

**Thesis Portfolio**

**Identifying Nuclear Membrane Proteins that Facilitate Chromosomal  
Mechanotransduction**

(Technical Report)

**The Technological Momentum of Cosmetic Procedures**

(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

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Spring, 2020

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## **Sociotechnical Synthesis**

Only a few centuries ago, heroin was prescribed for asthma, morphine was used to quiet crying babies, and bloodletting was a common procedure for a variety of illnesses and injuries (Greenstone, 2010; Walsh, 1923). Today, these ‘treatments’ are perceived as both outdated and taboo due to increased understanding both within the medical profession and among the general public. This increased knowledge along with the rise in medical technology has led to treatments, procedures, and diagnostics that have changed how society views health and medicine. Both the proposed technical and sociotechnical topics utilize and investigate the rise of such technologies for medical practices.

The technical project is focused on Idiopathic Pulmonary Fibrosis (IPF), an end-stage lung disease that is mediated by force interactions within the lung epithelium. The current standard of care aims to reduce the symptoms of the disease through non-curative drug treatments or by lung transplantation. Our team aims to determine an additional upstream target that would reduce the progression of fibrosis. We hypothesize that LRP-130, CAPZ- $\alpha$ , and MATR3 are proteins that play a role in force mechanotransduction and ultimately IPF. To determine the proteins involved in the mechanosensitive signaling pathway, a magnetic precipitation technique is used that isolates the pathway and proteins from the rest of the cell. These proteins are then analyzed through proteomics techniques such as western blotting and immunofluorescence. A knockdown study was performed to determine the individual role the proteins play in YAP/TAZ nuclear translocation. LRP-130, CAPZ- $\alpha$ , and MATR3 have been identified as potential proteins in the pathway and have been identified in samples subject to force. The localization of these proteins has been linked to the nuclear membrane. Additional

knockdown studies will be performed to determine the extent to the protein's effect on YAP/TAZ nuclear translocation. Overall, we have observed that these proteins play a role in regulating the cellular response to force mechanotransduction. This work is significant to the future of IPF treatments as these proteins serve as potential targets for curative therapies.

The aim of the sociotechnical paper is to determine the factors that contribute to the momentum in cosmetic procedures, and whether these procedures are valuable for the public. With a 431% increase in cosmetic procedures in the United States since 1997, a gap has been created between the complexity of its technology and the simplicity in its measures for suitability and postoperative success (Richardson, Mattison, Workman, & Gupta, 2015). To clarify, there are no standardized measures to determine suitability of a patient for cosmetic enhancement, or whether the procedure was beneficial for the patient (Higgins & Wysong, 2017). Medical professionals have an ethical responsibility of beneficence, or having the best interest of the patient in mind. If there is not a uniform way for physicians to determine the maximum benefit for the patient, how can they uphold this basic ethical principle? Through the Actor-Network Theory (ANT) and technological momentum frameworks, cosmetic enhancement are analyzed both in terms of social factors that led to its rise and the ways in which technology continues its growth as a dominating medical field. With better understanding of ethical considerations for patients undergoing cosmetic enhancement, this research aims to emphasize the importance of proper technological usage and development so that optimal treatment is provided.

Working on both the technical and sociotechnical projects has given me a richer understanding of the medical field, and that science will raise ethically ambiguous questions that

must be addressed as long as it continues to develop. In performing laboratory research to study a progressive lung disease, I was able to grasp the rigor and complexity involved in medical research and treatments. While an entire year was put into this project, it is still realistically over fifteen years of additional upstream research that must be conducted before patients benefit. For this project, it was easy to visualize the end result, and that this treatment will be ethically sound once it goes through enough studies and trials. On the other hand, the sociotechnical paper investigates a field of medicine that is not as ethically sound. There are morally gray areas within the field of cosmetic procedures that have not yet been addressed, and looking into the implications of the effects of what would happen if they were ignored made me understand the importance and time-sensitive nature of creating ethical and validated procedures for patients. The future of medicine depends on both scientifically and ethically informed medical professionals so that the questions raised for both the technical and sociotechnical topic can be fully addressed.

## **Table of Contents**

1. Identifying Nuclear Membrane Proteins that Facilitate Chromosomal  
Mechanotransduction
2. The Technological Momentum of Cosmetic Procedures
3. Thesis Prospectus