Sociotechnical Synthesis
(Executive Summary)

Between the years of 1971 and 2015, the number of people living with cancer in the United States increased from 3 million to over 15 million. Forecasts predict that the number of individuals living with cancer will continue to rise, leading to more individuals in need of effective cancer treatments. In addition to the higher prevalence of cancer cases, the costs of cancer medications have also increased by over ten-fold within the last twenty years. Costs are expected to continue to rise, causing the perpetuation of the already existent cost burden placed upon cancer patients and their families. The technical portion of this project explores biological pathways, specifically sphingolipid metabolism, and the genetic factors that may cause the development of certain cancers like colorectal cancer. This information provides greater insight into the molecular mechanisms involved in cancer development, which may then be utilized to assist in the future development of cancer treatments. My STS research explores the cost burden associated with current cancer treatment options and strives to better understand the impact and success of organized efforts of the cancer community against high cancer medication costs. By understanding not only the technical components but also STS frameworks that impact design and innovation within the field of cancer research and treatment development, progress within this field may become more inclusive of the greater social needs of cancer patients.

In my STS research, I explored the organization of the cancer community in response to high medication costs. Through documentary research and analysis, I was able to group the cancer community's responses into the following categories: formation of advocacy groups, petitions and protests, and legislative efforts. Each response category provided past and current examples of organized efforts that may guide future directions and actions. Overall, a common

theme found among successful organized efforts from the cancer community involved the collaboration of multifaceted groups that utilized various media platforms and the Internet. The technical portion of my thesis explored the biological complexity of sphingolipid metabolism and its connection to colorectal cancer development. Specifically, I analyzed the genetic makeup of Enterotoxigenic *Bacteroides fragilis* (ETBF), a toxin-producing strain of *Bacteroides fragilis* thought to be involved in colorectal cancer development, and cross-referenced the findings with other sphingolipid-producing bacteria that comprise the gut. Bioinformatics and computational approaches yielded results showing statistically significant alignments between ETBF and other common sphingolipid-producing bacteria. The most statistically significant match occurred between ETBF and *Bacteroides fragilis*, and this information was used for genetic comparisons. Further analysis determined that certain genetic sequences within strains of gut bacteria play a role in proper sphingolipid metabolism. Without the presence of the proper genetic makeup, dysregulation of sphingolipid metabolism may occur and potentially evolve into colorectal cancer.

Both of these projects provided me with a more holistic understanding of the factors that impact the field of cancer medication and therapeutics. Not only are there barriers within the field in the form of gaps of knowledge, but there are larger social issues such as financial limitations that affect access to cancer treatments. Without understanding the interconnectedness of scientific innovation and the related social impact within cancer research, progress within this field may not occur. By completing both projects simultaneously, I was able to not only apply the technical skills that I have learned through the biomedical engineering curriculum, but I was also able to understand the social context of cancer treatment innovations and thoroughly explore the ethical debate over whether or not patients in need of cancer treatment should receive care

due to their financial situation. Overall, my STS research project and technical portion of my thesis has allowed me to directly apply my understanding of the ethical responsibilities of the engineer to greater societal problems associated with cutting-edge innovations and research.

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