

Thesis Project Portfolio

Finite Element Analysis of a Female Pelvis to Model Pelvic Organ Prolapse
(Technical Report)

Disparities in Oncology Clinical Trial Enrollment
(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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Spring, 2025

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Sociotechnical Synthesis

For my last year, I found myself diving head-first into the realm of women's healthcare and found a multitude of issues that surround current research and treatments. In my technical project, I constructed a 3D model of a female pelvis to look at the muscle properties of pelvic organ prolapse (POP), so that hopefully, new treatments for POP can be created to replace the current options. To analyze the impact of healthcare on women's health, for my STS project, I researched how a gender bias in healthcare has impacted the enrollment numbers in oncology clinical trials, as many of these trials have a higher percentage of male enrollees despite a higher burden of disease for women.

For my capstone project, I have been working on creating a 3D model of a female pelvis to simulate pelvic organ prolapse muscle conditions. Pelvic organ prolapse occurs when one or more of the pelvic organs drop from their original placement. I first got images taken from an MRI and used these to create segmentations of each necessary piece in 3d Slicer. These parts were: vagina, uterus, rectum, urinary bladder, levator ani, anal sphincter, rectus abdominis, psoas major, anal canal, and coccygeus. Then these individual parts were smoothed, refined, remeshed, and the facets were automatically fixed to help with meshing errors. Unfortunately, I spent the majority of my second semester trying to get the meshing errors to go away in order to run Ogden material property simulations while the model was in the Valsalva maneuver placements, but I couldn't get the model to work.

For my STS paper, I analyzed clinical trial enrollment disparities between genders. To look at this more closely, I focused on clinical trials in the field of oncology. I used the social construction of technology to analyze how the field of clinical trials has been disproportional towards women since the 1900s. I found three common issues. One, it wasn't until the 1980s that women were allowed to join clinical trials, since they had "child-bearing capabilities" that needed to be protected. Two, all of the base knowledge that researchers and physicians use as their knowledge to diagnose and treat patients or create a new drug is based on cis-white men, which causes setbacks in women getting diagnosed or treated. This also goes along with the fact that women have different biological systems from men, yet are treated the same. Three, there are no set initiatives to force researchers to include a minimum amount of one population group in their surveys in order to qualify for FDA approval.

I believe that working on these projects simultaneously brought great value to the research that I was conducting. None of my projects (capstone, prospectus, or thesis) were on the same topic, but instead the same theme, so it was interesting to think about how each of the different and also overlapping themes, reasons, and ideas all worked together or against each other. My technical project gave me insight into how bad medical procedure complication rates still are, especially in women-only procedures. This led me to start researching the entirety of the medical field as a whole and how females are at a disadvantage. The ideas and data that I learned from this research led to my prospectus and thesis topics, which looked at how research practices and funding affect women every time they go to a hospital or receive a treatment. In summary,

working on both during both semesters really allowed me to look outside of one scope and research the broader impacts within the issue of healthcare.