Thesis Project Portfolio

Utilizing DREADDs to Transiently Open the Blood Brain Barrier for Drug Delivery
(Technical Report)

A Technological Politics Analysis of the Inequitable Political Consequences of Chemotherapy in the United States

(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

My technical and STS research projects are connected primarily through their focus on improving the accessibility of current cancer treatments. Central to both projects, accessibility refers to how easily cancer care can be reached and utilized to achieve the best possible health outcomes (Board et al., 1999; Wang & Onega, 2015). In my technical work, my team aims to lay the groundwork for a more affordable and less invasive drug delivery platform, which could be utilized for chemotherapy treatment in the future. Relatedly, my STS research examines the disproportionate political implications of the common cancer treatment method, chemotherapy, in the United States. Accordingly, both projects address accessibility issues related to current cancer treatments.

My technical work explores the possibility of utilizing designer receptors exclusively activated by designer drugs (DREADDs) to noninvasively deliver drugs from the bloodstream, through the blood-brain barrier (BBB), and to the brain. Through a computational model and in vitro experiments on mouse-derived brain endothelial cells, my capstone team achieved promising results. We discovered that, when activated with a specific drug, DREADD-transfected cells display decreased cell monolayer resistance levels. Additionally, activated DREADD-transfected cells contained less claudin-5, which is an essential tight junction protein of the BBB. Therefore, activated DREADDs exhibited the ability to reduce both resistance and tight junction protein activity in vitro, which could be translatable to the BBB in vivo. Although DREADDs have never before been utilized in this manner or for this purpose, my capstone team reached encouraging milestones. Accordingly, our capstone mentors are motivated to continue investigating the efficacy of DREADDs to assist with noninvasive drug delivery, possibly for chemotherapy drugs.

My STS research also pertains to the limitations of current cancer treatments but from a non-technical angle. By employing the STS framework of Technological Politics, developed by Langdon Winner, I examine how chemotherapy is an inherently political technology (Winner, 1980). In my paper, I claim that chemotherapy unintentionally favors the clinical outcomes and well-being of cancer patients with access to various resources, while marginalizing those with accessibility barriers. I establish how the greatest benefits of chemotherapy, including positive clinical outcomes and improved well-being, are far more attainable for cancer patients with sufficient access to financial, emotional/lifestyle, and geographic resources. By understanding the inevitable political implications of chemotherapy, I aim for this research to promote improving the accessibility of chemotherapy administration in the United States.

By working on these projects in tandem throughout the year, I had the opportunity to include technical and political contexts within both. The background of my technical work provided a greater understanding of current cancer treatments and their accessibility barriers, motivating my projects to prioritize accessibility in cancer research and treatments. My technical work was aimed at our long-term goal of developing a more affordable and less invasive method for treating cancer. My STS research led me to understand how current cancer treatments, such as chemotherapy, are not accessible to all cancer patients in the United States. Following graduation, I will pursue my PhD in biomedical engineering at Boston University. Inspired by

both projects, I am determined to prioritize accessibility and be conscious of the political implications while performing biomedical engineering research.

REFERENCES

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