

Thesis Project Portfolio

***An in silico* Approach to Understanding Pain Associated with the Chest Tube**

(Technical Report)

The Deadly Impacts of Privatized Pharmaceutical Data

(STS Research Paper)

An Undergraduate Thesis

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

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Sociotechnical Synthesis

The sensation of pain perturbs both psychological and physiological processes that comprise human existence. While both acute and chronic pain cause emotional distress, pain also interferes with biological homeostasis, quality of life, and disease recovery. Over the past few decades, medical practice has devoted more attention towards researching and addressing pain. However, the opioid epidemic has revealed the difficulty in striking a balance between successful and ethical pain management. In 2019, the National Institutes of Health launched the HEAL Initiative to focus specifically on creating and researching non-opioid-based therapies. Although the federal government has directed more funding towards alternative pain management techniques, multi-billion-dollar pharmaceutical companies have such a tight grasp on the market that it remains virtually impossible for new competitors – with effective products – to break into the field.

The following technical thesis seeks to deepen the understanding of pain associated with the chest tube and to create a virtual model of the thoracic cavity for *in silico* modeling. Since the difficulty of studying pain lies in its highly variable nature, the first part of the project revealed underlying consensuses about pain from the healthcare provider's (HCP) view. In the second part of the thesis, we conducted finite element analysis on a computer model of the chest in order to simulate stress concentrations and strain deformations under external loads. The simulation results – coupled with our survey finding that 85 percent of HCPs believed that the chest tube needs improvement – indicate that a true clinical need exists and must be addressed.

The Science, Technology, and Society (STS) thesis focuses largely on the ethical and societal implications of privatizing prescription data and using it to inform pharmaceutical marketing decisions. The process of prescription “datafication” has successfully increased the

revenues of brand-name pharmaceuticals at the expense of doctor's privacy and patient's livelihoods. When this controversial practice came before the Supreme Court, the Court held that exchanging prescriber-identifiable pharmaceutical data was tantamount to corporate expression and must be protected under the First Amendment. The STS research analyzes the prescription data mining system as one manifestation of neoliberalism within biopower, where a free-market mentality drives nation-state practices towards prioritizing the business, rather than the individual.

The technical research revealed that that medical field has neither sufficiently nor successfully addressed pain management, while the STS research focuses on how one highly-defended business practice creates a barrier to pharmaceutical market entry. Although the technical project was unable to provide a chest tube dressing that reduced pain, the creation of an anatomically-correct thoracic cavity model has wide-reaching applications for *in silico* modeling. The STS thesis successfully analyzed the prescription data mining system as an engrained corporate practice, leading to the rise of the corporate Frankenstein monster.

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