

CareLine

by

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Submitted to
the Faculty of the School of Information Technology
in Partial Fulfillment of the Requirements for
the Degree of Bachelor of Science
in Information Technology

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Merideth Moore

April 15, 2019

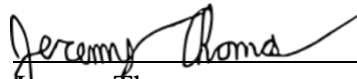
Date



Garrett Souders

April 15, 2019

Date



Jeremy Thomas

April 15, 2019

Date

Abdou Fall, Faculty Advisor

University of Cincinnati
College of
Education, Criminal Justice, and Human Services

April 2019



CareLine

Your Line To Care, Right Away

DEDICATION

For my centenarian grandma Baldwin – *Garrett*

For John Warren Thomas II and June Sawyer Thomas – *Jeremy*

For Joyce and James Moore; Vivian and Harold Meyer; Charles Dusseau - *Merideth*

ACKNOWLEDGEMENTS

We would like to express our sincere appreciation to everyone who has supported and guided us in the development of CareLine and give a special acknowledgement to Professor Jim Scott and our project advisor, Abdou Fall, for their leadership and guidance in Senior Design.

We would further like to thank the School of Information Technology and all of our professors, instructors, and mentors who have helped prepare us for the development of this project over the years. It is they who have allowed us to succeed.

Lastly, we would like to thank our family, friends, and coworkers. Each of you have supported and encouraged us through the development of the project, and we cannot be more grateful for your support. This has enabled our journey into the exceptional IT profession and allowed us to succeed in the future.

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ABSTRACT

If a relative were placed in a long-term healthcare facility tomorrow, we would all love to be able to communicate frequently with them over the web, wouldn't we? In many places, we simply cannot. According to the Centers for Disease Control and Prevention (CDC), over eight million people receive some form of long-term care annually. Whether at a nursing home, adult service center, or mental health institution, long-term care has great importance in our society. Yet these facilities mostly operate using dated technology and software. We built CareLine to bridge that communication gap between families, patients, and caretakers. CareLine provides an innovative solution that features a mobile friendly site, built-in office appointment-making, text and video chat, and email notifications with automated updates as a means to ease the anxiety that comes with long-term care. CareLine is a sleek and modern web application that features a built-in calendar for office appointments, text and video chat, and email notifications with automated updates. It has a TypeScript front end with a NodeJS and Fastify back end and a Microsoft SQL Server database. Our app is HIPAA compliant and secured with modern authentication tools. CareLine is designed to increase the amount of communication between not only the family and their relatives in long-term care situations, but also the family and the facility's caretakers. There is a myriad of concerns that come along with these scenarios, which our app aims to ease. While we do not provide the care ourselves, we offer a platform to give families a direct line. CareLine is your line to care, right away.

INTRODUCTION

PROBLEM

According to the Centers for Disease Control, over eight million people receive some form of long-term care service and support annually, whether that's an adult service center, a nursing home, a mental health facility, or a hospital for patients undergoing successive surgeries. Long-term care has a great importance to our society.

Long-term facilities already face their fair share of challenges. Most operate with dated technology and are entirely unable to provide families with a digital care report or frequent updates on their relatives. Conversely, many families do not have the time nor ability to see their relatives daily, so consistent communication can be a barrier against ensuring their loved one is being cared for properly. Many will visit personally when they can or try to rely upon emails, however the market does not feature an adequate application – neither web, nor mobile – which can provide daily updates and the ability to communicate between all concerned parties.

SOLUTION

CareLine is a comprehensive web application that provides families with the ability to receive daily updates such as behavior, feelings, diet, and overall health status. This application also features prescription information, treatment options, and feedback on quality of care. Further, CareLine also includes notifications for the purpose of alerting families of when emergencies occur, as well as daily reports or other important information. Lastly, CareLine includes a messaging and video communication system that promotes swift communication between all family members.

The focus and intent of CareLine is to provide the caregiver, family members, and relatives in the facility with a singular platform that is effective while modern and sleek. CareLine includes many varying features for the different types of users and provides the right kinds of functions and information to put family members of the relative at ease.

GOALS

The goal of CareLine is to develop a cross-platform web application that provides Caregivers, Relatives, and Family Members the ability to create, provide, and receive daily updates on their loved ones in long-term care. CareLine promotes the creation of daily reports on behalf of relatives as well as allowing those in the facility with the ability to provide feedback to the Caregiver and communication options.

CareLine is a web application that has a sleek and modern design using Fastify and Angular framework. Fastify is a NodeJS framework and Angular version 7 provide an intuitive and easy to navigate application that will meet all generations. CareLine stores data in Microsoft's Transact - Structured Query Language (T-SQL) Server database and meets Health Insurance Portability and Accountability Act (HIPAA) requirements.

OVERVIEW

The remainder of this report outlines in detail how the project was completed. The report includes the following sections: design, process management, technical overview, testing, conclusion, and appendixes.

DESIGN

CONCEPT

CareLine was inspired by Merideth Moore, Garrett Souders, and Jeremy Thomas. Merideth initially proposed an idea to the team that involved creating an application or portal allows families with relatives in long-term care to get a daily status and update on them. Jeremy theorized the suite of features, roles, and interactions between user groups and crafted its name. Garrett planned out the software structuring and suggested adding video chat. Together, the team worked to refine and bolster the potential of their long-term health care dashboard project idea.

Prior to the first day of classes, the team met to narrow down their list of ideas and the others fell quickly to this final one. They then brainstormed problems in the healthcare industry (such as the lack of technology in long-term care facilities, visitation time, and prior experiences with relatives) and potential features for the application. Finally, after determining the potential of the project, the group decided on the idea, and CareLine was established.

OBJECTIVES

After settling on the idea, the team gathered together and brainstormed the objectives for the project. The objectives of CareLine were to:





- Develop a functional and beautiful web application with a visually appealing graphical interface that will be both desktop accessible and mobile friendly.
- Provide caregivers with the ability to convey Patient health status, behavior, mood, diet, prescription information, treatment recommendations, and notes to the Client.
- Allow clients the ability to offer advice on treatment options and provide healthcare feedback, as well as give subtle Patient tendencies, preferences, or other information to the Caregiver. Clients will also have the ability to initiate Instant Message (IM) or video chat with the Patient if they are mentally fit enough.

- Present patients with the ability to talk about their wants, needs, and quality of care, alongside a function to survey their own behaviors/moods and rate their Physician, with the Client. Additionally, allow patients to IM and video chat may be conducted too, depending upon their mental state.
- Administrators of Clinics will have the ability to register their Clinic and create, edit, and delete both Physician and Patient Accounts; they will also manage Clinic pages and view Physician ratings.

Meeting these objectives allowed the team to provide a comprehensive suite that streamlines communication and feedback in order to promote enhanced mental well-being of relatives in long-term care.

USER PROFILE DIAGRAM

Upon drafting of objectives for CareLine, the team gathered together and created a User Profile which depicts a general outline regarding the design of CareLine and who would utilize the web application. As presented on the next page, **Table 1: User Profile** provides an enhanced look is regarding the user for CareLine, their potential experience with other applications, frequency of use, and lastly what is to be expected once the application is fully developed.

<p>PROJECT</p> <p>CareLine (Long-Term Care Web Application)</p>			
<p>POTENTIAL USERS</p>			
 <p>Caretakers Nurses, Physicians, etc.</p>	 <p>Client/Clientele Families, Legal Guardians, etc.</p>	 <p>Patient Mentally fit patients of facilities</p>	 <p>Administrators Clinic Staff</p>
<p>SOFTWARE, INTERFACE, AND RELATED EXPERIENCE</p> <ul style="list-style-type: none"> • CareLine will be targeted towards casual technology users; some will have plenty of experience and some will have very little, so it strives to appeal to both. • The web design interface of CareLine is loosely based off of the modern look and feel of sites such as Stripe, Always UC, and TheRegister. • CareLine will be both mobile friendly and desktop accessible, being compatible with major browsers such as Chrome, Edge, and Firefox. 			
<p>EXPERIENCE WITH SIMILAR APPLICATIONS</p> <ul style="list-style-type: none"> • There are applications, neither mobile nor desktop, on the market which provides the benefits that CareLine offers; however, CareLine users could have a similar experience with the following products: <ul style="list-style-type: none"> • PatientTouch System (Patient Safe Solutions) • Spok Mobile (Spok) • Marbella (GetWellNetwork) • CareAware Connect (Cerner) • ITriage (Aetna) • MyChart Mobile (Epic Systems) 			

TASK EXPERIENCE

- Based on the various roles for CareLine, each user will experience variety in the performance of tasks:
 - **Administrators** will experience creating objects, setting up accounts, and approving authorization requests.
 - **Caretakers** will experience entering in patient updates, receiving family feedback, dealing with Power of Attorney (POA) status family members and presenting treatment options.
 - **Clients** will experience receiving information, two-way communication with the patients, using the calendar interface and coordinating visits.
 - **Patients** will experience two-communication with their families and providing feedback.

FREQUENCY OF USE

- CareLine is expected to be used differently based upon the role in question. Administrators may need to log in only once or twice a week, while the Caretakers may use it on almost a daily basis, and the Patients and Clients at their own leisure. These estimates will fluctuate depending on the type of care received.

KEY PROJECT DESIGN REQUIREMENTS THAT THE PROFILE SUGGESTS

- Mobile friendly and desktop accessible
- Daily status/update report
- Built-in office appointment-making
- Text and video chat
- Email notifications with automated updates

Table 1: User Profile

USER CASE DIAGRAM

The model seen below in **Figure 1: User Case Diagram** presents an enhanced look at the features of CareLine. This view is role-oriented, showing the features developed for each user and how they will interact with CareLine.

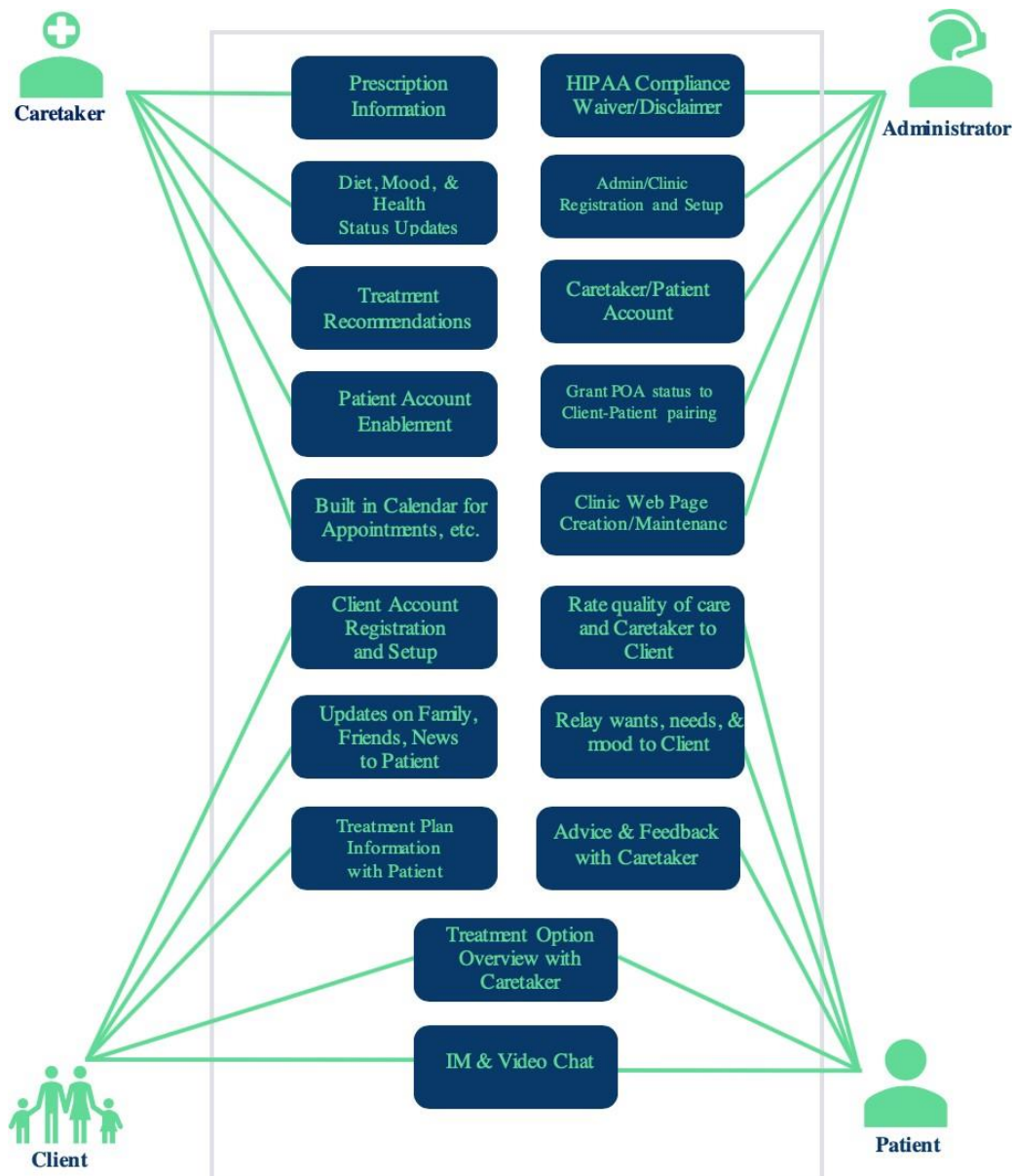


Figure 1: User Case Diagram

APPROACH & METHODOLOGY

To approach the development of CareLine, Jeremy started by creating a draft user interaction model, from which the team developed a list of feature ideas. As a group, they brainstormed about the functionality we wanted to implement for this new technology. Merideth, Garrett, and Jeremy each provided individual ideas and the value that they would bring by being included in the application.

