

Thesis Project Portfolio

Developing an Intranasal HIV-1 mRNA Vaccine Using Short Carbon Nanotubes (CNTs) as a Delivery System
(Technical Report)

Ethics of the Publication of the HeLa Cell Genome Through a Duty Ethics Lens
(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 STS research are connected through the importance of biomedical research ethics and how those should manifest in specific research settings. The biomedical research ethics that I use as a reference discuss the importance of social as well as scientific value in addition to transparency with and respect for human participants in research projects. The two works differ in the way these research ethics are applied. In my technical work, these research ethics serve as a reminder of the importance of the project outside of pure scientific value. On the other hand, my STS research uses these research ethics as a basis for uncovering unethical activity in a specific research project. Therefore, while these two projects differ in their application of these research ethics, they are both extremely reliant on these principles.

My technical work was done with two other UVA biomedical engineering students through the company Luna Labs and consisted of the development of a new vaccine delivery system to be used intranasally to prevent HIV-1. We developed several formulations of the vaccine and ran various experiments to determine efficacy and safety of the formulations. We used protocols previously developed at Luna Labs and modified them for our specific experiments. Our work will likely be continued by another capstone team, but is contributing to the overall project of a novel vaccine delivery system that Luna Labs and other UVA students had been previously working on for many years. The eventual goal of this project by Luna Labs is to send the formulations for animal testing, then set up human clinical trials, and eventually be able to manufacture an FDA approved HIV-1 vaccine, which does not yet exist. The methods used for development of this vaccine will also be used by Luna Labs and future students to create vaccines for other diseases that are difficult to prevent and treat. Through this entire process, it

was extremely important to follow research ethics by establishing the scientific validity and safety of the vaccine formulation as well as recognizing the social and clinical impact.

These research ethics served as the cornerstone for my STS research, in which I explored the ethics of the publication of the entire HeLa cell genome by a research group. I used the ethical theory of duty ethics to analyze the motivations and outcomes of the publication of this information. I applied a set of guiding principles for ethical research developed by the NIH as well as the duty ethics principle that all people have intrinsic value to argue that the research group was unethical in their decision to publish this information due to the lack of informed consent by the patient, its negative impact on the family of the patient, and the treatment of the patient as a means to an end. The goal of this paper was to emphasize the responsibility of researchers to follow this set of principles, especially when conducting research with human subjects, in order to preserve integrity and respect for others while still acquiring impactful scientific data.

Working on this STS paper while conducting the laboratory research for my technical project gave me an increased understanding of the social impact of the research in addition to the pure scientific impact. It can be incredibly easy to focus so intently on the experiments themselves that the actual end goal and social implications of the project can be overlooked. Working on this STS paper in tandem with my technical project served as a reminder of how important the social implications of any scientific research are, specifically in the case of my technical project, which has profound impact on many medically underserved populations.