

Force Sensing Interventional Radiology Device
(Technical Report)

**Actor-Network Theory Analysis of Personal Protective Equipment in the UK and Its
Relationship to Discrimination Within the National Health Service System on the Basis of
Sex**
(STS Research Paper)

An Undergraduate Thesis Portfolio

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Bachelor of Science in Biomedical Engineering

By

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Socio-technical Synthesis: Healthcare Technology and Technological Bias

My technical work and STS research are connected through the concept of developing medical technologies and the importance of addressing technological bias when creating them. My technical work focuses on providing a new technology in the minimally invasive (MI) sector of healthcare that functions independently of the device operator's anthropometrics, in order to avoid technological bias. Coincidentally, my STS research focuses on the implication of a failure to address technological bias in personal protective equipment (PPE) and the downstream marginalization of women in the UK healthcare sector as a result of its design. Together, my technical work and STS research address the issue of gender-based technological bias through attempting to create a technology that avoids bias by functioning independently of user anatomy and a discussion of the impact of healthcare technological bias in society.

My technical work is focused on developing a device solution to the issue of operator-induced patient injury during MI procedures. My capstone team developed an early-stage prototype of a force-sensing interventional radiology (IR) device. To create this device, a force sensor was designed by our team and built around a commercial IR device already used in some MI procedures. The sensor on the device provides feedback to IR surgeons on the level of force being applied by the device on blood vessel walls. Our solution was designed with the intent of providing a numerical force measurement feedback device to operators to inform them of their force application on patients during procedures, in order to avoid patient injury. By building our sensor around a pre-existing medical device rather than an operator's anatomy — as done in previous technology like force-sensing gloves which are dependent on operator hand size — we were able to address to concern of creating technological bias on the basis of sex in our solution.

My STS research paper aims to address the concern of technological bias on the basis of sex in a different way. My research looks at a socio-technical case study where the failure to address the technological bias of PPE perpetuated the marginalization of female healthcare workers. Using actor-network theory and Callon's theory of network formation, known as translation, I identify what actors failed in network formation and how that led to the technological bias of PPE design towards female healthcare workers (HCWs) in the UK's National Health Service (NHS) system. I argue that Public Health England (PHE), a UK executive agency, is the key actor responsible for this network failure. The goal of my research is to bring awareness to and increase discussion around the topic of technological bias in healthcare design and the importance of addressing these issues in order to create a more equitable society using engineering.

Working on these two projects helped develop my understanding of discriminatory issues in biomedical engineering while also giving me the opportunity to address these issues in my own engineering solutions. My technical work gave me a better understanding of how to design medical devices while also providing me the opportunity to actively prevent technological bias in a healthcare innovation. This experience allowed me to understand the process and actions needed in order to design for *all* users. My STS research provided me insight into what happens when actors fail to account for technological biases in healthcare design which has taught me how to counteract these types of issues in my own engineering practice. In conclusion, working on my STS research paper and technical project has given me a wholistic understanding of how technological bias occurs as well as information and experience on how to prevent it.

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