

**Three-Dimensional Modeling of Lung Volumes in Application to Scoliosis**  
(Technical Report)

**A Duty Ethics Analysis of Turing Pharmaceuticals' Daraprim Price Hike**  
(STS Research Paper)

An Undergraduate Thesis Portfolio

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By

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## **Table of Contents**

Socio-technical Synthesis

Three-Dimensional Modeling of Lung Volumes in Application to Scoliosis

A Duty Ethics Analysis of Turing Pharmaceuticals' Daraprim Price Hike

Prospectus

Socio-technical Synthesis: 3D Modeling to Enhance Disease Treatment and the Ethics of Drug Pricing

My technical work and my STS research are connected through their situations within the realm of healthcare. However, the two projects differ slightly in the ways with which they approach this field. My technical project focuses on the development of a new computational model to enhance disease treatment, whereas my STS research explores the morality of drug price hikes. While my technical work and my STS research approach the field of healthcare from different angles, they are ultimately both concerned with improving treatment of patients.

My technical work is focused on using computational modeling to enhance treatment of scoliosis in pediatric and adolescent patients by enabling lung volume calculation from X-ray images. Specifically, my capstone team improved upon existing code to analyze anonymized CT scans of scoliosis patients of varying age, sex, height, and weight for their mediastinum volumes. The mediastinum is the entire area within the chest cavity excluding the lungs. Additionally, we developed a ribcage model from X-rays by using a point-and-click method on frontal and lateral views to obtain coordinates of the ribs, then plotted these coordinates three-dimensionally to reconstruct said ribs. These two major deliverables are preliminary steps to be passed down to another capstone team next year who will build upon our work on this project with the overall goal of providing a safer method for physicians to measure lung volumes in their patients and determine the best plans for scoliosis treatment.

My STS research is also relevant to the healthcare field, but in a different area than my technical work. My research focuses on the morality of the Vyera (Turing) Pharmaceuticals price hike of the drug Daraprim. I employ Immanuel Kant's Theory of Duty Ethics to analyze the company website and press coverage about the price hike to determine whether the company acted morally. In my paper, I explore whether or not Turing acted in accordance with either form the categorical imperative, the universal moral rule outlined in Kantian theory. My claim is that Turing Pharmaceuticals' actions to hike up the price of Daraprim were immoral because the company was not in compliance with either formulation of the categorical imperative. The goal of my research is to demonstrate how we as engineers can make ethical judgments about technologies using reasoning in the event that the law does not align with morals.

Working on both of these projects simultaneously contributed positively to both. My technical work gave me a better understanding of the importance of safe and accessible healthcare in enhancing the treatment of diseases, since the computational model will make treating adolescent scoliosis both safer and more accessible. Likewise, the research I conducted for my STS paper illuminated the immorality of unreasonable pricing of drugs, further highlighting the importance of accessible healthcare. Overall, both my technical work and STS research support the idea that accessibility is crucial in the healthcare field, and the ability to work on both projects together contributed to improving the quality of both.