Predicting Potential Patient Issues Project Charter

Prepared by the students of CSC 4610 – FALL 2021

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Under the direction of

Dr. William Eberle (Professor)

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1. Concept

We are creating an app/web interface that will be able to aggregate patient vital signs from multiple devices and, using machine learning, will be able to predict potential problems with patients. Medical devices that are connected to the local network will have their data fed directly into the app, and any others will be entered manually through the app's UI. Patient data will be fed into the app from a local database, and this information will be used in tandem with the vital signs to make predictions about when/if the patient will code.

The results of our application will assist doctors and nurses by displaying the severity of ICU patients. Alerts will be sent through the app to notify medical professionals of potential patient issues.

2. Project (Elevator) Statement

For healthcare workers who want to provide better, quicker, and easier care for their patients. The app/web interface is a medical tool that will allow healthcare workers to look at all their patients' medical data in one spot and will send them notifications when a patient is about to code. They can also simply view the data to make their own observations that might not be provided by the app. Unlike the current EHR system, our solution is to provide a piece of software that makes this essential part of healthcare easier for the actual providers.

3. Measures of Success and Sliders

We will measure success by time, scope, quality, and cost.

Success Slider

	Fixed			Flexible
Time	X			
Scope				X
Quality		X		
Cost			X	

- Time is fixed because we must have a fully completed project by the end of the semester.
- Scope is flexible because the team leads behind this project, Megan Kozub especially, are more interested in what we can do with the concept than the finalized product as this project deals with learned machine learning and required a trained model to work properly.
- Quality is more fixed than flexible because our team wants to deliver a quality product, despite the flexibility of the scope.
- Cost is more flexible than fixed because both Tennesse Tech and NavSEA can pay for products that we may need, however they most likely will not approve of unessential items.

4. Challenges / Roadblocks

- Retrieving a server from Tech and setting it up.
- Accessing the medical databases that were given to us by Megan Kozub.
- Finding and coding an accurate and efficient method to predict patient issues.
- Liability concerns when considering the privacy of patients.
- HIPAA compliance as this is a medical application.

5. Definition of Done

Work is considered finished when code is:

- The product is fully tested by each individual member of the team and meets quality standards, i.e. every part of the product runs as expected.
- Fully submitted to GitLab and is tested in multiple systems to ensure quality.
- The result is as imagined as per the user story which it was based on.
- Has met the customers' expectations.

6. Stakeholders

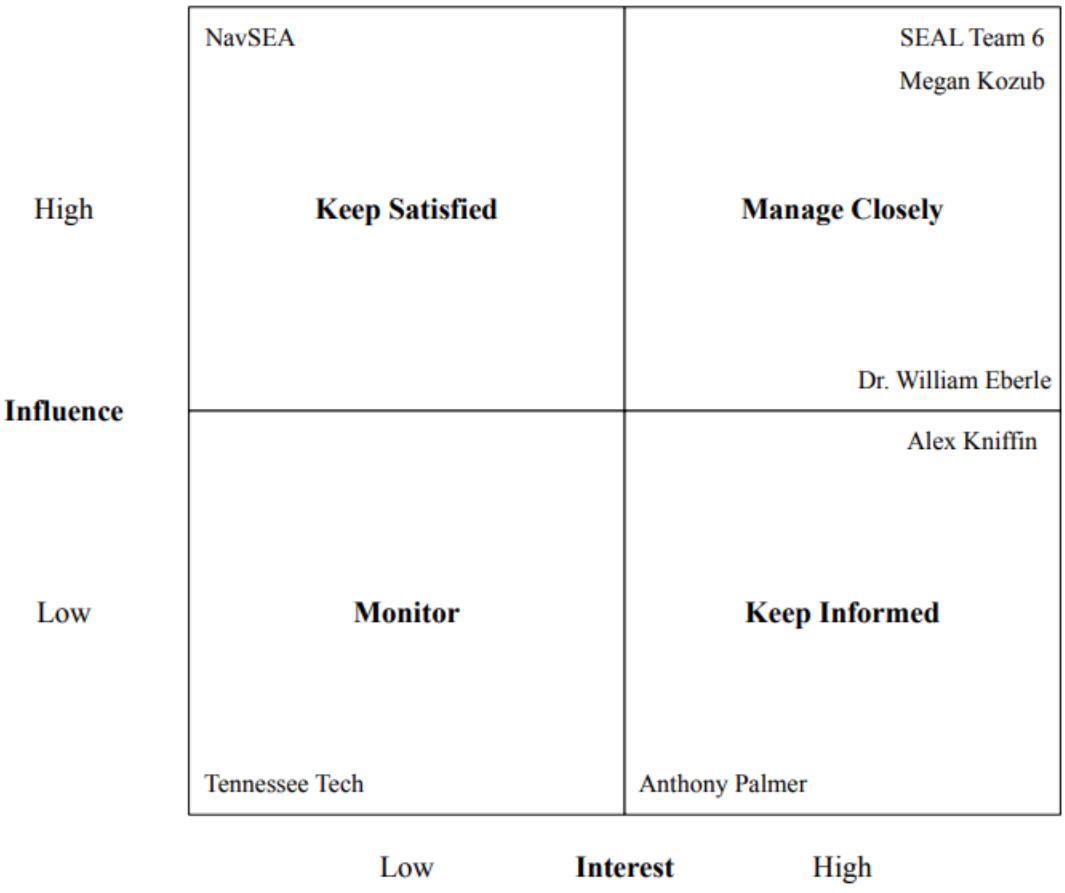
NavSEA:

- Megan Kozub
- Alex Kniffin
- NavSEA

Tennesse Technological University:

- Dr. William Eberle
- Anthony Palmer
- Software Development Team – Team 6 (SEAL Team 6)
- Tennesse Technological University

Interest-Influence Matrix:



7. Users and Personas

- System Managers (Megan Kozub, Alex Kniffin)

Erik Cooper

"A quotation that captures this user's personality."

