Thesis Project Portfolio

Modeling Endothelial Barrier Properties of Diseased Cerebral Vasculature
(Technical Report)

Venture Capital Investment Criteria Impact on Success of Women's Health Products
(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

There is a significant lack of representation for women in the medical field, whether that be the entrepreneurs representing healthcare companies, researchers conducting studies, or even in participants used for clinical trials. My interest in women's health and in this disparity motivated me to choose my thesis topic of researching Venture Capital and its impacts on women's health. While this interest was not the motivating factor for why I chose my technical topic of working on developing an in vitro model to study cerebral cavernous malformations, being in a research lab did inspire certain questions I asked while conducting research. By being exposed to academic research for the first time, it motivated me to look into topics such as the percentage of researchers that are women, how many grants were awarded to female researchers, and what percentage of those female researchers were likely to be published as compared to their male counterparts. Having the ability to ask questions such as those allowed me to find credible sources that further developed my thesis.

Cerebral cavernous malformations (CCM) is a genetic vascular disease that results in leaky, malformed blood vessels (lesions) in the brain. There is currently no prevention therapy available and the only form of treatment is surgical removal of the lesion (*Cerebral Cavernous Malformation | National Institute of Neurological Disorders and Stroke*, n.d.). KRIT-1 (or CCM-1) is one of three genes responsible for the disease, with the phenotype usually caused by a "two-hit" mechanism: a congenital mutation of one allele and a spontaneous mutation of the second to produce a homozygous loss-of-function mutation (Pagenstecher et al., 2009). While KRIT-1 has been confidently linked to CCM, its role in the cell signaling pathways that regulate endothelial behavior and morphology is not well understood. First, we simulated the conditions of CCM lesion formation with a parallel-plate flow chamber, using at first only wildtype cells

and recently cells where KRIT-1 expression has been knocked down. In these flow experiments we show that endothelial cells will align under flow. We used silencing RNA (siRNA) to knock down KRIT-1 protein expression for use in both flow chamber experiments and in a Western blot to confirm that the protein was in fact knocked down. Additionally, we created the first iteration of a flow system that included a hydrogel model of a channel, in which we worked to implant cells. This flow system is the first step towards creating an in vitro model that will one day allow for this disease to be studied and allow for therapeutics to be developed.

The success of a start-up company in its early stages is heavily dependent on the ability of the company to raise funds. Those funds typically come from Venture Capital investments. Through my STS research I have investigated the investment criteria used by venture capitalists, and how that criteria leads to the underfunding of women's health companies. Women's health products are severely underfunded compared to men's health products. I show that the vague language used in investment criteria leaves room for personal gender biases of venture capitalists to influence decisions made by the firm. Venture Capital is a male-dominated industry and the inherent biases held by those investors hurts the success of female entrepreneurs, especially those women representing women's health companies. Through this research I show that there is an issue within the Venture Capital system, specifically with the investment criteria. This criteria needs to be modified in order to reduce the potential for gender bias to dominate decision making.

Working on both my STS thesis and my technical project exposed me to two different phases of medical development that is valuable for my future work of medical product development. It is not typical to be able to gain the experience of early phase experiments and prototyping for a project while simultaneously researching the process that start-up companies go

through while trying to raise funding to further develop their products. In the future I anticipate I will have to prototype a medical device, hopefully in women's health, in its early stages while also working towards acquiring funding for my project. My deep dive into Venture Capital investment processes will allow me to anticipate future challenges and necessary steps in my career.

Works Cited

Cerebral Cavernous Malformation | National Institute of Neurological Disorders and Stroke. (n.d.). Retrieved October 24, 2022, from https://www.ninds.nih.gov/health-information/disorders/cerebral-cavernous-malformation

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