Thesis Portfolio

Development of a Continuous Sampling System for *In Situ* Monitoring of Anaerobic Coculture

(Technical Paper)

Assessing the United States' Healthcare System through an Actor Network Theory Framework

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

The thesis and the technical report are related in that they are geared towards improving healthcare in the U.S.. The technical report is focused at a more specific scale, designing a technology that aims to reduce hospital-borne infections through early diagnosis. The thesis approaches healthcare improvement at a much broader perspective, providing suggestions on how the macroscale healthcare system could change to benefit most everyone in the U.S., lowering overall healthcare expenditures along with improving upon healthcare metrics at the same time.

The technical report was based on the work from my capstone project. The goal of this project was to develop a continuous sampling system for in situ monitoring of anaerobic coculture using *Clostridiodes difficile (C. difficile)* growth kinetics and germination as a model. The Swami laboratory plans to incorporate this coculture system with impedance cytometry, which is a research method to assess the electrical properties of a population of cells in a fast, label-free manner. Upon successful completion of the capstone project and further design validations, the anaerobic coculture system will be able to rapidly assess patient susceptibility to *C. difficile* infection in the clinic, reducing the amount of nosocomial *C. difficile* infections since proper sanitation procedures can be utilized with susceptible patients. This will save both the hospital and patients money and time and improve healthcare outcomes overall.

The thesis was focused on the United States (U.S) healthcare system from a broader perspective. Specifically, key actors of the U.S. healthcare system were identified in order to most properly depict the system and identify reasons why the U.S. spends the most on healthcare out of any country, yet ranks relatively low in healthcare metrics such as mean life expectancy. Case studies were then performed on the Canadian healthcare system and the Swedish healthcare

system. The healthcare system networks were first described, and then unique aspects contributing to the successes of their respective healthcare systems were identified. Some of these ideas include a small, universal healthcare plan, increasing the government's role in healthcare, and creating more emphasis on preventative healthcare in various aspects of society. These ideas would shift the current healthcare network, but not so significantly that the solutions should be deemed unrealistic, as detailed in the thesis.

Overall, by completing the technical paper, I learned how to utilize the engineering design process from start to finish. I have learned how to build a device from scratch, keeping the long-term clinical application in mind while accomplishing short-term experiments and deliverables. Additionally, I have learned how to combine various technologies into one integrated product that has potential for even further scientific discoveries. With the STS thesis, I have learned how to utilize various social theories and methodologies to identify problems within the macroscale healthcare system. More importantly, I have learned how to apply these frameworks and analytical methods to be able to provide realistic suggestions for healthcare improvement.