Age: 29
Work: System Manager
Family: 3rd of 27 children; Married 11 years; has 14 daughters and 2 sons.
Location: Bessemer, AL
Character: Lawful Good

Personality

Introvert	Extrovert
Thinking	Feeling
Sensing	Intuition
Judging	Perceiving

Organized | IT Background | Leadership

Goals

- To make the IT world a better place.
- To retire by thirty-five.
- For all my children to have children of their own.

Frustrations

- Poor coding practices.
- People being late to meetings.
- People using insecure passphrases.

Bio

Growing up in Alabama my whole life I never got exposed to the world of IT until college. Ever since, I've had a passion for technology and leading people to a better more technologically inclined future.

Utilizing my knowledge from my degree and my 5 years of experience, I'm able to decisively lead teams to complete our goals and make the future one step closer to reality. Ever step of the way I get to learn more and more, truly that's the greatest benefit of the job.

Motivation

Incentive
Fear
Growth
Power
Social

Brands & Influencers

Preferred Channels

Traditional Ads
Online & Social Media
Referral
Guerrilla Efforts & PR

- Medical Practitioners (Customers i.e.. Doctors, Nurses)

8. User Stories

Link to user stories on Gitlab: [Issues · CSC 4610 F21 / Group-06 / Predicting Patient Issues · GitLab (tntech.edu)]

Iteration 1:

User Stories in Weight: 66

Features:

- Medical professional log in: As a medical professional, I need to log in to my account with my username and password so that I can access patient information in the application.
    - Jacob Hill

- Create data diagram: As a developer, I want to make a diagram for how the data will flow through the frontend, API, and database so that I can reference this during development.
    - Timothy Kelley

- Create mockup home screen: As a developer, I need to create a mockup for the home screen of our application so that the customer can get a good idea of our concept and redirect us if need be.
    - Amanda McGuire

- Create mockup notification center: As a developer, I need to create a mockup for the notification center of our application so that the customer can get a good idea of our concept and redirect us if need be.
    - Amanda McGuire

- Create mockup login screen: As a developer, I need to create a mockup for the login screen of our application so that the customer can get a good idea of our concept and redirect us if need be.
    - Amanda McGuire

- Create a mockup patient profile: As a developer, I want to create a mockup of the patient profile UI so that I have a basis on what the final product will look like for myself and the stakeholders.
    - Amanda McGuire

- Create a mockup associate profile: As a developer, I want to create a mockup of the associate profile UI so that I have a basis on what the final product will look like for myself and the stakeholders.
    - Amanda McGuire

- Delete an entry from the user table: As a developer, I want to delete an entry from the user table via python APIs so that I can remove a user from the database.
    - Robert McKay, Jacob Hill

- Read data from the user table: As a developer, I want to read data from the user table with python APIs so that I can retrieve information from the table.

    - Robert McKay, Jacob Hill

- Connect to the backend database with python APIs: As a developer, I want to connect to a database on the server with a python APIs so that I can create CRUDs for tables in the database.
    - Timothy Kelley

- Update an entry in the user table: As a developer, I want to be able to update an entry in the user table using python API's so that end users can change their name/password.
    - Robert McKay, Jacob Hill

- Create an entry in the user table: As a developer, I want to be able to create an entry in the user table with python APIs so that end users can have accounts.
    - Robert McKay, Jacob Hill

- Create database table for users: As a developer, I want to create a database table that will store user credentials so that they can log in securely.
    - Joseph Doonis

- Create a database for persistent storage of user data: As a developer, I want to create postgres database on the server so that the front end can store user information.
    - Joseph Doonis

- Acquire TN Tech Server: As a software developer, I need to acquire a TN Tech server with at least 100 GB of data so that I can store project files, datasets, and development code for the whole team.
    - Robert McKay

- Download & Build eICU Dataset – PostgreSQL: As a software developer, I need to download and build the eICU dataset databases on PostgreSQL so that I can begin looking through the data.
    - Timothy Kelley

- Configure Python 3: As a software developer, I need to install python version 3 and pip package manager on the server so that I can download and install the python requirements and run the fast-api backend API service.
    - Jacob Hill

- Select all roles: As a developer, I want to be able to select all rows from the roles table in the userinfo database via fastapi so that the frontend can display all current roles to the user.
    - Robert McKay

- Delete a role: As a developer, I want to be able to delete a role from the roles table in the userinfo database via fastapi so that the frontend can remove a role.
    - Robert McKay

- Add new role: As a developer, I want to be able to insert a new role to the roles relation in the userinfo database via fastapi so that the frontend can add roles to the app.
    - Robert McKay