A Gantt Chart and Work Breakdown Structure (WBS) were set up based upon the planned concepts and the timeline provided by the senior design course. See **Figures 2 and 3** for the representation of those files. These helped outline our list of objectives and move the team forward with determining the critical technology pieces that would make the project a success.

While the development phase for the project was underway, more artifacts were created in order to ensure that the project guidelines were being met. Jeremy built a Requirements document that specified which items were what and prescribed their priority level. Furthermore, Merideth put together a few wireframes of dashboards not yet created as a visualization tool for their development.

Overall, following these documents and working with this approach allowed the team to meet the goals of CareLine.

WORK BREAKDOWN STRUCTURE

In addition to utilizing a Gantt Chart, a Work Breakdown Structure was created to help manage the phases of the project. **Figure 3: Work Breakdown Structure** represents the Work Breakdown Structure that was utilized in each term to ensure that phases of the project were being met.

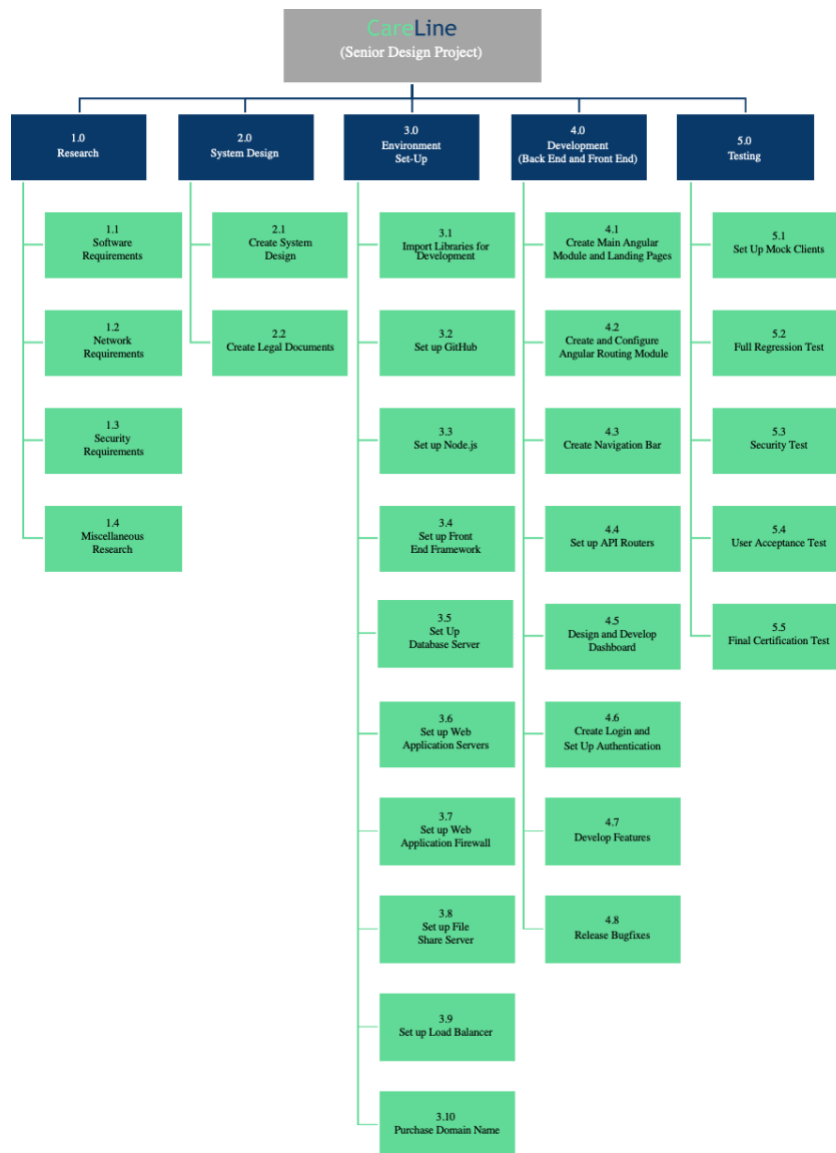


Figure 3: Work Breakdown Structure

PROJECT MILESTONES

As a means to demonstrate the critical project milestones, the team decided to create an additional and simpler chart based off of the major project phases listed in the Gantt Chart and Work Breakdown Structure. Each section of the table provides an outline for the key milestone of the application's development timeline. Below in **Table 2: Deliverable Milestones** is a quick breakdown of the primary project goals and the anticipated completion date for each semester.

Deliverable Milestones	
Fall of 2018 Milestones	
Research and Project Requirements (Development Languages, HIPAA)	9/24/18
System Design (Diagrams, Legal Disclaimers, External Interviews)	10/1/18
Initial Environment Set-Up (Digital Ocean Droplets, Database Server, Domain Name)	10/15/18
Initial Development (Back End, Front End)	10/29/18
CareLine Demonstration and Technical Review	11/19/18
Spring of 2019 Milestones	
Final Development (Back End, Front End)	2/11/19
Testing (Full Regression Test, Security Test, User Acceptance Test, Final Certification Test)	3/25/19
CareLine Demonstration and Technical Review	4/1/19
IT Expo	4/9/19

Table 2: Deliverable Milestones

BUDGET

Creating CareLine involved several expenses. A majority of the project was open source or supplied through the University of Cincinnati's (UC) free resources, however a Domain Name, Secure Sockets Layer (SSL) Certificate and Unix droplets from Digital Ocean needed to be purchased in order to host the web application. Additionally, the team also incurred several expenses when designing and preparing the IT Expo Booth. **Figure 4: Budget** displays the budget for CareLine in both expected and actual cost.

Project Members:	Merideth Moore, Garrett Souders, Jeremy Thomas	Project Areas:	Web/Mobile Development	Project Advisor:	Abdou Fall		
Project Asset Type			Funding Source (if applicable)				
Operational Improvement	Comments: CareLine will improve communication at long term care facility		Self	Comments: CareLine is funded by Merideth, Garrett, and Jeremy			
Risk Identification							
	<i>Risk Rating* 1-5 (5 is high)</i>	Comments	Weight	Score			
Work Effort	3	Estimated 733.72 Hours spent on the project over two semesters	40%	1.20			
Complexity	4	Product is not on the market	60%	2.40			
Project Risk Score:				3.60			
Estimate of Benefits							
Select other benefits the project may bring a customer or user:							
Risk Avoidance							
Improved customer satisfaction	X	CareLine will allow families to be at ease with the care their relatives will receive. CareLine will also promote a feedback system for the care that patients are receiving the care					
Increased system availability	X	CareLine will be available to all users 24/7					
Productivity or process improvement	X	CareLine will allow promote proactiveness for CareTakers and provide Daily Reports for Clients					
Reduced costs							
Estimated Cost Rough Order of Magnitude:							
	Projected One Time			Ongoing Annual			Comments: Work Effort Breakdown: 3 People x 8 hours a week (Estimate) = 24 Total Hours Fall Semester: 111 Days/15.85 Weeks = 380.57 Total Hours Spring Semester: 103 Days/14.71 weeks = 353.14 Total Hours Total Work Effort (Hours) = 733.71 Misc. Cost Breakdown: 11.17: NameCheap: Domain Name and SSL Certificate 62.00: Digital Ocean: Unix Droplets and Hosting 150.83: IT Expo Booth Design Total Misc Costs = \$224.00
	Rate Per/Hr	Work Effort (Hours)	1 X Costs	Rate Per/Hr	Work Effort (Hours)	1 X Support Cost	
Labor - IT	\$ 20.00	733.71	\$ 14,674.20	\$ 20.00	250	\$ 5,000.00	
Labor - External	\$ -	0	\$ -	\$ -	0	\$ -	
Software - External	\$ -	0	\$ -	\$ -	0	\$ -	
Hardware - External	\$ -	0	\$ -	\$ -	0	\$ -	
Misc.	\$ -	0	\$ -	\$ -	0	\$ 21.17	
TOTAL			\$ 14,674.20			\$ 5,021.17	
Description							
	5- Year Expected		Conservative (1.5)				
Total Costs	\$	39,780.05	\$	59,670.08			
Total Benefit	\$	-	\$	-			
Total Costs/Benefit Differential	\$	(39,780.05)					
Conservative Costs/Benefit Differential	\$	(59,670.08)					

Figure 4: Budget

REQUIREMENTS

When developing CareLine and handling the features of the project, the team determined that requirements were critical to maintain focus on the objectives of each role and their features.

It also helped to limit any potential scope creep from arising in the creation of this product.

Table 3: Requirements represents requirements that were followed to complete CareLine.

Item	Description	Domain	Role	Priority
Clinic registration for Admin	Database entity tied to Ca., Pa., and Clinic Pages	Auth. U.A.	Admin	1-Critical
Separate news feed style posts on Patient Page	Patient health status updates, diet plan, & treatment recommendations	Auth. U.A.	Caretaker	1-Critical
IM chat between Client and Patient	Six months of history saved	Auth. U.A.	Client, Patient	1-Critical
Video chat between Client and Patient	Six months of metadata saved	Auth. U.A.	Client, Patient	1-Critical
Reset password	All users can adjust their password on demand	Auth. U.A.	Ad., Ca., Cl., Pa.	2-High
Caretaker account setup	Activation, info addition	Auth. U.A.	Admin	2-High
Caretaker account maintenance	Deactivation, info modification	Auth. U.A.	Admin	2-High
Patient account setup	Activation, info addition	Auth. U.A.	Admin	2-High
Patient account maintenance	Deactivation, info modification	Auth. U.A.	Admin	2-High
Patient prescription info/fill	Sends direct email if low	Auth. U.A.	Caretaker	2-High
Patient Page maintenance	Ability for Caretakers and Clients with POA to send updates	Auth. U.A.	Caretaker, Client	2-High
Patient Page view	Ability for Caretakers and Clients to view updates	Auth. U.A.	Caretaker, Client	2-High
Response option to news feed if POA=true	Feedback, advice/suggestions, & treatment overview to Caretaker	Auth. U.A.	Client	2-High
Pinned news feed on comm. window	Relay wants/needs/mood info, Ca. rating, & overall care rating to Client	Auth. U.A.	Patient	2-High
Admin to grant POA status	Power of Attorney field set true or false for a Client-Patient relationship	Auth. U.A.	Admin	3-Medium
Patient behaviour/mood updates	Rating system	Auth. U.A.	Caretaker	3-Medium
Patient account access based on mental status	Reduced access if mental health status unstable	Auth. U.A.	Caretaker	3-Medium
Pinned news feed on comm. window	Updates on family/friends, world news, & treatment plan to Patient	Auth. U.A.	Client	3-Medium
Ability for Client to customize account	Client can change notification and other settings	Auth. U.A.	Client	4-Low
Clinic Page creation	Admin creates a page for their Clinic upon registration	Auth. U.A.	Admin	5-Extra
Clinic Page maintenance	Admin can adjust Clinic Page information on demand	Auth. U.A.	Admin	5-Extra
HIPAA Compliance Disclaimer	Key for Admin & Client registration; login for all	Guest U.A.	Account Regis.	1-Critical
Account registration for Admin	First step in Clinic-side activation	Guest U.A.	Account Regis.	1-Critical
Account registration for Client	Separate process from other account types	Guest U.A.	Account Regis.	1-Critical
Website landing/home page	Main webpage for CareLine	Guest U.A.	Guest Viewing	2-High
Website about/contact/help page	Secondary webpage for CareLine	Guest U.A.	Guest Viewing	4-Low
Clinic Page view	Guests can read overviews for Clinics registered on CareLine	Guest U.A.	Guest Viewing	5-Extra
Email notification system	Service to send automatic email updates	Web/App Setup	Back End	1-Critical
Mobile friendly & desktop accessible web app	Positive user navigation and viewing	Web/App Setup	Front End	1-Critical
Secure site login capability	Includes lockout after repeated failed attempts	Web/App Setup	Front End	1-Critical
Idle timeout logout	Saves data & returns user to login page	Web/App Setup	Front End	1-Critical
Patient Page creation	Automatic upon creation of Clinic-Patient relationship	Web/App Setup	Back End	2-High
Office appointment/calendar	Meeting arrangements	Web/App Setup	Caretaker, Client	4-Low

