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# Tuberculosis as A Metaphor for Isolation: An Interdisciplinary Examination of Tuberculosis

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# Tuberculosis as A Metaphor for Isolation:

## An Interdisciplinary Examination of Tuberculosis



Stefanie Pavlick, 2015

Sponsor: Dr. Pascal Lafontant

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## Acknowledgements

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## Preface

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The sight of perfectly pressed curtains, the smell of schnitzel, and a feeling of overwhelming comfort meet me at the door of my grandparents' condominium in Venice, Florida. I arrive in the late afternoon and am greeted by tight hugs, numerous kisses and a not so hidden once-over just to make sure that I am well. As is typical of Austrian culture at this time of day, we chat over a table of different kinds of cookies and a steaming hot pot of coffee, which was crocheted by my oma (grandmother) and is covered by a small coffee hat in Austrian colors, a vibrant red and brilliant white. As I look into my grandparents' eyes it hits me. Never could a stranger guess the numerous hardships that my grandparents endured. Never would anyone assume that they were forced to sacrifice just about everything to achieve what they have now. Despite their jovial spirits, there is a story within each wrinkle and every sore joint. These stories have inspired me since I was a young girl and one of them in particular, the story of my oma's mother, has motivated my study of tuberculosis.

My oma, Maria Bitner (now Katzfuss), was born in the tiny village of Illatscha in present day Austria but what used to be Yugoslavia. Illatscha was a small village inhabited by Donauschwaben, a group of Germans from a region bordering the Danube. My oma was born to Josef and Suzanne Bitner who later had one more child, Erwin. My great-opa, Josef Bitner, was a *Tischler*, or carpenter in English, in the village as well as a *Grackel*, or soda pop, maker. By Illatscha's standards, the Bitner family was relatively well off. They lived on a large farm at the end of the *Gasse*, or street, that ran through the center of town. The village was primitive compared to today's standards but living there was fulfilling and culturally rich nonetheless. Additionally, life in Illatscha was not without its hardships. Living as Donauschwaben in Yugoslavia gradually became more dangerous as Josef Tito and the communist Partisan Army,

or *Partisaner* as my oma calls them, became more powerful (“The Resistance Movement in Yugoslavia,” 2014). The *Partisaner* were not fond of Germans after the Nazis took over Yugoslavia. They invaded German villages in the dead of night to snatch away able-bodied men to work in camps in Siberia and rape their wives, sisters, and mothers. The Donauschwaben in Illatscha constantly lived in fear of an invasion. For that reason, my oma slept between her grandmother’s feet clutching tightly to a small sack containing her belongings every night.

Tragically, on October 14, 1944 the fears of an invasion were realized. A siren blew loudly throughout the village, and the *Partisaner* announced that Illatscha’s villagers had six hours to pack their belongings and leave Yugoslavia. My oma and her family quickly bundled up everything they could and fled. Running through the field of tall wheat, my oma desperately clung to her grandmother’s hand with one hand and onto her small sack containing her few precious belonging with the other. As they fled as fast as their feet could travel, a plane flew lowly overhead shooting at them and the other fleeing villagers. To this day my oma remembers this terrifying day as if it was yesterday. They left behind their farms, their church, their school, their jobs, and the only life my oma ever knew.

Eventually, the Bitner family and other Illatscha villagers were loaded onto a cattle train to be taken to an undisclosed location. Would it be Siberia? Would it be a new place to start their lives? Luckily, after days upon days of traveling by cattle train as well as horse and wagon, the Bitner family and other villagers from Illatscha arrived in Linz, Austria where my family still lives today. Not everyone survived the long, dangerous, and arduous journey through Yugoslavia, part of Hungary, and much of Austria. However, those that survived were placed in the *erste Lager*, or the first building of the refugee camp at Linz. Here the Bitners waited to go through health screenings, be assigned to their respective jobs, and be given a barrack to live in.

They waited to learn what their future would hold in a large over-crowded room filled with families all anxiously awaiting the same thing.

Eventually, my opa Bitner was assigned to work at the steel plant, and the Bitner family was given a one-roomed barrack to live in. This living arrangement was typical for the refugee camp in Linz. Entire families shared a single room heated by one source that doubled as both a furnace and a stove. A one-roomed schoolhouse was the only educational establishment available for children, and those that were fortunate eventually learned a trade. The women of the refugee camp cooked, cleaned, and worked if they were given a job. The men worked, usually in the steel plant, to provide for their families. Hearing my oma talk about life in Linz is like traveling back in time to a year and place that stands in such stark contrast to life in the twenty-first century. It hardly seems possible that one person could experience such extremes. Yet despite these struggles, there is a hint of nostalgia in her voice when she talks about life in Austria.

Beyond any of the struggles and primitive physical surroundings that my Oma experienced in Linz, it is evident that she misses the proximity in which she lived to her family as well as being immersed in the rich Donauschwaben culture. Families spent almost all of their time together. They relied on each other for safety and provision, and helped each other in times of need. Unfortunately, when tragedy struck my oma's family, there was nothing that other family members or neighbors could do help. This tragedy took the form of a deadly disease that many people in the refugee camp were familiar with. In 1944, when my oma was five years old, her mother was diagnosed with tuberculosis. During the health screening process in the *erste Lager* as the family was in the process of gaining admittance into the refugee camp, she was given a chest X-ray that confirmed the diagnosis.

Because much of the Bitner family's wealth was left behind when they fled Illatscha, the family did not have abundant financial resources with which to ensure that my great-oma was given the best medical treatment available. However, she was under the care of the physician at the refugee camp who prescribed her medication. The disease did not seem to react to the medication, so she was removed from the Bitner household in order to prevent any other members of the village from contracting the disease. Suzanne, my great-oma, was admitted to a sanitarium when it was discovered that the medication was still not affecting her infection. When my oma was able to visit her mother, she interacted with her solely by looking at her through a large window. She saw her mother in a room containing many others suffering from tuberculosis. Quietly peering into the isolation room, my oma remembers the immense loss she felt. I can hear the pain in my oma's voice as she describes what it was like to be separated from her mother at such a young age. She says that amongst all of the sick people in the sanitarium it was nearly impossible to recognize her mother. She was gaunt, thin, and looked ill just like the rest of the tuberculosis patients admitted to the sanitarium. My oma said that, from what she could remember, her mother had looked like "nothing but skin and bones" for some time before her diagnosis so it is difficult to know exactly how long my great-oma had been sick for.

Although she was still alive, Suzann's separation from the family was palpable, real, and almost overwhelming. Her absence left a large hole in the Bitner family. Without a mother in the household, the cooking, cleaning, and sewing duties fell onto my oma and her grandmother. My oma tells me how she missed her mother terribly. Her mother was loving, and a woman to be admired. My oma looked up to her, and her tuberculosis infection irreversibly separated my oma from her mother. "No child should have to go through that," recounts my oma as she reminisces

on life during her mother's illness. "Your Onkel Erwin didn't even get to know his mother," she explains.

Three and a half excruciatingly long years went by. My great-oma was still in the sanatorium and now my oma was nine years old. My great-opa had enough. Nothing could be done to rid Suzanne of the horrendous bacteria colonizing her lungs. It was already known that my great-oma would die of this disease, but she was adamant that the last months of her life would no longer be spent in a sanitarium. Although it was ill advised, my great-opa struck a deal with a nearby farmer. For a price, the farmer allowed my great-oma to live in a one-room storage structure on his land. So, my great-oma spent the final six months of her life being visited by family while staying in self-quarantine. Thankfully, my oma was able to see her mother, bring her food, and spend limited amounts of time with her there.

Six months after moving into self-quarantine, on October 23, 1948, Suzanne Bittner succumbed to tuberculosis. She died at age 28 leaving behind her husband and two young children. Slowly, the family healed. My great-opa remarried, my oma's grandmother helped take care of the family, and life fell into a new rhythm. However, the devastating effects of the disease and its treatments left a lasting impact on my oma. Looking at her mother through the sanitarium window, bringing food to her house on the farm, and having to once again completely adjust her life after it was irreversibly altered are all as vivid to my oma now as they were then. Memories such as those are not easily forgotten.

After hearing my oma retell this story, I became more curious about tuberculosis. Questions about the disease itself, treatment option, and public health interventions continually came to mind. However, throughout my research on the topic it became apparent that in addition to specifics of the disease and its treatment, stigma seriously affects patients suffering from the



disease. Tuberculosis is associated with multiple stigmas and can be perceived differently within different cultural contexts, but some stereotypes of people with active tuberculosis infections are cross-culturally and internationally the same. Even in my oma's re-telling of her mother's struggle with the disease, concepts such as fear and isolation were repeatedly associated with her perception of her mother's illness. Therefore, considering perceptions of tuberculosis as well as scientific information regarding the disease are both important components to understanding tuberculosis.

My great-oma's story has inspired me to study tuberculosis. My oma has been curious about the disease, so hopefully through my research I will be able to explain more about it to her in order to contribute to her knowledge about her mother's life. Both my oma and opa have taught me many things, things too numerous to count, that they have learned throughout their difficult yet inspirational lives. They are two of the strongest people I know, and I am blessed to be related them. They are two of my biggest role models. After writing Suzanne Bitner's story and hearing my oma tell it again and again I was reminded of one lesson that both my oma and opa have taught me, which now rings truer than ever. Family is one of the greatest gifts that we are given so cherish it because you never know where life will take you.



Figure 2. The wedding of Suzanne Strumberger (left) and Josef Bitner (right) in 1936.



Figure 3. The Bitner Family in front of their barrack in Linz, Austria. From left to right: Suzanne, Maria, Erwin, and Josef Bitner.

## PRELUDE

Even though my great-oma suffered from tuberculosis approximately half of a century ago, the disease still persists today. Many factors contribute to why tuberculosis plagues humans across the world. The two factors this thesis will address are strengths and limitations of current treatment programs and perceptions of the disease that hinder patients from being treated. Overall, there are many other factors that contribute to tuberculosis's continued presence throughout human history as well, but they are beyond the scope of this thesis.

This thesis is divided into two sections. The first aims to highlight disease characteristics, current treatment methods, and additional complications that can arise with tuberculosis infection. Building upon this background information, the first section includes analysis of the strengths and limitations of current treatment options. The goal of the second portion is to show the reader that tuberculosis's damage extends beyond the physical wasting away of the patient's body. The disease is a metaphor for isolation, which explains why the tuberculosis also emotionally scars its host. Finally, the thesis will conclude with connecting the first two portions in attempts to explain the interplay between the physical and emotional damage experienced by patients suffering from tuberculosis.

Ultimately, there is not one way to eradicate tuberculosis and solve all of the problems that it creates. There is not one treatment program, one miracle drug, or one stupendous leader that can eradicate the disease. Instead, based on my research, it seems as though ridding the world of tuberculosis will depend on culturally sensitive treatment methods that are focused on the patient. This might require additional resources, specifically financial and labor resources, but eradicating this disease will benefit the global population.

## Background

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My great-oma, Suzanne Bitner, lived during a time when only a few of the currently used treatments were available, and the disease itself was not as understood as it is today. However, tuberculosis already had a rich history by the time she contracted the disease. The years in which she lived have guided me and served as benchmarks during my construction of a brief history of tuberculosis. The historical information and background details about the causal bacterium itself are necessary to clarify what TB disease is. This information is crucial to highlighting relevant disease specifics before analyzing how tuberculosis is being addressed today and what perceptions of the disease entail. The background information includes characteristics of the disease's causal bacterium, symptoms of TB infection, and components of diagnostic tests that are used to ensure a patient is correctly diagnosed as having tuberculosis.

## HISTORY

Tuberculosis has plagued human beings for centuries. Young and old, rich and poor, famous and otherwise have all suffered from this devastating disease. Ancient human populations first suffered from tuberculosis in Africa thousands of years ago. Then, it spread to South America by seals traveling across the Atlantic Ocean. Seals were a major food source for humans living in South America around 2,500 years ago. Therefore, when humans ingested a seal infected with tuberculosis bacteria, they contracted the disease themselves. After tuberculosis had reached South America, many different strains of the disease traveled the globe with their human hosts. As humans migrated to other areas of the world and settled in different locations, tuberculosis followed (Bos et al., 2014). These prehistoric movements set the stage for

the rest of tuberculosis's history as one of the most infamous and tragic diseases in the history of humankind.

According to Thomas Daniel, MD (1999), who has written accounts of tuberculosis's history after extensive study of the disease and experience with it, researchers discovered ancient remnants of the disease in the vertebrae of mummies preserved since pharaohs ruled Egypt (p. 9). Specimens dating back to around 3000 BCE containing evidence of tuberculosis bacteria have been found in the town of Dra Abu El-Naga on the Nile River in Egypt as well as in Thebes. In these mummies, the characteristic sign that the individual suffered from a tuberculosis infection is the presence of abnormal lesions in the spine. Although these mummies provide an important key to recognizing how long people have suffered from tuberculosis, they are not the only evidence of early tuberculosis infections. Many Egyptian art forms from this era depict people suffering from the disease. The pieces of art depict individuals with hunchbacks, a telltale sign of tuberculosis infection in the spine (Daniel, 1999).

Numerous other early tuberculosis cases in countries such as Peru, India, and China have been discovered that date back to around 2000-1300 BCE. These discoveries contained evidence of tuberculosis in the spine as well as the more commonly known lung infection of tuberculosis. Also, writings and other artifacts from these civilizations show that various communities had different names for tuberculosis. In India, ancient civilizations referred to it as *yakshma*, and in China it was called *laoping*. Hundreds of years later, after 460 BCE, the father of medicine, Hippocrates, addressed tuberculosis and provided additional insight into the treatment of the disease. Hippocrates called the disease *phthisis* and used this word in his case notes to describe tuberculosis (Daniel, 1999). Dr. Daniel (1999) mentions that Hippocrates's notes, containing various observations regarding the physical manifestations and symptoms of the disease itself,

seem to correspond with current clinical presentations of the disease (p. 18). Hippocrates characterizes *phthisis* as the most widespread disease at the time, and warns his fellow physicians to stay away from patients with the infection (“A History of Tuberculosis Treatment,” n.d.).

Other famous ancient physicians observed and wrote about tuberculosis. Arteus wrote about it in ancient Greece around 200 BCE, and Galen studied it ancient Rome. However, following these writings there was a gap of 1,000 years, during the Middle Ages, in which tuberculosis discussion was sparse. Interestingly, the most talked about form of tuberculosis discussed in writings from this age were not the infections present in the lungs or spine. The most commonly discussed form of tuberculosis from this time was called scrofula (Daniel, 1999). Dr. Daniel (1999) highlights the familiarity with which scrofula was discussed by mentioning that even Shakespeare includes it in *Macbeth* (p. 24). In patients suffering from scrofula, the lymph nodes become swollen but are still relatively painless (“Scrofula,” 2015). This term is still used today to describe this specific manifestation of tuberculosis characterized by the infection of the lymph nodes with the tuberculosis bacteria.