- Login Authentication API Function: As a developer, I want to authenticate a user's login through a FastAPI function so authenticated users can access the web app.
    - Timothy Kelley, Robert McKay, Jacob Hill

- Create fast API: As a developer, I want to implement a service using fast api so I can connect the database backend with the UI.
    - Robert McKay

- Add models of database schema to API: As a developer, I want to utilize model objects representing database tuples from each table so I can train the machine learning model.
    - Timothy Kelley

Spikes:

- Install & Configure NetExtender VPN: As a software developer, I need to install and configure NetExtender VPN so that I can access the remote TN Tech server off-campus.
    - Everyone

Iteration 2:

User Stories in Weight: 76

Features:

- Save session token in accessible format to use for requests: As a developer, I need to save the user id token in an accessible format in the browser's local storage so that it can be read in and used as a header in requests requiring authentication.
    - Jacob Hill

- Configure server for docker: As a developer, I want the server to have docker configured so that I can deploy the application with docker.
    - Robert McKay

- Material design app bar on home page: As a user, I want the home page to have a material design app bar so that I can easily access features of the application.
    - Timothy Kelly, Joseph Doonis

- Notification panel on home screen: As a medical provider, I want the home screen of the application to have a notification panel so I can quickly see urgent issues with patients.
    - Timothy Kelly, Joseph Doonis

- React table for patient information: As user of the application, I want the home page to display a table of patients so that I can easily view patient information.
    - Robert McKay, Amanda McGuire

- Docker compose file for application development: As a developer, I want to create a docker compose file to run the application so that I can develop within docker containers.
    - Robert McKay

- Set up docker environment: As a developer, I want to set up a docker environment so that I can develop the application in a containerized environment.
    - Joseph Doonis, Jonas Fornehed, Jacob Hill, Timothy Kelley, Amanda McGuire, Robert McKay

- FastAPI router for patient table: As a developer, I want a FastAPI router for the patient table in the userinfo database so that the frontend can interact with the table.

    - Robert Mckay

- CRUD for patient table: As a developer, I want a CRUD for the patient table in the userinfo database so that the fastapi can interact with the table.
    - Robert McKay

- Create database for patient information: As a developer, I want a database on the server for patient information so that I can store information from the frontend.
    - Robert McKay

- Create a homepage for the app: As a user of the app, I want the application to have a home screen so that I can view access the features of the app.
    - Jacob Hill

- Research LSMT ML model in TensorFlow: As a developer, I want to learn how to create an LSMT ML model in TensorFlow so I can create an accurate model for predicting critical patient events.
    - Jacob Hill, Jonas Fornehed

- Research recurrent neural networks: As a developer, I want to learn more about recurrent neural networks so I can implement one in TensorFlow.
    - Jacob Hill, Jonas Fornehed

- Severity Indicator Patient List: As a medical professional, I need to be able to see a list of patients with a severity indicator ranging from low to high so that I know which patients a priority is to see first.
    - Robert McKay, Amanda McGuire

- Tie together Table, AppBar, and Notification Center: As a developer, I want to tie together the Table, AppBar, and Notification Center so I can set a foundation for the frontend.
    - Timothy Kelly, Robert McKay

- Automatic updating for display data: As a medical professional, I want the display data to update automatically so I can receive critical notifications without having to refresh.

    - Timothy Kelly

Spikes:

- Improve PostgreSQL skills: As a developer, I want to learn more about PostgreSQL so I can use the test databases more efficiently.
    - Joseph Doonis, Jonas Fornehed, Jacob Hill, Timothy Kelley, Amanda McGuire, Robert McKay

(Predicted) Iteration 3:

User Stories in Weight: TBD

Features:

- Reading from database in chunks: As a developer, I want to learn how to get data from the database in smaller chunks so I can more efficiently train our model.
    - Jacob Hill, Jonas Fornehed

- Preprocess eICU data for machine learning: As a developer, I want to preprocess data from the eICU dataset so that I can effectively train a machine learning model to predict patient events.
    - Jacob Hill, Jonas Fornehed

- API Route for machine learning model: As a developer, I want an api route to the machine learning model that predicts patient issues so that the frontend can interact with the model.
    - Robert McKay, Jacob Hill

- Train Python Machine Learning Model: As a software developer, I need to train a python machine learning model that can accurately (>90%) predict if a patient is going to code/crash and make it accessible to the python webserver.
    - Jacob Hill, Jonas Fornehed, Joseph Doonis

- Enter patient data into UI: As a medical provider, I want to be able to enter patient data into the UI so the system can predict patent events.
    - Robert McKay, Amanda McGuire

- Add refresh button to AppBar: As a nurse, I want to refresh the data so I can have the latest patient information.
    - No one is assigned to this story at this time.

- Integrate usernames: As a user, I want to see my username so I can identify my username.
    - No one is assigned to this story at this time.

- Parse live patient data into Notification center: As a patient, I want to see live notifications on patient data so I can react to adverse events when needed.
    - No one is assigned to this story at this time.

- Add new patients to the table: As a medical provider, I want to be able to add patients to the table so that I can keep an updated list of patients.
    - No one is assigned to this story at this time.

- Delete a patient from the table: As a medical provider, I want to be able to delete a patient from the table so that I can keep the list of patients up to date.
    - No one is assigned to this story at this time.

