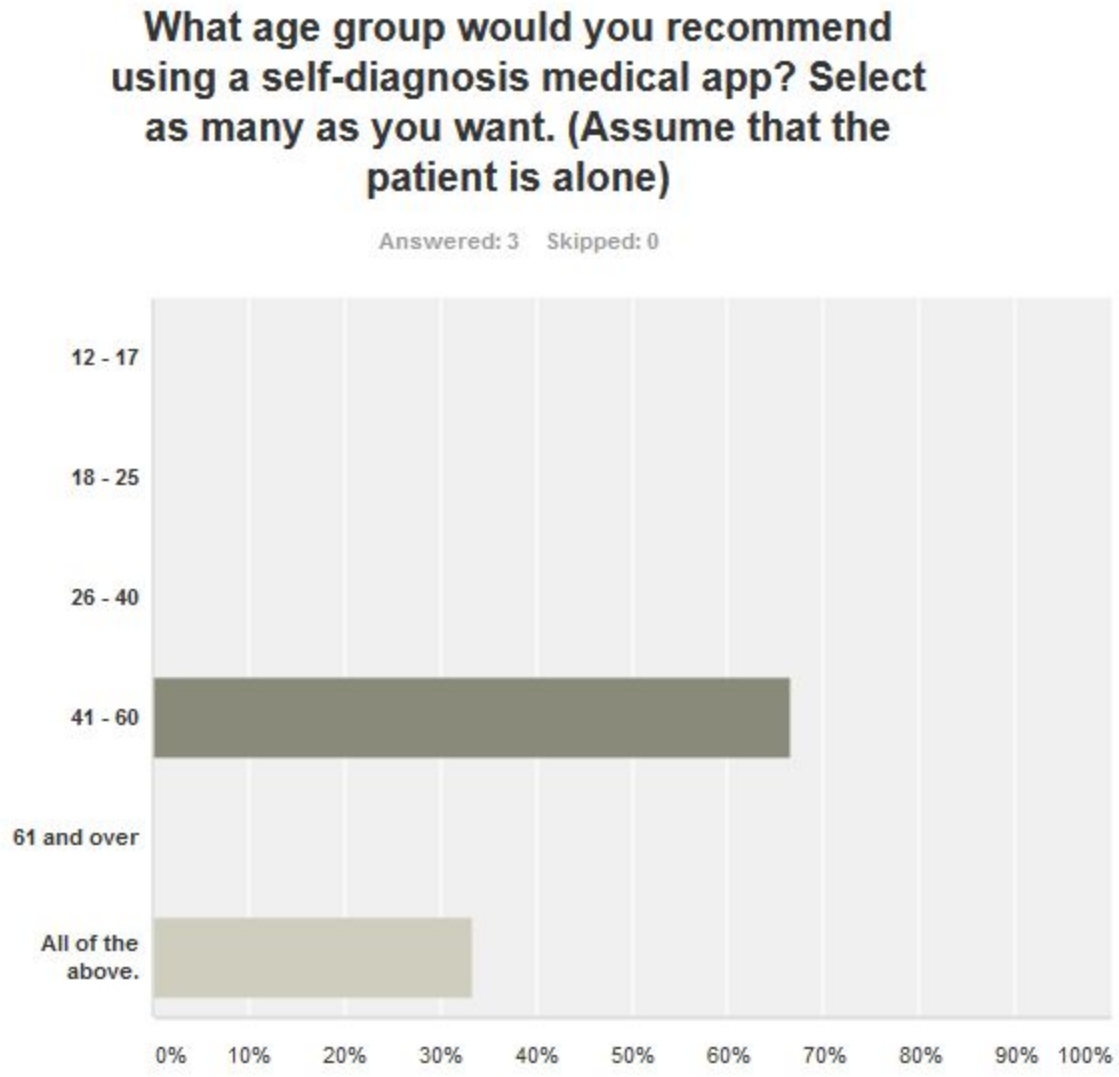
OnlineDocMeetApp: Questions for Doctors (Survey III)