For the next hundred years, bouts of tuberculosis came and went claiming many lives along the way. Tuberculosis deaths were at their highest in England in 1780 when one-quarter of the population died of tuberculosis. Although the death rate was not as high, tuberculosis was still present in the nineteenth century. In addition to Shakespeare, Dr. Daniel (1999) explains to readers that many famous individuals, such as members of the Brontë family and other notable artistic and literary figures, died of the disease that was commonly referred to then as “consumption” (p. 30). However, on March 24, 1882, a monumental step was taken in curing the disease. On this date, Robert Koch announced that he had discovered the bacterium responsible



for tuberculosis. Koch's identification of the bacterium *Mycobacterium tuberculosis* as tuberculosis disease's causal agent was the first step in a long journey to accurately diagnose and treat the disease (Centers for Disease Control and Prevention [CDC], 2014a).

After Koch's Nobel prize winning discovery of *M. tuberculosis*, several other physicians and researchers used this information to experiment further with the bacteria. For example, in 1907, Clemens Freiherr von Pirquet, the pediatrician responsible for discovering serum sickness as well as creating the terms allergy and allergen, injected himself just under the skin with diluted tuberculin. Von Pirquet continued to experiment with tuberculin and injection dosages for the next two years. Based on the information he gathered from his experimentation, von Pirquet discovered a maximum amount of tuberculin that could be injected into an individual without them contracting the active disease. Interestingly, he realized that injecting this amount of tuberculin into children who did not suffer the full symptoms of the active disease allowed him to determine whether or not they had an unknown latent infection of tuberculosis bacteria (Daniel, 2006). A few years after Clemens Freiherr von Pirquet's discovery, in 1919, my great-oma Suzanne Bitner was born. Therefore, her story begins while researchers were still learning about fundamental aspects of the disease. A little more than ten years after my great-oma was born, in the 1930s, Florence Seibert expanded upon Clemens Freiherr von Pirquet's discovery. Siebert formulated a purified protein derivative (PPD) of tuberculin. PPDs are still used in a simple skin test to determine whether or not an individual has latent tuberculosis (Daniel, 2006).

Although the discovery of the PPD was and still is extremely helpful to diagnose cases of latent tuberculosis, creating an effective and sustainable treatment solution remained elusive. Other treatment methods that did not rely on medications were explored. Years before the discovery of the PPD, in the 1850, sanatoriums were established all over the world. Many

tuberculosis patients, including my great-oma, were admitted to sanatoriums after being diagnosed with active tuberculosis infections. These facilities attempted to provide their inhabitants with a good diet, exercise regime, and restful environment that would supposedly allow people suffering from the disease to recover. Tuberculosis patients did find respite in these places, but whether or not sanatoriums played a role in curing them of the disease is unknown (Daniel, 2006).

Despite the questionable effectiveness of sanatoriums, it was not until the twentieth century that scientists began to achieve some success in the development of tuberculosis vaccinations. In 1921, Albert Calmette and Camille Guérin developed the BCG vaccine. They noticed that cattle could suffer from tuberculosis, but the *Mycobacterium bovis* bacteria rather than *Mycobacterium tuberculosis* bacteria caused tuberculosis in cattle. Calmette and Guérin cultured a weakened strain of *M. bovis* and injected this into people suffering from tuberculosis to heal them. It was unclear what drugs my great-grandmother was given even after speaking with my oma about her mother's battle with tuberculosis. Since my oma was young when her mother was ill, she could not remember if her mother received the BCG vaccine. However, it was a widely used vaccine during this time. Its immediate efficacy resulted in thousands of people, adults and children alike, being vaccinated with the new BCG vaccine (Daniel, 2006).

As the twentieth century progressed, new potential tuberculosis treatments arose while BCG was being used to vaccinate individuals. In 1943, Jorgen Lehmann discovered para-amino salicylic acid (PAS) and Gerhard Domagk created thiosemicarbazone. Both of these drugs became the first effective agents to treat tuberculosis. Unfortunately, these drugs only stopped *M. tuberculosis* from replicating without actively killing the bacteria that were already present in the infected individual. Although it was an important step toward curing people of tuberculosis, a

more effective and potent killing agent was necessary in order to rid a patient of tuberculosis. In 1944, the answer to this need was discovered. Albert Schatz, Elizabeth Bugie, and Selman Waksman announced their discovery of the antibiotic streptomycin. Streptomycin was more effective than either PAS or thiosemicarbazone because it killed the *M. tuberculosis* bacteria instead of solely halting its replication. As streptomycin continued to be used to combat tuberculosis, more medications were formulated, and tuberculosis treatment radically changed. Unfortunately, my great-grandmother lost her struggle with tuberculosis in 1948, not long after the Bitner family arrived at the refugee camp in Linz. I do not know whether or not she received streptomycin as part of her treatment regimen, but she passed before being able to reap the benefits of newer antibiotics developed to fight tuberculosis. The 1950s brought isoniazid and rifamycins, thus beginning an era of new drug therapies available to treat the disease and improve patients' survivability (Daniel, 2006).

The development of vaccines and antibiotics was not the only way to attack tuberculosis. Many campaigns were launched to raise awareness of the disease and raise funds to continue to research ways to eradicate tuberculosis. For example, in 1948, the year in which my great-grandmother died, UNICEF and the Danish Red Cross sponsored a campaign to control tuberculosis. Beginning in Poland, spreading across Europe, and eventually reaching Ecuador, the International Tuberculosis Campaign resulted in 30 million people being tested for tuberculosis and 14 million people being vaccinated with BCG in only three years. This campaign was the first disease control program that an agency of the WHO, World Health Organization, undertook (Daniel, 2006).

Since then, many different organizations have attempted to combat tuberculosis. The WHO frequently publishes reports on tuberculosis and developed the Stop TB Strategy, which

builds off of previously developed treatment methods in order to continue to create effective ways to rid humans of this tragic disease (World Health Organization [WHO], 2015a). The Global Fund funnels billions of dollars to local program across the globe to improve the treatment options for people suffering from this disease (“The Global Fund,” 2015). High profile donors, such as the Bill and Melinda Gates Foundation, donate thousands of dollars to many organizations and programs designed specifically to address tuberculosis (Bill & Melinda Gates Foundation, 2015). Overall, strategies to combat this ancient disease have significantly improved and continue to work to fight it.

All of these international strategies and advancements in medicine development are helpful, but they are not enough. In 2013, 9 million people contracted tuberculosis, and 1.5 million died from it. Even more devastating is the fact that most of these deaths are preventable. Tragically, this ancient disease still plagues humans across the globe in the twenty-first century (WHO, 2015b). The image below shows the incidence rates of tuberculosis in 2012. As this image clearly shows, tuberculosis is still a concern in the twenty-first century.

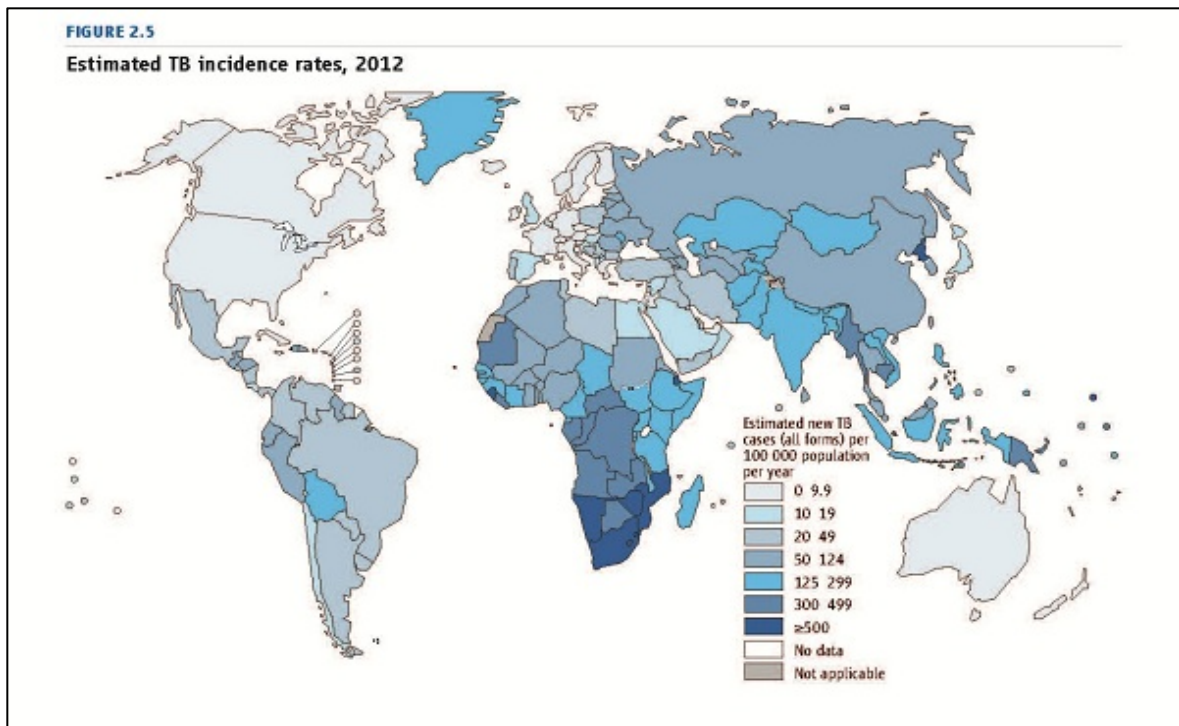


Figure 4. Estimated TB Incidence Rates, 2012. Adapted from StopTB.org, n.d., Retrieved November 12, 2014, from <http://www.stoptb.org/countries/tbdata.asp>. Copyright 2015 by UNOPS.

## DISEASE SPECIFICS

Before further analysis of tuberculosis can occur, information about the tuberculosis's causal agent is necessary for understanding the disease. As mentioned in the previous section, tuberculosis is caused by an infection of the bacterium *Mycobacterium tuberculosis*. *M. tuberculosis* is a rod-shaped bacteria, or bacilli, which is both non-motile and acid-fast. Each bacterium is usually 2-4 micrometers in length and 0.2-0.5 micrometers in width (Todar, 2012a). An important characteristic of *M. tuberculosis* that is crucial to understanding the way that the bacteria act when they infect a host is that the bacteria grow incredibly slowly. Their generation time is usually between 15-20 hours whereas many bacteria have generation times lasting in minutes (Todar, 2012b).



Figure 5. *M. tuberculosis* Bacilli. Adapted from the National Institute of Allergy and Infectious Diseases, 2012, Retrieved February 20, 2015, from <http://www.niaid.nih.gov/topics/tuberculosis/understanding/pages/cause.aspx>.

Additionally, *M. tuberculosis* is an obligate aerobe. Bacteria classified as obligate aerobes need oxygen to grow (“Obligate Aerobe,” 2015). Therefore, these bacteria are usually found in environments that provide the bacteria with a consistent and sufficient source of oxygen. For example, *M. tuberculosis* usually infects humans’ lungs, which provide an environment saturated with oxygen that is conducive to *M. tuberculosis*’s metabolic requirements. Specifically, after the infection has occurred, these bacteria usually concentrate and begin to grow in the upper regions of the lungs. The upper regions of the lungs are well aerated which perfectly satisfies the requirements of this vicious obligate anaerobe (Todar, 2012a).

A tendency to cluster in the oxygen rich area of the upper lungs is not the only characteristic of the bacteria that helps it thrive in its human host. *M. tuberculosis* is one of many



bacteria classified as facultative intracellular bacteria. The “facultative” portion of this descriptor means that the bacteria can replicate both inside and outside of cells. (“Facultative Anaerobe,” 2015). Typically, *M. tuberculosis* lives and grows within macrophages, cells that engulf and destroy pathogens and other molecules tagged for destruction (Todar, 2012b). Therefore, if *M. tuberculosis* infects these immune cells, there are serious implications for immune function. It is incredibly ironic that the cells responsible for killing things that invade and potentially harm the human body are the ones usurped by this fatal agent.

Unfortunately, it is relatively easy to become infected with *M. tuberculosis*. The bacteria are spread from a host with an active and contagious tuberculosis infection to another individual through the air. For this reason, tuberculosis is considered to be an airborne disease. When an infected individual with active and contagious TB coughs, sneezes, or even speaks, bacteria are launched into the air. Luckily, every time an infected individual coughs, sneezes, or speaks it is not guaranteed that someone around them will contract tuberculosis. Specific factors affect the likelihood of being infected with tuberculosis. Susceptibility of the potential host, the infectiousness of the infected individual, and the surrounding environment all contribute to tuberculosis transmission. If a potential host is immune-compromised, they are more susceptible to contracting the disease. If the infected host releases a lot of the bacteria instead of only a few bacilli, it is more likely that people surrounding them will become infected. Also, if a potential new host is around an individual with active tuberculosis for a long time and is in proximity to them, the chance that this individual will become infected with tuberculosis increase. Airborne tuberculosis bacteria can stay in the air for several hours making the bacteria even more likely to be inhaled by another potential host (CDC, 2014b).

As if contraction of the disease did not involve enough steps to be taken into account when considering ways to treat the disease, tuberculosis's behavior in the body is multi-faceted as well. The growth and presentation of tuberculosis can be broken down into four main phases. The first stage, transmission of the bacteria, begins with the new host inhaling *M. tuberculosis* bacteria. Next, the bacteria are ingested through the new host's mouth or are inhaled through the nasal passages. Once ingested, the bacteria travel through the upper respiratory tract, reach the bronchi, and end their journey upon reaching the alveoli of the lungs. This process usually takes one week. Once the bacteria reach the macrophages in the alveoli, infection begins (Todar, 2012c). Once in the alveolar sacs, *M. tuberculosis* is ingested by macrophages, immune cells responsible for engulfing and degrading pathogens, and other foreign substances. Depending on the size of the bacteria and the macrophage's strength, macrophage ingestion of *M. tuberculosis* does not ensure destruction of the bacteria (Müller, 2011).