- Maintain global state for app: As a developer, I want to maintain a global state for the frontend app so that I can easily access data.
    - No one is assigned to this story at this time.

- Refactor code: As developer, I want to refactor the code so that the project does not accumulate technical debt.
    - No one is assigned to this story at this time.

Spikes:

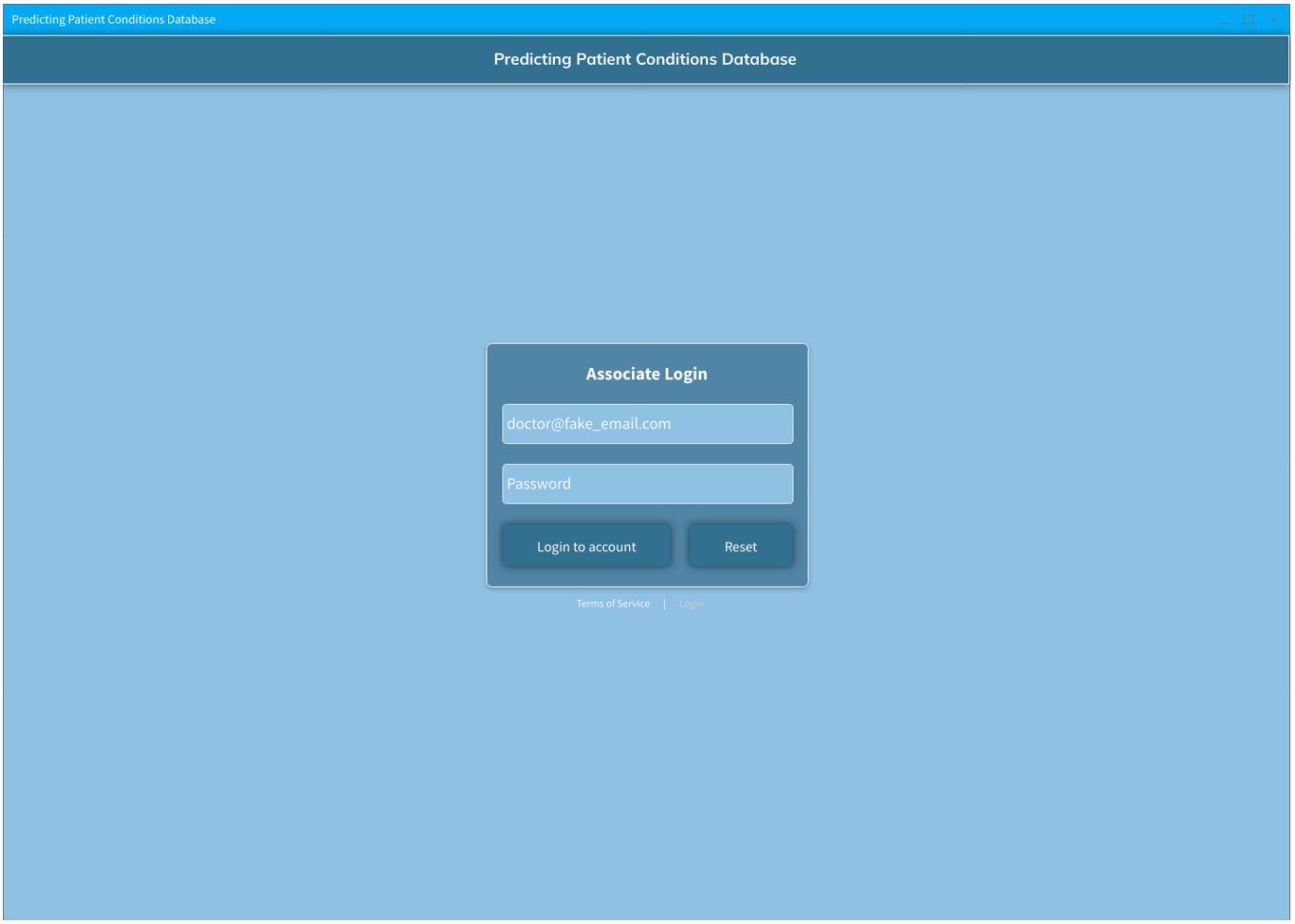
- Learn python machine learning libraries: As a developer, I want to learn how to use python for machine learning libraries so I can help with the creation of the machine learning model.
    - Joseph Doonis, Jonas Fornehed, Jacob Hill, Timothy Kelley, Amanda McGuire, Robert McKay

