Automated VTE Surveillance and Quality Assurance

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Mentors: Mr. Dean Kleissas (JHU APL NLP expert), Mr. Gorkem Sevinc (JHM TIC Manager), Dr. Paul Nagy (JHM TIC Director), Mr. Brandyn Lau (JHM VTE Expert), and Dr. Elliot Haut (JHU Surgeon & leading VTE researcher).

Background Information and Relevance:

Venous Thromboembolism (VTE) is a disease process that includes both Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE). DVT is caused by blood clots forming in the deep vein. The associated symptoms include pain, redness, and swelling in that region. ⅓ of the time, DVT may suddenly lead to PE which can be fatal. PE happens when the blood clot detaches from the deep vein and makes its way over to the pulmonary vein, obstructing the blood flow through the lungs. Symptoms include difficulty breathing, heart palpitations, and abnormally low blood pressure. ⅓ patients with DVT will get PE. This is a disease that is difficult to diagnose, with DVT having diffuse symptoms that gets significantly more serious once the disease evolves to PE. Diagnosis is mostly done through imaging modalities like ultrasound and CT. The general course of treatment involve anticoagulants and surgical intervention.

VTE has been a difficult problem for hospitals. In fact, research shows that ⅔ of VTE cases occur during hospitalization where patients are often limited in their mobility. In the United States, VTE is responsible for 100,000 deaths, where 25% die from pulmonary embolism before medical intervention can even occur. Exacerbating this issue, there is oftentimes a delay between when the radiographer diagnoses VTE from a patient scan and when the clinician gets access to the narrative and can begin treatment, making this problem a significant one for hospitals to tackle.

Currently, the JHU Applied Physics Laboratory has collaborated with the JHU Technology Innovation Center to develop an NLP tool that takes in radiography scans and parses out annotated data specific to VTE research.

Technical Summary Of Approach:

Our goal is to create a database to store the results from the NLP tool. The database would then be able to output a wide range of queries that the user would be interested in such that one can perform rich retrospective analysis to create useful trends and statistical models. Additionally, this database would have the added component of being able to automate the process of notifying the clinicians when a patient is diagnosed with VTE and providing them with sufficient patient information to aid in immediate treatment.

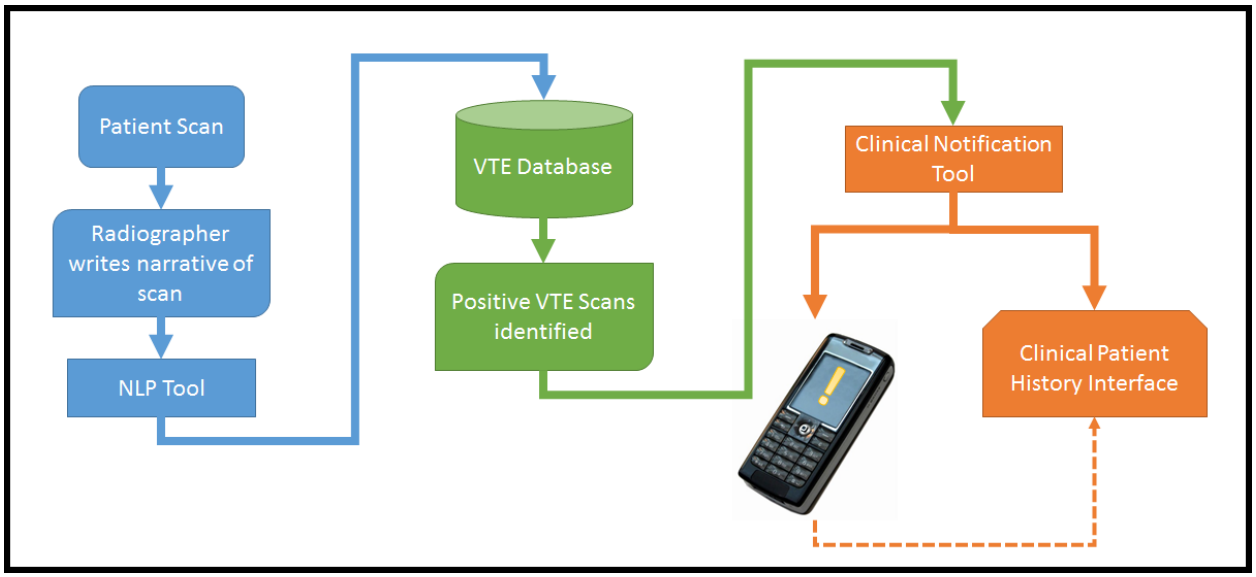
Research Implementation:

The research aspect of the project involves creating a database to organize patient scans based on the existence of clots. Through a front-end web tool, it will allow for isolation of important factors such as time of scan, location of clot, current symptoms, associated patient history, location of patient

during scan, and current treatment. This tool will be used for future research to identify trends and find correlation between factors during a patient's stay at the hospital and the manifestation of VTEs.

Clinical Implementation & Workflow:

The clinical aspect of the project involves using our database to provide a rapid notification tool so that on-call physicians can be notified when a patient develops VTE. The VTE Database filters through the submissions for scans positive for VTE and sends them to our Clinical Notification Tool. This tool will both send a ping to the appropriate clinician on-call, as well as siphon the patient-specific data from our database to a portal that can be viewed by the clinician. This is an important distinction from our database front-end to which the clinicians will not have access--the plan is to compartmentalize patient specific information versus demographic specific information. Once the clinician receives the ping, they can access the portal using their login credentials.