Table 3: Requirements

INTERVIEW PROCESS & KEY TAKEAWAYS

As a means to identify needs from an external perspective, in the fall term, Jeremy engaged multiple people for insight. Each filled a mock role based upon those depicted previously in **Figure 5: User Case Diagram**. We created a loose questionnaire for the interviews to follow, as spelled out in **Appendix D: Interview Questions**; these were conducted somewhat informally in places such as coffee shops so that the interviewees would feel comfortable and relaxed. We were able to collect plenty of interesting ideas on topics that we had not thought of or fully explored yet, and in some areas our existing ideas were reinforced by their comments.

From this process, there were some leading outcomes which we made sure to utilize in our product. In response to a question pertaining to Patient priorities, it was put forth that many who are in long-term care are completely isolated from the world and current events. We knew that family news was important already, due to separation anxieties and homesickness being common, but had rated global news as a lower priority until this was revealed. Meanwhile, our Client identified our plan to keep all records of digital status updates for historical use as an essential selling tool for both the Clients and Clinics alike, because it will help for accountability and statistics. Also, as they pointed out from prior experience, an application like this will die if there is no data consistently input and obtainable.

In the spring, we held a second round of interviews to fill them in on our progress from the intervening months, and further we offered them a chance to partake in User Acceptance Testing. These opportunities definitely helped us round out our product and shape it to fit the needs of its intended stakeholders, while boosting our confidence that we went in the right direction with our features.

TECHNICAL ELEMENTS

CONCEPTUAL INTERACTION

The previously depicted User Cases, as well as our Requirements, were based upon features spun out of an initial sketch of interaction needs. This was created in August as a means to help define the scope and nature of CareLine. **Figure 5: User Interaction Diagram** is the refined version of this early model. Captured between its different nodes are lists which represent conceptual user roles and intended functionality, respectively.

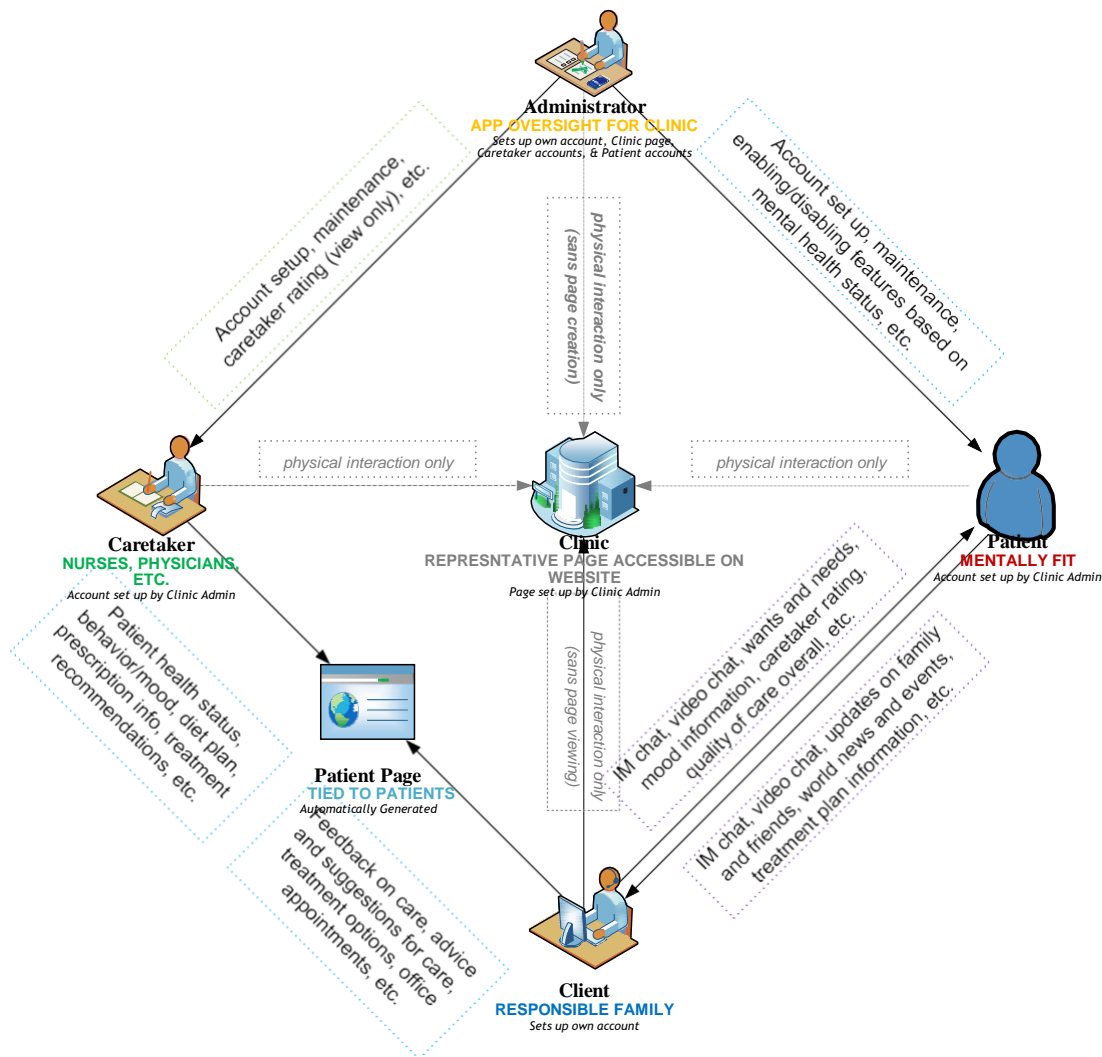


Figure 5: User Interaction Diagram

WEB APPLICATION SCREENSHOTS

CareLine is designed to be simplistic, yet beautiful and user-friendly, as presented in **Figures 6 – 13**. Each screenshot displays the various CareLine pages at their completion.