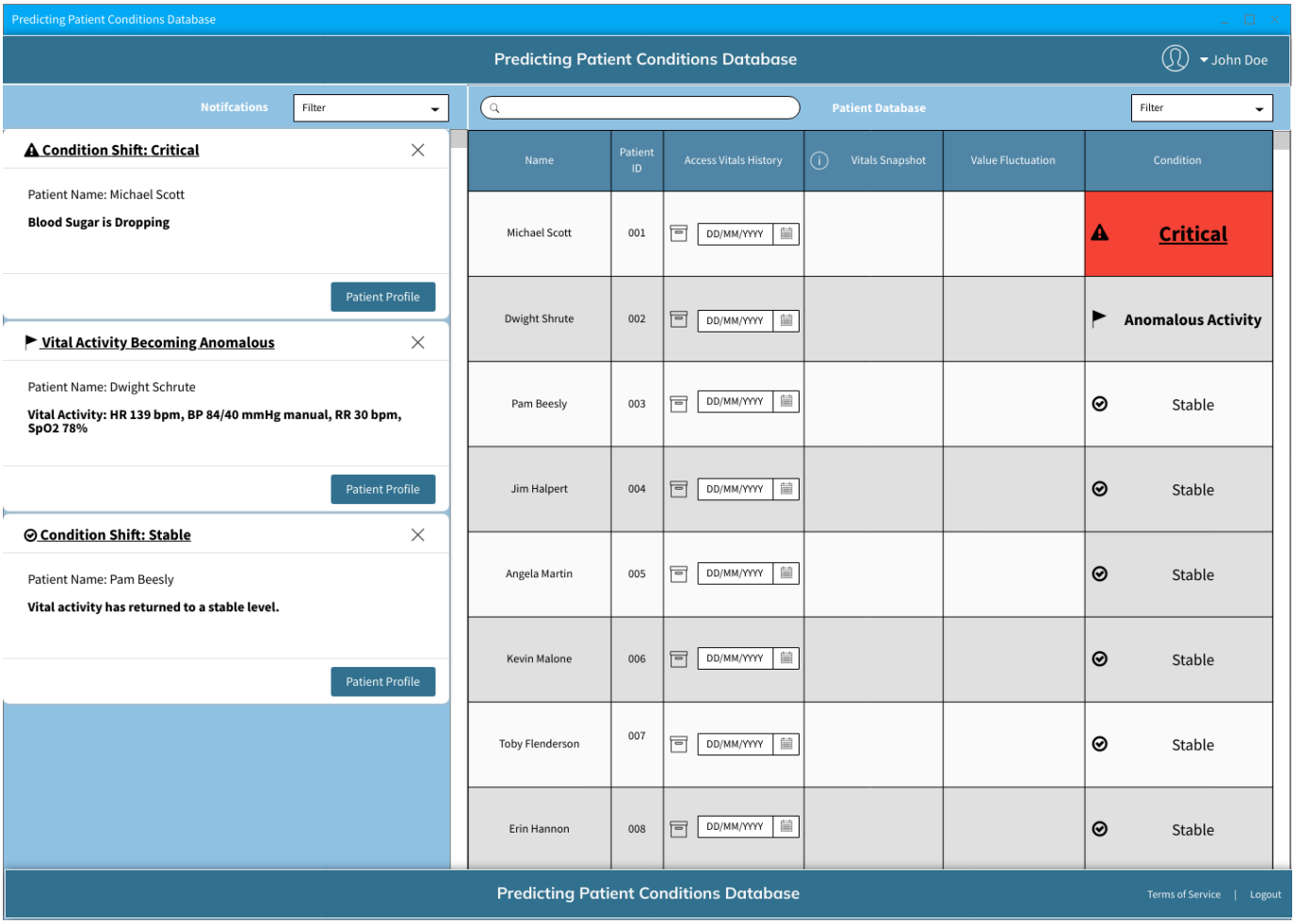
- Encrypt patient data: As a developer, I want to learn how to encrypt patient data so I can make sure patient data is secure.

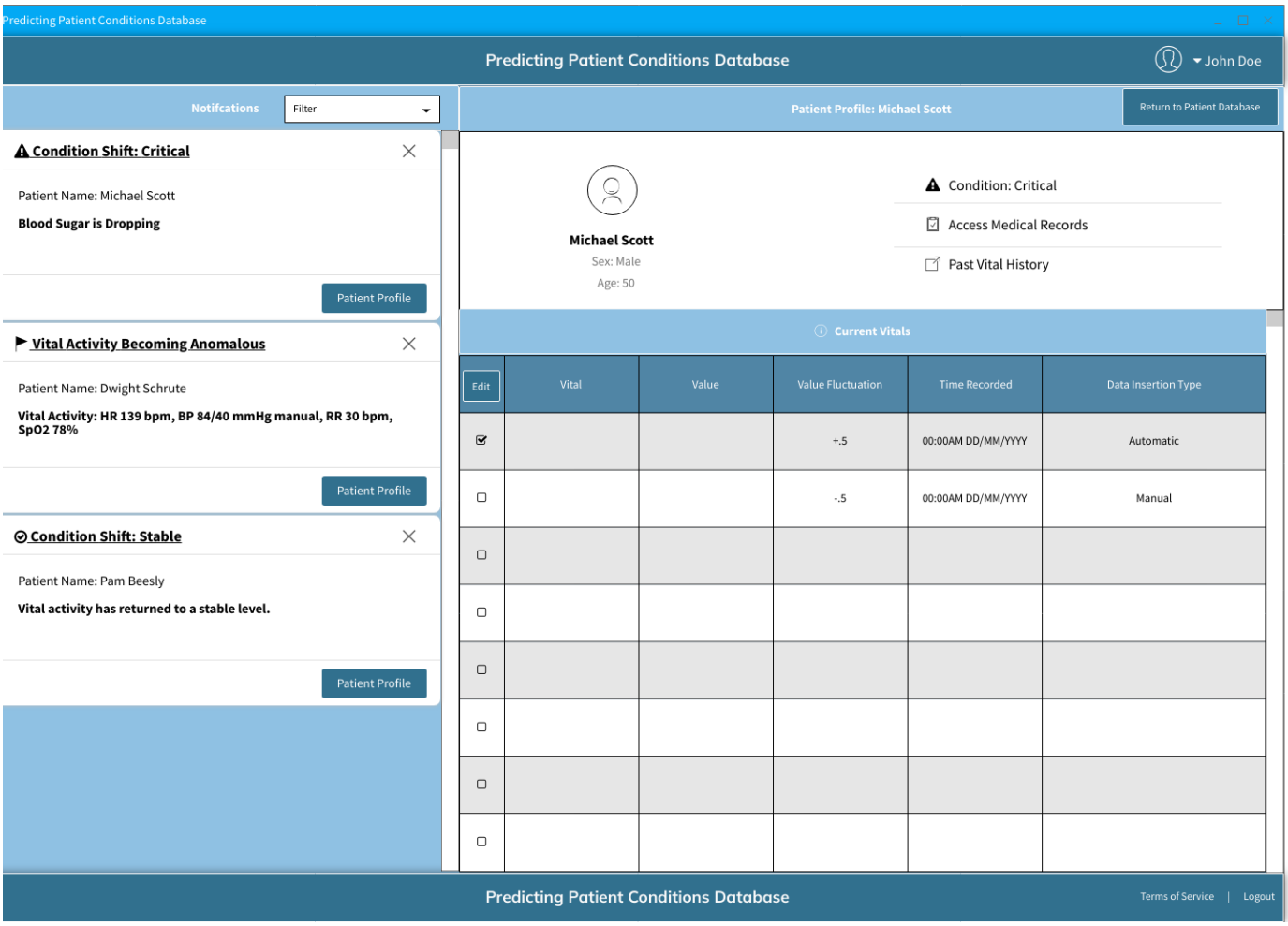
    - Joseph Doonis, Jonas Fornehed, Jacob Hill, Timothy Kelley, Amanda McGuire, Robert McKay

