Thesis Portfolio

Computational Modeling of Esophageal Stricture

(Technical Report)

Biased Data in Academia: A Virtue Ethics Analysis of Medical Physiology Literature

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis: Computational Modeling and Gender Bias in Health Data

My technical report and STS research paper focus on the use of medical data as an educational tool. Patient data and physiological parameters provide vital information to medical professionals and biomedical engineers alike, and allow for the advancement of patient care. Yet while referencing similar core components, my technical report focuses on the use of patient data to create anatomical models, while my STS paper uses patient data to explain the implications of gender bias in medical education. Both papers consider the importance of patient data in the predictive modeling process, and how medical information is used as a reference for both biomedical engineers and medical professionals.

My capstone project focused on optimizing temporary therapies to relieve esophageal stricture. My team focused on first understanding the precursor to this medical implication, which involves the reconfiguration of patient's esophagi who are born with esophageal atresia. Our main focus of research was in understanding the forces present in the esophagus when undergoing a stricture, and what implications the stricture has on the patient's ability to eat. We obtained IRB approval to use patient data from the UVA Health System to access diagnostic x-rays of patients with esophageal stricture, then used images to create 3D models of the esophagus in AutoDesk Fusion. These models were then subjected to computational flow dynamic modeling in the software ANSYS Fluent. This provided us with values for static and dynamic pressure, wall stress, and the coefficient of skin friction while fluid is passing through a strictured esophagi. Through this project, we sought to understand the reasons why current interventions, such as stent placement, do not permanently mitigate the formation of esophageal strictures in patients born with esophageal atresia.

My STS paper also uses patient data, but to consider its shortcomings as opposed to its modeling capabilities. My research explores the importance of ethics in medical education. In my paper, I determine whether a physiology textbook used by UVa professors is fundamentally rooted in gender-biased health data. I use the lens of virtue ethics to provide examples in which the author's implicit biases diminish the learning objectives of medical education textbooks. I explain that while the textbook is able to provide students with basic anatomical and physiological information, it is unable to do so without the use of gender-biased data. My paper intends to perpetuate and enhance current conversations on gender equality in the medical field as well as biomedical engineering.

It was extremely insightful to collect patient data while exploring the information and language in the physiology textbook. My STS research helped me to comprehensively evaluate patient information, and made me more aware of the implicit biases present in the health system. Before this, I was not exposed to this mindset, as it is not a viewpoint that is explored in the engineering school curriculum. In conjunction, my technical work helped me to better understand the anatomical and physiological information that I had so often studied in my biomedical engineering courses. To conclude, working on my technical report and STS research paper simultaneously has helped me to take a multifaceted approach to both projects to understand both quantitative data as well its long-term, societal impacts.