If the macrophages in the alveoli do not kill *M. tuberculosis*, stage two of the disease usually begins about three weeks after initial infection of the patient. At the beginning of this stage, macrophages continue to engulf the bacteria, and the bacteria exponentially replicate within them. Once they can no longer accommodate the replicating bacteria, the macrophages burst, and *M. tuberculosis* spills out into the surrounding tissue. As the macrophages overflow with TB bacteria, other immune cells are recruited to address the issue. A cell-mediated immune response initiates the recruitment of T cells and other leukocytes to the lungs so an inflammatory response can begin. Additionally, at this phase of the disease, an infected individual will test positive for tuberculosis when a PPD skin test is administered (Müller, 2011).

As exponential replication of *M. tuberculosis* wanes, the disease enters its third stage. After the bacteria kill the macrophages surrounding them, the host environment immediately

surrounding the bacteria and macrophages becomes anoxic and acidic. Therefore, bacterial replication gradually comes to a stop, and the lungs sequester the bacteria in this region. At this point, the infection is controlled and stabilized. If an individual at this point of infection coughs, bacteria will not be launched into the surrounding air because the bacteria are restricted to specific clusters within the lungs. In other words, they are no longer contagious, which is fascinating because the individuals are still infected with the bacteria. The clusters in which *M. tuberculosis* congregates are called tubercles (Todar, 2012c). Tubercles are hard, slightly round regions of tissue made up of dead cells with *M. tuberculosis* at the center, and they are characteristic of tuberculosis infections (“Tuberculosis (TB),” 2015). The bacteria can stay within tubercles for years. The acidic and anoxic environment keeps the bacteria from replicating, so the bacteria are unable to leave these clusters within the lungs. An individual with tubercles in their lungs is said to have a latent tuberculosis infection or primary TB (Müller, 2011).

Tuberculosis does not always stop at this asymptomatic primary TB phase, thus making the disease significantly more frightening. Some patients with latent tuberculosis have additional health concerns that allow TB bacteria to re-activate and enter stage four. For example, patients whose immune systems weaken some time after their latent tuberculosis established itself are at risk for their TB bacteria re-activating. Also, patients who are immune-compromised before coming in contact with the tuberculosis bacteria might incur a TB infection that never enters the latent stage and continues to progress to stage four without stalling at stage three. Whatever the case may be, primary TB can become active TB. Once an individual has active tuberculosis, they are considered to be in stage four of tuberculosis infection. Once activated, *M. tuberculosis* bacteria rapidly replicate again and quickly spread through the lungs using the host’s immune

cells to spread. In some cases, the bacteria leave the lungs and infect other parts of the body. For example, as was seen in mummies found in ancient Egypt, infection of the spine with tuberculosis bacteria can potentially occur if tuberculosis is left untreated. When a patient suffers from active tuberculosis, they are contagious once again. Every cough, sneeze, or other related activity results in the spewing of infectious *M. tuberculosis* into the air waiting to be inhaled by a new host. If left untreated, active tuberculosis is potentially fatal (Müller, 2011).

Although symptoms depend on which stage of infection a patient's tuberculosis is in, there are a few characteristic signs of the disease, mostly associated with the active form, which are noteworthy. When a patient has latent tuberculosis, he or she does not have any symptoms. About 2 billion people have latent tuberculosis. Despite the lack of symptoms, patients with latent tuberculosis are still urged to seek treatment so that they do not develop active tuberculosis in the future. On the other hand, patients with active tuberculosis present with symptoms that are commonly associated with the disease. These symptoms include coughing, chest pain, and among others. If the tuberculosis infection spreads to other bodily structures, the patient will suffer from additional symptoms depending on what other organs or tissues are affected. For example, if tuberculosis infects the spine, back pain might follow. Also, if tuberculosis affects an organ such as the kidneys, bloody urine could ensue (Mayo Clinic, 2014).

The symptoms associated with tuberculosis are very indicative of active tuberculosis disease, but diagnostic tests are performed on individuals to confirm the diagnosis. Medical health professionals use a variety of tests when diagnosing a patient with tuberculosis. The tests employed to diagnose a patient with tuberculosis usually include a TB skin test or TB blood test. Depending on the results of these tests, additional methods such as a chest X-ray or a more specific bacterial test are administered to confirm the diagnosis (CDC, 2014c).

A TB skin test, or the Mantoux tuberculin skin test, is an easy and relatively non-invasive test. The tests are relatively painless, which seems to be small price to pay to determine whether or not an individual has this potentially life-threatening disease. A small amount of tuberculin, which is an extract of *M. tuberculosis*, is injected under the skin of the patient's lower forearm. Once injected, a small bubble is visible under the skin. Within 48-72 hours, a reaction to the tuberculin will or will not have occurred. After this allotted amount of time, the patient has a medical professional read the skin test and declare it either positive or negative. If the test is positive, a raised red bump where the tuberculin was injected will be visible. The injection site will be slightly swollen, and the injection point will feel hard upon palpation. A positive TB skin test means that the patient has tuberculosis, and additional tests will be administered to confirm this preliminary diagnosis or treatment will begin. On the other hand, a negative TB skin test is characterized by the absence of any characteristics associated with a positive result, such as hardness and swelling at the tuberculin injection site. If a patient's TB skin test is negative, the patient most likely does not have active or latent tuberculosis (CDC, 2014d).

A TB blood test can also be administered as a preliminary test to determine whether or not a patient has tuberculosis. TB blood tests are usually performed on patients that continually do not return to see a medical professional after their TB skin test has been administered or patients that have been vaccinated with the BCG vaccine. Many countries still vaccinate their citizens with BCG to protect them from a tuberculosis infection. However, this vaccination involves injecting a form of *Mycobacterium* into the patient. Ironically, patients vaccinated with BCG and later receive a TB skin test will have a positive reaction to the injected tuberculin. Although biologically this is logical, it seems contradictory for an individual to test positively to a diagnostic test because of a vaccine. TB blood tests, or interferon-gamma release assays,

determine whether or not *M. tuberculosis* is present in the individual based on how the patient's immune system responds when it comes in contact with the bacteria. Blood is extracted from an individual and is exposed to *M. tuberculosis* in the lab. Then, the strength of the immune response in the presence of the bacteria is measured. A positive IGRA means that a person has *M. tuberculosis* bacteria in their body whether as a latent infection or an active one. Additional tests are required to determine which form of the disease is present. A negative IGRA means that the patient has no *M. tuberculosis* in their body and therefore does not have latent or active tuberculosis (CDC, 2014e).

Another way to determine whether or not an individual is infected with tuberculosis is to perform a chest X-ray. Medical professionals take posterior-anterior images of a person's chest in order to locate any abnormal regions in the lungs. Usually, lesions indicative of tuberculosis infection will be visible on these images. X-ray images have been used to diagnose tuberculosis for decades. Before gaining admittance into the refugee camp at Linz, my oma and her family, like all incoming individuals, were required to pass a health-screening test before living in the camp. It was during her health screening test, which included a chest X-ray, that my great-oma received her diagnosis of tuberculosis. There is a significant amount of variance in lesion size, shape, and density in radiographic images, so an X-ray is helpful to rule out false positive TB skin and blood tests. If a chest X-ray contains abnormalities, additional tests are usually performed to formulate a more concrete and confident diagnosis (CDC, 2011d).



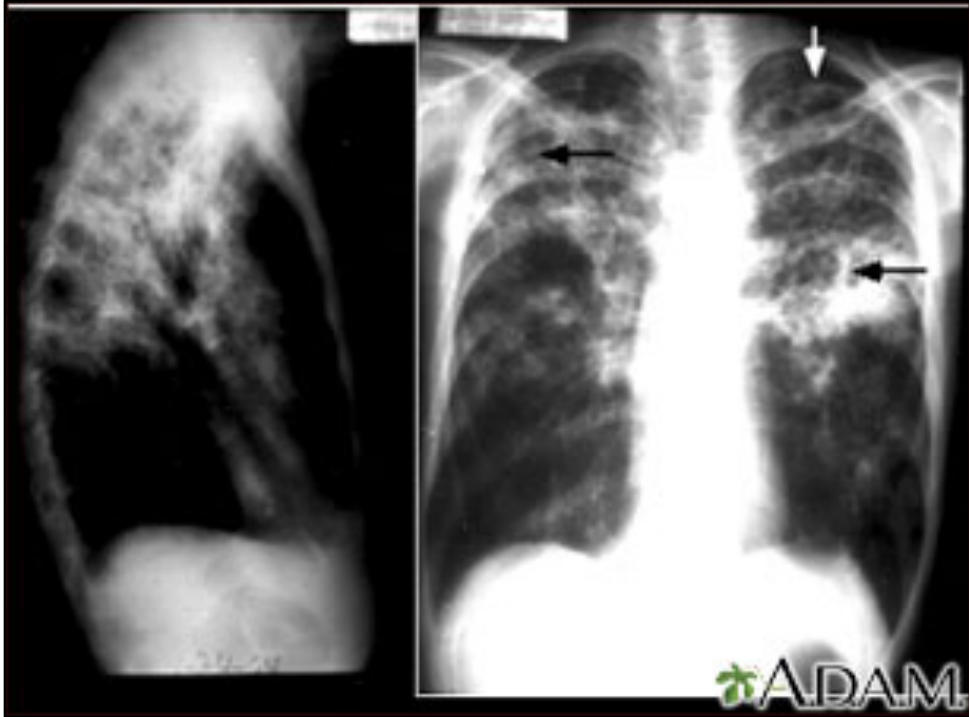


Figure 6. Chest X-ray of a Patient with Tuberculosis. Adapted from MedlinePlus, September 1, 2012, Retrieved November 12, 2014, from <http://www.nlm.nih.gov/medlineplus/ency/imagepages/1607.htm>.

The final diagnostic test that could be used to determine whether or not a patient is suffering from tuberculosis is acid-fast microscopy. Once again, *M. tuberculosis* has a strategy to avoid easy detection, thus supporting its survival. *M. tuberculosis* is an acid-fast bacteria meaning that the bacteria cannot be dyed with some dyes used for microbiological staining. Therefore, acid fast bacteria would not be as visible when observed under a microscope. The outer coat of *M. tuberculosis* does not allow the dye to bind to the cell, so normal staining procedures are unhelpful. Specific methods, such as the Ziehl-Neelsen stain, are used instead. The Ziehl-Neelsen staining method requires that *M. tuberculosis* be smeared and fixed onto a slide where it is stained with carbon-fuchsin dye, decolorized with acid-alcohol, and then

counterstained. When stained using the Ziehl-Neelsen method, *M. tuberculosis* will appear pink when observed under a microscope (Todar, 2012a). However, *M. tuberculosis* is not the only acid-fast bacterium. So, when a procedure such as the Ziehl-Neelsen method is performed and pink acid-fast bacteria are visible, the visible bacteria is cultured to determine whether or not *M. tuberculosis* is present. If the culture contains *M. tuberculosis*, the patient is diagnosed as having TB disease (CDC, 2011d). After a TB disease diagnosis is confirmed, treatment is the next step in curing the patient of tuberculosis.



## Treatment

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After receiving a diagnosis of tuberculosis, patients must receive proper and effective treatment as soon as possible. A variety of treatment procedures are available for patients. Almost always, drug therapy is prescribed and it requires patients to take a variety of drugs for 6-9 months (CDC, 2012a). However, drug therapies are not the only treatment options for patients suffering from tuberculosis. Isolation, a treatment method used in my great-oma's case, is a widely used method in addition to medications. Highlighting the drug therapies and additional treatment methods associated with tuberculosis is important because they are the root of many controversies and problems regarding why humans still suffer from the disease. The available treatment methods for patients with tuberculosis as well as their strengths and limitations will be discussed in this section.

### MEDICATION

Decades of research have been dedicated to creating anti-tuberculosis drugs, and many have been developed. Interestingly, not all are frequently distributed. Although many drugs are approved as safe and effective treatment methods, only four drugs are the most widely used to treat tuberculosis. These four drugs are isoniazid, rifampin, ethambutol, and pyrazinamide (CDC, 2012a). Isoniazid interferes with *M. tuberculosis* replication and metabolism. The drug does not allow the bacteria to make mycolic acids, which are necessary when forming the bacterial cell wall. Also, isoniazid interacts with a bacterial enzyme so that *M. tuberculosis* cannot properly metabolize ("Isoniazid," n.d.). Rifampin impedes the function of bacterial RNA polymerase. It binds to an enzyme so that RNA polymerase cannot transcribe DNA (Wehrli, 1983). Ethambutol does not allow the formation of metabolites necessary for *M. tuberculosis* replication. However,

it is only effective in bacterial cells that are actively replicating. Additionally, it is involved in the killing of *M. tuberculosis* cells (Forbes et al., 1962). Lastly, pyrazinamide works against *M. tuberculosis* by interfering with its membrane's ability to transport substances. Not much else about pyrazinamide's function is known (Zhang et al., 2003).

Tuberculosis medications are administered differently for patients suffering from latent infections and those suffering from active infections. The recommended drug regimens for patients with latent infections involve taking one or two drugs for a specific amount of time. The most frequently prescribed regimen for individuals suffering from latent tuberculosis infection requires the patient to take isoniazid daily for nine months. This regimen is usually prescribed for children and patients also infected with HIV (CDC, 2012b).

Another potential treatment that can be administered involves a combination of isoniazid and rifapentine, a drug that does not allow RNA polymerase to transcribe DNA (Munsiff et al., 2006). This combinatorial treatment is divided into 12 doses taken over the course of three months. The isoniazid and rifapentine regimen is recommended for specific patients. Individuals 12 years and older who are healthy other than their latent TB infection and who are highly likely to develop active TB disease in the near future are usually given this regimen. The last recommended treatment requires that patients take rifampin daily for four months. This regimen is divided into a minimum of 120 doses. Alternative drugs, dosages, and times are available depending on specific patient needs, but these are the treatments most commonly diagnosed for patients suffering from latent tuberculosis infections (CDC, 2012b). Regardless of which drug regimen is administered, each one is complicated and involves a significant amount of planning, thus making tuberculosis drug therapy a potentially difficult task.

Patients suffering from active TB disease are treated differently than those with latent infections. However, the drug regimens remain complex and time dependent. Although the drugs involved are largely the same, treatment regimens are divided between two phases, the initial phase and the continuation phase. The recommended treatment requires patients to take isoniazid, rifampin, ethambutol and pyrazinamide daily in 56 doses over the course of eight weeks. These eight weeks fulfill the initial phase of treatment. The continuation phase, which is not required for all patients, follows the initial phase and lasts between four and seven months. This phase requires patients to take isoniazid and rifampin daily for 126 doses over eight weeks. Alternatively, the patient can take isoniazid and rifampin twice a week for 36 doses over 18 weeks. Patients are usually suggested to complete the four-week continuation phase regimen, but this is not necessary in all cases (CDC, 2012b).

