**Thesis Project Portfolio**

# Developing EGFR-Targeted Nanoliposomal Therapeutics in Head and Neck Squamous Cell Carcinoma

(Technical Report)

# Best Practices of Information Gathering for At-Risk Patient Populations

(STS Research Paper)

An Undergraduate Thesis

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

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Bachelor of Science, School of Engineering

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## Sociotechnical Synthesis

Advancements in medical treatments have the potential to dramatically change the outcome of patients with diseases characterized by poor prognosis. The current system of care follows a general timeline of diagnosis followed by treatment. While medicine focuses on improving treatment, there are many other factors that can influence its efficacy, including accessibility and compliance. My theses are related through examination of this treatment process. The technical thesis addresses the treatment process at the stage of simple compliance, examining the efficacy of a novel method for drug delivery in treating Head and Neck Squamous Cell Carcinoma (HNSCC). The STS thesis addresses how Electronic Medical Records can be reformulated to allow patients to get to this stage of compliance, as many at-risk populations are not able to receive the treatment that they need.

The technical thesis evaluates the use of a therapeutic developed called Ceramide Nanoliposome (CNL) combined with different FDA-approved drugs to determine if these combinations are more effective in treating HNSCC. Despite the large volume of HNSCC cases and poor patient outcomes, only one targeted therapy, Cetuximab, has been developed specifically for HNSCC treatment. The main objectives of this research were to: 1) encapsulate Epidermal Growth Factor Receptor inhibitors Erlotinib and Gefitinib in liposomes and confirm efficacy of both combinations in treating HNSCC in cancer cells, 2) conjugate and test Cetuximab conjugated to the CNL to confirm efficacy in treating HNSCC cancer cells, and 3) test both therapies *in vivo*. We were successful in encapsulating Erlotinib and Gefitinib in liposomes and creating the CNLs, but were not able to test either therapy *in vitro* or *in vivo*.

The STS thesis investigates the development of potential avenues where Electronic Medical Records and associated systems might be improved upon to capture essential social determinants of health and need that prevent at-risk populations from receiving effective treatment. Healthcare disparities have persisted for decades and have been well-documented in literature; however, they have yet to be properly assessed or addressed in a clinical care setting, leaving large groups of populations lacking proper healthcare. This research evaluates the potential for EMRs as a source for potential information gathering and the efficacy of reformulated EMRs in addressing social determinants of health. Analysis of current initiatives and studies on patient-centered interaction suggest that best practices in creating modified EMRs directly incorporate social determinants in the information gathering process and noting cultural differences that could improve treatment.

While my STS research is complete, my technical research remains incomplete due to lab access restrictions and time restrictions. While we were unable to test our therapies *in vitro* or *in vivo*, we were able to successfully create the liposome and drug combinations. Our team ran into multiple challenges, including taking an unexpected amount of time to identify the best drug/liposome formulation. Future researchers should apply our identified formulations in both cells and mice to understand how effective they are in treating HNSCC.