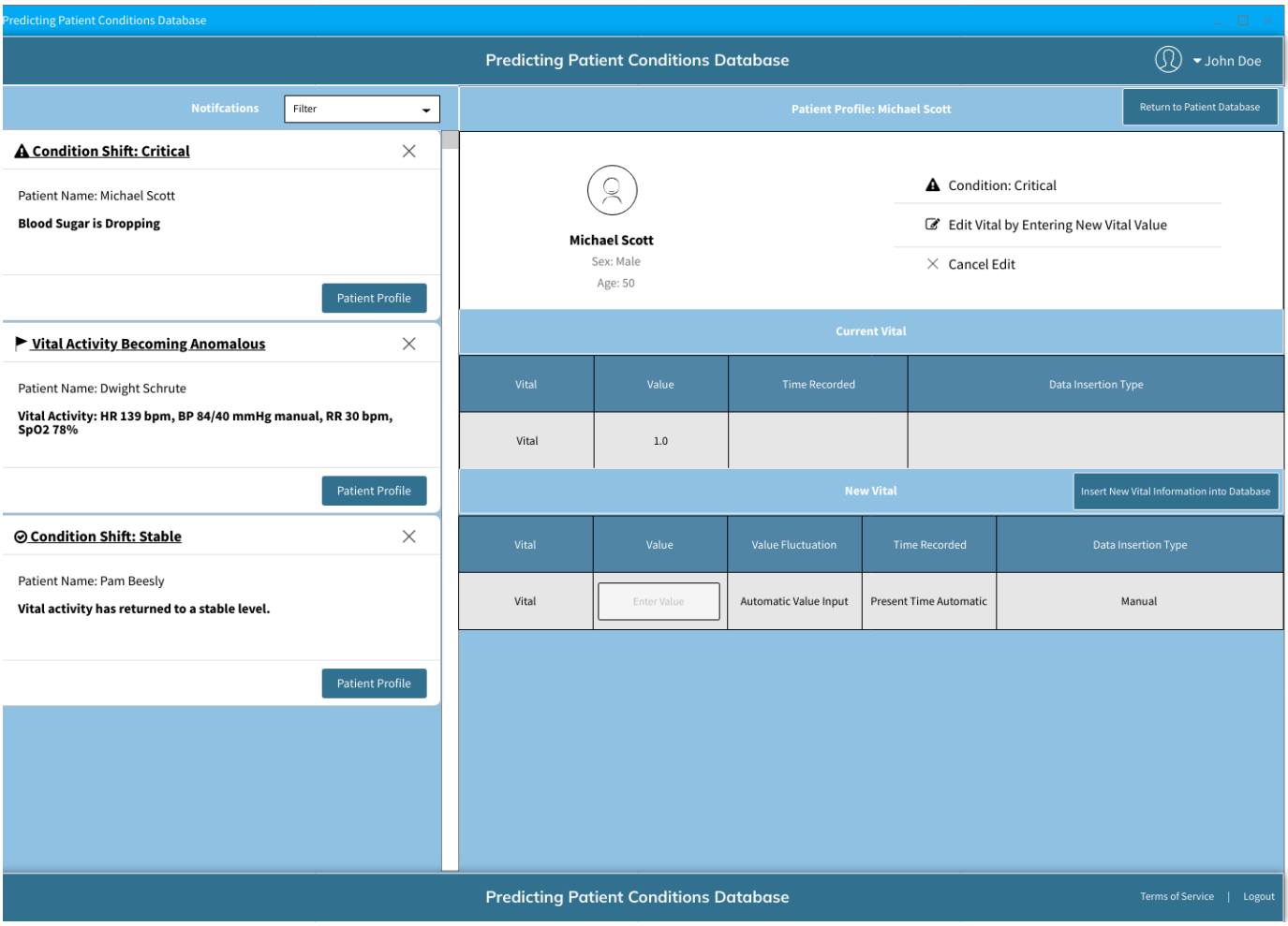
- HIPAA Compliance: As a developer, I want to learn more about HIPAA compliance, so the software stays HIPAA compliant.
    - Joseph Doonis, Jonas Fornehed, Jacob Hill, Timothy Kelley, Amanda McGuire, Robert McKay