The initial and continuation phases mentioned above are the regimens that are preferred and most commonly administered. However, successful alternative treatments are also available if necessary (CDC, 2012b). New treatments are currently in trial phases (“Working Group on New TB Drugs,” 2015). Hopefully, these new drugs will begin to rid the patient of the disease sooner than the drugs currently used, destroy drug-resistant bacterial strains, and cause fewer side effects for the patients taking them.

## ISOLATION

Historically, tuberculosis was not always treated with drugs. Rifampin, isoniazid and many of the other drugs used to cure tuberculosis in the twenty-first century were not an option for many patients suffering from tuberculosis throughout history. The development of other methods to decrease the spread of tuberculosis was necessary. One method that has been used for

decades and is still used in some cases today is isolating a patient with active tuberculosis. Isolation is the separation of a patient who is contagious and has already been diagnosed as being infected with tuberculosis. A standardized way to isolate patients was first used in the Middle Ages and has been used ever since (CDC, 2014f). Whereas drug therapies wreak havoc on a patient's body, isolation can cause significant emotional damage to an individual. Because of this, isolation continues to be an incredibly controversial treatment strategy that many consider to be unethical.

However, many large organizations involved with tuberculosis treatment support isolation as an important step in addressing tuberculosis infections. The Stop TB Strategy, a strategy created by the WHO to reduce the spread of tuberculosis, published a pamphlet for patients with infectious tuberculosis. The pamphlet explains what patients should expect regarding TB and its treatment. An entire chapter is devoted to preparing patients for isolation if it becomes a necessary step in their treatment (Thorn, 2007). Paul Thorn (2007), the author of the pamphlet, states, "Many people who have been through the isolation experience say that it is the hardest part of having TB" (p. 14). Isolation rooms are characterized as small, potentially under negative pressure, and usually with a phone. In isolation, a patient's diet is most likely different from what they are accustomed to and exercise is encouraged if the room size allows. According to the Stop TB pamphlet, isolation usually lasts between 14-30 days and can be an emotionally taxing experience (Thorn, 2007).

## DIRECTLY OBSERVED THERAPY SHORT-COURSE

Fortunately, isolation is not the only method available to stop the spread of tuberculosis. Other methods have been incorporated into standard tuberculosis treatment methods that work in

conjunction with drugs to effectively kill *M. tuberculosis* and cure patients of TB disease by extension. The WHO has created DOTS, or directly observed therapy short-course, as a way to guide nations toward decreasing the incidence and prevalence of tuberculosis across the world. DOTS can be broken down into five main elements. These elements include the presence of political commitment and consistent financing, better diagnosis and detection of cases, supervision and support for patients receiving treatment, enough medication and trained people to manage them, and a system that can track the disease as well as its impact on communities that it affects (WHO, 2015a). As is evident through these components, DOTS is a multifaceted approach to address issues associated with tuberculosis ranging anywhere from small-scale interventions such as patient support to larger scale interventions such as political involvement.

The first element of DOTS, political and financial commitment, calls for governmental commitment to curing tuberculosis by being consistently involved and increasing their financial support. When governments of different countries show dedication to the same goal, the eradication of tuberculosis, in this case, supportive and beneficial partnerships can form between them. The partners can begin to develop strategies together that will improve tuberculosis treatment availability as well as many other factors that can bring local communities and the greater international community one step closer to eradicating this disease. A large part of what political involvement can do to benefit tuberculosis treatments is providing continual and substantial funding. Proper financing for sufficient and good quality tuberculosis treatments for all people that need it begins with political commitment. Once governments have addressed tuberculosis domestically, international partnerships can provide additional assistance and support where necessary. All of these suggestions for political involvement are considered with the main goal to ensure that TB patients are able to receive treatment (WHO, 2015a).



The second element of the DOTS therapy is to be able to more efficiently and accurately diagnoses cases of tuberculosis using better detection methods. As mentioned in the previous chapter, one of the ways to determine whether or not a patient is infected with *M. tuberculosis* is to perform acid-fast microscopy and culture the acid-fast bacteria. If *M. tuberculosis* is present in the culture, then the individual is diagnosed as being infected with tuberculosis bacteria. Acid-fast microscopy is an effective and accurate way to diagnose TB disease. Unfortunately, not everyone has the luxury of receiving these tests let alone receive them in a timely manner. Therefore, it is necessary for labs that are better equipped with the proper technology and trained lab personnel to be accessible to all patients who need these services. All of these labs should follow international guidelines as well as provide staff with routine training in order to ensure that patients are treated properly (WHO, 2015b). Eventually, if element two is put in place, case detection rates should improve and more immediate treatment of infected patients will follow.

The third element of the DOTS strategy is that patients need to be supplied with standard treatments and should be supported in completing their respective treatments. Standardizing treatments requires medical professionals to provide their patients with the recommended drug regimens and dosages. The WHO made this information available and provided guidelines regarding standardized treatment that are accessible to medical professionals. Standardizing treatment across the globe benefits the global community for many reasons. One of the main reasons that treatment should be standardized is that it will reduce the development of new multi-drug resistant strains of tuberculosis. Since multi-drug resistance strains are often incurable, doing anything possible to reduce the occurrence of these strains is incredibly beneficial (WHO, 2015c).

The third element of the WHO's recommended DOTS program involves providing patients with support and supervision while they are receiving treatment for tuberculosis. One of the main reasons that multi-drug resistant strains of *M. tuberculosis* develop is because of non-compliant patients. Some patients do not finish their drug regimens or only take them at intermittent times rather than at regular time intervals like they are suggested to do. In order to eliminate this behavior, observing patients as they take their medication is a suggested way to ensure patient compliance. Observation can be done anywhere and by any trained individual that the patient allows to supervise them. This method keeps patients accountable for taking their medication as well as ensures that providers are properly administering medications. Lastly, this element suggests that support group for patients in need could also be a beneficial addition to tuberculosis treatments (WHO, 2015c).

As part of this third element of the WHO's DOTS program, patients are supervised while receiving their tuberculosis medication through Directly Observed Therapy (DOT). DOT has been used extensively because of its efficacy in increasing the tuberculosis cure rates. DOT requires a trained healthcare professional or other individual to watch a patient receiving tuberculosis treatment swallow every pill in the correct dosage on the designated treatment days to ensure that the patient is taking their medication appropriately. This usually involves ensuring that the patient takes four anti-tuberculosis drugs five days a week for two months. After completing the two months of initial treatment, the patient will most likely take isoniazid and rifampin once a day for three to five days every week for an additional four to seven months (Friedland et al., 2004). DOT is not always employed when a patient receives treatment for tuberculosis, but there are some groups of patients for whom this therapy is recommended. Patients suffering from drug-resistant strains of tuberculosis, those receiving treatment

intermittently, and patients considered likely to not adhere to the guidelines of taking tuberculosis drugs are those enrolled in DOT programs. Potentially noncompliant patient populations usually include homeless patients, children, those that abuse drugs or alcohol, and patients suffering from disabilities. Additionally, individuals with latent tuberculosis infections, specifically those that are at a higher risk to develop an active infection, can also undergo DOT (CDC, 2012c).

There are multiple components of Directly Observed Therapy programs to ensure that patients are monitored when receiving tuberculosis treatment. DOT requires the healthcare worker or other designated individual to check the patient for side effects, verify that the correct medication and correct dosage will be given to the patient, watch the patient swallow the entire dose, and finally document the patient's visit. Some DOT programs go beyond these few steps. They help patients keep their appointments, provide incentives that encourage patients to continue treatment, and even provide transportation to and from the location that provides DOT. This location does not need to be in a medical clinic. DOT is usually given in a health care facility, referred to as clinic-based DOT, but field-based DOT is also an option for patients. Field-based DOT is defined as DOT provided to patients outside of a healthcare facility. It can be performed anywhere that is agreed upon by the patient and the individual providing the DOT. Locations such as at the patient's home or workplace are commonly used (CDC, 2012c).

Even if patient support and adequate supervision is available, tuberculosis treatment will be non-existent if drugs are unavailable. Therefore, the fourth pillar of the DOTS program is that enough drugs should be available for patients in need, and a management system should be in place in order to administer these drugs effectively. This element mostly concerns healthcare facilities. It challenges these facilities to have a reliable way of receiving the correct drugs in

necessary amounts so that they can be properly distributed to patients in need. Interestingly, this element states that anti-TB drugs should be free for all who need them. By providing these drugs free of charge, the WHO states that society as a whole will benefit because tuberculosis transmission to others will become less of a concern (WHO, 2015d).

The final element of the DOTS strategy is that a system that can track the disease as well as its impact on communities that it affects. Recording and reporting systems are necessary to fulfill this element. These systems would be extremely beneficial because they will allow governments and health facilities to track tuberculosis so that they can address the proper areas in need of assistance. The way that data, including patient information and the treatment method used, is reported and recorded should be the same. After standardization is implemented, these records can be compiled after a stated amount of time and compared to older records to reach conclusions about the current state of tuberculosis in that region. If standardization of the information is achieved, then it can be easily read and analyzed. Although this element will require additional staff training to ensure that all people are aware of the proper way to report information, this element will provide information that will positively influence tuberculosis treatment and outcomes in the future (WHO, 2015e).

### **DIRECTLY OBSERVED THERAPY SHORT-COURSE PLUS**

The five elements of Directly Observed Therapy Short-Course, as outlined by the WHO, were expanded upon in 2000. The new expanded version of DOTS is called DOTS-plus, and it includes additional guidelines and suggestions when attempting to eliminate the presence of multidrug-resistant strains of tuberculosis. This revised version of DOTS should strengthen the

original DOTS program and improve it in a way that allows it to be applied to more patients suffering from tuberculosis infections (Grover & Takkar, 2008).

DOTS-plus includes five main pillars, like the original DOTS program, that structure its suggested approach to effectively dealing with MDR-TB cases. Two pillars of the DOTS-plus program directly overlap with the DOTS plan. These two pillars are that political commitment is a necessary component to address multidrug-resistant cases of tuberculosis, and that quality anti-TB drugs should always be available to patients in need. The three pillars that are unique to the DOTS-plus program are proper drug susceptibility and culture testing to diagnose MDR-TB, the availability of the necessary amount of second-line drugs and other treatment strategies, and a recording system that keeps track of MDR-TB cases, how they are treated, and can report the treatment outcome. All of the pillars of the DOTS-plus program, even those that overlap with the original DOTS program, require a significant amount of financial resources and a fully operational DOTS program before DOTS-plus can be effective (Grover & Takkar, 2008). Therefore, implementing the DOTS-plus program is even more reliant on political commitment, specifically from a financial perspective, in order to work toward the goal of effectively treating all patients infected with tuberculosis.

## TREATMENT STRENGTHS AND LIMITATIONS

Tuberculosis can be treated in multiple different ways. All of the treatment methods currently used to treat tuberculosis are effective to some degree. However, despite their strengths, isolation, Directly Observed Therapy Short-Course, and Directly Observed Therapy all have limitations that make components of these methods ineffective, thus contributing to why people still suffer from tuberculosis.

Isolation is a controversial, although widely used and recommended, method when considering various treatment options that are available to address tuberculosis infections. From one perspective, isolation can be seen as an effective and beneficial way to reduce the spread of tuberculosis. Isolation prevents contagious individuals suffering from active tuberculosis infections from interacting with their families and other members of their communities, thus eliminating the potential for transmitting the disease. Many prominent healthcare organizations recommend that patients undergo isolation when they are diagnosed with an active tuberculosis infection. Chapter 7, entitled “Tuberculosis Infection Control, ” of the CDC’s (2014g) booklet containing their recommended guidelines in addressing tuberculosis, states, “Persons who have or are suspected of having infectious TB disease should be placed in an area away from other patients, preferably in an airborne infection isolation (AII) room” (p. 197). An airborne infection isolation room houses one person and has an altered environment that discourages the transmission of tuberculosis (CDC, 2014g). Isolation is an effective and widely used strategy because it reduces the transmission of tuberculosis to other potential hosts by removing the patient from coming in contact with other individuals.

On the other hand, isolation has been shown to have significant emotional effects on patients that lived through the experience. Being taken away from family and friends to live alone while suffering from a potentially fatal disease and undergoing difficult drug regimens results in significant emotional distress. Mel Burden, an individual originally from the United Kingdom that contracted tuberculosis after working in a hospital located in rural South Africa, was isolated upon returning to the United Kingdom after living in South Africa. Ms. Burden explicitly stated the emotional turmoil she suffered while in isolation (Burden & Bakere, 2012). She describes the feeling of living in isolation:

I was very low, frustrated, and overwhelmingly lonely. I had only just started my new job and already missed the companionship and the office banter. These feelings were made worse by the complicated treatment and associated side effects. I felt extremely nauseous and tired. (p. 2)

Burden later discusses the difficulties in the treatment itself and mentions that these difficulties make defaulting from treatment an appealing option (Burden & Bakere, 2012). Based on these reflections, isolation seems to be a challenging and damaging treatment method for a patient suffering from tuberculosis.

Isolation is usually required to be voluntarily chosen by the patient, but in specific cases a patient's isolation can be involuntary. Patients subjected to involuntary isolation are usually those that are contagious but adamantly refuse treatment even after being warned of the dangers of transmitting tuberculosis to others. There are multiple laws that must be followed and additional extenuating circumstances that must occur in order for involuntary isolation to be administered. These laws ensure the legality of subjecting a person to involuntary isolation. Also, extenuating circumstances ensure that this is the last resort and only used in the most desperate of situations. For example, an extenuating circumstance related to this issue could be when a patient is unable to take their own medication or if a patient refuses to take infection control measures despite the use of every possible way to reason with them (WHO, 2010). In these cases, an ethical tension arises between doing what is best for the patients and doing what is best for the community. According to Mel Burden's testimony, isolation seems to be incredibly discouraging to the patient. However, subjecting a patient to isolation reduces the possibility that tuberculosis will spread throughout a community. Therefore, a difficult decision must be made to determine whether or not patients should undergo isolation.

