Thesis Project Portfolio

Expression of SARS-CoV-2 Spike Protein (SP) and ACE2 via Lentiviral Vectors (LVs) to Target Glioblastoma (GBM): *In Vitro* Model for Viral-Mediated Fusogenic Therapy and Tumor Suppression

(Technical Report)

COVID-19 Vaccination Rollout: How Individuals with Disabilities Were Failed

(STS Research Paper)

An Undergraduate Thesis

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Table of Contents

Sociotechnical Synthesis

When the COVID-19 pandemic finally ended, there was much relief, anticipation, and gratitude. However, this was quickly replaced by the urge to reflect, evaluate, and optimistically improve upon our actions. During this reflection period, we quickly learned that one result of the pandemic was an overwhelming amount of data, much of which did not make sense. Yet, in a world that is filled with data analytics, it is hard for people to determine which data should be kept, discarded, or revisited later and how to leverage it to improve their field of study. This was an important dilemma. We needed to balance reflecting on the past with moving forward while evaluating the strengths and weaknesses of key actors during a defining moment in our history. Fortunately, the pharmaceutical industry was able to work quickly to develop a vaccine for COVID-19. My technical project investigates if the spike protein from COVID-19 could be leveraged to target the killing of Glioblastoma (GBM) cells, the most aggressive form of brain cancer. A shortcoming of the pandemic was the inefficient policies made to distribute the vaccines. For my STS project, I researched how people with intellectual and developmental disabilities were left behind in the vaccine roll-out.

While there is no current treatment for GBM, there are many current studies investigating potential solutions. For example, Dr. Purow at the UVA department of neurology wanted to investigate the potential of the spike protein in COVID-19 to aid in cancer cell death. My team and I worked with him to investigate how different combinations of GBM cells expressing the ACE-2 receptor, spike, or ACE-2 and spike affected syncytia formation, if at all. We used the U251 GBM cell line and transfected them with different lentiviruses to create spike expressing, ACE-2 expressing, and spike and ACE-2 expressing stable cell lines. These were then combined in different ratios and analyzed by luminescence reading and fluorescent imaging. Our fluorescence results confirmed the successful creation of stable cell lines and showed that the combination of the ACE-2 receptor and spike protein caused the GBM cells to form syncytia. However, our luminescence results need to be replicated, as the current results are inconclusive.

During the pandemic, people with intellectual and developmental disabilities were not prioritized enough, especially considering that many of those individuals have pre-existing health conditions that make it considerably harder for them to fight off the disease. These policies were neither fair nor ethical. Through analyzing the built environment of the vaccination centers themselves and the intersectionality of socioeconomic status and race of the many people with disabilities, I attempt to expose the disparities in vaccination access for people with disabilities during the COVID-19 pandemic. I urge not only policymakers and vaccination center designers but the greater American public to educate themselves on these issues and strive to promote inclusion in their everyday lives.

Upon reflection of these projects, I think I made a small dent in tackling the larger, general problem of pandemic data overload. Through my STS paper, I was able to narrow down

which research resources and data mattered to this specific accessibility issue and consolidated it for future use. In the lab, we were able to determine that syncytia can be formed with the transfection of these cells by the lentivirus, answering one of Dr. Purow's initial questions. We did not accomplish all that we set out to do, but we have laid a foundation for the next group of researchers. By examining both a scientific breakthrough and one societal shortcoming from that time period, I gained a slightly clearer understanding of how to apply what we've learned to future crises. Yet, there is still work to be done. To continue to tackle the broader conflict, future researchers should ask themselves: How do we ensure that lessons from crises like COVID-19 are institutionalized rather than just remembered? What frameworks could help researchers filter and repurpose large datasets for new investigations? How can future designs of healthcare infrastructure account for intersectionality? And, how could viral protein strategies be applied to more aggressive diseases?

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