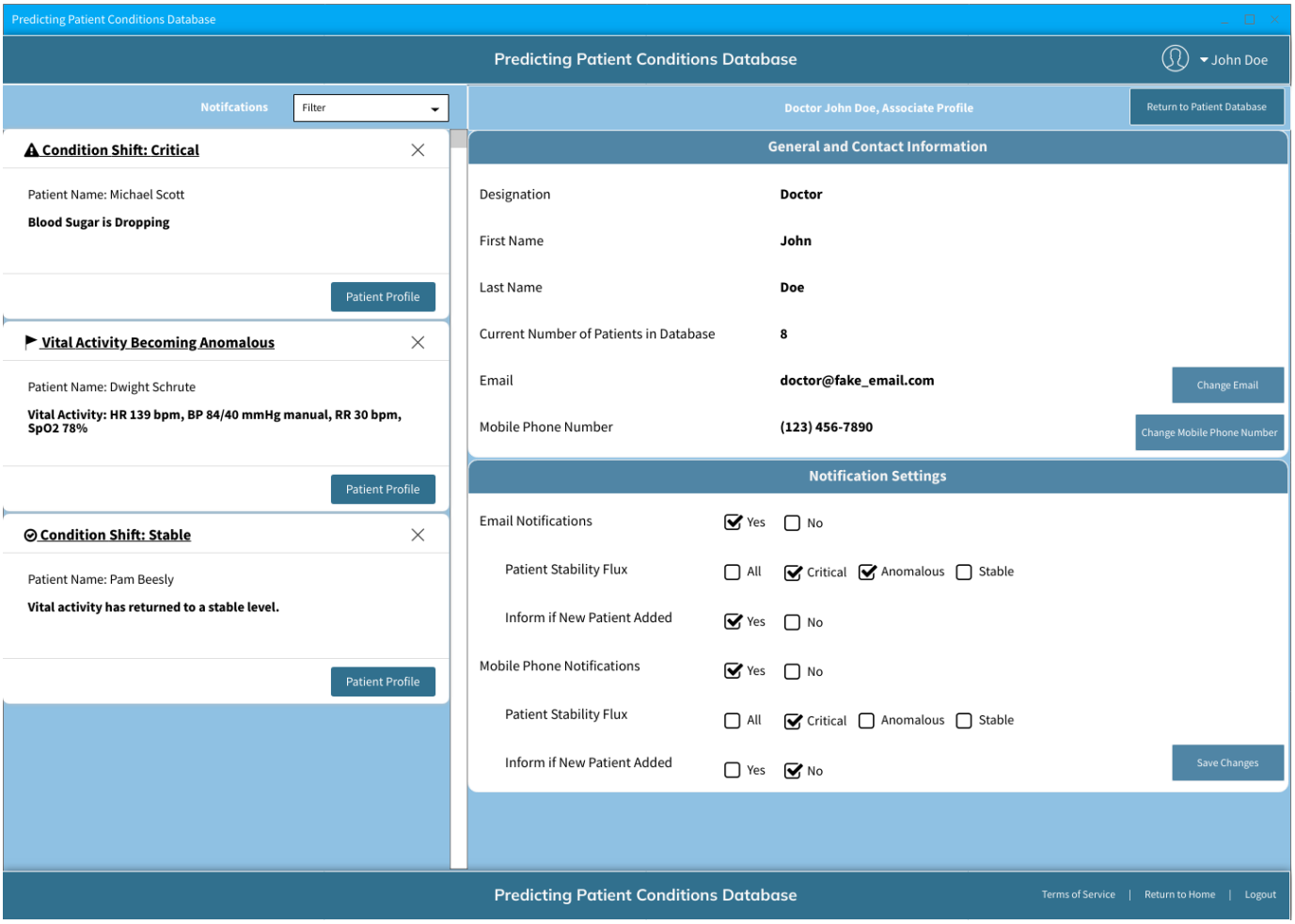
9. UX/UI Design


Predicting Patient Conditions Database
Predicting Patient Conditions Database
Associate Login
doctor@fake_email.com
Password
Login to account
Reset
Terms of Service | Login


