Thesis Portfolio

The Development of a Pediatric Interventional Cardiology Arm Positioning Device
(Technical Report)

Imaging the Future: Ethical Challenges of AI in Diagnostic Radiology
(STS Research Paper)

An Undergraduate Thesis
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As research continues to shape technological advancement in healthcare, it is important to consider what is prioritized and what considerations are overlooked when defining success. My STS research and technical project work examine how a narrow focus on the majority of outcomes in medical innovation, while only causing negative outcomes for a minority of stakeholders, carries serious ethical implications leading to a decrease in the quality of the healthcare system. My technical project highlights how pediatric care and innovation is affected by this narrow focus described, as McGough et al. (2024) note that only 9 percent of health care spending is allocated to pediatrics in the United States, despite this minority group making up about a quarter share of the population. In contrast, my STS research addresses the ethical evaluation of Artificial Intelligence (AI) implementation in diagnostic radiology, and whether the focus on only accuracy and efficiency is disproportionate to other important factors such as patient-physician relationships and data privacy.

In my technical project, I worked with a team to address a current disparity in the development of medical devices in pediatric care, which accounts for a large minority of patient care yet receives disproportionately less research and funding. Working with the UVA hospital, our project involves the design and build of a device for use in pediatric catheterization procedures. In a catheterization procedure, the patient's arms must be positioned overhead to allow lateral X-rays to continuously image the abdomen, providing visibility as doctors navigate the catheter through intricate cardio vasculature. Devices that hold this position in place exist for adults, but no device that exists is adaptable for children. This causes a lack of standardization in preparation for pediatric patients and leaves them at risk for brachial plexus injuries due to improper positioning while under anesthesia. Through research and understanding of the procedure, we outlined our main design specifications: adjustability for ages 0 to 19, ability to

maintain position throughout the procedure, and ability to withstand the weight of the patient's forearms.

My STS research addresses the lack of clarity and risk evaluation in the development and implementation of AI in diagnostic radiology, a field undergoing the rapid adoption of this technology with inconsistent regulation. Utilizing both utilitarianism and ethics of care frameworks, I highlight case studies that compare the potential advantages and disadvantages to both diagnostic quality and physician-patient relationships. Through a thorough analysis of benefits and risks, I identify the effects that AI could have on all stakeholders, rather than highlighting only outcomes affecting the majority. Finally, I identify legislation that could help to prevent minority stakeholders from being overlooked as the technology continues to develop within our healthcare spaces.

In both my STS research and technical work, I emphasize the consequence of an approach to medical innovation that does not consider the experience of all stakeholders in healthcare. My technical project successfully combats this through the development of a pediatric arm positioning device for catheterization procedures, in which we designed and 3D printed a model that meets the specifications set out initially in the design process. With the timeline and scope of the project, we recognize our device would require further iteration to be approved for mass production and use in hospitals, such as improvements to the ergonomics of the design. Additionally, my STS research identifies potential legislation to combat the narrow focus that is used to evaluate AI implementation. However, further ethical analysis of the advancement of AI must be tailored to each field of healthcare, adapting to the technology as it grows to replace core aspects of care.

I would like to thank my technical project capstone group members, Keelin Reilly and Anastasia Nicholson, for working with me to design, iterate, and build a meaningful contribution to pediatric cardiology. Additionally, I would like to thank Dr. Michael Shorofsky from the UVA hospital for identifying this disparity in his specialized field of medicine and mentoring us throughout this project. Finally, I would like to thank Professor Caitlin Wylie and Professor Josua Earle for their guidance throughout my work on my STS research.