

**Thesis Portfolio**

**Design Optimization of an Ergonomic Lead Garment**

(Technical Report)

**The Actor Network that Contributed to the Rise of the Opioid Epidemic**

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science  
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree  
Bachelor of Science, School of Engineering

Briana Fuller  
Spring, 2020

Department of Biomedical Engineering

## **Table of Contents**

Sociotechnical Synthesis

Design Optimization of an Ergonomic Lead Garment

The Actor Network that Contributed to the Rise of the Opioid Epidemic

Thesis Prospectus

## **Sociotechnical Synthesis**

My technical work to create an ergonomic lead garment sparked interest in the opioid epidemic as an STS research topic. The purpose of the technical work was to decrease orthopedic pain caused by lead garments in health professionals. While looking at the increased orthopedic pain caused by lead garments, I questioned how these health professionals may be treated to reduce the pain. At the beginning of the century, opioids may have been readily prescribed to people who experience orthopedic pain. Therefore, it struck interest in how the structural factors surrounding the opioids contributed to the widespread epidemic.

### *Design Optimization of the Ergonomic Lead Garment*

A lead garment is protective clothing used by radiographers, surgeons, and medical teams to protect against the side effects of radiation. As surgery is moving towards more minimally invasive procedures the use of x-rays and need for protective clothing has increased. The lead garment usually consists of one or two pieces which can weigh up to a total of 20 pounds leading to a significant amount of orthopedic stress on health professionals. Health professionals wear these garments from anywhere from four to ten hours a day while performing operations. Health professionals experience more low back pain than other occupations (Karahan, Kav, Abbasoglu & Dogan, 2009) and a significant amount miss work because of this pain (Pelz, 2000). This device causes a significant amount of stress on their shoulders and lower back leading to persistent pain as they progress through their careers. Therefore, the primary goal of this project is to design and test a modified lead garment support to reduce orthopedic stress on medical teams. In order to reduce stress on the shoulders a lead garment support is developed that is worn over the scrubs and under the lead garment. The lead garment support consists of two hooks that hover over the shoulders and connect to the user with a belt like feature. The support reduces the

pressure on the shoulders and transfers the weight to the hips. With this improvement surgeons are able to perform operations more effectively as a significant stress factor is reduced. It allows increased mobility and functionality as the technical capability in clinical practice will increase significantly. Thus, this project serves as an important resource in the surgery field especially the emerging minimally invasive surgery field. As the patient demand for these surgeries is increasing the research conducted will significantly impact that field. This project leads to an improved quality of health and medical outcomes, as well as improved performance and reduced health care costs.

### *The Actor Network that Contributed to the Rise of the Opioid Epidemic*

The opioid epidemic is one of the most widespread public health crises in the United States, causing 28,000 deaths per year and affecting nearly every race and socioeconomic group (Conrad, 2017). The opioid epidemic was largely affected by multiple stakeholders, such as pharmaceutical companies, physicians, pharmacists, nurses, and individuals who misuse opioids. The research question at hand is: How did the surrounding actor-network contribute to the rise of the opioid epidemic in the United States? Actor-network theory is applied to reframe the issue by focusing on the structural factors that contributed to the opioid epidemic rather than blaming individuals who misuse opioids. A network analysis of relevant stakeholders is conducted to develop an understanding of the relationships, organizational structures, and hierarchies between each stakeholder. A policy analysis is used to question the formation and implementation of multi-level pharmaceutical and healthcare policies that drove the rise of the opioid epidemic. In addition, a historical case study of West Virginia is conducted to understand the socioeconomic dynamics of the state that made it a susceptible area for widespread effect of the opioid epidemic. This research aims to define the relationships that connect the different sectors of the

medical field that contributed to the opioid epidemic. This research is conducted to dive deep into a public health crisis that was largely caused by the medical industry.

### *Conclusion*

Simultaneously working on both projects together helped give me different perspectives when researching about both the opioid epidemic and improvements to the lead garment. This research allowed for more creative ideas for my technical work with different viewpoints in mind. Working with many different professionals in the medical field allowed me to have a firsthand experience of the power structure in hospitals between doctors, technicians, and nurses that can be seen in the opioid epidemic. Through my technical and STS research I learned that engineering can help improve problems in the medical field for both patients and healthcare professionals.