Emily Geyman

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Drug-Resistant Tuberculosis: MDR/XDR-TB

Mrs. S. Bass

Washington Middle School

2101 Jackson St.

Seattle WA 98144

Contest Region: Western Washington

You're sick. Severe coughing, fever, night sweats, an overall feeling of fatigue, but this time it's different. A week's rest and Dayquil don't improve the condition. Frustrated that the illness continues to worsen, you visit the doctor. A few tests later, the doctor announces that you have tuberculosis or TB, a bacterial infection caused by Mycobacterium tuberculosis. "What?" you think. "I thought TB was eradicated years ago!" While many people in developed countries believe this, in fact one third of the world's population has TB, and there are almost two million TB-related deaths worldwide per year, about five thousand per day. For decades, TB has been partially controlled by vaccines and antibiotics, but new drug-resistant TB is now a growing public health concern 50 years after TB was thought to be almost eradicated.

Evidence of tuberculosis has been found as far back as 2400 BCE in Egyptian mummies and Greek literature. Fast forward to the early 20th century when TB was thriving. In 1921, a breakthrough was introduced, the Bacille Calmette Gurin or BCG vaccine which became available after testing. Still widely used today, the vaccine was made using weakened bacteria similar to M. tuberculosis, which is weak enough to not make one sick, but still prepares the immune system to fight M. tuberculosis when it strikes. Unfortunately, the BCG vaccine had a low success rate, often well below 80 percent, so people continued to contract TB.

In November of 1944, the first antibiotics were shown to treat tuberculosis. With the development of antibiotics, the TB problem was considered solved, and scientists turned to other diseases. However, tuberculosis soon posed a new threat, as many strains of TB became resistant to the drugs treating them. There are two types of drug-resistant TB: multi drug-resistant tuberculosis, or MDR-TB, and extensively drug-resistant

tuberculosis, or XDR-TB. These drug-resistant strains can arise from a number of causes including skipping medications, not completing treatment, or using improper medication. Because there are only a few effective alternative drugs for treating these drug-resistant strains, TB is making a comeback.

Today, scientists are working on vaccines and treatments for the new drug-resistant strains. Scientists are making the vaccine stronger through autophagy, a recycling process in which body cells turn damaged cell pieces into new building blocks. Not only are the vaccines being improved, but the delivery systems are also being revised. At Harvard School of Public Health, bioengineers have found a new method for delivering vaccines through a dry-spray technique rather than needles. This dry-spray delivery method proved more effective than injections when tested on guinea pigs, and holds numerous benefits including better heat stability and a sterile alternative to needles which can pass blood-transmitted infections or diseases if unsterile. These developments in vaccines and vaccine delivery may lower TB rates and help improve vaccines for other diseases.

The recommended tuberculosis treatment consists of 6-12 months of antibiotics. With proper antibiotic treatment, TB is curable. However, when a patient skips the medications or stops treatment early, the TB can become drug-resistant and much harder to treat. Other antibiotics have been introduced for MDR or XDR-TB, but these are often less effective. In response to these drug-resistant strains, many new TB antibiotics are currently being tested and developed. Scientists have found a new antibiotic, diarylquinoline, that can work against both drug-sensitive and drug-resistant M. tuberculosis. Diarylquinoline is currently in Phase II clinical trials and, when tested on

mice, proved more effective than traditional TB antibiotics. Other antibiotics are also in early stages of testing.

Strains of drug-resistant TB are constantly posing new threats to the world's population. Through animal testing, new treatments and delivery systems are being developed which may hold the key to eradicating TB. By creating new treatments and broadening access to TB vaccines and antibiotics, especially in developing countries, we may be able to control these new drug-resistant strains and eventually eliminate tuberculosis throughout the world.

Reflection:

I was very interested to learn about tuberculosis. Before researching it for my paper, I knew nothing about TB, excluding a couple brief references in episodes from the recent T.V. show *House*. For a long time, I have had a specific interest in public health and healthcare in developing countries. Organizations such as Doctors Without Borders continue to interest me, and I took this assignment as an opportunity to see if I'm actually interested in it. Initially, I was hesitant to choose this topic based on the somewhat obvious missing part of the assignment: Biomedical Breakthroughs ***and My Life***. How does TB affect my life? Well since then, I've learned how while this topic may not have affected my life in the past, TB very well may affect my life in the future as a profession in public health or other related studies.

In researching this project I have not only learned a lot about tuberculosis, but I have also learned a lot about problems with access and distribution that also serve as barriers in other diseases. These areas specifically interest me, and by studying this individual disease I have widened my scope to realize how many of these common issues with TB overlap into other diseases and areas of health. Diseases such as Methicillin-resistant Staphylococcus aureus or MRSA, and two of the four human malaria parasites are only a few on a list of many. I am glad to have had the opportunity to research tuberculosis and am extremely interested in this area of medicine. TB may not have affected my life so far, but I am fairly confident to say that TB will affect my future if I pursue a career in public health.

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