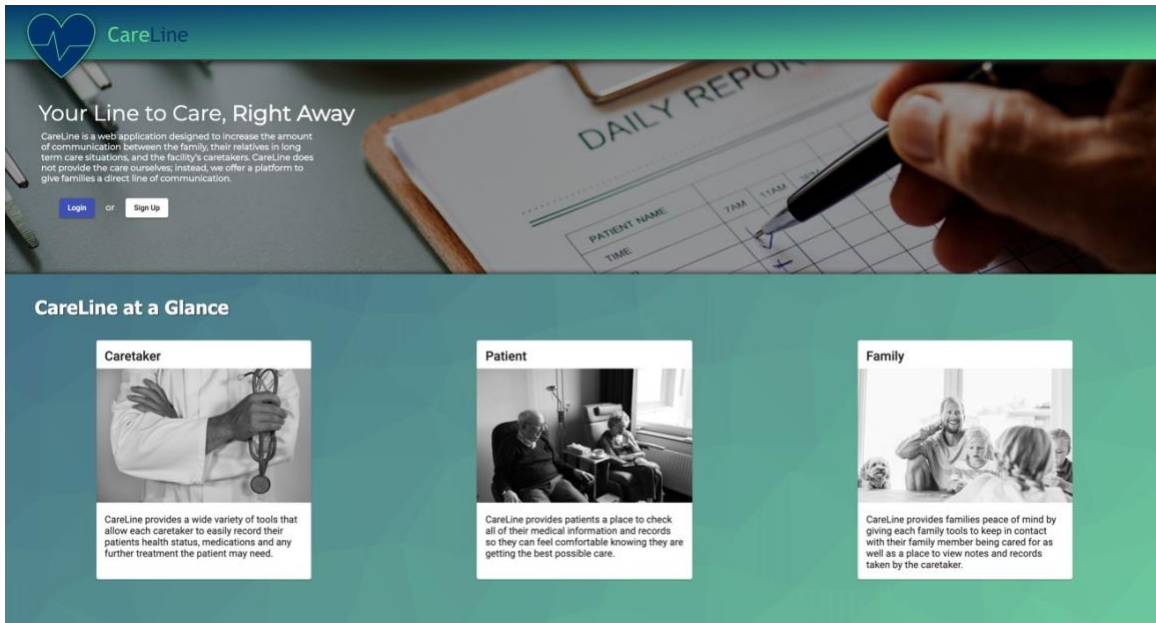


Figure 6: Homepage

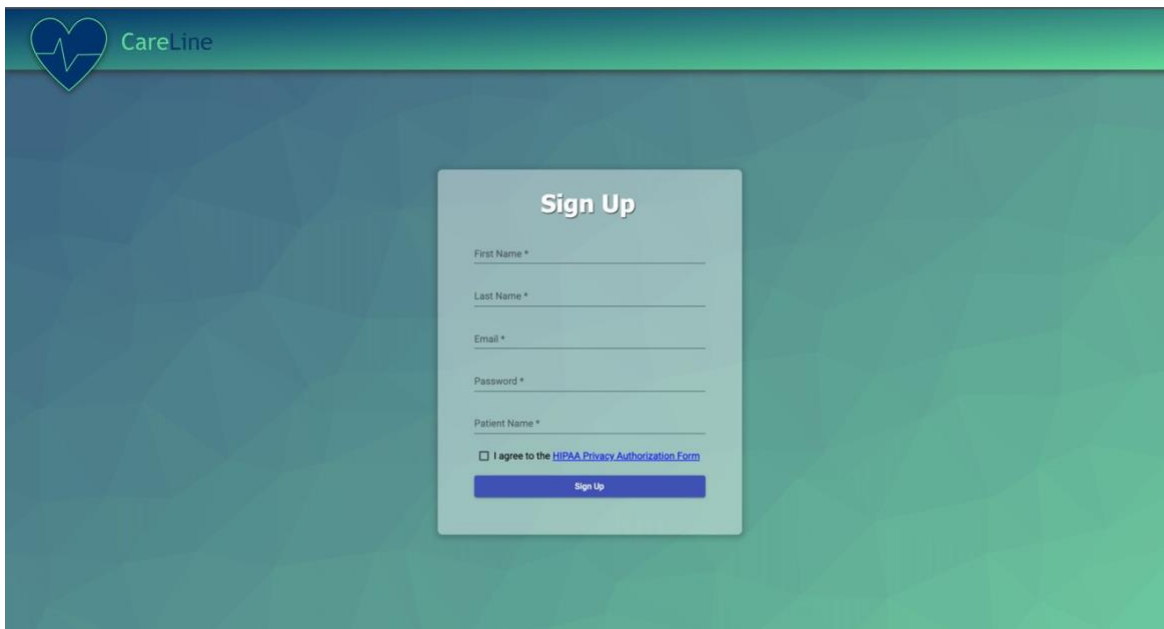


Figure 7: Sign Up Page

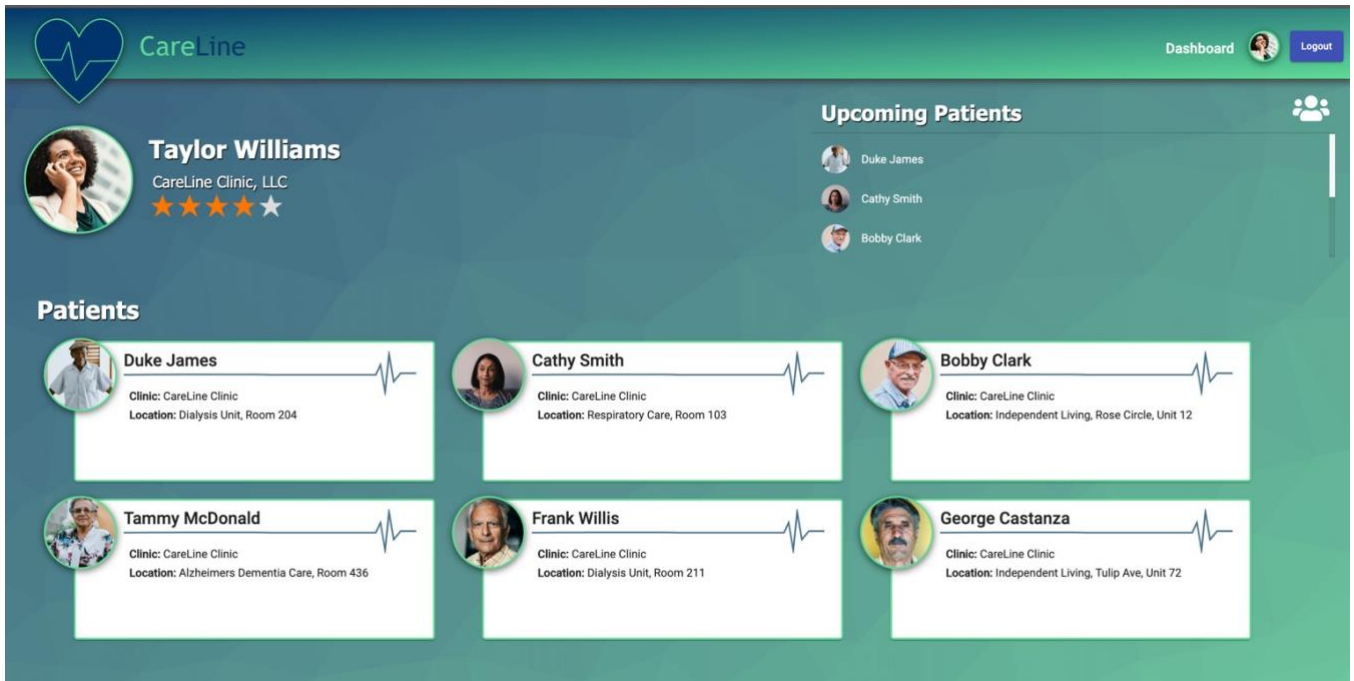


Figure 8: Caretaker Dashboard

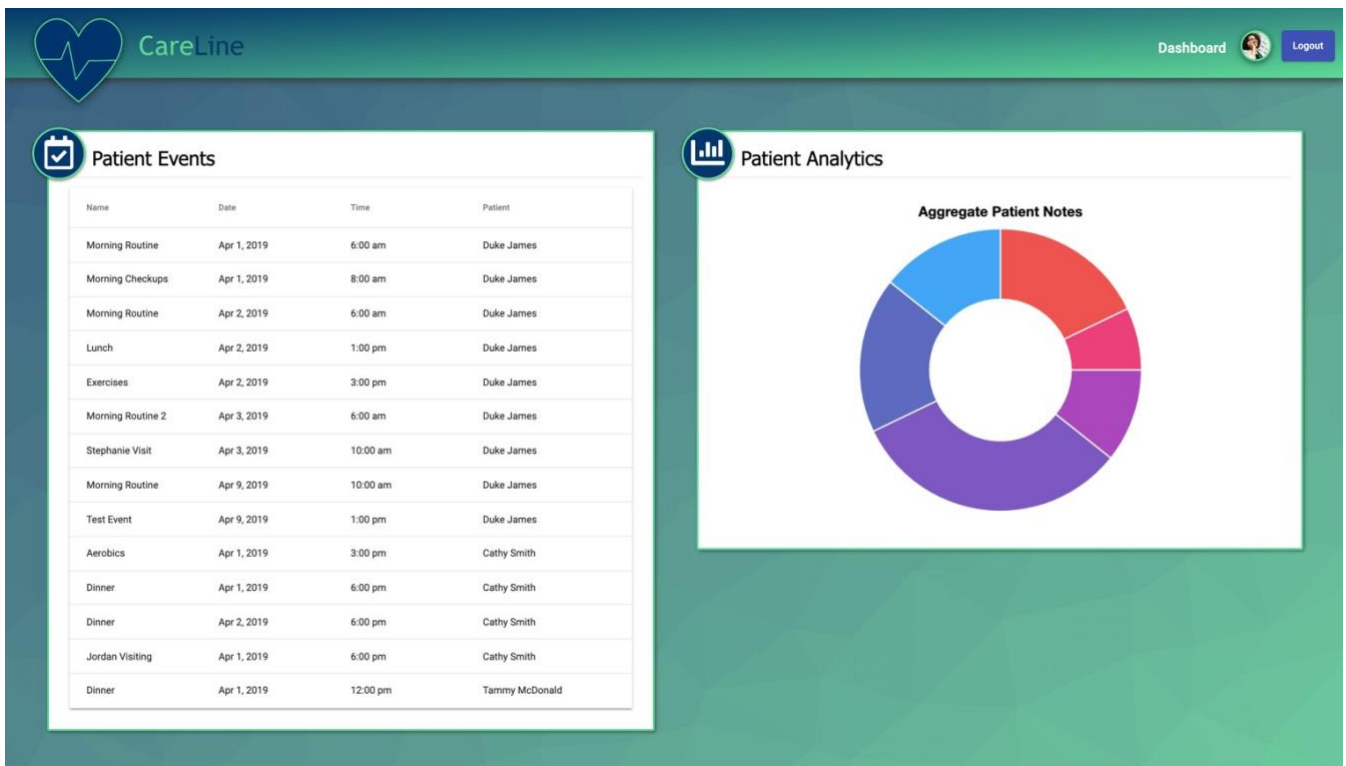


Figure 9: Caretaker Dashboard

Schedule

Sunday Mar 31, 2019	Monday Apr 1, 2019	Tuesday Apr 2, 2019	Wednesday Apr 3, 2019	Thursday Apr 4, 2019	Friday Apr 5, 2019	Saturday Apr 6, 2019
No Events	Morning Routine Morning Checkup...	Morning Routine Lunch Exercises	Morning Routine... Stephanie Visit	No Events	No Events	No Events

Patient Information

General Info

Birthdate: Feb 23, 1943
 Bloodtype: A-
 Mobile Phone: 5133514554
 Home Phone: 5135253210
 Height: 75 in
 Weight: 186 lbs

Diet Information

Diet Name: Pescetarian
 Diet Info: Variety of protein with more fish, beans, and peas
 Allergies: Peanuts, Milk, Eggs
 Likes: Avocados, Lamb, Bell Peppers
 Dislikes: Anchovies, Cilantro

Medical Notes

Morning Results

Activities: Showered, Morning Coffee, Juice and Breakfast - Enjoyed morning newspaper and chatting about daily or national news.
 Health Concerns: Duke's Blood Pressure was showing high rates and he is down 3 pounds from the previous day
 Comments: Continue checking on Duke's Blood Pressure

Midday Updates

Activities: Lunch, Rest time, Folded clothes and completed light chores in room
 Health Concerns: Duke's blood pressure is still displaying high rates, but is looking a bit better
 Comments: Keep an eye on how Duke's blood pressure is trending in the evening

Nightly Conclusion

Activities:

Figure 10: Patient Page

Schedule

Sunday Apr 14, 2019	Monday Apr 15, 2019	Tuesday Apr 16, 2019	Wednesday Apr 17, 2019	Thursday Apr 18, 2019	Friday Apr 19, 2019	Saturday Apr 20, 2019
No Events	No Events	No Events	No Events	No Events	No Events	No Events

Add Event Modal

Name *

Description

Choose a date *
4/14/2019

Time *

Cancel Add

Patient Information

General Info

Birthdate: Feb 23, 1943
 Bloodtype: A-
 Mobile Phone: 5133514554
 Home Phone: 5135253210
 Height: 75 in
 Weight: 186 lbs

Diet Information

Diet Name: Pescetarian
 Diet Info: Variety of protein with more fish, beans, and peas
 Allergies: Peanuts, Milk, Eggs
 Likes: Avocados, Lamb, Bell Peppers

Medical Notes

Health Concerns *

Comments *

Patient Mood / Feeling:

😊 😐 😞 😡 😟 😩 😫

Cancel Save

Patient & Family Requests

Figure 11: Patient Page, Add Event

The screenshot shows the CareLine Clinic Page. At the top left is the CareLine logo. The top right has a 'Dashboard' link and a 'Logout' button. Below the logo is a profile for 'CareLine Clinic, LLC' with the address '2700 Bearcat Way, Cincinnati, OH 45221'. The main section is titled 'Caretakers' and contains six staff profiles: Taylor Williams (Nurse Practitioner), Howard Brown (Physical Therapist), Franny Miller (Nurse Practitioner), Monica Lee (Resident Psychologist), Madison King (Physical Therapist), and Steve Anderson (Nurse Practitioner). Each profile includes a photo, name, job title, and work phone. Below this is the 'Patients' section with three profiles: Duke James (Dialysis Unit, Room 204), Cathy Smith (Respiratory Care, Room 103), and Bobby Clark (Independent Living, Rose Circle, Unit 12). Each profile includes a photo, name, and location. There are 'Add' buttons in the top right of each section.

Figure 12: Clinic Page

The screenshot shows the CareLine Feedback Page. At the top left is the CareLine logo. The top right has a 'Dashboard' link and a 'Logout' button. Below the logo is a profile for 'Taylor Williams' at 'CareLine Clinic'. The main section is titled 'Feedback' and contains a form with the following fields: 'Title', 'Feedback', a five-star rating system, and 'Cancel' and 'Save' buttons. There is an 'Add' button in the top right corner.

Figure 13: Feedback Page

SOFTWARE DEVELOPMENT

The frontend and the backend of CareLine was developed using TypeScript, a superset language to JavaScript. Garrett used Angular 7, the latest distribution of Angular Frontend framework developed by Google. As an experienced AngularJS developer, he chose the newest version to challenge himself to learn something new. Also, Google Material Design was chosen for our application style guide.

On the backend, CareLine uses NodeJS, a Javascript runtime engine with Fastify as the backend framework. The decision to use Fastify and NodeJS as the runtime engine was made based on Garrett's experienced using ExpressJS as a backend framework; Fastify is built off ExpressJS but is a faster and newer by comparison.

For the database, CareLine depends upon a Microsoft SQL Server. The tables, triggers, and stored procedures for this were written by Jeremy in T-SQL. This solution was chosen over others due to his familiarity with it, as well as its known reliability and flexibility.

LOGICAL NETWORK MODEL

The CareLine website front end and the application back end are both hosted on Linux through one provider, while the Windows database server is run separately. This plus the mobility of users accessing our web application warranted the creation of **Figure 15: Network Diagram** in order to visualize these interactions.