Figure 1: Q1, Average Age of Patient



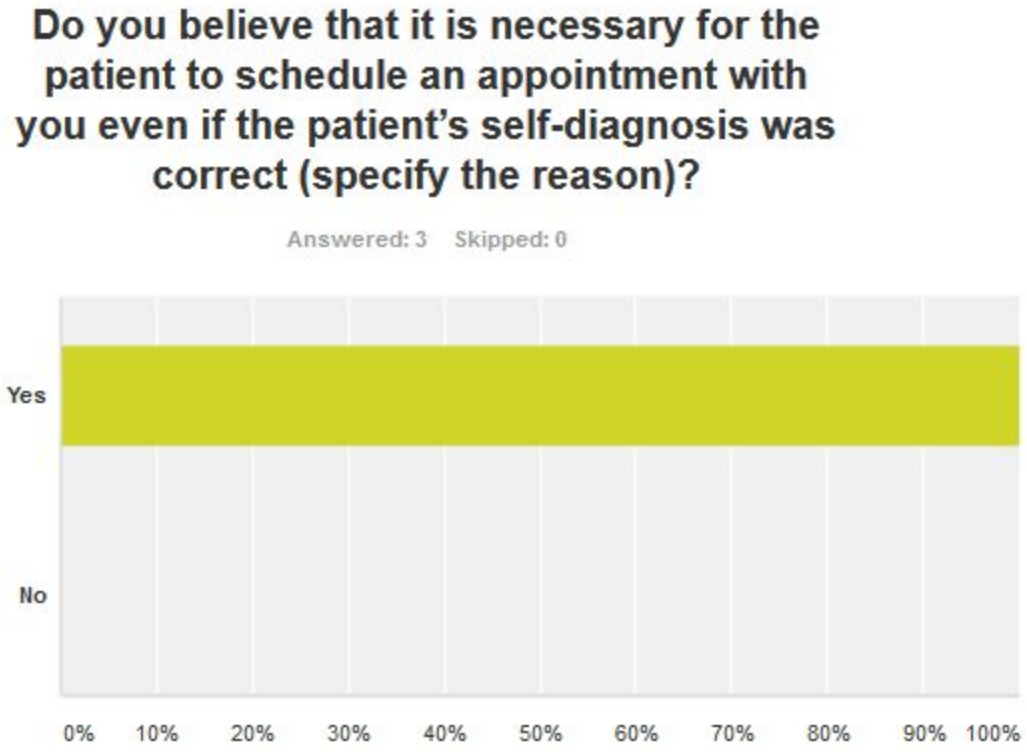
Answer Choices	Responses	
0 - 18	0.00%	0
19 - 25	0.00%	0
26 - 40	0.00%	0
41 - 60	0.00%	0
61 and over	100.00%	3
Total		3

Figure 2: Q2, Recommended Age Group for Self-Diagnosis Application



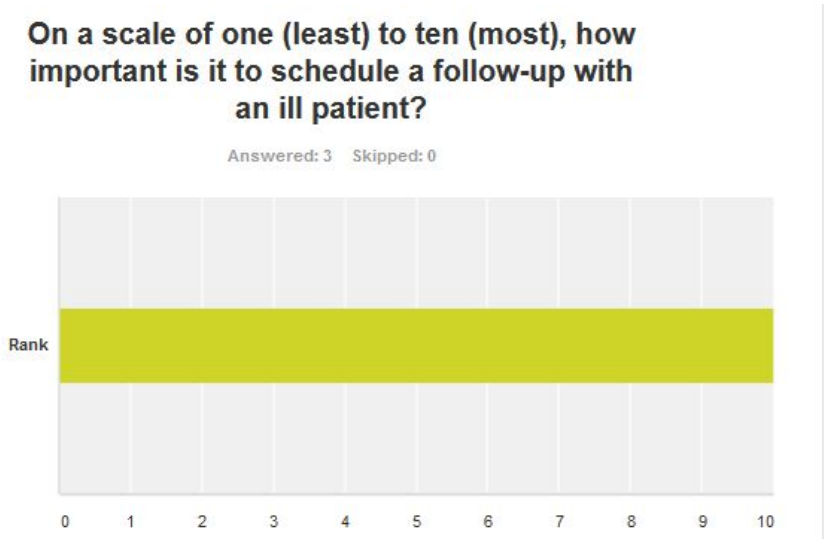
Answer Choices	Responses	
12 - 17	0.00%	0
18 - 25	0.00%	0
26 - 40	0.00%	0
41 - 60	66.67%	2
61 and over	0.00%	0
All of the above.	33.33%	1
Total Respondents: 3		