In addition to the ethical concerns regarding isolation as an effective way to control tuberculosis, other recommended treatment options are surrounded by controversy as well. For example, Directly Observed Therapy Short-Course, as recommended by the WHO, is not effective in every community that uses it. Initially, the Directly Observed Therapy Short-Course program to address tuberculosis sounds like a program that would be incredibly effective at combatting tuberculosis. However, the program has many limitations. In 2001, 155 countries used the WHO's DOTS program. The program is considered successful if greater than 85% of the patients enrolled in the program complete their treatment. However, countries using the DOTS program rarely reach this percentage. The number of patients that complete their tuberculosis drug regimens due to their enrollment in DOTS are variable because the program is not always implemented effectively. Many countries suffer from a lack of people able observe patients taking their medication, a lack of anti-tuberculosis drugs, not enough political commitment, as well as a number of other factors. In cases where DOTS is not implemented correctly, tuberculosis patients do not receive the benefits that the program has the potential of providing (Friedland et al., 2004). In these cases, the program could potentially do more harm than good to patients and communities by administering anti-tuberculosis medication to people without supporting them in their completion of the regimens.

Despite many potential inconsistencies in the implementation of the DOTS program, there are some countries that have had success using the program. For example, DOTS programs have been successful in the Nyandeni district of South Africa's Eastern Cape because of the inclusion of DOTS supporters. These supporters encourage patients as they participate in the DOTS program. Much of the success of this program can be contributed to the incentives present for individuals involved with the program. Motivating the workers observing patients taking



their medications is crucial. Additionally, providing support and encouragement for patients involved in DOTS is important. When all individuals involved with correctly implementing a DOTS program are motivated to continue to follow the program, the program is more successful (Dick et al., 2005). In this case in South Africa, adding DOTS supporters to the program increased motivation to participate in the program. Although this might not work in all cases, it could be a factor to consider if morale is low in DOTS programs implemented in other countries.

Another country in which the DOTS program has been particularly successful is Bangladesh. In 1993, Bangladesh began to implement the DOTS program in a rural portion of the country. Sputum smears were performed on the patients enrolled in the study over the next two years. Of the new smear-positive patients in the study, 78% were cured of tuberculosis. After this promising cure rate had been realized, Bangladesh expanded its DOTS program to cover 67 million people three years later. One of the unique factors that Bangladesh implemented when the country began the DOTS program was that the health care facilities and networks already in place around the country were used. The researchers reported that the “decentralization of sputum smear microscopy and treatment delivery services to peripheral health facilities” heavily influenced their success. Additionally, the researchers recommended that case monitoring and detection needs to be increased to continue to effectively cure tuberculosis cases (Kumaresan et al., 1998). Although these factors employed by the DOTS program in Bangladesh were successful in this cultural context, they might not be successful in all areas of the world. Therefore, these factors could potentially be used as helpful starting points in increasing the effectiveness of DOTS programs, but they should be altered when necessary depending on the cultural context in which DOTS is employed.

The Directly Observed Therapy Short-Course program has many components, as previously mentioned. Specifically, the Directly Observed Therapy, or DOT, portion of the DOTS program suggested by the WHO is extremely controversial. The main strength of DOT is that it ensures that patients take their full drug regimen. When patients take their full regimen and take the drugs at proper times, the chance that the patient will develop a drug-resistant strain of tuberculosis decreases. Also, DOT ensures that the patient takes their drugs at the required times. When the patient follows the time schedule that specifies when they should take their medication, patients become non-contagious much quicker than if they were to take their medication intermittently. DOT is also an effective way of ensuring that the patient reacts well to their tuberculosis medication. Health care workers or the individuals designated to administer DOT monitor the patient for side effects and make sure that the patient is reacting well to the treatment (CDC, 2012c). Anyone that is approved by the patient to administer DOT can be, but analyzing the differences in the effectiveness of family members, co-workers, or medical professionals in providing DOT is beyond the scope of this paper.

According to the WHO, DOT is considered to be an ethical way to treat patients with active tuberculosis infections as long as the treatment remains patient-centered and a few concepts are kept in mind when implementing the program. To be considered an ethical approach to combating tuberculosis, DOT programs must reduce the costs that tuberculosis treatment has on patients, allow the patients to choose their observer, explain the consequences of discontinuing treatment, and properly manage the patients' side effects. Additionally, the WHO requires that DOT programs, in order to be considered ethical, educate communities about tuberculosis disease and treatment to reduce the stigma associated with the disease (WHO, 2010). The WHO (2010) states, "Directly observed therapy should be seen as a process for

providing support, motivation, and understanding to patients” (p. 16). DOT should be a patient-centered approach to distributing tuberculosis medication.

In a study performed by Anuwatnonthakate et al. (2008), the effects of directly observed therapy on tuberculosis treatment were studied in four provinces in Thailand (p. 1). The researchers gathered epidemiological data from patients at hospitals in these four hospitals that had pulmonary tuberculosis, were never diagnosed with the disease before their current infection, and did not have a drug resistant strain of the disease. After administering DOT for two months, the effectiveness of the program was determined by the amount of patients that stopped their treatment. The researchers found that fewer patients defaulted from treatment when involved with the DOT program than those that were not (Anuwatnonthakate et al., 2008). When patients do not stop treatment and take it correctly, they are more likely to be cured from the disease quicker than those that do not. Therefore, DOT supported this agenda in Thailand. Thailand is not the only country in which DOT has reduced the amount of patients that stop tuberculosis treatment. Countries across the world that have employed DOT have realized decreased incidence of tuberculosis and a decrease in drug resistant strains (Friedland, 2004).

Although all of these strengths of DOT are compelling evidence that it should be implemented in most tuberculosis cases, there are significant limitations to the therapy that should cause medical professionals to think twice before employing this program. The limitations of DOT depend mainly on the way one considers a treatment method to be successful. In the Thailand example mentioned above, DOT could be considered effective because it reduced the amount of patients that defaulted from treatment. However, the paper did not mention whether or not DOT was perceived as a respectful way of treating patients suffering from tuberculosis. DOTs limitations are heavily rooted in patient perception of the program.

DOTs could also be considered unsuccessful because the program could be interpreted as insulting to many patients. Telling a patient that they are unlikely to take their medication as they were told implies that the patient is irresponsible, possibly uneducated, and has other negative attributes that make them delinquent. Labeling an individual in this way is demeaning, and the entire DOT program is frequently seen as punitive (CDC, 2012c).

One compromise that could potentially foster respect for the patient as well as promote adherence to tuberculosis drug regimens is home-based directly observed therapy. As previously mentioned, fully analyzing the effectiveness of different individuals that can provide directory observed therapy is beyond the scope of this paper. However, recognizing the effectiveness of home-based directly observed therapy could provide a potential solution. The CDC mentions that family members are not the preferred people to serve as DOT volunteers for their family members (CDC, 2012c). However, based on a study performed in Botswana, patients that received directly observed therapy from family members did not exhibit significantly different cure rates from patients that received directly observed therapy from facilities (Kabongo & Mash, 2010). According to Kabongo & Mash (2010), “HB-DOT is at least as good as FB-DOT in term of the treatment outcomes” (para. 5). Perhaps, if a patient is able to receive directly observed therapy from a family member, a patient might feel a sense of safety and respect even while someone watches them take their medication. HB-DOT eliminates the unfamiliarity between a patient and his or her DOT provider. Therefore, the situation might be more respectful.

Overall, these results in Botswana are promising, and perhaps home-based directly observed therapy can be improved in order to be more effective in increasing the cure rates of tuberculosis while fostering respect for the patient. However, this treatment method might not

work all over the world. Not every patient in every cultural context will react the same way to a treatment method. Therefore, home-based directly observed therapy, and even directly observed therapy in general, might need to be culturally adjusted based on the context in which it is employed.

Despite the many strengths associated with currently methods used to treat tuberculosis, limitations still hinder these methods from being completely effective. Recognizing the limitations associated with tuberculosis treatment methods is the first step toward eliminating them. Promising case studies provide new concepts and additional factors that can potentially be applied to tuberculosis treatment programs in other communities so that tuberculosis can be fought efficiently and effectively.

## Complications

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Although the presence of treatment options and strategies to help countries fight tuberculosis seems promising, complications and additional factors make reducing the prevalence and incidence rates of the disease more difficult. Two major factors that influence patients suffering from tuberculosis are HIV/TB co-infections and the rise of drug resistant strains of tuberculosis. Both of these factors add new things to consider when discussing appropriate and effective treatment of tuberculosis. HIV/TB co-infections require different medications because the patient is suffering from two different diseases, and drug resistant strains of tuberculosis are not killed with the normal antibiotics used to eliminate tuberculosis. Therefore, analyzing these two complications to tuberculosis infection is important because they add caveats to consider when analyzing the presence of tuberculosis.

### HIV/TB CO-INFECTION

HIV and AIDS themselves are both major concerns around the world. However, the concerns associated with them are exponentially increased when considering tuberculosis in the context of HIV positive patients. Tuberculosis is the main infectious killer of patients suffering from HIV/AIDS (“TB & HIV/AIDS,” 2015). According to data from the WHO, patients with HIV are 26 and 31 times more likely to contract tuberculosis than others. Additionally, in 2013, 1.1 million people of the nine million new cases of tuberculosis were infected with HIV previously to being diagnosed with tuberculosis (WHO, 2015f). These statistics reinforce the importance of addressing HIV/AIDS issues when considering tuberculosis. Unfortunately, these two diseases are often present together even though both diseases are preventable and treatable. The graph below shows the percentage of patients infected with tuberculosis and HIV.

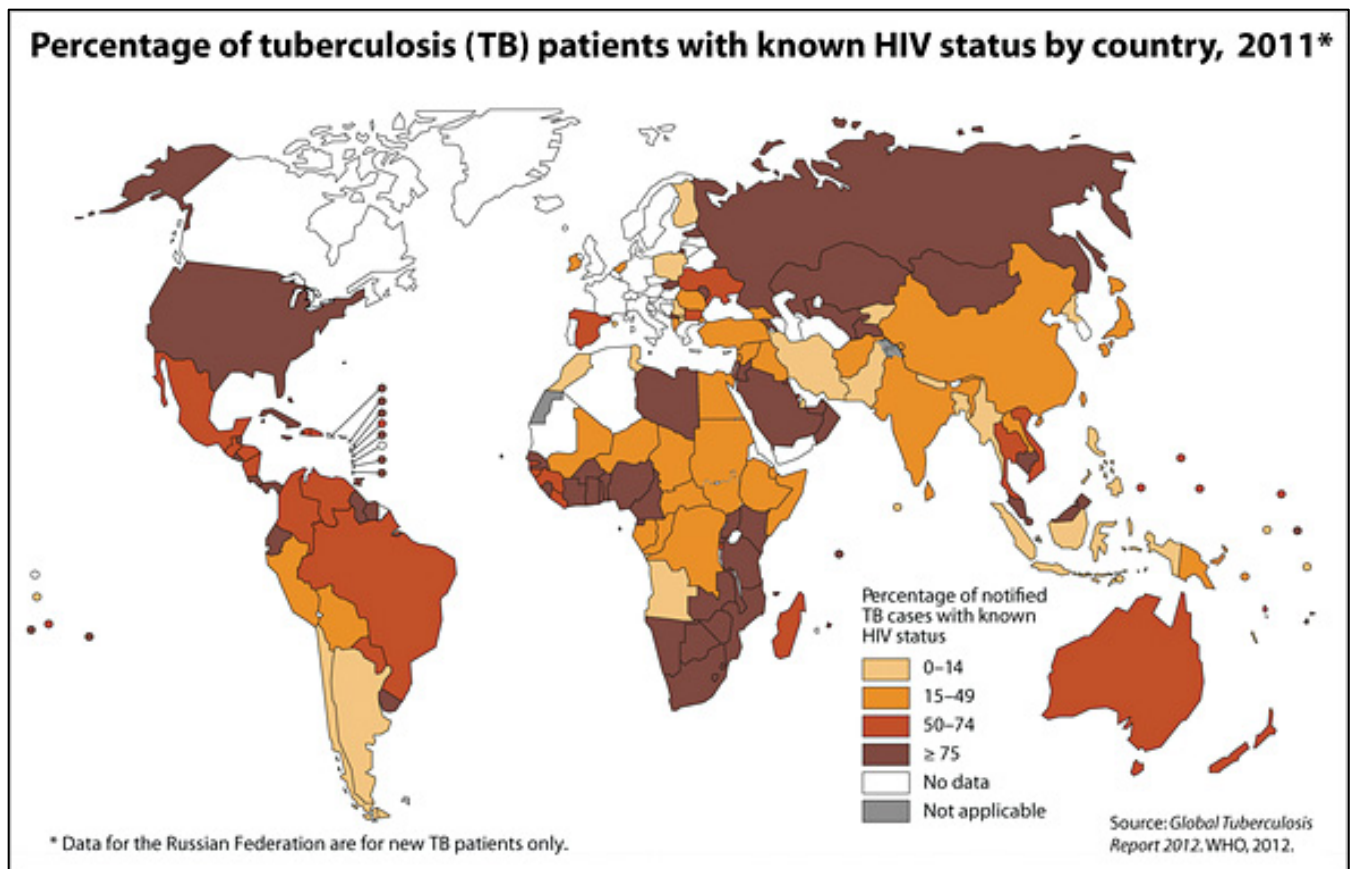


Figure 7. Percentage of tuberculosis (TB) patients with known HIV status by country, 2011.

Adapted from the Global Tuberculosis Report, 2012, Retrieved November 12, 2014, from <http://www.therapyceu.com/courses/386/tb-hiv-by-country-2011.jpg>.

HIV and tuberculosis are so frequently found together because one disease allows the other to progress. When a patient is infected with HIV, they have a weakened immune system. This weakened immune system is due to a decrease in the number of T cells when an individual is HIV positive. T cells are one of two subtypes. They can be helper T cells that express the CD4 ligand or killer T cells that express the CD8 ligand. HIV specifically targets T cells expressing the CD4 ligand, otherwise known as helper T cells. Both types of T cells are crucially important in killing pathogens that an individual's immune system recognizes as foreign, but helper T cells are especially useful for initiating apoptosis. Apoptosis, or programmed cell death, will begin

when the host's immune system recognizes and targets a cell that it wants to destroy (Alimonti et al., 2003). When HIV infects an individual's body, it uses the host's helper T cells as viral replication factories to continue to make more HIV virus. The virus kills the T cells in the process, by increasing the expression of DNA protein dependent kinases, DNA-PK. DNA-PK molecules signal for the CD4+ T cells to die ("NIH Scientists Discover How HIV Kills Immune Cells," 2013). Therefore, as HIV progresses into AIDS in patients not receiving treatment, the patients have fewer T cells to attack the HIV virus and other infections that the individual may encounter.

