

Thesis Project Portfolio

Design of a Pembrolizumab Manufacturing Plant Utilizing a Perfusion Bioreactor and Precipitation Chromatography

(Technical Report)

A Care Ethics Analysis of the DuPont Chloroprene Production Plant in St. John Parish, LA

(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

My technical project and my STS synthesis both center around oncology and the inequity surrounding cancer prevalence and treatment. Cancer is a global phenomenon, but economically and politically disenfranchised communities face disproportionately high rates of cancer and cancer-related deaths. Both my technical paper and research paper highlight this inequity. My technical work demonstrates a means of making high-efficacy cancer treatment more accessible, whereas my STS research explores the disproportionate cancer burden of environmental injustice on communities of color. Insomuch, both components of my paper approach oncological inequity, but they do so from opposite ends: causes of cancer and treatments of cancer.

My technical project delineates a continuous pharmaceutical production process to manufacture a lower cost monoclonal antibody cancer therapeutic called pembrolizumab. Monoclonal antibodies are immunological proteins, which bind to and inhibit the proliferation of specific cells or pathogens, such as cancer. My capstone group designed an end-to-end commercial manufacturing process, including fermentation of cells, purification of the protein drug substance, and fill and formulation of the final drug product. We sized each individual unit operation based on our calculated media and buffer flow rates and our estimated cell inputs and product outputs. This project illustrated coverage of 20% of the cancer therapeutic market at half of the cost of the brand-name drug, Keytruda. Our goal was to demonstrate a theoretical method for producing this life-saving drug at a cost that is more accessible to low-to-middle income countries.

My STS research focuses on regional disparities in carcinogen exposure due to environmental injustice and racial capitalism. I employed Carol Gilligan's framework of care ethics to specifically analyze the asymmetrical relationship between DuPont and the historically

Black community of St. John the Baptist Parish, Louisiana. In my argument, I claim that DuPont failed to act morally following Joan Tronto's four phases of care ethics: attentiveness, responsibility, competence, and responsiveness, by taking economic advantage of the historic and ongoing oppression of the community. Furthermore, my paper illuminates the way DuPont propagated this political disenfranchisement of a black community into a severe health injustice by polluting St. John the Baptist Parish with a known carcinogen, chloroprene, and neglecting to acknowledge or address its toxic emissions. By doing so, I endeavored to highlight how historical discrimination continues to burden communities of color through a political and economic vulnerability that engineers and corporations must be sensitive to.

Undertaking my technical project and STS research in parallel added significant value to my work by elucidating the multifaceted nature of health inequity globally. My STS research supported the motivation of my technical project by delineating the pre-existing disparity in cancer prevalence as an impetus for making cancer treatments more accessible to disenfranchised communities. Likewise, my technical work aided my understanding of how development and administration of oncological treatments is exceptionally challenging in regions that lack strong commercial infrastructure. In summary, my combined work illustrated how reducing cancer inequity will require parallel efforts on all links of the industrial chain, not just on treatment cost reduction or environmental contamination reduction.