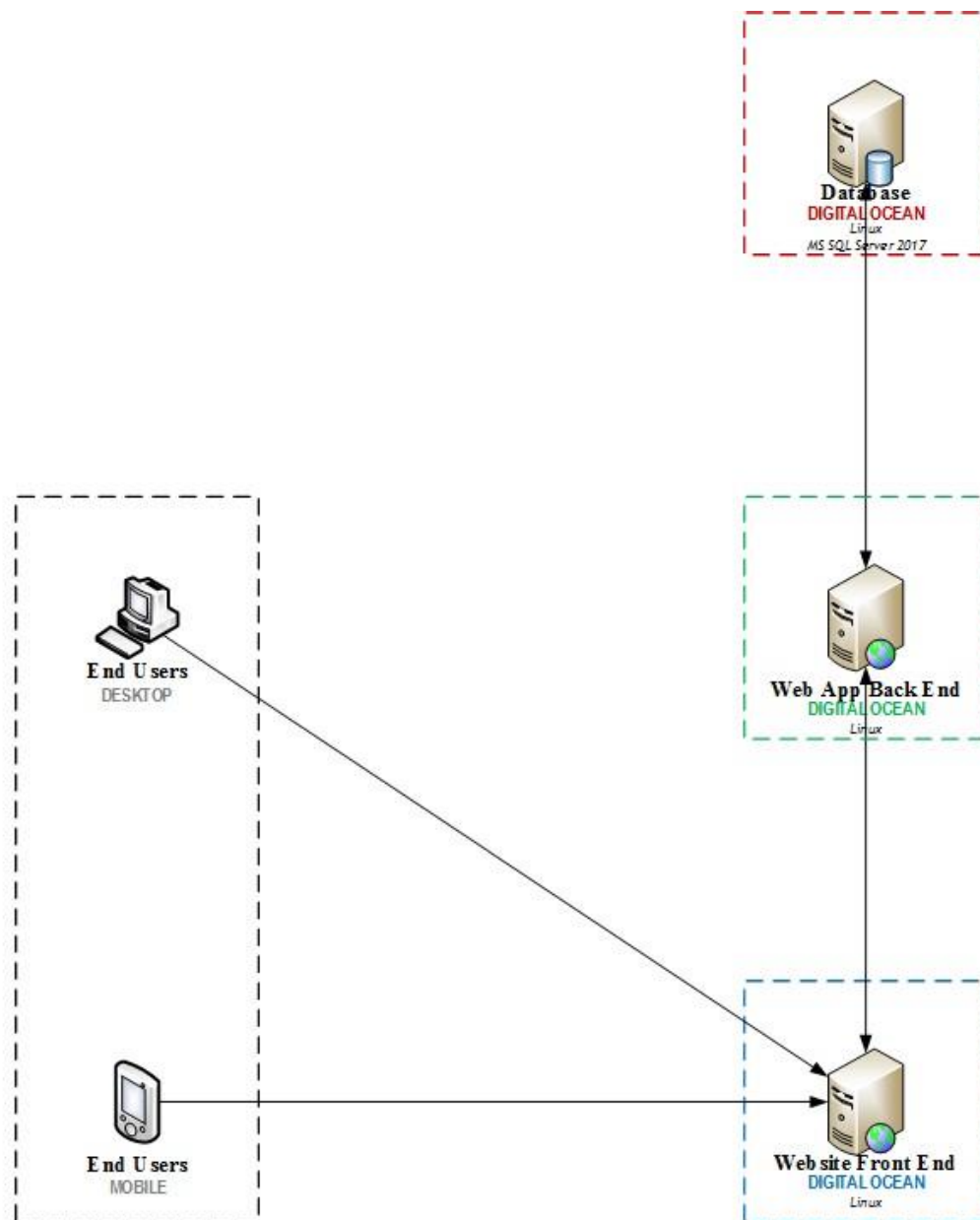


Figure 15: Logical Network Diagram

SECURITY OVERVIEW

A critical element to the design of CareLine was HIPAA and creating a web application compliant to its standards. As a medical application, Merideth (Security Analyst) led the process to ensure the application met HIPAA requirements.

CareLine was thus designed to meet these guidelines. Research was conducted when it was determined that the application would definitely contain Personal Health Information (PHI). Attaining HIPAA compliance status involved doing preliminary research through the HHS and OCR government websites. Merideth read and analyzed the 1996 bill and authored a compliance checklist for the team. **Table 4: HIPAA Compliance Checklist** displays the HIPAA compliance checklist that was developed to ensure CareLine met HIPAA standards.

CareLine Health Information Privacy Accountability Act (HIPAA) Compliance Checklist							
Item	HIPAA Citation	Standard	Safeguard	Description	Priority	Status	
1	Risk Assessment	164.308(a)(1)	Security Management Process	Administrative	Conduct Risk Assessment (Penetration Test) and outline the results as well as the use of PHI and potential areas for a breach	Critical	New
2	Administrator Resource	164.308(a)(2) 164.308(a)(5) 164.308(a)(6)	Assigned Security Responsibility Security Awareness Training, Security Incident Procedures	Administrative	Allocate and train IT Administrator at Long-Term Facilities to handle security responsibilities and report incidents when necessary	Critical	New
3	User Training	164.308(a)(3) 164.308(a)(5)	Workforce Security, Security Awareness Training	Administrative	Prepare documentation and train Caretakers who use CareLine to ensure they understand their rights, policies, and potential violations	Important	New
4	Legal Disclaimers	164.308(a)(4) 164.308(a)(6)	Information Access Management, Security Incident Procedures	Administrative	Complete HIPAA Authorization Form and Privacy Policy listed on sign-up page that details PHI data, policies, and security procedures	Critical	Complete
5	Contingency Plans	164.308(a)(6)	Security Incident Procedures	Administrative	Contingency plans are defined and detailed in the event of an emergency. Backups are active and tested as needed	Critical	New
6	Facility Access	164.310(a)(1) 164.310(a)(2)	Facility Access Controls, Facility Security Plan	Physical	Detailed list of CareLine Administrators at Long-Term Facilities and proper authorization has been assigned to accounts to ensure workstations and data is properly secured	Important	New
7	Device Security/Management	164.310(b) 164.310(c) 164.310(d)	Workstation Use, Workstation Security, Device and Media Controls	Physical	Acknowledgement of devices using CareLine have security in place and regular checking that proper devices are authorized to utilize the application	Important	New
8	Login Credentials	164.312(a) 164.312(d)	Access Controls, Person or Entity Authentication	Technical	Ensure unique usernames and passwords for are utilized for users when signing up and logging into CareLine	Critical	Complete
9	User Roles	164.312(a), 164.312(b)	Access Controls, Audit Controls	Technical	Differentiation of Roles (Client, Administrator, Caretaker, Patient) created and secured upon sign up	Critical	Active
10	Session Timeout	164.312(a), 164.312(c)	Access Controls, Integrity	Technical	Automatic timeout of 30 Minutes (Maximum) set for users of the application	Important	Active
11	Activity Logs	164.312(b)	Audit Controls	Technical	Database and Server Logging are turned on and actively working. Critical to ensuring that PHI is recorded in the event it is compromised, altered, or destroyed	Critical	Active
12	Secure Messaging	164.312(e)	Transmission Security	Technical	Messaging system for CareLine is encrypted and no PHI is being shared through notifications or overall communication system	Critical	New

Table 4: HIPAA Compliance Checklist

TESTING

OVERVIEW

Upon the completion of the development phase in the spring semester, the team created a set of five test phases based upon standard practices, in order to thoroughly the application's requirements and functionality. This section details the Functional and Non-Functional methodology tests that conducted to validate the CareLine application. The following individuals should utilize this section:

- Project Managers
- Application Developers
- System Administrators
- QA Analysts

SCOPE

The scope of testing is mapped to verify technical functionality of the CareLine website; its features, formatting, and accessibility. This includes the validation of its features on modern web browsers (e.g. Mozilla Firefox, Google Chrome, Microsoft Edge, and Apple Safari) both on desktop and mobile devices. This modern web application is accessible via <https://www.carelinetechnology.com/> on any device with a connection to the Internet.

OBJECTIVE

The objective of testing is to validate that CareLine has met the defined requirements for all roles and the application is ready for production deployment. The decision to employ the testing phases described below was drawn from our experiences in the industry through co-op.

ENTRY AND EXIT CRITERIA

Entry:

- Development completed
- Testing sheets finalized
- User Acceptance Testers provided with instructions, credentials, and testing sheets

Exit:

- All functional and non-functional tests successfully completed
- Results, comments, and bugs documented

LOGGING TEST AND REPORTING

Logging is done through Google Sheets where the testing plans are stored. These are utilized by and provided to the User Acceptance Testers for use by, the CareLine project team. Specific sheets exist for each role. Issues are reported through the sheets' inbuilt drop-down choice list menus, and additional notes can be made in the comment's column. For Unit and Security Tests, which are conducted by members of the CareLine project team, any issues encountered will be reported to the rest of the group.

In the event that a tester has found an issue, the individual will document it accordingly. Upon completion, the CareLine project team will review the results and determine the severity of the any bug and begin investigating potential resolutions. The developer will have the final decision on bugs and ultimately be responsible for implementing the changes when necessary. Likewise, the database administrator for database matters and the security analyst for vulnerabilities.

TESTING DESCRIPTIONS AND PROCEDURES

CareLine has a variety of functional and non-functional methodology tests designed and organized to validate that the application has met the previously defined application requirements. The functional and non-functional tests are:

1. **Unit Test:** For a Unit Test, Angular uses Karma to automatically generate validation components to test the system. This occurs whenever the code of the website front end has been modified. The total runtime for this basic unit test is under one minute.
2. **Quality Assurance Test:** For the Quality Assurance Test, five spreadsheets were created (one for each user role and also for a guest) that outline a series of tasks and task steps. These cover all required functionality for the roles and test for negative result paths in addition to the positive ones. The total runtime for this test plan is thirty minutes.
3. **Security Test:** For the Security Test, a single spreadsheet was created that outlines a penetration attack that is designed to highlight and identify any potential vulnerabilities in the web application or its associated backend and database. Several common security methods were utilized based upon the information gathered from this white hat test as a means to prevent future successful hacks. The total run time for this is fourteen days.
4. **User Acceptance Test:** For the User Acceptance Test, five people previously interviewed about CareLine will fill mock roles mapped to their interview role. They will receive a link to the website, credentials to log into that role, and a link to their testing spreadsheet. That sheet will have them go through the same procedure as shown in the Quality Assurance Test section of this document. The total run time for the longest UAT is about ten minutes in length.
5. **Final Certification Test:** For the Final Certification Test, basic access and functionality will be smoke tested prior to the Presentation and Expo. Specific features will be targeted based on known issues, UAT feedback, and anything that may have consistently come up during Unit Testing. The total run time for this test phase is thirty minutes.

The testing procedures for all but the Unit Test are documented on the test sheets shown below:

CareLine – Quality Assurance Test Plan: Caretaker Role						
Task #	Step #	Action	Description	Expected Result	Result	Comments
1	1	Validate login	Navigate to CareLine website in Chrome or Firefox. Not recommended for IE or Opera	Website loads without issue	Pass	
1	2	Validate login	Enter intentionally incorrect login credentials	Login rejected	Fail	
1	3	Validate login	Enter actually correct login credentials	Login accepted	Blocked	
1	4	Validate login	After login, routed automatically to Caretaker Dashboard	Page loads without issue	N/A	
2	1	Sort Patient Pages	Click on "Sort" dropdown choice list	Choice list opens	N/A	
2	2	Sort Patient Pages	Choice list: Last (asc. or desc.), First (asc. or desc.), Last Updated (asc. or desc.)	Such display without issue	N/A	
2	3	Sort Patient Pages	Select any option	Patient Pages reorganize accordingly	N/A	
3	1	Create Patient Page Update	Find a Patient Page on the Caretaker Dashboard. Select	Page loads without issue	N/A	
3	2	Create Patient Page Update	View any existing Notes and (Client) Feedback, or "No updates yet." if none	Such display without issue	N/A	
3	3	Create Patient Page Update	Return to a Patient Page. Select "Create a new Note"	New Note opens	N/A	
3	4	Create Patient Page Update	Fields: Health Rating, Mood, Diet Plan, Prescription Info, Treatment Recommendations	Fields display without issue	N/A	
3	5	Create Patient Page Update	Fill in fields, except for one required field. Save	Creation rejected	N/A	
3	6	Create Patient Page Update	Fill in all required fields. Save	Creation accepted	N/A	
4	1	Edit Patient Page Update	Select "Edit" on an existing Note that is older than 72 hours	Fields do not open for editing on Note	N/A	
4	2	Edit Patient Page Update	Select "Edit" on an existing Note that is not older than 72 hours	Fields do open for editing on Note	N/A	
4	3	Edit Patient Page Update	Adjust fields, leave one required field blank. Save	Modification rejected	N/A	
4	4	Edit Patient Page Update	Adjust fields, leave no required fields blank. Save	Modification accepted	N/A	
5	1	Check Alerts and Notifications	Return to the Caretaker Dashboard. Find the Alerts and Notifications. Select	Page loads without issue	N/A	
5	2	Check Alerts and Notifications	Select "Dismiss" on a to do item	Alerts and Notifications count decreases	N/A	
5	3	Check Alerts and Notifications	Select "To Do" on a dismissed item	Alerts and Notifications count increases	N/A	
6	1	Validate logout	Select "Logout"	Logout accepted	N/A	