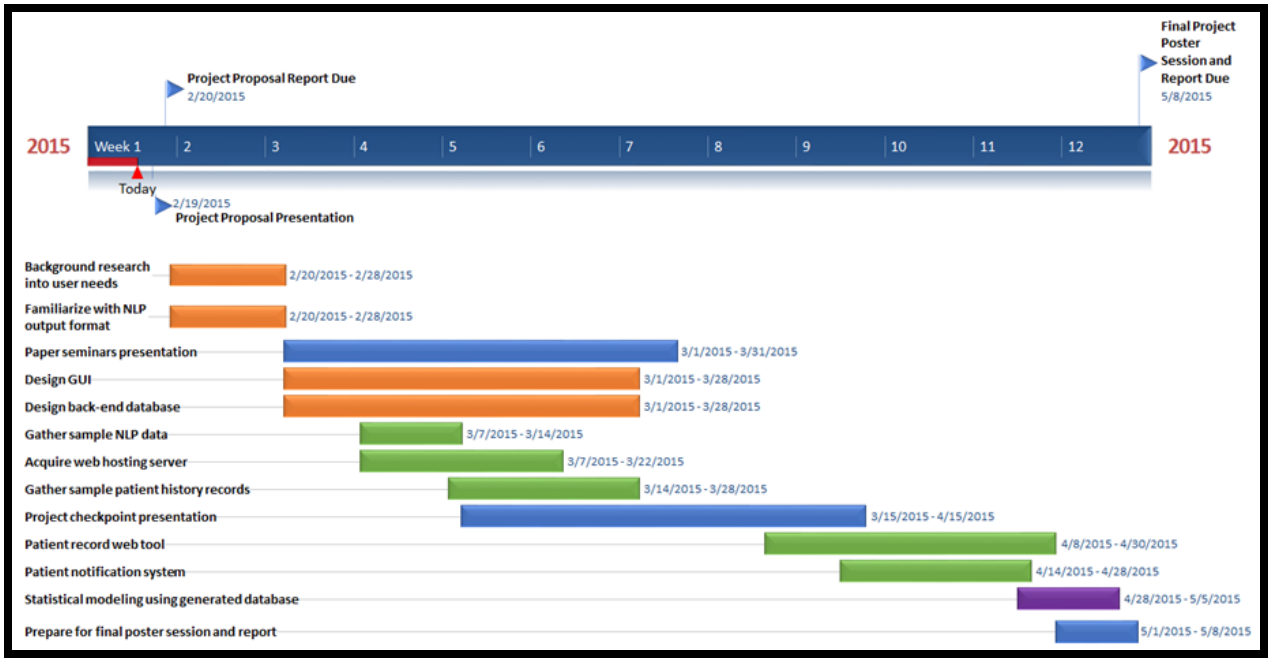
Deliverables:

Minimum: Create a database that provides results to basic queries based on patient scan annotations acquired from the NLP tool that has been developed by our mentors at APL.

Expected: Incorporate patient history and current treatment plan in patient record into database. Furthermore, integrate automation of clinical workflow in cases of VTE to provide immediate notification.

Maximum: Perform statistical modeling with the database to identify potential causal factors for VTEs and assess the efficacy of different treatment plans.

Project Timeline:



Assigned Responsibilities:

Both of us will be collaborating extensively throughout the project, and we plan on sharing all of the work load. That being said, we have assigned the tasks from the project timeline to each person for particular ownership:

Stephen:

- Background research
- Front-end Research GUI
- Familiarize with NLP format
- Gather NLP data
- Patient Record web tool

Vamsi:

- Background research
- Back-end database
- Gather patient history records
- Acquire web hosting service
- Clinical Notification system

Management Plan:

We have set forth a set of guidelines for managing our project efficiently:

- We will meet together at least twice a week for around two hours in the CS Undergraduate lab.
- We will be meeting with our mentors bi-weekly at JHMI on Wednesdays, from 2pm-3pm
- We will keep track of our tasks using Asana or some other equivalent management tool
- We will use GitHub for source version control, to keep our software up-to-date and synchronized between us.

Dependencies:

1. Annotated CT and Duplex Ultrasound Scans
    a. We've already discussed with Brandyn, our VTE expert, about acquiring these, and we will be coordinating with him to get them very soon.
2. Patient history records
    a. Emailed Brandyn today about this.
3. Before we acquire patient history, we need to get HIPAA training as well as potential IRB approval.
    a. Currently talking to Brandyn about how to approach this, will talk to Dr. Taylor as well if needed.
4. Pager or applicable notification tool
    a. This depends on us talking to our contacts at the hospital and finding out what medium they use to notify on-call residents--if it is a standard phone, then this is not a dependency
5. Web Hosting/Domain name
    a. We might need to come up with our own independent source, but chances are the hospital will provide us with an internal domain to host our database, so this should not cost any money. We will be talking to our mentors in the Technology Innovation Center at JHMI for this.

Reading List:

Lau BD, Haider AH, Streiff MB, et al. Eliminating Health Care Disparities With Mandatory Clinical Decision Support: The Venous Thromboembolism (VTE) Example. Med Care. 2015;53(1):18-24.

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