Thesis Project Portfolio

Designing an Affordable Distal Radius Fracture Reduction Simulator for Medical Training

(Technical Report)

Telehealth and Its Effect On Access to Healthcare in Urban and Rural Communities

(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Executive Summary

The technical report and STS paper in this portfolio represent the culmination of my four years at the University of Virginia and were completed during my final year. Both papers are centered around topics related to medicine and patient care. My technical project was completed with a group of eight students, including myself, over the course of two semesters. It was focused on creating an affordable, easily replicated device to help physicians practice fixing a type of common wrist fracture. My STS paper was written based on a research question that I was already interested in due to my experiences during the Covid pandemic, which had to do with the increasing popularity of telehealth. My dad, an orthopaedic surgeon, had to do much of his work remotely during the worst periods of Covid, and this made me curious how telehealth had and would continue to affect access to healthcare in various communities. Each of these projects challenged me in a variety of ways and forced me to draw on what I had learned during my time at UVA.

As mentioned above, my technical project was the result of two semesters of work alongside my teammates, and the assistance of our two faculty advisors, Dr. Aaron Freilich and Dr. Jason Forman. Our advisors had previously worked to create a prototype for a medical simulation device that simulated performing a closed reduction of a distal radius wrist fracture. This type of wrist fracture is extremely common across all demographics, and occurs at the end of the radius, one of two bones in the forearm, furthest from the body. When this occurs, naturally occurring tension in the forearm from ligaments and tendons pulls this bone fragment, and thus the patient's hand, towards the elbow, creating a displacement. Doctors deal with this by anchoring the patient's arms and pulling the hand back into place, known as a closed reduction. Currently, physicians and medical students are primarily taught on live patients, which carries

inherent risk. We were tasked with designing an affordable, easily replicated device that mirrored this technique, allowing doctors to practice this procedure in a low-risk environment.

My STS paper was also focused on a healthcare issue: telehealth. The goal of this paper was to analyze, via the Social Construction of Technology framework, to what extent the recent advent of telehealth during the Covid pandemic has affected access to health care in both urban and rural areas. I used this framework to look at how the development of telehealth has been driven by various social groups. This paper was written knowing that there has long since existed a disparity between urban and rural communities with regard to healthcare. Rural residents typically have to travel farther to reach hospitals, which are often struggling financially and offer less specialized care than their urban counterparts. Utilizing scholarly articles, interviews, and new reports, this paper explored how telehealth has evolved in recent times. This paper found that telehealth has certainly aided rural communities in some instances, allowing for healthcare to be more accessible. However, it also created more work for some doctors, and in rural regions where internet is still unavailable, did very little to improve health care for these residents.

As a whole, both of these projects were successful. On the technical side, my group and I delivered a design that accomplished the vast majority of our original objectives and was approved by both of our advisors. We published our design and instructions to multiple online forums in the hope that medical professionals can begin using our design to improve patient care. My STS paper presented a difficult research challenge. However, I was able to overcome this challenge and deliver a paper that comprehensively answered my proposed research question utilizing the Social Construction of Technology framework. I learned a lot from writing this paper, and am very intrigued to see how telehealth continues to evolve in the future. Working on these projects simultaneously was beneficial because it forced me to use both a technical and

STS lens while working. Had I not been writing my STS paper while working on our technical project, I believe that I would've been less concerned with how our design will affect users in the future, and only focused on the technical aspects. Overall, both of these projects proved to be challenging, forcing me to apply many of the skills and techniques I've learned during my time here at UVA. I'm curious to see how future students continue to improve upon our work going forward.