Figure 16: Caretaker Role

CareLine – Quality Assurance Test Plan: Client Role						
Task #	Step #	Action	Description	Expected Result	Result	Comments
1	1	Validate login	Navigate to CareLine website in Chrome or Firefox. Not recommended for IE or Opera	Website loads without issue	Pass	
1	2	Validate login	Enter intentionally incorrect login credentials	Login rejected	Fail	
1	3	Validate login	Enter actually correct login credentials	Login accepted	Blocked	
1	4	Validate login	After login, routed automatically to Client Dashboard	Page loads without issue	N/A	
2	1	Sort Patient Pages	Click on "Sort" dropdown choice list	Choice list opens	N/A	
2	2	Sort Patient Pages	Choice list: Last (asc. or desc.), First (asc. or desc.), Last Updated (asc. or desc.)	Such display without issue	N/A	
2	3	Sort Patient Pages	Select any option	Patient Pages reorganize accordingly	N/A	
3	1	Create Patient Page Response	Find a Patient Page on the Client Dashboard. Select	Page loads without issue	N/A	
3	2	Create Patient Page Response	View any existing Feedback and (Caretaker) Notes, or "No updates yet." if none	Such display without issue	N/A	
3	3	Create Patient Page Response	Select "Create a new Feedback"	New Feedback opens	N/A	
3	4	Create Patient Page Response	Fields: General Text Feedback, Treatment Options, Patient Specific Advice	Fields display without issue	N/A	
3	5	Create Patient Page Response	Fill in fields, except for one required field. Save	Creation rejected	N/A	
3	6	Create Patient Page Response	Fill in all required fields. Save	Creation accepted	N/A	
4	1	Edit Patient Page Update	Select "Edit" on an existing Feedback that is older than 72 hours	Fields do not open for editing on Feedback	N/A	
4	2	Edit Patient Page Update	Select "Edit" on an existing Feedback that is not older than 72 hours	Fields do open for editing on Feedback	N/A	
4	3	Edit Patient Page Update	Adjust fields, leave one required field blank. Save	Modification rejected	N/A	
4	4	Edit Patient Page Update	Adjust fields, leave no required fields blank. Save	Modification accepted	N/A	
5	1	Check Alerts and Notifications	Return to the Client Dashboard. Find the Alerts and Notifications. Select	Page loads without issue	N/A	
5	2	Check Alerts and Notifications	Select "Dismiss" on a to do item	Alerts and Notifications count decreases	N/A	
5	3	Check Alerts and Notifications	Select "To Do" on a dismissed item	Alerts and Notifications count increases	N/A	
6	1	Verify Communications	Return to the Client Dashboard. Select the Communication Portal	Page loads without issue	N/A	
6	2	Verify Communications	Click on "Sort" dropdown choice list	Choice list opens	N/A	
6	3	Verify Communications	Choice list: Last (asc. or desc.), First (asc. or desc.), Last Updated (asc. or desc.)	Such display without issue	N/A	
6	4	Verify Communications	Select any option	Patients reorganize accordingly	N/A	
6	5	Verify Communications	Select a family member ("Patient") to chat with from the Communication Portal	Chat window loads without issue	N/A	
6	6	Verify Communications	View any existing News Updates and (Patient) Responses, or "No updates yet." if none	Such display without issue	N/A	
6	7	Verify Communications	Type nothing into the Instant Messaging Chat field. Hit Enter	No message is sent	N/A	
6	8	Verify Communications	Type something into the Instant Messaging Chat field. Hit Enter	A message is sent	N/A	
7	1	Create Communications Update	Select "Create a new News Update"	New News Update opens	N/A	
7	2	Create Communications Update	Fields: Family and Friends Updates, World Updates, Treatment Plan and Progression	Fields display without issue	N/A	
7	3	Create Communications Update	Fill in fields, except for one required field. Save	Creation rejected	N/A	
7	3	Create Communications Update	Fill in all required fields. Save	Creation accepted	N/A	
8	1	Edit Communications Update	Select "Edit" on an existing News Update	Fields open for editing on News Update	N/A	
8	2	Edit Communications Update	Adjust fields, leave one required field blank. Save	Modification rejected	N/A	
8	3	Edit Communications Update	Adjust fields, leave no required fields blank. Save	Modification accepted	N/A	
9	1	Validate logout	Select "Logout"	Logout accepted	N/A	

Figure 17: Client Role

CareLine – Quality Assurance Test Plan: Patient Role

Task #	Step #	Action	Description	Expected Result	Result	Comments
1	1	Validate login	Navigate to CareLine website in Chrome or Firefox. Not recommended for IE or Opera	Website loads without issue	Pass	
1	2	Validate login	Enter intentionally incorrect login credentials	Login rejected	Fail	
1	3	Validate login	Enter actually correct login credentials	Login accepted	Blocked	
1	4	Validate login	After login, routed automatically to Communication Portal	Page loads without issue	N/A	
2	1	Verify Communications	Click on "Sort" dropdown choice list	Choice list opens	N/A	
2	2	Verify Communications	Choice list: Last (asc. or desc.), First (asc. or desc.), Last Updated (asc. or desc.)	Such display without issue	N/A	
2	3	Verify Communications	Select any option	Clients reorganize accordingly	N/A	
2	4	Verify Communications	Select a family member ("Client") to chat with from the Communication Portal	Chat window loads without issue	N/A	
2	5	Verify Communications	View any existing Responses and (Client) News Updates, or "No updates yet." if none	Such display without issue	N/A	
2	6	Verify Communications	Type nothing into the Instant Messaging Chat field. Hit Enter	No message is sent	N/A	
2	7	Verify Communications	Type something into the Instant Messaging Chat field. Hit Enter	A message is sent	N/A	
3	1	Create Communications Update	Select "Create a new Response"	New Response opens	N/A	
3	2	Create Communications Update	Fields: Clinic Overall Rating, Caretaker Specific Rating [droplist], Wants & Needs, Mood	Fields display without issue	N/A	
3	3	Create Communications Update	Fill in fields, except for one required field. Save	Creation rejected	N/A	
3	4	Create Communications Update	Fill in all required fields. Save	Creation accepted	N/A	
4	1	Edit Communications Update	Select "Edit" on an existing Response	Fields open for editing on Response	N/A	
4	2	Edit Communications Update	Adjust fields, leave one required field blank. Save	Modification rejected	N/A	
4	3	Edit Communications Update	Adjust fields, leave no required fields blank. Save	Modification accepted	N/A	
5	1	Validate logout	Select "Logout"	Logout accepted	N/A	

Figure 18: Patient Role

CareLine – Quality Assurance Test Plan: Administrator Role

Task #	Step #	Action	Description	Expected Result	Result	Comments
2	1	Create User, Caretaker	Open Caretaker account creation feature	Page loads without issue	N/A	
2	2	Create User, Caretaker	Fill in fields, except for one required field. Save	Creation rejected	N/A	
2	3	Create User, Caretaker	Fill in all required fields. Save	Creation accepted	N/A	
3	1	Create User, Patient	Open Patient account creation feature	Page loads without issue	N/A	
3	2	Create User, Patient	Fill in fields, except for one required field. Save	Creation rejected	N/A	
3	3	Create User, Patient	Fill in all required fields. Save	Creation accepted	N/A	
4	1	Modify User, Caretaker	Open Caretaker account modification feature	Page loads without issue	N/A	
4	2	Modify User, Caretaker	Adjust fields, leave one required field blank. Save	Modification rejected	N/A	
4	3	Modify User, Caretaker	Adjust fields, leave no required fields blank. Save	Modification accepted	N/A	
4	4	Modify User, Caretaker	Select "deactivate account" checkbox	Modification accepted	N/A	
5	1	Modify User, Patient	Open Patient account modification feature	Page loads without issue	N/A	
5	2	Modify User, Patient	Adjust fields, leave one required field blank. Save	Modification rejected	N/A	
5	3	Modify User, Patient	Adjust fields, leave no required fields blank. Save	Modification accepted	N/A	
5	4	Modify User, Patient	Select "deactivate account" checkbox	Modification accepted	N/A	
6	1	Modify Object, Clinic Page	Open Clinic Page modification feature	Page loads without issue	N/A	
6	2	Modify Object, Clinic Page	Adjust fields, leave one required field blank. Save	Modification rejected	N/A	
6	3	Modify Object, Clinic Page	Adjust fields, leave no required fields blank. Save	Modification accepted	N/A	
7	1	Grant POA status	Select a Patient-Client relationship field	Page loads without issue	N/A	
7	2	Grant POA status	Set Power of Attorney (POA) field to "True". Save	Modification accepted	N/A	
8	1	Remove POA status	Select a Patient-Client relationship field	Page loads without issue	N/A	
8	2	Remove POA status	Set Power of Attorney (POA) field to "False". Save	Modification accepted	N/A	
9	1	Setup Patient-Client link	Open RELEVANT PAGE / FEATURE	Page loads without issue	N/A	
9	2	Setup Patient-Client link	Select only a Patient or Client. Save	Setup rejected	N/A	
9	3	Setup Patient-Client link	Select both a Patient and a Client. Save	Setup accepted	N/A	
9	4	Setup Patient-Client link	Delete a Patient-Client relationship. Save	Deletion accepted	N/A	
10	1	Setup Caretaker-Patient link	Open RELEVANT PAGE / FEATURE	Page loads without issue	N/A	
10	2	Setup Caretaker-Patient link	Select only a Caretaker or a Patient. Save	Setup rejected	N/A	
10	3	Setup Caretaker-Patient link	Select both a Caretaker and a Patient. Save	Setup accepted	N/A	
10	4	Setup Caretaker-Patient link	Delete a Caretaker-Patient relationship. Save	Deletion accepted	N/A	
11	1	Validate logout	Select "Logout"	Logout accepted	N/A	

Figure 19: Administrator Role

CareLine – Quality Assurance Test Plan: Guest Role						
Task #	Step #	Action	Description	Expected Result	Result	Comments
1	1	Validate login	Navigate to CareLine website in Chrome or Firefox. Not recommended for IE or Opera	Website loads without issue	Pass	
1	2	Validate login	Enter false login credentials	Login rejected	Fail	
2	1	Access open site pages	Navigate to About page to read information regarding CareLine itself	Page loads without issue	Blocked	
2	2	Access open site pages	Navigate to Contact and Help page to read CareLine support information	Page loads without issue	N/A	
2	3	Access open site pages	Use the search function to type in a Clinic name	Clinic Page loads without issue	N/A	
3	1	Validate Client registration	Select "Register an Account"	New dialogue box opens ...	N/A	
3	2	Validate Client registration	HIPAA Compliance Form and Disclaimer pops up	Document displays without issue	N/A	
3	3	Validate Client registration	Read form. Click "I have read and agree to this form and disclaimer"	New dialogue box opens ...	N/A	
3	4	Validate Client registration	Fields: Prefix, First, Mid., Last, Suffix, Mobile Phone, DOB, Patient Name, Patient Clinic	Fields display without issue	N/A	
3	5	Validate Client registration	Fill in fields, except for one required field. Enter	Registration rejected	N/A	
3	6	Validate Client registration	Fill in all required fields. Enter	Registration rejected	N/A	
3	7	Validate Client registration	Returned to CareLine website main page	Website loads without issue	N/A	
4	1	Validate login	Enter intentionally incorrect login credentials	Login rejected	N/A	
4	2	Validate login	Enter actually correct login credentials	Login accepted	N/A	
4	3	Validate login	After login, routed automatically to Communication Portal	Page loads without issue	N/A	
5	1	Validate logout	Select "Logout"	Logout accepted	N/A	