Figure 3: Q3, Doctors' opinions on follow-up appointment after patient's correct self-diagnosis



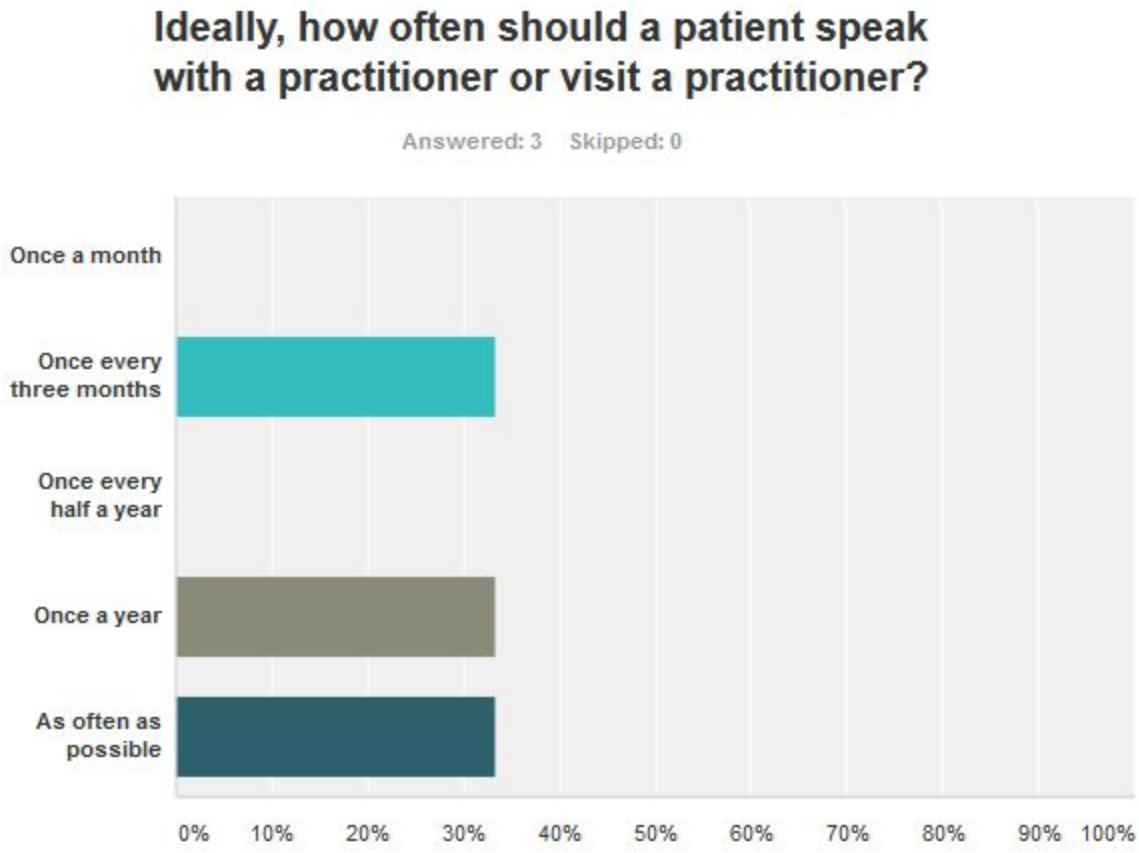
Answer Choices	Responses	
Yes	100.00%	3
No	0.00%	0
Total		3

Figure 4: Q4, Doctors' opinions on follow-up appointment with ill patient.