In the context of tuberculosis, a lack of helper T cells and thereby a weakened immune system has especially dangerous consequences concerning patients with latent TB infections. As previously discussed, patients with latent tuberculosis do not suffer any symptoms from the infection because the bacteria is not spread through out their lungs and potentially other body parts. Instead, the host's immune system uses macrophages and other immune cells to sequester *M. tuberculosis* in one region of the lungs forming a tubercle to keep the bacteria walled off from the rest of the body (Todar, 2012c). However, in patients with latent tuberculosis infections that are also infected with HIV, there are not enough immune cells present to keep *M. tuberculosis* trapped in tubercles. Therefore, latent tuberculosis can quickly become active tuberculosis, and *M. tuberculosis* spreads throughout the host's body (Avert, 2015).

Many of the symptoms present in patients with HIV and TB co-infections are the same as those in patients with only active tuberculosis. These symptoms include coughing, chest pain, and fever. Unfortunately, patients suffering from HIV/TB co-infections frequently do not exhibit many of these classical TB symptoms or even any symptoms that usually signify a potential tuberculosis infection. Therefore, recognizing and diagnosing tuberculosis in HIV positive



patients can be challenging. In fact, it is even more challenging to diagnose tuberculosis in patients with HIV than patients without it. For example, approximately 20% of the chest X-rays performed on HIV positive patients that are suspected to have tuberculosis are negative for many of the usual indicators seen in X-rays of patients with tuberculosis. Additionally, HIV positive patients with tuberculosis also frequently test negative on sputum smear tests. The inaccuracy of chest X-rays and sputum smears in patients with HIV/TB co-infection makes it even more difficult to diagnose these cases. The inability to diagnose the co-infection quickly and correctly results in numerous cases that do not receive treatment in a timely manner or go completely unnoticed (TB Facts, n.d.-a).

Treating HIV/TB co-infections can be challenging because of the difficulties in mixing the drugs prescribed as the typical treatment for each disease. As previously mentioned, treatment for drug sensitive active tuberculosis infections is divided into the intensive phase and the continuation phase (CDC, 2012a). In HIV positive patients that also suffer from an active tuberculosis infection, it is recommended that the patient complete the initial phase by take isoniazid, a rifamycin, pyrazinamide, and ethambutol for two months followed by a continuation phase of isoniazid and a rifamycin for the last four months. The dosages of these drugs and how often they are taken per week will be adjusted based on the severity of each patient's HIV infection (CDC, 2014h). Regardless of the CD4+ T cell levels in patients suffering from HIV/TB co-infections, it is recommended that all patients begin antiretroviral treatment to stop the progression of HIV disease and suppress the virus itself. Usually, a patient infected with HIV and tuberculosis is recommended to begin their ARVs about two to eight weeks after beginning their anti-tuberculosis drugs (WHO, 2015g). Nucleoside/nucleotide reverse transcriptase inhibitors (NRTIs), non-nucleoside reverse transcriptase inhibitors (NNRTIs), protease inhibitors

(PIs), entry/fusion inhibitors, integrase inhibitors, and combinations of these treatments are all used as ways to stop HIV from replicating in an individual's body ("Overview of HIV Treatments," 2009).

Unfortunately, there are many potentially disastrous side effects that can result from taking tuberculosis medications and ARVs at the same time. These side effects include hepatotoxicity, severe skin reactions, and other more serious concerns. One of these dangerous issues is tuberculosis immune reconstitution syndrome, or TB IRIS. TB IRIS is a specific condition that occurs in an individual suffering from tuberculosis when their immune system partially recovers and causes an exaggerated inflammatory response to infectious particles (TB Facts, n.d.-a). I realize that there are many other dangerous side effects with mixing anti-tuberculosis drugs and ARVs, but discussing those and their treatment implications is beyond the scope of this paper.

One of the main concerns regarding HIV/TB co-infections is that patients suffering from these diseases are frequently diagnosed with having multi-drug resistant strains of tuberculosis. Therefore, this relationship led many people to believe that somehow HIV/TB co-infection can increase the mutation of the tuberculosis bacteria to cause new drug resistant strains. However, studies have shown that this is not necessarily the case. There are many associated factors between HIV and multi-drug resistant tuberculosis, such as shared risk factors that promote transmission of both diseases, that seem to make these two issues more epidemiologically related than they actually are (Suchindran et al., 2009). Despite the fact that one disease does not directly cause the other, the acknowledgement that HIV positive patients are frequently infected with multi-drug resistant strains of tuberculosis is important to consider in order to correctly treat a patient suffering from tuberculosis.

## TREATMENT CONCERNS

Treatment of HIV and tuberculosis co-infections provides a great challenge to the healthcare systems established in many countries. Specifically, effective coordination of drug intervention is important in addressing HIV and tuberculosis co-infections with success. Early detection of HIV infection and tuberculosis infection sets the stage for additional effective treatment methods and programs to be employed. The goal in treating tuberculosis and HIV co-infection is to promote effective tuberculosis and HIV treatment while eliminating the negative effects these treatments have on each other.

Unfortunately, there are many challenges associated with effectively addressing HIV/TB co-infections. One of the major challenges, as was mentioned previously, is managing the drug toxicities associated with anti-tuberculosis drugs as well as antiretroviral drugs. Drug toxicity can be an issue when both rifamycins, such as rifampin, are prescribed with some antiretroviral agents. Modification in either of these regimens may be recommended depending on what drugs are prescribed to the individual in order to maximize the efficacy of both treatments. A major concern associated with drug toxicities is the potential that a patient could develop hepatotoxicity, or liver damage from drugs used to address tuberculosis or HIV infections. Therefore, resources need to be appropriately allocated to ensure that patients are monitored for this potential side effect. In order to decrease the risk of potential side effects associated with drug toxicity, public health systems must coordinate with physicians, patients, and clinics and facilities to ensure that patients are safely and effectively treated for HIV/TB co-infection (AIDSinfo, 2015).

The WHO outlines many recommendations associated with treating tuberculosis and HIV co-infections. One of the main recommendations the WHO provides is that countries should

follow the “Three I’s” for HIV/TB co-infection treatment and containment. The first “I” represents intensified TB case finding. Many people that test positive for HIV and receive antiretroviral drugs still die of undiagnosed tuberculosis. Therefore, implementing a way to effectively recognize and diagnose tuberculosis in patients that are HIV positive is important (WHO, 2015h). The second “I,” which stands for isoniazid preventive therapy (IPT), encourages the prescription of isoniazid to patients suffering from tuberculosis and HIV co-infections because it does not negatively interact with antiretroviral drugs like rifamycins do (WHO, 2015i). The third “I,” infection control, involves administrative, environmental, and individual ways to reduce the transmission of tuberculosis in populations vulnerable to contracting it. Some potential ways to reduce the transmission of tuberculosis are the formation of an effective triage system to diagnose patients and connect them with the proper medical professionals, improve ventilation in rooms, provide sufficient protective equipment for individuals working with patients suffering from this co-infection, and encourage patients the proper cough etiquette (WHO, 2015j).

Following the three “I’s” and the WHO’s recommendations for addressing TB/HIV co-infections are very labor and resource intensive. The significant resource requirements to treat TB/HIV co-infections refers back to the WHO’s DOTS program, which is still implemented in areas suffering from high burdens of HIV/TB co-infection. Political support and involvement, a component of DOTS, might be even more necessary in HIV/TB co-infection treatment so that sufficient resources are available (Steinbrook, 2007).

Ideally, all of these factors would be followed correctly and would be effective in all cases. However, in order for the three “I’s” to be the most effective at addressing HIV/TB co-infections, they need to be adapted and potentially altered when necessary. One country that

altered the three “I’s” to meet its citizens’ needs was South Africa. In South Africa, isoniazid preventive therapy has included that tuberculin skin testing, TST, opportunities need to be available to patients that need it after realizing the benefits of TST in some local communities (WHO, 2015i), South Africa’s adaptation of isoniazid preventive therapy is a perfect example of how the WHO’s recommendations will be most effective if they are altered based on the context in which they are operating. Even though the benefits of tuberculin skin testing were seen in South Africa, this does not mean that an increase in tuberculin skin testing should be applied to programs all over the world that address HIV/TB co-infection. Therefore, an effective way to treat HIV/TB co-infections would most likely be one that builds off current effective recommendations while uniquely altering them to the needs of the community in which they are being applied.

## DRUG RESISTANT TUBERCULOSIS

The second major complication that arises regarding tuberculosis treatment is that not all *M. tuberculosis* infections respond to the drug regimens that are prescribed to kill them. As previously discussed, many effective drugs are available to treat patients suffering from both latent and active tuberculosis infections. Unfortunately, they are not effective in all patients suffering from TB disease. These strains of tuberculosis are called multidrug-resistant or extensively drug resistant. Multidrug-resistant tuberculosis, or MDR-TB, is incredibly difficult to kill. In some cases, nothing can be done for patients suffering from drug resistant strains of the disease. To be classified as multidrug-resistant, the tuberculosis strain infecting an individual must be resistant to at least isoniazid and rifampin, which are the two strongest tuberculosis drugs available (CDC, 2012d). Five percent of all TB cases in 2013, an estimated 480,000

people, developed multidrug resistant tuberculosis. Only 48% of these people survived the disease. One of the driving factors behind these dismal statistics is the inability to diagnose patients with multi-drug resistant strains of tuberculosis in a timely manner. If all TB positive patients had been tested for multidrug-resistant strains of the bacteria, 300,000 MDR TB cases could have been detected and potentially received appropriate treatment sooner (WHO, 2014). The figure below shows the number of multi-drug resistant strains of tuberculosis around the world in 2013.

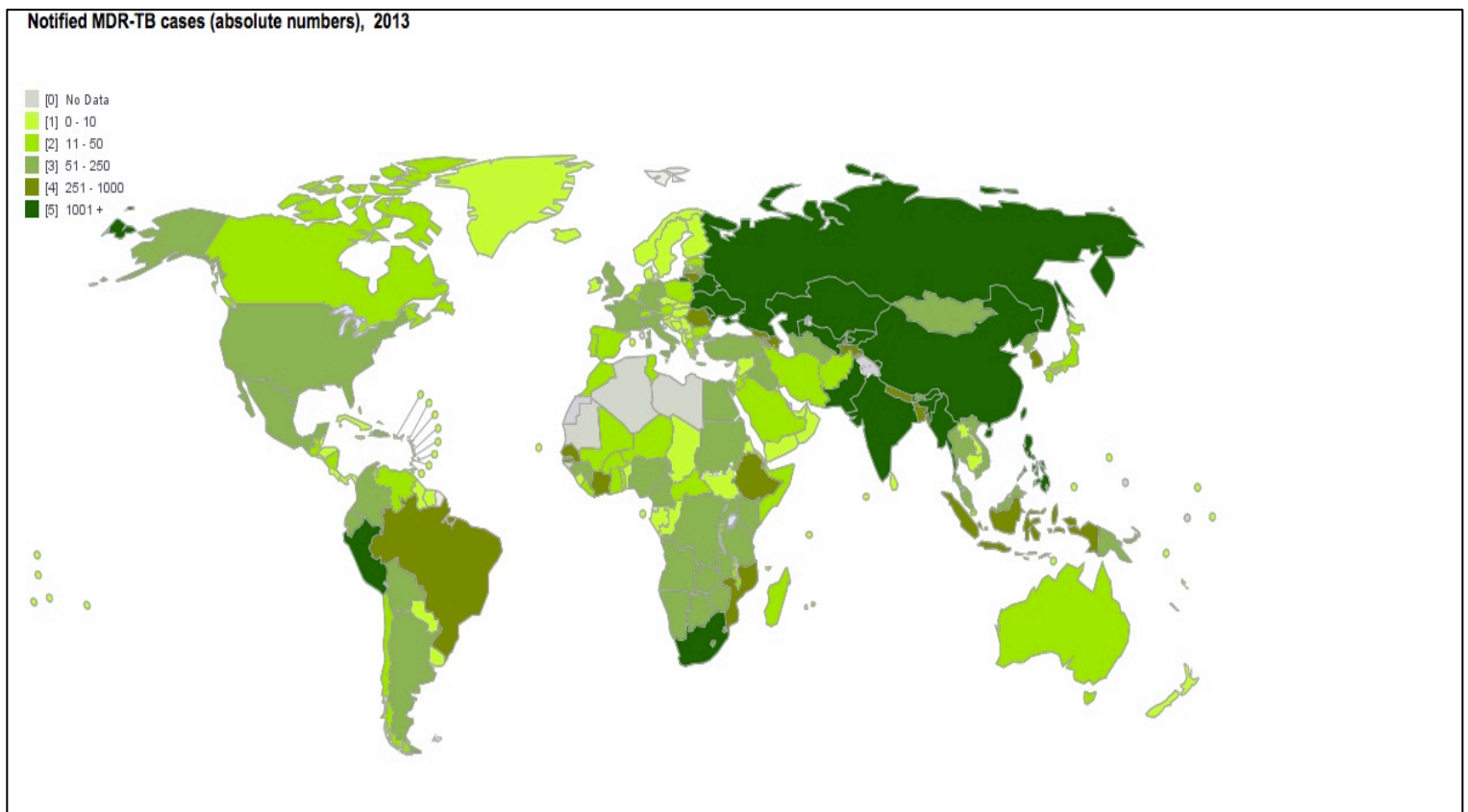


Figure 8. Notified MDR-TB Cases (Absolute Numbers), 2013, Adapted from the Global Health Observatory (GHO) Data, n.d., Retrieved November 12, 2014, from [http://www.who.int/gho/tb/drug\\_resistant/en/](http://www.who.int/gho/tb/drug_resistant/en/). Copyright 2015 by the WHO.

Multidrug-resistant tuberculosis is spread through infectious bacteria traveling from one host to another through the air in the same way that tuberculosis strains that are sensitive to drug interventions spread. Additionally, the symptoms of MDR TB are the same as non-resistant tuberculosis (CDC, 2014i). However, there is an additional step taken when diagnosing a patient with a drug resistant strain of tuberculosis. A drug susceptibility test, or DST, is performed in order to determine what drugs an individual's strain of tuberculosis is sensitive to or to ensure that the patient's tuberculosis infection is drug resistant. A DST can be either phenotypic or genotypic. A phenotypic DST is either direct, inoculating one set of media containing drugs and one set of media without drugs with tuberculosis bacteria, or indirect, inoculating media containing tuberculosis drugs with a pure culture of tuberculosis bacteria. In both cases, the way that the cultures grow on the media is observed. If the culture grows on media containing drugs, then the bacteria are drug resistant. Genotypic drug susceptibility tests, the alternative to indirect or direct phenotypic drug tests, are performed to identify exactly what mutation occurred in the bacteria for it to become resistant to specific drugs (TB Facts, n.d.-b). Despite the addition of a DST to series of tests used to diagnose a patient with tuberculosis, the only major difference drug sensitive tuberculosis infections and multidrug-resistant strains of tuberculosis is their responses to tuberculosis drugs.