Figure 21: Guest Role

CareLine – Security Test Plan						
Task #	Step #	Action	Description	Expected Result	Result	Comments
1	1	Open Source Intelligence (OSINT) Gathering/Reconnaissance	Intelligence collection via finding, selecting, organizing, analyzing public sources	No major information is public	Pass	
1	2	Passive Reconnaissance - Google Cache/Dorks and Public Forums	Open information returned via simple search queries	No Usernames, Passwords, Email Lists Public	Fail	
1	3	Semi-Reconnaissance - Shodan.io	Search Engine with results of Internet-connected devices related to CareLine	Digital Ocean Server Is Returned	Blocked	
1	4	Active Reconnaissance - DNS Reverse Lookups	Resolving IP Address, Domain Name for CareLine	IP Address, Domain Names	N/A	
2	1	Scanning Techniques	Application gathering via use of technical tools	Limited ports are open	N/A	
2	2	Nmap - All Ports	Scanning all ports for CareLine using Nmap	Limited ports are open	N/A	
2	3	Nmap - Top 3 Ports	Scanning Top 3 ports for CareLine using Nmap	Top 3 ports are open as expected	N/A	
2	4	Nmap - Operating System	Scan of Operation System information for CareLine	Operating system information provided	N/A	
2	5	Vulnerability Scan	Scan of common vulnerabilities for CareLine	No significant vulnerabilities discovered	N/A	
3	1	Access - Gain Application Access	Gaining and Maintaining access to CareLine	Should not be able to access application	N/A	
3	2	Cross Site Scripting	Injection attack using malicious scripts to test trusted websites	Should not be able to modify code	N/A	
3	3	SQL Injection	Injection attack using malicious SQL query to modify database	Should not be able to modify database	N/A	
3	4	Broken Authentication and Session Management	Capture or bypass the authentication methods utilized by CareLine	Should not be able to compromise authentication	N/A	
3	5	Directory Traversal	HTTP attack to access restricted directories	Not able to access directories	N/A	

Figure 22: Security Test

PASS/FAIL CONDITIONS

It is expected that CareLine will pass all tests described and that the documented procedures on each testing sheet will satisfy the User Acceptance Testers. If a procedure has failed, obscured, or otherwise halted, that phase of the tests will not be considered passed until the matter has been conclusively addressed or resolved.

OUTCOMES AND FINAL RESULTS

Upon the completion of Exit Criteria, our team analyzed the results and evaluated the severity of all issues that were found. Based on that, we fixes were created and changes were deployed to the appropriate components. Once done, all failed portions of the test plan were revisited for validation. All things verified post implementation, the testing phase was determined to be complete and the application ready for production.

CONCLUSION

PROBLEMS ENCOUNTERED

When developing CareLine, the team encountered several problems. First, the team struggled choosing a hosting environment for our web application server. There were internal team discussions that weren't problematic per se, but there were differences in regard to application functionality that had to be solved by writing requirements and creating visualizations in order to get everyone on the same page. Finally, there were some minor timing issues that seemed more bothersome at first than they ended up being, as everything came together well as the time went on. Lastly, throughout the course of each term, Garrett encountered several programming issues with Fastify and Type ORM plugins. As a result, he developed custom ORM plugins to meet the need of the project.

LESSONS LEARNED

Over the course of the fall semester and spring semester, the team learned valuable lessons. Creating a web application from scratch required significant dedication to meet the objectives and expectations of the team. Each member had to sacrifice time and valuable work days to create the project. Additionally, the team found that it is crucial to manage your time properly. Project requirements are often overlooked and work is often seen as ad hoc without a document like that available. New technologies are challenging, as each person on a team has a different way of visualizing their own interpretation of how it will look and work, so communication is key. Another key is creativity, as the team discovered that there are multiple right answers to a given scenario. Overall, the team enjoyed the challenges of the project and showing it off at the IT Expo. There was a great appreciation for the application that the team created and there was no shortage of

GROWTH OF ABILITIES & SKILLS ACROSS THE TEAM

Developing CareLine has been a phenomenal opportunity for Merideth, Garrett, and Jeremy. Each team member was challenged in both a technical and professional manner. As the Project Management and Security Analyst, Merideth was challenged by ensuring the project was on track and meeting the HIPAA compliant requirements. Merideth had to utilize her knowledge and prior security experience to create two new policies (HIPAA Consent Form and Privacy Policy) for the application. Merideth ultimately led the team through these selective areas and enhanced her leadership, management, and decision-making skills.

Garrett was tested through the development of the project and his uses of technical coding languages. Prior to the start of the project, Garrett was familiar with JavaScript, AngularJS, and NodeJS. Garrett challenged himself and the project by learning TypeScript using the new front-end framework Angular 7 and the new back end framework of Fastify.

Lastly, Jeremy picked up business analyst skills as he assisted Merideth with project documentation and learned to write requirements for CareLine. He went outside of his normal operating comfort zone by giving the class rehearsal elevator speech, conducting interviews, and setting up test plans. His system and database administration duties, both fields in which he was already comfortable, were easy by comparison.

Overall, each member of the team was challenged in their area of expertise. Merideth, Garrett, and Jeremy each faced obstacles regarding their decisions, but they came together to support one another and develop a successful web application.

CONCLUSION, FUTURE OVERVIEW, AND OTHER RECOMMENDATIONS

Looking forwards, CareLine development would be geared towards improving upon and building out a number of aspects, but primarily in four areas. The first would be enhancements for the notifications system, including email triggers upon updates to patient pages. This would better fulfill the requirement of mobile friendly communication.

Patient analytics would also need to be vastly expanded, so as to better oversee the trends in the care for and well-being of patients and facilities alike. All four user roles would greatly benefit from being able to visualize this information.

The current use case, a senior living facility, is rather limited by nature and intent so that we met the class structure and timeline. Future work would expand the usability of this in order for it to cross over to other forms of long-term care. The primary goals for this would be to include mental health institutions and extended stay hospitals.

The last primary focus is a cut requirement; the ability for Administrators to designate one Client for Power of Attorney (POA) status in relation to one Patient. This was highlighted as necessary by our interviewees but took a back seat as more pressing work had to be taken care of by the group.

From the start, we could have all better understood what each of us had in mind for this project. While none truly conflicted, there was a lot to get through at various points that could have been handled sooner, so as not to take up time later on. We also received some feedback on usability and color scheme that could have been improved upon.

Each of us learned at the IT Expo that giving the pitch over and over can really help for presenting, and make the time go by incredibly fast. The slowest part was the last twenty-five minutes before the awards ceremony when people stopped passing by.

APPENDIX A: LIST OF ACRONYMS

CDC	<u>Centers for Disease Control and Prevention</u> CDC is one of the major operating components of the Department of Health and Human Services. CDC works 24/7 to protect America from health, safety and security threats, both foreign and in the U.S. Whether diseases start at home or abroad, are chronic or acute, curable or preventable, human error or deliberate attack, CDC fights disease and supports communities and citizens to do the same.
HIPAA	<u>Health Insurance Protection and Accountability Act</u> Relevant Title II establishes national health standards for electronic health care, including an outline of PHI requirements.
HHS	<u>Health and Human Services</u> United States Cabinet-level Department under which the CDC operates.
HTTPS	<u>HyperText Transfer Protocol, Secure</u> Application layer protocol designed to provide communication securely over a network, using SSL
IM	<u>Instant Message</u> Real-time text communication
OCR	<u>Office for Civil Rights</u> Branch of HHS which is charged with ensuring the enforcement of protections listed in HIPAA, among others
ORM	<u>Object-Relational Mapping</u> Software interface enabling access to the database from the back end
PHI	<u>Protected Health Information</u> Any information about health status, health care, or health records that is collected or created by a “Covered Entity” (defined by HIPAA) and can be linked to a specific individual. Includes payments and any Personally Identifiable Information
SQL	<u>Structured Query Language</u> Utilized for managing structured data as a Relational Database Management System
SSL	<u>Secure Sockets Layer</u> Application layer protocol designed to provide communications security cryptographically over a network
T-SQL	<u>Transact Structured Query Language</u> Proprietary extension of SQL; used by Microsoft SQL Server
UC	<u>University of Cincinnati</u> Cincinnati-based public research and space-grant institution that is a member of the University System of Ohio
UML	<u>Unified Modeling Language</u> General purpose, standardized software engineering visualization paradigm used for development and design
WBS	<u>Work Breakdown Structure</u> Project management diagram designed to lay out the work needed to be done as individualized tasks

APPENDIX B: GLOSSARY OF TERMS

Active	<u>Active work state</u> Status indicator for Gantt Chart and Requirements; means that work on a given item is in progress.
Admin	<u>Medical facility administrator</u> A person responsible for the maintenance of CareLine user accounts at a Clinic
Auth. U.A.	<u>Authenticated User Action</u> Functionality tied to logged in users, based on their role
Blocked	<u>Blocked work state</u> Status indicator for Gantt Chart and Requirements; work cannot continue, pending the completion of something else
Caretaker	<u>Medical professional</u> Clinic employee responsible, in whole or in part, for the health and welfare of a patient or patients
Client	<u>Family member of a Patient</u> Responsible relatives, who may or may not have Power of Attorney
Clinic	<u>Clinic concept item</u> Any clinic, hospital, institution, or other long-term health care facility
Clinic Page	<u>Clinic informational page</u> Informational page of a Clinic, maintained by the Admin
Complete	<u>Complete work state</u> Status indicator for Gantt Chart and Requirements; work is wholly done and the task closed
Critical	<u>Critical priority level</u> Key feature required for the app to meet minimum functionality
Extra	<u>Extraneous priority level</u> Ancillary feature for the app if there is spare time
Guest U.A.	<u>Guest User Action</u> Functionality open to visiting users
High	<u>High priority level</u> Necessary feature for the app to achieve its goals
Low	<u>Low priority level</u> Bonus feature for the app to be completed thoroughly
Medium	<u>Medium priority level</u> Important feature for the app to attain adequate user satisfaction
New	<u>New work state</u> Status indicator for Gantt Chart and Requirements; work has not yet begun
Patient	<u>Long-term care recipient</u> Patient at a Clinic who has been deemed mentally fit to use the app
Patient Page	<u>Patient updates page</u> Status updates page of a Patient
Tentative	<u>Tentative work state</u> Status indicator for Gantt Chart and Requirements; work is effectively finished, yet needs verification

APPENDIX C: SOFTWARE DESIGN

Repository	<u>GitHub</u> Repo Accessible: https://github.com/Soudergt/Care-Line
Front End	<u>TypeScript</u> Superset language to JavaScript, written here using Angular 7
Back End	<u>NodeJS</u> Javascript runtime engine with Fastify as the backend framework
Database	<u>T-SQL</u> Proprietary SQL language, central to Microsoft SQL Server
Hosting	<u>Digital Ocean</u> Production environment location

APPENDIX D: INTERVIEW QUESTIONS

Loose Interview Questionnaire Structure:

1. [*start*] Describe CareLine. Unscripted to make it more natural
2. [*segue*] Ask, based on their role, what benefits they could see from implementing this application. Let them talk at length
3. [*segue*] Ask, based on their role, what specific features they would want to see in this application. Make sure to get each idea
4. [*segue*] Ask, based on those responses, which features we have for that role that they did not mention. Do not go into much depth
5. [*start*] Ask, based on the other roles, how they think of the functional goals of this application. Do not go into much depth on other roles

6. [*start*] Ask, based on their experience, what unforeseen challenges could face this application. Only stop them if we have an answer

7. [*return*] Ask, based on the earlier feature discussion, how they would rate the priority of each feature for this application. Pace the replies
8. [*segue*] Ask, based on those priorities and if/how/why we have rated them vastly different, what made them rate those as such. Optional

9. [*start*] Ask, based on their role, if they would be interested in participating in another interview and/or in user acceptance testing of the application in the January-March time frame

10. [*start*] Ask, based on the progress of the interview and as a means to begin the conclusion, if they have any additional questions, comments, concerns, ideas, or suggestions for CareLine
11. [*finish*] Thank them for their time

APPENDIX E: RESOURCE CONTACTS

The following external professional resources were contacted for interviews to assist with the development of CareLine:

- Burke, Mollie. Undergraduate student, University of Cincinnati. Role: Patient
- Moore, Evelyn. Executive Director, Embassy Healthcare. Role: Administrator
- Scott, Jim. Assistant Professor, University of Cincinnati. Role: Client
- Smith, Eathan. Undergraduate student, University of Cincinnati. Role: Caretaker
- Gulbrandsen, Megan. Registered Nurse, Mercy Health. Role: Caretaker

APPENDIX F: LOGOS AND BRANDING

Upon the decision to move forward with the CareLine concept, the team developed a logo and brand for the web application. The development of the logo and branding included creating and evaluating potential logos, color schemes, and font. **Figure 22: Logos and Branding** presents the creation of the CareLine logo and brand theme.