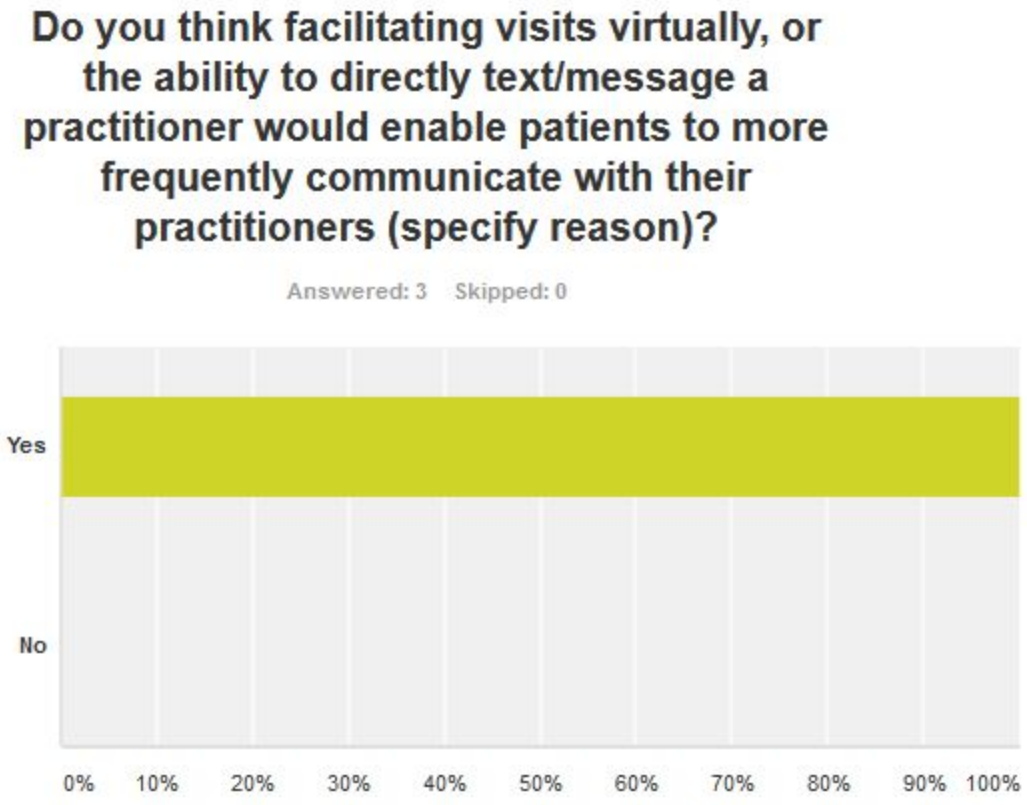
	1	2	3	4	5	6	7	8	9	10	Total	Weighted Average
Rank	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0	100.00% 3	3	10.00

Figure 5: Q5, Frequency on patient's personal visit or online teleconference. (Doctors' opinions)



