

**Thesis Project Portfolio**

**Life Cycle Assessment of Stainless Steel Surgical Tools (Reusable vs. Single-use) in the  
UVA Hospital**

(Technical Report)

**An Analysis of the C-QUR Surgical Mesh Using Virtue Ethics**

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

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Bachelor of Science, School of Engineering

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## **Sociotechnical Synthesis**

Within the healthcare industry, there are a number of technological and moral considerations in the design and implementation of novel innovations. This idea is especially apparent in the case of medical devices, which are at the center of both the technical capstone project and STS research paper. These projects examine the effect of medical devices on society and the world, albeit focusing on different devices and research scopes. The technical project serves as an analysis of medical device waste, specifically surgical instruments, in the UVA Hospital System, while the STS research paper focuses on surgical mesh for hernia repair and the moral shortcomings of scientists and executives that led to patient harm. Despite the two projects analyzing different medical devices, they both aim to draw conclusions that can inform future decisions in healthcare to improve sustainability and patient safety.

The primary goal of the technical capstone project is to analyze operating room waste of surgical instruments in the UVA Hospital System to propose solutions for increased sustainability. In order to do so, the project has two main components: a cradle-to-grave analysis of surgical instruments in the UVA Hospital and a life-cycle assessment (LCA) of disposable and reusable stainless steel surgical instruments. The hospital waste analysis documents current procedures and sources of operating room surgical tool waste and allows for future recommendations to reduce the environmental impact of the hospital. Using these results, the LCA will expand upon the waste analysis by analyzing disposable and reusable surgical instruments in the UVA hospital based on several categories, including cost, global warming potential, energy usage, water usage, and landfill output. By comparing the two types of surgical instruments, the LCA gives insights into how the UVA Hospital system can increase

sustainability by promoting the use of reusable tools over their single-use counterparts, therefore reducing the hospital's waste output and environmental impact.

The STS research paper explores a different type of medical device: surgical hernia mesh. Specifically, it focuses on the failure of Atrium Medical Corporation's C-QUR surgical mesh, which was found to cause complications in patients that required further procedures to correct. This triggered the FDA to issue a recall on the mesh, citing patient injury and manufacturing violations. In order to analyze the actions of Atrium engineers and executives, the virtue ethics framework is utilized with an emphasis on Pritchard's virtues for morally responsible engineers. This framework highlights several key characteristics that govern the morality of actions, and thus by lacking those virtues Atrium is demonstrated to be morally deficit in several major situations throughout the lifespan of the C-QUR mesh's development and production.

Completing both the STS research paper and the capstone project simultaneously allowed for insights gained from an ethical standpoint to be implemented into the technical project. By examining the virtues for morally responsible engineers, as well as their application for medical devices, the research paper influenced decisions based on how aspects of the project would affect society. When looking at increasing sustainability in the UVA Hospital, it is important to keep the safety of the patients above any other factors. Therefore, when designing changes to the surgical instrument sourcing and life cycle, it must not compromise the duty of engineers to their users. Completing the STS research paper alongside the capstone project ensures that ethical and moral considerations are used as the primary determining factors in technical decisions.