

Thesis Project Portfolio

The Development of a Pediatric Interventional Cardiology Arm Positioning Device

(Technical Report)

Children Are Not Small Adults: Prioritization of Pediatrics in Medical Device Innovation

(STS Research Paper)

An Undergraduate Thesis

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Keelin Reilly

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Department of Biomedical Engineering

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Sociotechnical Synthesis

My biomedical engineering technical capstone project and my STS research relate through their shared intention of improving pediatric healthcare. In both projects, I focus on the case of the overhead arm positioning device used to stabilize patients during catheterization procedures for visualization of lateral X-ray imaging. In my technical project, my team designed an adjustable pediatric version of the current commercially available adult device. In my STS research, I studied the need to prioritize pediatric patients in medical device innovation for this case study and beyond. In both projects, I focused on the key stakeholders of the arm positioning device, especially pediatric patients who deserve an improved standard of care.

In my technical project, I worked with my team to create a device that offers a secure platform for pediatric patients to rest their arms overhead during catheterization. During our initial research, we observed our advisor, Dr. Michael Shorofsky, perform a catheterization procedure on an 8-month-old patient. He and the nurses had to use various readily available materials, including rolled-up towels and foam blocks, to position the patient's arms out of the way of the lateral X-ray. They had to readjust this makeshift solution multiple times throughout the procedure. Our goal was to design a device tailored to the needs of pediatric patients and their physicians. While determining the design specifications, it was crucial to consider the various forearm lengths, upper arm lengths, shoulder widths, and arm weights of children ages zero to twenty-one. We prototyped using computer-aided design and 3D printed each iteration, working to build a functioning pediatric overhead arm positioning device.

In my STS research, I use the overhead arm positioning device case study to explore the general lack of prioritization for pediatrics in medical device innovation. I investigate the network of relevant stakeholders using the Actor-Network Theory (ANT) framework, with this device as the center artifact of my network, arguing that pediatric patients are not sufficiently prioritized and

investigating where we can improve the system. The shortage of approved pediatric devices negatively impacts medical device users. Healthcare professionals are inconvenienced and challenged, pediatric patients are at risk of injury, and their parents/guardians may lose trust in the healthcare system or face difficulties when treating their child at home. Medical device providers lack incentives and motivation to prioritize pediatrics because of how the system is structured. Engineers face technical challenges, investors see lower returns on investment, and regulatory agencies have insufficient resources to conduct extensive reviews of each device application. However, communication and collaboration between the user and provider groups could lead to significant advancements in the pediatric device system.

Working on both projects simultaneously has highlighted the importance of improving pediatric care and imagining how we can consciously design with vulnerable populations in mind. My technical design challenge, prompted by Dr. Shorofsky's clinical experiences, inspired my STS research by shedding light on a challenge and case study that I may not have identified otherwise. This process emphasizes the influence healthcare professionals can have on medical innovation and the importance of advocating for change rather than remaining complacent with existing systems. These projects together address the need for standardized care in pediatric medicine. After graduating college with my biomedical engineering degree, I hope to continue my passion for advocating and designing for pediatric patients.