Predicting Patient Conditions Database
Predicting Patient Conditions Database
John Doe
Notifcations
Filter
Condition Shift: Critical
Patient Name: Michael Scott
Blood Sugar is Dropping
Patient Profile
Vital Activity Becoming Anomalous
Patient Name: Dwight Schrute
Vital Activity: HR 139 bpm, BP 84/40 mmHg manual, RR 30 bpm, SpO2 78%
Patient Profile
Condition Shift: Stable
Patient Name: Pam Beesly
Vital activity has returned to a stable level.
Patient Profile
Patient Database
Filter
Name
Patient ID
Access Vitals History
Vitals Snapshot
Value Fluctuation
Condition
Michael Scott 001 DD/MM/YYYY Critical
Dwight Shrute 002 DD/MM/YYYY Anomalous Activity
Pam Beesly 003 DD/MM/YYYY Stable
Jim Halpert 004 DD/MM/YYYY Stable
Angela Martin 005 DD/MM/YYYY Stable
Kevin Malone 006 DD/MM/YYYY Stable
Toby Flenderson 007 DD/MM/YYYY Stable
Erin Hannon 008 DD/MM/YYYY Stable
Predicting Patient Conditions Database
Terms of Service | Logout


Predicting Patient Conditions Database
Predicting Patient Conditions Database
John Doe
Notifcations
Filter
Condition Shift: Critical
Patient Name: Michael Scott
Blood Sugar is Dropping
Patient Profile
Vital Activity Becoming Anomalous
Patient Name: Dwight Schrute
Vital Activity: HR 139 bpm, BP 84/40 mmHg manual, RR 30 bpm, SpO2 78%
Patient Profile
Condition Shift: Stable
Patient Name: Pam Beesly
Vital activity has returned to a stable level.
Patient Profile
Patient Profile: Michael Scott
Return to Patient Database
Michael Scott
Sex: Male
Age: 50
Condition: Critical
Access Medical Records
Past Vital History
Current Vitals
Edit
Vital
Value
Value Fluctuation
Time Recorded
Data Insertion Type
+.5
00:00AM DD/MM/YYYY
Automatic
-.5
00:00AM DD/MM/YYYY
Manual
Predicting Patient Conditions Database
Terms of Service
Logout


Predicting Patient Conditions Database
Predicting Patient Conditions Database
John Doe
Notifcations
Filter
Condition Shift: Critical
Patient Name: Michael Scott
Blood Sugar is Dropping
Patient Profile
Vital Activity Becoming Anomalous
Patient Name: Dwight Schrute
Vital Activity: HR 139 bpm, BP 84/40 mmHg manual, RR 30 bpm, SpO2 78%
Patient Profile
Condition Shift: Stable
Patient Name: Pam Beesly
Vital activity has returned to a stable level.
Patient Profile
Patient Profile: Michael Scott
Return to Patient Database
Michael Scott
Sex: Male
Age: 50
Condition: Critical
Edit Vital by Entering New Vital Value
Cancel Edit
Current Vital
Vital
Value
Time Recorded
Data Insertion Type
Vital
1.0
New Vital
Insert New Vital Information into Database
Vital
Value
Value Fluctuation
Time Recorded
Data Insertion Type
Vital
Enter Value
Automatic Value Input
Present Time Automatic
Manual
Predicting Patient Conditions Database
Terms of Service
Logout


Predicting Patient Conditions Database
Predicting Patient Conditions Database
John Doe
Notifcations
Filter
Condition Shift: Critical
Patient Name: Michael Scott
Blood Sugar is Dropping
Patient Profile
Vital Activity Becoming Anomalous
Patient Name: Dwight Schrute
Vital Activity: HR 139 bpm, BP 84/40 mmHg manual, RR 30 bpm, SpO2 78%
Patient Profile
Condition Shift: Stable
Patient Name: Pam Beesly
Vital activity has returned to a stable level.
Patient Profile
Doctor John Doe, Associate Profile
Return to Patient Database
General and Contact Information
Designation
Doctor
First Name
John
Last Name
Doe
Current Number of Patients in Database
8
Email
doctor@fake_email.com
Change Email
Mobile Phone Number
(123) 456-7890
Change Mobile Phone Number
Notification Settings
Email Notifications
Yes
No
Patient Stability Flux
All
Critical
Anomalous
Stable
Inform if New Patient Added
Yes
No
Mobile Phone Notifications
Yes
No
Patient Stability Flux
All
Critical
Anomalous
Stable
Inform if New Patient Added
Yes
No
Save Changes
Predicting Patient Conditions Database
Terms of Service
Return to Home
Logout

10. Release Plan

Milestones:

- Web app
- Machine learning
- Providing a way to accurately provide a prediction system

Iteration Plan:

Iteration 00:

- GitLab Configured
- Team Charter Completed in Microsoft Teams
- Resources Requested from Dr. Eberle
- Project Design and Concept (Languages, Platforms, etc.) Decided and Agreed Upon by all Team Members
- UI/UX Designed in Mockflow
- Initial User Stories Created
- User Personas created in Xtensio
- Retrospective
- Team Iteration Report
- Server Environment Setup

Iteration 01:

- Backlog grooming
- Identify MVP
- Research existing eICU machine learning models
- Refine data set.
- Create data flow chart.
- Finish Mockup UI/IX
- Implement backend API routes

Iteration 02:

- Configure a Dockerized development environment

- Configure server for deploying with docker
- Practice training LSTM model
- Continue to implement required backend API routes
- Begin to implement frontend features

Iteration 03:

- Continue to implement frontend features
- Implement any required backend API routes
- Train an LSTM model with subset of data
- Deploy a prototype to the server