

Thesis Portfolio

The Effect of Hornerin Knockdown on Tumor Vasculature in Melanoma
(Technical Report)

The Advancement and Shortcomings of Ethics in Clinical Research
(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

Zainab Aziz
Spring, 2021

Department of Biomedical Engineering

Table of Contents

Sociotechnical Synthesis

The Effect of Hornerin Knockdown on Tumor Vasculature in Melanoma

The Advancement and Shortcomings of Ethics in Clinical Research

Thesis Prospectus

Sociotechnical Synthesis

The technical report delivers an optimized vessel analysis software, specifically for application in a treatment for melanoma, but will be one that can ultimately be expanded to serve as a therapeutic screening software for vessel normalization in a broad spectrum of cancers. The STS research paper follows the human-driven advancement, and shortcomings, of research ethics, specifically, how various codes of ethics, developed in unique political and cultural climates, have contributed to the field. The technical report and the STS research paper both have an underlying thread of medical and clinical research, though each will approach the field from a unique perspective. Further, the therapeutic of interest in the technical report, though currently in its early stages of development, may ultimately enter human clinical trials. Therefore, the STS research paper looks at the societal aspect of medical and clinical research, specifically research ethics.

The technical report has a two-fold aim: first, to deliver an optimized vessel analysis software, and second, to characterize the effect of hornerin knockdown on vessel normalization in melanoma. Hornerin, a protein, has been identified as a compensatory pathway in angiogenesis, or blood vessel growth, and thus, offers a potential target for treatment in melanoma. The current vessel analysis software requires lengthy and manual analysis of blood vessel parameters. With an optimized vessel software, parallel processing capabilities will allow users to more quickly and effectively characterize the effect of a therapeutic on vessel normalization. Specifically, in the context of the technical report, the optimized vessel analysis software will be applied to characterize the effect of hornerin knockdown, using hornerin siRNA, on vessel normalization in melanoma.

The hornerin knockdown treatment mentioned in the technical report may ultimately enter clinical trials as a therapeutic for melanoma and will require validation from human clinical trials to go into market. As such, the STS research paper looks at the other end of the spectrum of research, namely the societal and ethical approaches to research itself. Influential codes of ethics, such as the Nuremberg Code and the Declaration of Helsinki, will be analyzed as well as the time periods and context in which they were written. Principles arising from such codes of ethics such as informed consent, will also be detailed. Additionally, the story of Henrietta Lacks will be looked into as an example of where, despite the presence of ethical guidelines, patients were treated unfairly and inequitably. Lastly, the actor-network framework will allow for a description of how interactions between actors, such as patients and physicians, and artifacts, such as the codes of ethics, produce social concepts, such as autonomy, in society.

Looking at the two research topics together will provide insight into both the scientific and societal aspects of clinical research, allowing for a more comprehensive understanding of the field. Scientific innovation is immensely important as we increase our knowledge about various diseases and therapeutics; however, in order to preserve the integrity of science, the ethics of how and why research is conducted in a certain way is also necessary. Therefore, the two research topics will ultimately provide a complementary conversation of clinical research and research ethics.