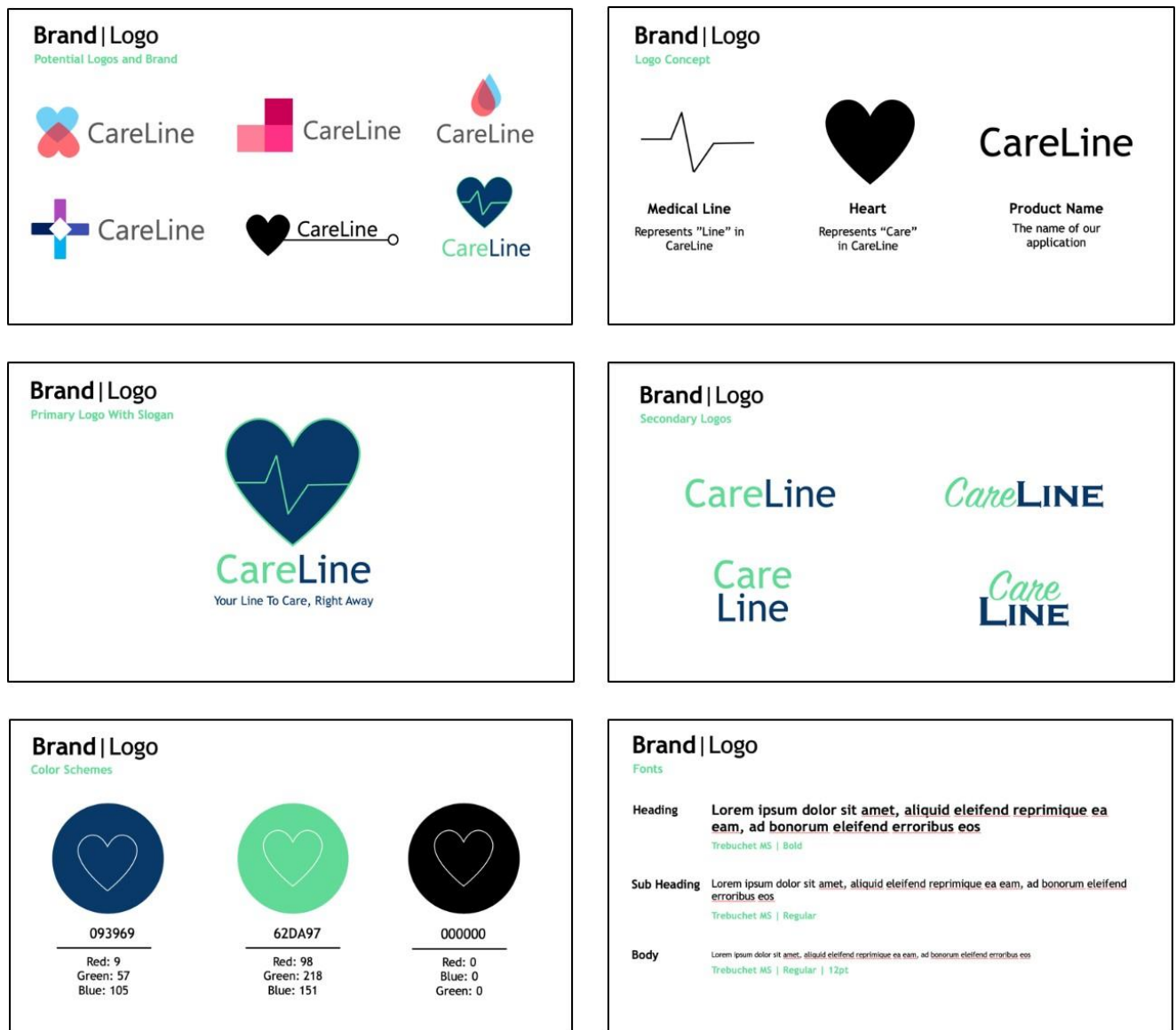


Figure 22: Logos and Branding

APPENDIX G: IT EXPO POSTER

When preparing for the IT Expo, the team created the following poster to display at the booth for visitors to view and gather a quick background on CareLine. The poster was designed to highlight the key aspects of CareLine and to match the application. **Figure 23: IT Expo Poster** presents the final poster displayed at the IT Expo.

CareLine
Your Line To Care, Right Away
www.carelinetechnology.com

Team 09: Merideth Moore, Garrett Souders, Jeremy Thomas
University of Cincinnati - College of Education, Criminal Justice, Human Services - School of Information Technology
Technical Advisor: Abdou Fall

200 BICENTENNIAL UNIVERSITY OF CINCINNATI

8.36 Million People Receive Some Form of Long-Term Care Service and Support Annually

OUR SOLUTION
A responsive web application platform that increases the amount of communication between not only families and their relatives in long-term care situations, but also between those families and the caretakers at long term care facilities.

THE PROBLEM

- Most long-term care facilities operate with dated technology and are unable to provide families with digital status reports nor send any kind of frequent updates on their relatives.
- Many families do not have the time nor ability to see their relatives daily, which can be a barrier against ensuring their loved one is properly cared for.
- The market does not feature an adequate application - neither web, nor mobile - that provides daily updates and communication between all parties.

OUR FRONT END
ANGULAR
MATERIAL DESIGN
TypeScript

OUR BACK END
nodeJS
fastify

OUR DATA END
Microsoft SQL Server

OUR HOST ENV.
DigitalOcean

DESIGN AND TECHNOLOGY

CareLine is a direct line of care communication that is revolutionizing and modernizing how families, patients, caretakers, and facilities interact in the caregiving process.

BENEFITS

- ON-DEMAND COMMUNICATION
- FEEDBACK AND CARE RATING SYSTEM
- CONSISTENT CARE REPORTING
- MODERNIZED CARE PROCESS
- HIPAA COMPLIANT

Ease of Mind for Long-Term Patients and Families Alike

Figure 23: IT Expo Poster

APPENDIX H: IT EXPO MARKETING PRESENTATION

In addition to having a poster displayed at the IT Expo, the team also created a marketing presentation that was presented in the back of the booth on a loop. **Figure 24: IT Expo Marketing Presentation** displays the presentation that was shown during the IT Expo.

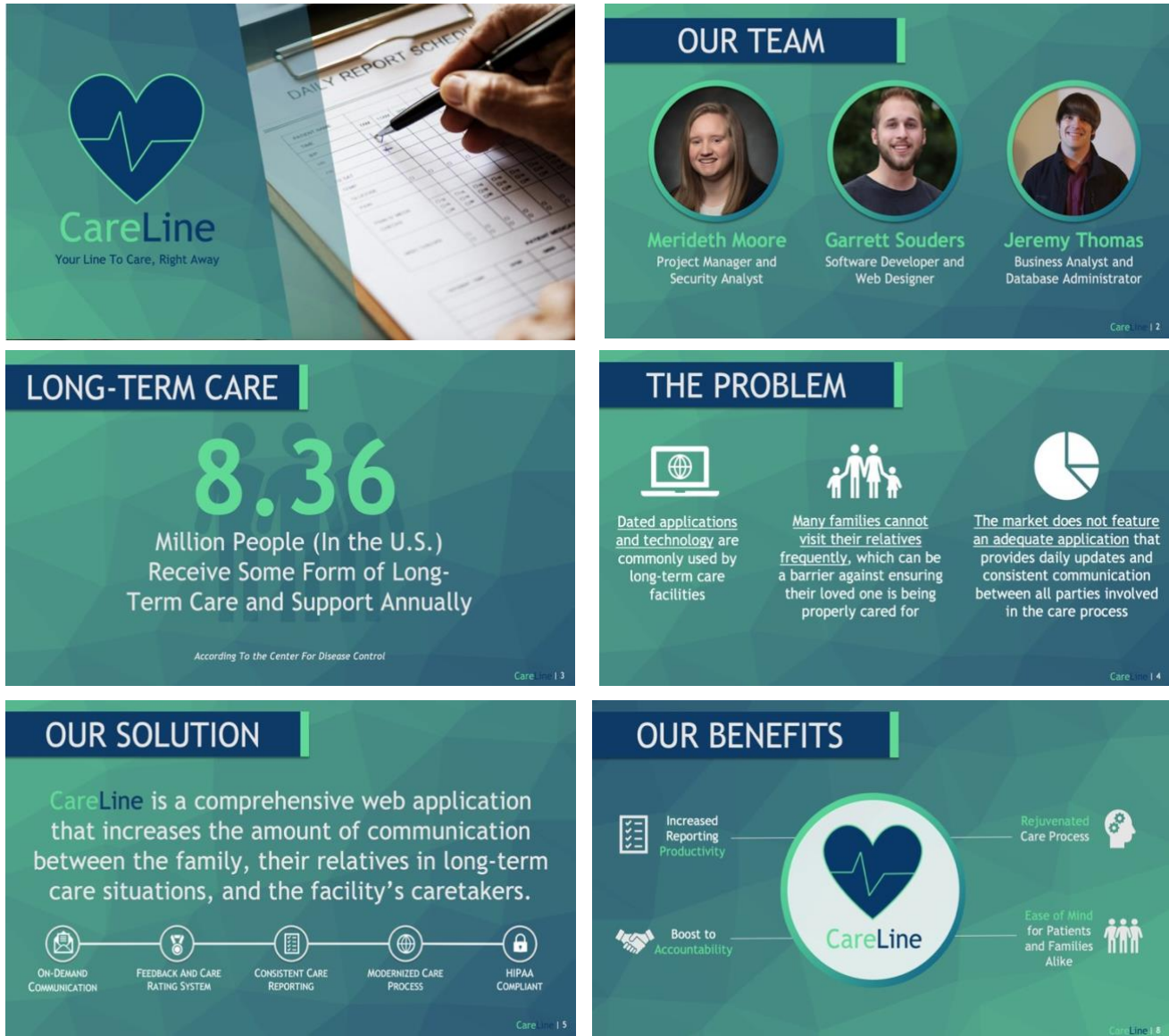
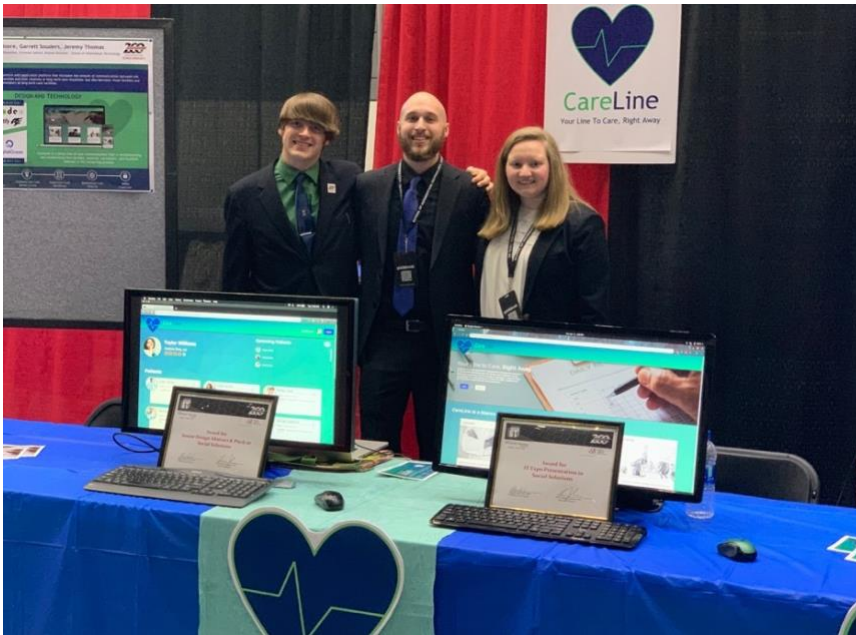


Figure 24: IT Expo Marketing Presentation

APPENDIX J: IT EXPO BOOTH AND RESULTS



APPENDIX J: REFERENCES

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