Thesis Portfolio

Vagina-on-Chip Model for Elucidating Underlying Mechanisms of Vaginal Cell Interactions

(Technical Report)

A Sociotechnical Analysis of Gender Bias in Biomedicine

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Introduction

The STS research paper focuses on the impact of gender bias in biomedical research for women in the United States. The technical project aims to create an organ-on-chip model to study the three-dimensional physiology of vaginal tissue. The connection between the two projects is evident, as the technical project seeks to fill the research gap that the STS research paper analyzes. Specifically, the creation of the vagina-on-chip model is a direct example of innovations in the female healthcare space that the STS project discusses. Reducing the knowledge gap in the U.S. healthcare system is the ultimate goal of both projects. Developing a clinically relevant model for studying vaginal tissue can reduce the research gap surrounding female physiology, allowing for the development of improved therapeutics and solutions to overlooked conditions in women's health. In this way, the STS research paper and the technical project are directly related. The creation of solutions to gaps in women's health such as the vagina-on-chip can allow for the reduction of gender bias in the same way that innovators in femtech are changing the investment landscape.

Technical Project

The vagina is a critical organ that remains understudied due to the current insufficient methods of studying clinically relevant tissue models. As a result, conditions affecting the vaginal organ are not well-understood, leaving millions of women suffering in the medical system due to lack of therapeutic solutions. The dynamic, multi-layer composition of the vagina makes native tissue response difficult to replicate, and thus no three-dimensional models exist to study its cell-cell interactions. As current research highlights the impact of women's health and the susceptibility to diseases, there is an increasing need for new ways of creating therapeutic

modalities. The emerging field of Organ-on-chip (OoC) technology utilizes advances in tissue engineering and microfluidics to reproduce tissue and organ-level functionality of living organs and systems. These models have been applied for the study of the specific functions of many other organs, including the female reproductive tract, but none have been developed to model the dynamic and layered structure of the vagina. Therefore, this individual technical project seeks to create the minimum functional unit for the first vagina-on-chip device that will mimic native vaginal tissue physiology and allow for predictive drug response.

STS Project

When first introduced to the vagina-on-chip project, I was curious to examine why such a model did not already exist. As I sought out information about the history of biomedical research, the reason for the existence of such gaps became quite clear. The exclusion of women from clinical trials has led to the creation of a significant gendered knowledge gap, where diseases presenting differently in females are often missed or misdiagnosed, preventing women from receiving adequate healthcare. While recent signs of potential change in both policy and scientific inquiry have begun to remedy this underrepresentation, not nearly enough progress has been made for gender equality in biomedical research. As women gain representation in STEM fields and gain access to capital, they have begun to fill these gaps with technical solutions in the startup space for conditions that affect women solely, differently, and/or disproportionately. While this rising industry, known as femtech, shows promise for improving female health, founders often struggle to gain traction, as they experience difficulty acquiring funding from male-dominated venture capital firms. To better understand the impact of such biases on women's health innovation, this research asks the question: what are the sociotechnical implications of gender bias in biomedicine? Furthermore, this question is contextualized in the

STS framework of co-production to understand the way that gender bias perpetrates the androcentric medical system that continues to harm women.

This research aims to create a novel connection between the ideology of co-production and the femtech industry. Through examining the impact of gender bias on the co-production of biomedical innovation, this paper aims to produce tangible and specific ways in which the system can promote sufficient study of female health. Lastly, gender bias in the biomedical research process is a wicked problem, but the implementation of policies that support gender-inclusive research and femtech innovation are discussed as potential avenues to reduce its impact.

Reflection

Working on the technical project and the STS research paper simultaneously allowed for the gain of valuable insights into ethical considerations. Developing the vagina-on-chip model required the exploration of funding opportunities and the search for collaborators. As a result, I was exposed to the same hurdles in developing my technology that femtech founders experience, facing stigma and misunderstanding of the vaginal organ, along with the underestimation of the clinical need for such a device. Additionally, I experienced unexpected obstacles due to the inaccessibility of vaginal tissue, with no opportunities for commercial purchase. The absence of a vaginal tissue biobank is a direct example of the negative impact of gender bias in biomedical research on the development of healthcare solutions for women. Therefore, the experience of creating the technical project allowed me to gain key insights into the process of femtech innovation, allowing me to examine how the impact of gender bias can be mitigated for women in the healthcare system.