Viruses as Medicine for Antibiotic-Resistant Bacterial Infections

One of the most groundbreaking medical discoveries has been the development of phage therapy. Phage therapy refers to the use of bacteriophages, viruses that infect bacteria, as a mechanism to defeat antibiotic resistant infections. Phage therapy was first researched due to the fact that, globally, 1.5 million people die from tuberculosis each year. Tuberculosis infection stems from the bacterium *Mycobacterium tuberculosis*. *M. tuberculosis* is highly antibiotic resistant which makes TB hard to treat. In a lab setting, researchers first used a closely related *Mycobacterium* species instead of *Mycobacterium tuberculosis* due to the virulence of *M. tuberculosis.* Researchers created a *Mycobacterium* *smegmatis* lawn on agar plates. The bacterium and their phages were inoculated together and plated. After an incubation period of twenty-four to forty-eight hours, plaques (clearings of the bacterial lawn that indicate the phage has killed the bacterium at that spot) are counted and then each plaque is isolated and purified to determine which phages would be best for therapeutic use. This is just a general overview of the entire process.

Bacteriophages are highly diverse and specific to certain bacterium. However, they are also abundant and easily accessible as they are found in the soil. The global phage database is kept at the University of Pittsburgh and is run by Dr. Graham Hatfull. Dr. Hatfull was one of the first scientists to research and make breakthroughs in phage therapy for TB infections. Due to both of these factors, one of the most popular Foundations of Biology labs at Pitt is the SEA-Phages research lab. This lab gives students a true insight into conducting their own research and taking responsibility for their work and results. The best decision I ever made was to take this lab. In Phages 1, I isolated, purified, and named my own bacteriophage. Its name is DjMenace and it will be sequenced this summer/fall. DjMenace is a *Gordonia terrae* phage. In Phages 2, I learned how to annotate phage genomes, identify where synteny exists within a genome, and comment on important or interesting genes found within the genome.

Throughout both parts of the course, an article published by CNN in May 2019. This article is about a teenage girl, Isabella, who has cystic fibrosis. Due to CF, she is prone to many bacterial infections. One of the Infections Isabella was dealing with was *Mycobacterium abscesses*, an antibiotic-resistant infection. After a double lung transplant, Isabella’s liver was failing, and she was given a <1% chance of survival. Isabella’s doctor consulted with Dr. Hatfull, and together they were able to genetically engineer a bacteriophage that was specific to Isabella’s infection. Soon after treatment the lesion on Isabella’s liver disappeared and other infection sites started to heal. Isabella is now living a nearly normal life. She is not cured but the phage therapy keeps her healthy and stable. The long-term effects of bacteriophages as drug therapy are unknown since it is a new technology, which is why the research that is done each year in Phages labs across the globe is crucial.

My phage most likely will never cure someone of a life-threatening disease but the information that is gained from it could be crucial in developing a specialized bacteriophage for a future patient. Phages are highly specific to their bacterial hosts and thus do not have a broad host range. That being said, with the current knowledge and archived phages we have, experiments can be done, and phages can be modified to fit a specific person’s needs. Phage therapy is hopefully going to be the future of medicine due to its ability to be highly specialized, potentially having fewer side effects than antibiotics, and the possibility for phage therapy to be more accessible for patients, especially TB patients (who are most likely in a developing country due to a higher prevalence of TB in developing countries) due to the diversity and abundance of phages.