Presentation of multidrug-resistant tuberculosis is slightly different in children than it is in adults. Where adults present with characteristic symptoms of the disease such as a persistent cough and significant weight loss, children do not present with these classic symptoms. Usually, their symptoms are less specific making tuberculosis cases in children much more difficult to diagnose. Additionally, children with tuberculosis normally have a lower load of tuberculosis bacteria in their bodies than adults do, so cases of children's tuberculosis are frequently missed.

Unfortunately, 30,000 children a year suffer from drug resistant strains of tuberculosis. Despite this large number of children suffering from these strains of tuberculosis, children are usually not a priority in diagnosing and treating drug resistant tuberculosis because they are less infectious than adults. However, the infection usually progresses more quickly in children than adults so children die of tuberculosis without even being diagnosed (Partners In Health, 2014).

There are many reasons that can cause a strain of tuberculosis to become resistant to drugs. The CDC mentions that drug resistance can be caused by improper drug prescriptions by the medical professional tending to the patient, an insufficient supply of drugs, or the usage of poor quality drugs. One of the most controversial ways that drug-resistance develops is through patients who do not complete their full-course of medication and are therefore characterized as non-compliant patients (CDC, 2014i). Specifically, patients that do not take their prescribed TB drugs when they should, or do not take the required dose of these medicines catalyze the creation of tuberculosis bacteria that will be resistant to the drugs the patient took (WHO, 2015k). By inappropriately taking medication, the tuberculosis bacteria undergo genetic mutations that allow them to survive once introduced to the drugs again (Grover & Takkar, 2008). Non-compliant patients are usually in areas of the world where tuberculosis treatment facilities are weak and lack a significant amount of resources (WHO, 2015k).

MDR-TB is a terrifying form of tuberculosis to be infected with but there is still one other form that causes even more concern. Extensively drug resistant tuberculosis is resistant to most of the extremely strong tuberculosis drugs including isoniazid, rifampin, any fluoroquinolone and at least one second-line injected drug. Because of its lack of response to many of the drugs usually used to treat tuberculosis, patients with extensively resistant tuberculosis do not have many other effective treatment options (CDC, 2012d).



## TREATMENT CONCERNS

Multidrug-resistant strains of tuberculosis cause significant treatment concerns due to their contagious nature, like normal tuberculosis, and their difficulty to cure. MDR-TB strains are present all over the world, so successfully treating these cases is crucial in taking steps toward ridding the world of tuberculosis. One of the major obstacles to treating drug resistant strains of tuberculosis effectively is diagnosing the disease in a timely manner. As previously mentioned, drug susceptibility tests are performed to determine whether or not a patient's strain of tuberculosis is susceptible to drugs and what drugs, if any, the bacteria are susceptible to. Unfortunately, drug susceptibility tests are either incredibly time consuming or expensive to perform (TB Facts, n.d.-b).

Indirect phenotypic drug susceptibility tests are particularly time consuming. Tuberculosis bacterial cultures must first be grown in the lab after scientists receive a sample from a patient. Culturing tuberculosis bacteria takes, on average, about four weeks to get a test result. Then, the culture is used in either direct or indirect phenotypic tests. It takes another four to six weeks after beginning a direct or indirect phenotypic drug susceptibility test to determine the results. The main problem with DST's taking so long is that the patient needs to begin treatment as soon as possible after being diagnosed with tuberculosis. Therefore, the longer it takes to determine what drugs, if any, a patient's strain of tuberculosis is sensitive to the longer it takes for a patient to begin treatment. One way to speed up the DST process is to use machines that use liquid media instead of solid media to determine drug susceptibility (TB Facts, n.d.-b).

These machines and those used to perform genotypic drug susceptibility tests are expensive. Therefore, not only is a significant amount of time required to perform drug susceptibility tests when diagnosing cases of drug resistant tuberculosis. Enough money to buy

these complex machines is also necessary and can be another obstacle in diagnosing drug resistant strains of tuberculosis in a timely manner. An insufficient amount of trained individuals that are able to operate these complex machines as well as a lack of financial resources to buy the machines in the first place both result in barriers to treatment of drug resistant strains of tuberculosis (TB Facts, n.d.-b).

Another public health concern related to drug resistant strains of tuberculosis is that children suffering from these strains go unnoticed. Children are less infectious than adults, frequently die of these strains without being properly diagnosed, and have lower loads of the bacteria in their bodies so their infections are difficult to detect. For these reasons and many more, children are not receiving enough medical attention in relation to their tuberculosis infections (Partners in Health, 2014).

Dr. Mercedes Becerra is a major player in addressing children's MDR-TB. Dr. Becerra works at Partners in Health as a tuberculosis specialist and as an associate professor at Harvard Medical School. She and her colleagues published an article that discusses children's multidrug resistant strains of tuberculosis and attempts to determine how many children in the world suffer from MDR-TB. Dr. Becerra states that discovering drug-resistant cases in children highlights that transmission has not been stopped, and a child did not receive treatment (Partners in Health, 2014). To respond to this issue and make the global community aware of the significant amount of children suffering from multidrug resistant tuberculosis, Dr. Becerra and Dr. Soumya Swaminathan, the head of India's National Institute for Research in Tuberculosis, formed the Sentinel Project in 2011 (Partners in Health, 2014). The Sentinel Project's goal is to increase access to effective treatment methods for children suffering from multidrug resistant strains

tuberculosis by reaching out to its international network of individuals that share this vision (Sentinel Project, n. d.).

Dr. Becerra mentions that an important step that needs to be in order to address tuberculosis infection in children is to implement contact tracing to identify people children have come in contact with. This will allow researchers and medical professionals to quickly determine how the child contracted the disease as well as other potential cases so that treatment can be administered as soon as possible. Dr. Becerra is currently working on increasing the amount of contact tracing used around the world. Ideally, this will eventually translate into recognizing children suffering from drug resistant strains of tuberculosis instead. Eventually, as a result of this recognition, fewer children will die from this preventable disease (Partners in Health, 2014).

Children are not the only ones suffering from multidrug-resistant strains of tuberculosis. Significant treatment concerns regarding how MDR-TB is addressed in adults are present all over the world. A country with one of the highest burdens of drug resistant strains of tuberculosis is Russia. Partners in Health has battled multidrug resistant tuberculosis in Russia since 1998 and a particularly beneficial initiative, the Sputnik Initiative, provides a variety of suggestions that could potentially be adopted by other countries around the world. Sputnik provides tuberculosis treatment every day to patients that are at a high risk of discontinuing their treatment. These patients are usually people that have been forced to leave hospitals due to behavioral problems, those that abuse substances, and people with socioeconomic struggles. The Sputnik Initiative shows the global community that patients from backgrounds that label them as unable to adhere to tuberculosis treatments can successfully complete tuberculosis treatments, and that a patient-centered approach to tuberculosis treatment outside of a hospital is an effective way to treat

tuberculosis. According to the PIH website, since its implementation, the Sputnik Initiative has had a treatment success rate of 71.1% (Keshavjee et al., 2014).

Both the Sentinel Project and Sputnik Initiative provide beneficial suggestions for how to best address multidrug resistance. Raising awareness of these strains and providing support for patients battling these types of tuberculosis have been effective in both of these instances. Perhaps, these concepts can be transferred to other areas of the world suffering from high burdens of multidrug-resistant tuberculosis in order to make treatment methods for multidrug-resistant strains of tuberculosis more effective.



## Perceptions of Tuberculosis

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As previously discussed, tuberculosis has plagued humans for centuries. Treatments improved as time progressed, drug resistant strains incurred additional damages to infected individuals, and the prevalence of HIV co-infection has added a new dimension to considering tuberculosis. However, these background facts and statistics provide only one lens through which to understand tuberculosis and those that it infects. Sontag (1989) writes, “My point is that illness is *not* a metaphor, and that the most truthful way of regarding illness – and the healthiest way of being ill – is one most purified of, most resistant to, metaphoric thinking” (p. 3). In other words, Sontag highlights the importance of considering the way that people, those infected and uninfected with it, perceive a disease. Not only does tuberculosis physically damage an individual’s body, tuberculosis metaphorically damages its victims by subjecting infected individuals to the various stigmas associated with the disease. This is referred to as the hidden burden of the disease (Somma et al., 2008). Applying Sontag’s suggestion, it is important to consider how people perceive tuberculosis and the stigmas associated with it, or what it is a metaphor for, when attempting to understand the disease and its implications.

Stigmas and perceptions arise in response to a variety of different factors. They are created when an individual behaves in a way that is not what society expects or has a unique trait or characteristic that sets them apart. Whatever these unique behaviors or characteristics are that an individual possesses, society interprets them negatively. Instead of being ways that an individual expresses his or her individuality, they become the source of ridicule or the catalyst for the devaluing of an individual (Dodor et al., 2008). In the context of tuberculosis, stigmas associated with the disease are created by infected individuals’ perceptions of themselves as well as the perceptions that unaffected community members have of people suffering from

tuberculosis. These perceptions and the stigma created by the perceptions that surround tuberculosis have a profound impact on individuals suffering from the disease. The perceptions affect treatment methods, the mental health of tuberculosis patients, and cohesion within a community in general. Since tuberculosis infects individuals all over the world, there are similarities and differences between the ways the disease is perceived. These perceptions establish tuberculosis as a metaphor (Sontag, 1989).

Both cross culturally and internationally, tuberculosis is a metaphor for isolation. Isolation due to the presence of active tuberculosis infection presents itself in many forms. Patients infected with tuberculosis feel isolated from their families, their communities as a whole, and even themselves. Interestingly, tuberculosis as a metaphor for isolation is also evident in the way the causal bacteria infect a host's body. Examining each of these different forms of isolation provides beneficial insight into how perceptions of tuberculosis impact the people suffering from it, the communities they live in, and how best to address the disease.

## BACTERIAL ISOLATION

Tuberculosis's use as a metaphor for isolation begins at the microscopic level. As previously mentioned, individuals can suffer from latent and active forms of the disease. The active form of tuberculosis infection involves the spreading of *M. tuberculosis* throughout the patient's body. The bacterial infection usually begins in the lungs, but can spread to other regions including the spine, lymph nodes, and brain as the infection progresses and especially if it is left untreated (Wiwatworapan & Anantasetagoon, 2008). A patient suffering from an active *M. tuberculosis* infection usually presents with symptoms characteristic of TB infection, such as

coughing, fever, and weight loss, and potentially with additional symptoms based on whether or not the bacteria spread and what region of the body they infected (WHO, 2015).

On the other hand, characteristics of the latent form of tuberculosis infection are the opposite of those related to active tuberculosis infection. Patients with latent tuberculosis infections do not show any of the characteristic symptoms. It is even possible for an individual to be unaware that they have a latent tuberculosis infection. In addition to the absence versus presence of symptoms, latent tuberculosis differs from active tuberculosis because the bacteria do not spread in individuals with latent infections. Instead, the bacteria are sequestered in tubercles within the patient's lungs. Tubercles are hardened nodules in the lungs containing macrophages infected with *M. tuberculosis*. The body forms these tubercles once it realizes that it cannot eliminate the infection. Therefore, its alternate option is to wall off a region of the lungs where the bacteria are concentrated. In other words, the body isolates the bacteria from the surrounding tissue (Müller, 2011).

The physical isolation of *M. tuberculosis* by the host's body when suffering from a latent infection is analogous to the other forms of isolation that an individual with active tuberculosis undergoes. Just like the host's body isolates *M. tuberculosis* from the rest of the lungs and surrounding tissue, patients with active forms of tuberculosis are isolated from their families and communities, and even suffer a more personal self-isolation. Unfortunately, these forms of isolation can be more emotionally and mentally damaging to the patient suffering from active tuberculosis disease, and they have serious implications when considering treatment efficiency and efficacy.



## ISOLATION FROM THE COMMUNITY

Beyond considering the actions of *M. tuberculosis* on the microscopic level, the isolation associated with tuberculosis infection affects human interaction in detrimental ways.

Tuberculosis as a metaphor for isolation is especially evident when considering the separation between infected individuals and the communities they live in. Unfortunately, individuals suffering from tuberculosis all over the world and from different time periods feel or have felt separated from their communities.

In the nineteenth and twentieth centuries, the tuberculosis's metaphor for isolation was employed by individuals looking to distinguish themselves from the lower class people of the time. People were no longer born into a social class. Instead, each individual asserted his or her own social status. In other words, people had to isolate themselves from lower levels of society in order to distinguish themselves as members of the upper class. This intentional isolation was especially applicable to women living in the nineteenth century. A new ideal of what the fashionable woman looked like was intimately intertwined with establishing ones self as upper class. It was trendy for women of the upper class to be gaunt. These women no longer hungrily ate their meals, but rather picked at them delicately (Sontag, p. 28).

Tuberculosis fits into this motif perfectly. The disease causes a loss in appetite and physical wasting away of the body, both of which resulted in the bodily image that was so desirable to women of the day. Susan Sontag (1989) mentions that during the nineteenth and twentieth centuries, "It was glamorous to look sickly" (p. 28). Additionally, long spells of coughing, as is common in individuals with active tuberculosis disease, were considered chic. Women suffering from this disease had no qualms about discussing these coughing spells with others. For example, Marie Bashkirtsev, a Ukrainian writer and painter, suffered from

tuberculosis (Kuipue, 2014). She explicitly discussed one of her coughing spells in her *Journal* in 1887 (Sontag, p. 29). She describes her coughing fit, “But for a wonder far from making me look ugly, this gives me an air of languor that is very becoming” (as cited in Sontag, 1989). Active tuberculosis infections helped women achieve the fashionable image of the time and assisted them in isolating themselves from society’s lower classes.

During this time period, women were not the only ones who actively used tuberculosis as a way of isolating themselves from lower societal classes. Creative geniuses of the time did this as well. Many artists, poets, and novelists living in the nineteenth and twentieth centuries were infected with tuberculosis. Famous people who suffered from tuberculosis include Percy B. Shelley, John Keats, and Franz Kafka (Sontag, 1989). Over time, tuberculosis came to be seen as a disease that specifically infected people who were artistic, passionate, romantic and interesting. Susan Sontag (1989) asserts, “The melancholy character – or the tubercular – was a superior one: sensitive, creative, and being apart” (p. 32). In fact, contracting the disease was even twisted, albeit possibly jokingly, into a complement. Shelley is quoted writing to Keats about their tuberculosis infections and saying, “this consumption is a disease particularly fond of people who write such good verses as you have done...” (as cited in Sontag, 1989). By associating active tuberculosis disease with famous and successful creative figures, tuberculosis gradually became a metaphor for establishing creative minds as superior ones, thus isolating them from individuals who were not creative and therefore not worthy of being infected by the disease.