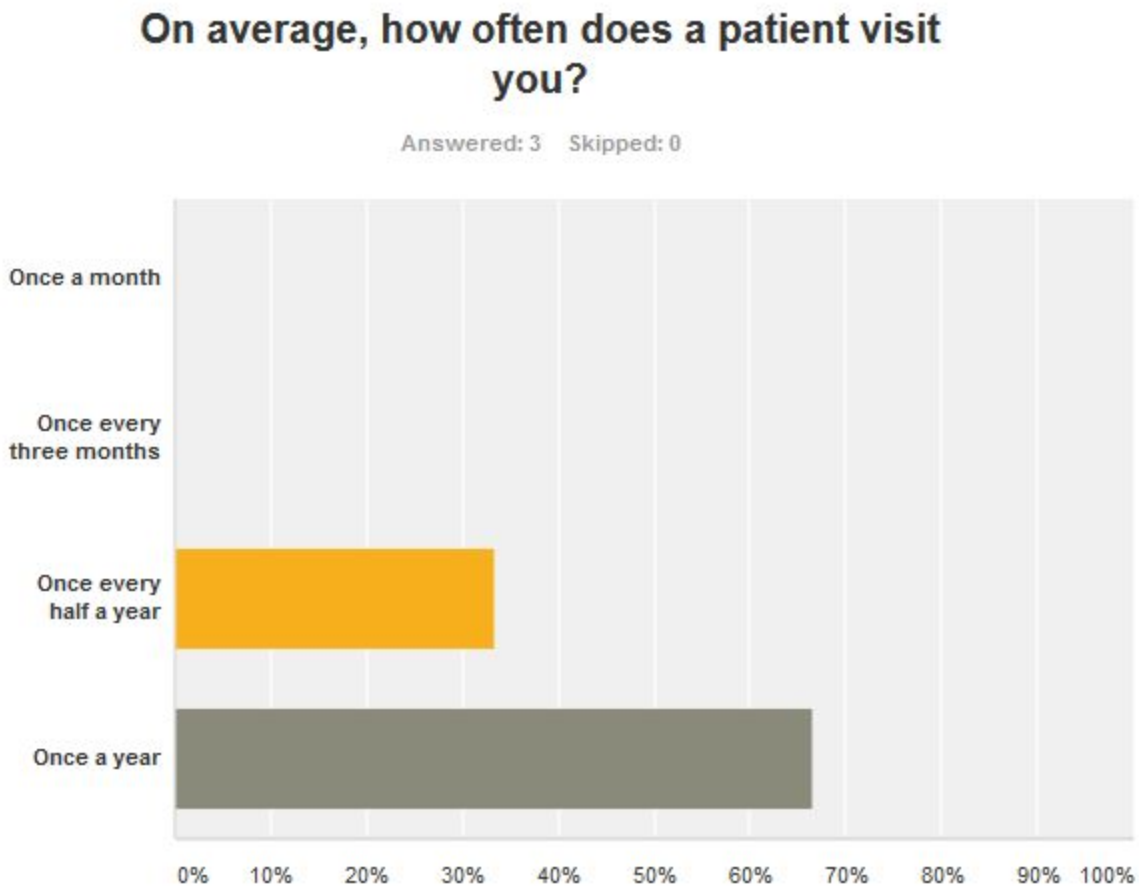
Answer Choices	Responses	
Once a month	0.00%	0
Once every three months	33.33%	1
Once every half a year	0.00%	0
Once a year	33.33%	1
As often as possible	33.33%	1
Total		3

Figure 6: Q6, Gauging the usefulness of a web application to encourage consultation and communications



Answer Choices	Responses	
Yes	100.00%	3
No	0.00%	0
Total		3

Figure 7: Q7, Average patient visit(s) over calendar year



Answer Choices	Responses	
Once a month	0.00%	0
Once every three months	0.00%	0
Once every half a year	33.33%	1
Once a year	66.67%	2
Total		3

Appendix G: References

[1] "How to Create Effective Documentation for Web Applications." *BitZestyIO*. Bit Zesty Ltd., Aug. 2011. Web. 20 Nov. 2016. <https://bitzesty.com/2011/08/06/how-to-create-effective-documentation-for-web-applications/>

[2] Aguiar, Marcio. "Recommendations for Web Application Performance Benchmarks." *Stack Overflow*. N.p., 3 Sept. 2018. Web. 20 Nov. 2016. <http://stackoverflow.com/questions/41857/recommendations-for-web-application-performance-benchmarks>.

[3] "HIPAA and VSee Video Conferencing", *VSee*, 2016. Web. 10 Dec. 2016. <https://vsee.com/hipaa/>.

[4] Ellingwood, Justin. "7 Security Measures to Protect Your Servers." *7 Security Measures to Protect Your Servers*. DigitalOcean™ Inc., 5 Mar. 2015. Web. 20 Nov. 2016. <https://www.digitalocean.com/community/tutorials/7-security-measures-to-protect-your-servers>.

[5] "Understanding Availability, Reliability, and Scalability." *Understanding Availability, Reliability, and Scalability*. Microsoft TechNet, 10 May 2002. Web. 10 Dec. 2016. <https://technet.microsoft.com/en-us/library/aa996704(v=exchg.65).aspx>

[6] "Operating Principles." *O'Reilly About*. O'Reilly Media, Inc., 2013. Web. 20 Nov. 2016. <http://www.oreilly.com/about/operating-principles.html>.

[7] "General Physician: Employment Info & Requirements." *Study.com*. N.p., n.d. Web. 13 Nov. 2016.