Thesis Project Portfolio

Manipulating DREADDs to Develop a Novel Method to Non-Invasively Disrupt the Blood Brain Barrier

(Technical Project)

Navigating Controversy: Political and Economic Dynamics Influencing the FDA Approval of Aduhelm

(STS Research Paper)

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Sociotechnical Synthesis

Introduction

My technical capstone work and my STS research project both focused on treatment options for neurological diseases and conditions. Historically, it proves difficult to deliver drugs in a targeted nature to the brain, as well as ensuring that treatment options are safe and effective. My capstone project aimed to develop a novel drug delivery platform for a wide variety of neurological conditions that is safe and effective for all patients. My STS research employed a case study of one specific drug to treat a neurological condition called Alzheimer's Disease. This drug, called Aduhelm, was accompanied by an approval process that was riddled with scientific mistakes, political power imbalances, and social scandal. Together, I was able to evaluate the drug approval environment before and after approval by the FDA in the healthcare system.

STS Project

My STS project centered around various factors involving the drug approval process that led to a new Alzheimer's drug entering the healthcare market. This drug, named Aduhelm, was developed by a pharmaceutical company called Biogen and while this approval was initially met with excitement, public opinion rapidly shifted once new information became available. I utilized the social construction of technology (SCOT) framework in order to evaluate the story of Aduhelm's approval through the stakeholders' perspectives and influences. I performed a SCOT analysis by collecting and analyzing scientific journal articles and news reports in order to determine what factors allowed this drug to enter the public market, why it was removed, and the long-term impacts of the controversy. Through this research, I was able to determine that both political and economic factors had a powerful influence on Aduhelm's approval and recall.

Various stakeholders, such as the FDA, Biogen, Alzheimer's patient advocacy groups, and the scientific community, directly impacted how and why Aduhelm was approved. Through retelling Aduhelm's story in the perspective of individual stakeholders' motivations and actions, I argue that stronger and more powerful regulations need to be established in order to ensure that the relationships between industry and regulatory agencies remain uncorrupted. Additionally, stricter criteria must be developed to prevent political influences from impacting public healthcare.

Technical Report

My capstone technical project aimed at developing a therapeutic platform that allows for targeted drug delivery to the brain. The blood brain barrier (BBB) is a network of blood vessels that form tight junctions that act like a shield to prevent harmful substances from entering the brain. However, this system also prevents 98% of small molecule drugs from reaching the brain tissue. Due to the BBB being so adept at filtering out substances from the brain, an obstacle is introduced when delivering therapeutics to brain tissue that have the potential to treat Alzheimer's disease, Parkinson's disease, and even mental illnesses such as OCD and depression. To treat these diseases, we needed to be able to deliver medication through the blood brain barrier. Current treatment methods, such as focused ultrasound and chemotherapy, are draining physically, mentally, and financially for patients and physicians. We aimed to design a new therapeutic platform that is more easily accessed and administered. To do this, we utilized designer receptors exclusively activated by designer drugs, or DREADDs. DREADDs are genetically modified receptors activated by specific drugs. Once activated, downstream chemical processes follow that allow for the temporary loosening of tight junctions, allowing drugs to pass through the BBB. Essentially, our platform can poke temporary holes in the brain shield enabling drug delivery. After the initial administration of our platform, the patient would simply need to

take a pill periodically and the drug would be delivered to the brain, saving the patient and physician time, money, and the stress of undergoing invasive surgeries.

Conclusion

I believe that by working on both of these projects, I have effectively understood both the drug development and drug approval process and the impact that they have on the healthcare system. Through my capstone project, I had to ensure that certain safety and efficacy metrics were met as well as consider any barriers my drug delivery platform may introduce to various populations. I was then able to contextualize the viewpoint of scientists developing neurological condition related drugs by examining a case study where due diligence in the drug approval process was neglected. Learning about the critical errors from pharmaceutical researchers in the past and observing the negative impact that these errors can have on the healthcare system motivated me to not make the same mistakes. If I had decided to not focus on the regulatory aspect of drug development for my STS project, my technical report would have excluded the social factors that need to be considered in order to ensure safety and inclusivity.