

Thesis Project Portfolio

**Computational Fluid Dynamic Analysis Of Pelvic And Abdominal Veins
Using Computed Tomography, Venography, And Duplex Ultrasound Imaging**
(Technical Report)

Health Concerns for People Who Depend on Food Assistance
(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

My technical work and my STS research are primarily connected through exploring the possibility of interventions that can be made to improve health outcomes. My technical project focuses on modeling iliac veins in the leg to predict whether a patient is at higher risk of forming another occlusion after stenting based on the parameters of maximum blood velocity, maximum pressure, and wall shear force. My STS research is focused on analyzing whether food assistance programs can contribute to a nutrient rich diet. While my technical project and STS research paper are focused on different pathways to potentially improve health outcomes, the theme of preventing probable downstream issues in healthcare is consistent across both projects.

My technical work involves a computational fluid dynamics analysis of pelvic and abdominal veins using computed tomography (CT), venography, and duplex ultrasound imaging. My groupmates and I began our modeling with raw CT data given to us by our advisors from their patients in the University of Virginia Health System. We then created a three-dimensional model of the stented vein in a software called 3D Slicer using the segmentation and concatenation features. Then, the model was manipulated in Autodesk Maya to create a flat surface on either end of the vein to be able to then define the inlet, outlet, and wall surfaces in ICEM CFD. Once the bounds were specified, the model was prepared for the flow dynamics simulation using ANSYS Fluent where constant values for blood viscosity and density were defined as based on literature. The inlet velocity was defined as a constant value which was unique to each patient's intravascular duplex ultrasound measurements taken at the time of the stenting procedure. The flow dynamics simulations were run for each model and defined to attenuate once the residuals reached a certain threshold. Using these results, the data was imported into TecPlot 360° to visualize the contour plots and for analysis. Statistical analysis

was performed to determine the pressure and velocity data to be statistically significant between patients who would develop stent re-thrombosis and those who would not at a follow-up CT scan. The regions of greatest curvature were identified in the iliac veins and found significant differences between the interior and exterior of the vein for the blood flow. Our project believes this method can be applied to a larger number of patients to provide insight on stenting procedures to reduce risk of stenosis in the iliac veins and other areas in the body where thrombus formation is common.

My STS research explores whether food assistance programs contribute to a nutrient-rich diet for those who qualify. I used the framework of technological momentum by Thomas Hughes with the main components I looked at as being system builders and reverse salient technology. My claim is that those receiving food assistance through the SNAP can have nutrient-rich diets due to the system builders and lack of reverse salient technology that food assistance programs have built into their technological system. My paper researched policies surrounding food stamp programs and the Supplemental Nutrition Assistance Program. I found that individuals who are receiving food assistance through the SNAP are much better off because of the reduced chronic health conditions and poverty. The lack of a reverse salient of technological momentum in the system of food assistance programs showed that there are many ways in which the program reinforces the good it does, so it does not impede itself. Finally, the creators of food stamp programs as system builders, such as the way that it began to benefit farmers with surplus food and those who could not afford food, show how the system has built upon itself to expand into something larger. The goal of my research was to demonstrate that the United States as a whole, along with individual state governments, should continue to invest in food assistance entitlement programs because it allows for low-income individuals and families to access more nutritious

food and decreases the prevalence of other chronic conditions that can arise when people do not have a nutrient-rich diet.