Along with tuberculosis’s association with isolating the creative minds of the nineteenth and twentieth centuries, the disease gave famous artists and writers a stereotypical image similar to the fashionable women of the time. In fact, Sontag quotes Théophile Gautier, a French poet and novelist, supporting this image (“Théophile Gautier,” 2014). He said, “When I was young, I

could not have accepted as a lyrical poet anyone weighing more than ninety pounds” (as cited in Sontag, 1989). These famous creative identities were thin, wiry, and sickly, which once again aligns with the effects that tuberculosis has on its host’s body. Tuberculosis isolated the creative geniuses of the time from the other members of the society by creating a stereotypical image in them that many others desired and attempted to attain. Unfortunately, since this stereotype was interwoven with a deadly disease, many artists, poets, and other writers ascribing to this image died at tragically young ages due to tuberculosis (Sontag, 1989).

Tuberculosis did not only affect the physical images of men, women, and creative figureheads of the nineteenth and twentieth centuries. Often, a geographical isolation became part and parcel of being a notable member of society infected with tuberculosis. Many famous individuals suffering from tuberculosis isolated themselves from society even further by going into exile. They traveled all around the world to reach the prime exilic location that they thought would heal them of their illness. Places such as Italy, the Mediterranean, the South Pacific, and the desert were all locations to which famous tuberculosis sufferers exiled themselves by their own will or after being advised to do so by a physician. Susan Sontag (1989) says, “The TB sufferer was a dropout, a wanderer in endless search of a healthy place” (p. 33). John Keats, Frédéric Chopin, Robert Louis Stevenson and D.H. Lawrence were all among those that ascribed to tuberculosis’s metaphor for isolation and went into exile to become cured of the disease (Sontag, 1989). Unfortunately, none of these famous figures were cured of their tuberculosis infections.

Currently, the metaphor for tuberculosis representing isolation remains applicable all over the world. Specifically, individuals in the United States, Ghana, South Africa, Bangladesh, and Malawi report feeling isolated from their communities for a variety of reasons directly

resultant of active tuberculosis infection. Isolation from the community manifests itself in various forms in different areas of the world. Despite these differences, it is crucial to recognize that regardless of what cultural context the disease operates in or where the person infected with it lives, patients suffer significant feelings of isolation from their communities that directly affect diagnosis and treatment of the disease.

One manifestation of patients' isolation from their communities is the fear of job loss and financial insecurity that presents itself in many males with active tuberculosis. Somma et al. (2008) describe these feelings in men suffering from active tuberculosis in Lilongwe, the capital of Malawi, and ten rural sub-districts of Bangladesh (p. 860). The researchers gave Semi-structured Explanatory Model Interview Catalogue interviews to 100 people at their data collection sites to assess a variety of factors regarding tuberculosis. However, they interviewed individual people to determine stigma. The researchers found that, in Malawi, when men are diagnosed with an active tuberculosis infection they are frequently unable to keep their jobs. These men are employed as skilled or unskilled laborers and provide for their families with the money they earn working at these jobs. Men with active tuberculosis were not allowed to continue working at their jobs and were also unable to return to those jobs once they began treatment. These men were even unable to return to their jobs after being completely cured of the disease. The researchers quoted one patient that said, "I was asked to stay away from work. I have been dismissed from work due to the illness. I would not be allowed to continue working with my employers after I finish the treatment" (as cited in Somma et al., 2008). Therefore, men living with active tuberculosis infections in Malawi feel a significant amount of isolation from their communities by suffering from job insecurity and by extension financial insecurity unlike the healthy men in Lilongwe (Somma et al., 2008).

In rural areas of Bangladesh, men infected with tuberculosis share a similar sentiment to patients in Lilongwe. These patients felt a significant amount of fear related to being unable to work due to tuberculosis infection. When an individual is infected with tuberculosis, he or she gradually becomes weaker due to the body's physical wasting. Therefore, weakness in men suffering from tuberculosis in Bangladesh makes it incredibly difficult for them to work as efficiently as their healthy counter-parts. In some cases, weakness prevents these men from working at all. Being unable to work results in being unable to provide for one's family. In Bangladesh, if a man cannot provide for his family, he must borrow from neighboring families in order to save his own. This action is heavily stigmatized (Somma et al., 2008). One patient mentioned, "We had to borrow because there is a crisis in our family. People did not say anything in from of my face after I got this disease, but they have said things in my absence" (as cited in Somma et al., 2008).

In a different study, a different manifestation of tuberculosis as a metaphor for isolation as noticed in Ghana. According to these researchers, many tuberculosis patients feel isolated to some degree by their communities because members of the community shame them for being infected with the disease. Dodor et al. (2008) conducted individual interviews and hosted focus groups with tuberculosis patients in the Shama Ahanta East Metropolitan District (p. 1048). Through their conversations, the researchers realized that many patients felt isolated from their communities because many people believed that contracting tuberculosis was the result of engaging in risky behaviors that the community deemed as inappropriate. These risky behaviors included smoking cigarettes and cannabis, drinking alcohol, and using hard drugs. Sharing these substances or the materials with which they are consumed or injected into the body with someone infected with tuberculosis was considered to be a way that tuberculosis is spread.

Additionally, members of the community believed that individuals with tuberculosis actively tried to spread the disease to others. It was expected by community members that tuberculosis patients isolate themselves in order to protect the community. If patients with tuberculosis do not isolate themselves, cough in public, or dispose of their sputum in anything other than a container that they keep on their person, it is interpreted as an intentional attempt to infect others with tuberculosis (Dodor et al., 2008). Therefore, suffering from tuberculosis in Ghana's Shama Ahanta East Metropolitan District represents isolation from the community because it incurs behavioral expectations that separate tuberculosis patients from healthy individuals living in the community.

Patients in this region of Ghana not only felt isolated from the community they live in as a whole but also specifically from the medical community. According to Dodor et al. (2008), "Certain practices of health staff were pointed out as making TB shameful and enhanced the fear of the disease" (p. 1050). The researchers discovered that community members thought doctors gave tuberculosis strange names. This concept combined with the physical separation of tuberculosis patients from other patients at the hospital caused tuberculosis sufferers to feel isolated from the medical community. Additionally, specific protective measures that health care professionals took around tuberculosis patients caused them to feel isolated from the medical community. For example, wearing gloves and masks around patients with tuberculosis made the patients feel uncomfortable. Tuberculosis patients interpreted these protective measures as meaning that individuals suffering from tuberculosis are not allowed to be in public or around individuals who are not infected with the disease. This interpretation even extended to patients that died of tuberculosis infection. One male participating in a focus group noted that the bodies of people killed by tuberculosis cannot be taken to the respective patients' homes. Instead, health

professionals performed post-mortem bodily preparation in the hospital, and then the bodies are taken directly to the cemetery. Therefore, these perceptions of tuberculosis as representing isolation result in tuberculosis patients feeling separated from their community (Dodor et al., 2008).

In all three cases mentioned above, active tuberculosis infections cause individuals to feel separated from their communities, thus further supporting the concept that tuberculosis is a metaphor for isolation. Additionally, in all of these cases, patients reported that the negative perceptions that their community members had of tuberculosis affected their attempts to seek medical attention regarding their disease. Perhaps if the stigma associated with tuberculosis as well as the metaphor for isolation surrounding the disease were debunked, more people would feel comfortable seeking medical attention. If this became the case, ideally more individuals would be diagnosed with the disease before it has significantly progressed. The elimination of stigma and the negative perception of tuberculosis might also benefit treatment methods. If patients felt more comfortable visiting medical clinics to receive their medication, perhaps more patients would successfully complete their drug regimens and be cured of tuberculosis.

## ISOLATION FROM FAMILY

Tuberculosis's metaphor for isolation that is present on the community level also affects the main subunit with which communities are built, the family. Tuberculosis and its effects on family life are especially relevant to women living in Bangladesh, India, Malawi, and Colombia (Somma et al., 2008). Despite the differences in the level of stigmatization associated with tuberculosis in various geographic regions, it is crucial to understand that women feel isolated from their families due to tuberculosis and its stigma. Addressing tuberculosis as a metaphor for

isolation in relation to the separation between women and their families could potentially positively influence treatment interventions and hopefully result in more women being cured of the disease.

Although the cases mentioned above are current examples of the isolation felt between women infected with tuberculosis and their families, women have felt this isolation for decades. In my great-oma's case, the isolation associated with tuberculosis is evident in the way that my oma talks about the disease to this day, specifically related to the way that tuberculosis and its metaphor for isolation affected their family. When she was diagnosed, Suzanne Bitner was isolated from the rest of the Bitner family by being admitted into a sanitarium. Her admittance into the sanitarium resulted in a physical isolation from the family, but the longer she stayed away the more isolated my oma felt from her. The rest of the Bitner family members' lives had to adjust with my great-oma living somewhere else. Suzanne Bitner no longer raised her own daughter. Instead, my oma's grandmother became her primary female authority. In turn, the isolation became gradually more psychological as well as physical. The feeling of isolation was only intensified when my great-oma was moved to the storage room in a nearby farmer's field for the last few months of her life. Despite being in better surroundings than the sanitarium, Suzanne Bitner remained isolated from interacting with her family due to her tuberculosis infection until she passed away.

Unfortunately, women living in the late twentieth and early twenty-first centuries still suffer isolation from their families due to tuberculosis infection. D. Somma et al. (2008) explore the gender-specific perceptions and stigma associated with active tuberculosis infections (p. 856). Interestingly, there are many similarities between the isolation felt by women suffering from tuberculosis in Chennai, India and Lilongwe, Malawi. In both of these countries, women



rely heavily on their husbands for support and protection. Therefore, a woman's marriage prospects are incredibly important. Suffering from tuberculosis is not something that potential husbands or their families value highly in a potential wife or daughter-in-law. As a result, women with tuberculosis disease in these two countries are concerned about their reputations as suitable wives, which will eventually determine whether or not they will marry (Somma et al., 2008). In turn, they feel isolated from the other healthy women also seeking potential husbands and therefore their future

The concerns mentioned above apply specifically to women suffering from tuberculosis before they are married, but if a woman is infected with tuberculosis after marrying the isolation associated with tuberculosis infection does not disappear. Many times, women are divorced because of their tuberculosis infection. Divorce does not occur in all cases when married women are diagnosed with tuberculosis but additional tensions that isolate the patient from the household are present. Often, infected women are forbidden from sharing food and utensils with other family members. Additionally, they will be relegated to their own sleeping spaces instead of sleeping beside their husband (Somma et al., 2008).

Women in Malawi and India are not the only ones suffering isolation from their families in relation to contracting tuberculosis. Tuberculosis as a metaphor for isolation is relevant to women living in rural Bangladesh as well. Becoming isolated from their families by being unable to fulfill their duties as wives and mothers is specifically a concern in this geographic location (Karim et al., 2011). In rural Bangladesh, it is frowned upon if women need assistance completing their housework. However, when suffering from tuberculosis, the body becomes increasingly weak and physically wastes away. Therefore, many women suffering from the disease need help doing their daily work. These women are heavily stigmatized and the results of

this stigmatization can be disastrous. In some cases, women are sent away from their husbands and children and back to their original homes to live with their biological families (Somma et al., 2008). Although this brings them closer to their original families, being forced to leave their husband and possibly children further isolates them and reinforces the idea that tuberculosis can serve as a metaphor for isolation.

Additionally, as identified by D. Somma et al., suffering from active tuberculosis can mean serious physical consequences to women living in this geographic region as well (p. 861). Unlike women in India and Malawi reported to the researchers, wives in Bangladesh reported suffering brutal assaults from their husbands after being diagnosed with tuberculosis. D. Somma et al. (2008) assert, “Many Bangladeshi women also reported that their husbands had physically or verbally assaulted them, or refused to bear any expenses associated with treatment” (p. 861). Being physically beaten by their husbands does not make wives feel more included in their families. On the contrary, it is likely that these verbal and physical abuses further a woman’s feeling of isolation from her family, specifically from her husband.

Unfortunately, because women’s mobility is limited and they are financially dependent on their husbands once they marry, contracting tuberculosis can tragically affect a woman’s life. Feeling isolated from her family causes significant insecurity regarding the woman’s marriage and whether she will be provided for. Therefore, many women hide their symptoms or diagnosis from their families and might not even seek medical attention to treat their infection. Receiving this assistance would mean public disgrace and ridicule (Somma et al., 2008). By not seeking medical attention, women with active tuberculosis are capable of spreading the disease to other members of their family or the community as a whole.

Overall, as the examples from India, Malawi, and Bangladesh all illustrate, women around the world feel significantly stigmatized and isolated from their families due to active tuberculosis infections. Eliminating the stigmas and negative perceptions associated with tuberculosis could significantly improve the lives of women all over the world suffering with tuberculosis. Without its stigma and metaphor for isolation, tuberculosis infections infecting women would no longer incur feelings of insecurity. Maybe, if tuberculosis was no longer a metaphor for isolation, women would seek treatment promptly and fewer would suffer and die from tuberculosis. Ideally, this would translate into fewer women transmitting the disease to their family members and eventually less of these family members transmitting tuberculosis to other members of the community that they come in contact with.

### ISOLATION FROM SELF

Characterizing the way a tuberculosis patient suffers from self-isolation is more difficult than characterizing the previous two ways that tuberculosis functions as a metaphor for isolation in the individuals that suffer from it. The information supporting the presence of self-isolation in tuberculosis patients relies on the honest testimonies of individuals suffering from the disease, which can some times be difficult to procure. Despite these difficulties, the concept of tuberculosis patients undergoing self or mental isolation is a major component of the hidden burden of tuberculosis. This personal form of isolation is present in tuberculosis patients across the world and has been plaguing patients for decades.

Although my oma was unable to definitively say whether or not my great-oma suffered through this type of mental turmoil, it is difficult to imagine that being stripped away from your family and living in a sanatorium would not result the manifestation of a personal form of

isolation or that a patient would remain unscathed. Suzanne Bitner was admitted to a sanatorium not long after he Bitner's arrival at the refugee camp in Linz, Austria, and never lived with her family again after that. Even after being able to leave the sanatorium, she knew that she still needed to isolate herself from the rest of the family and lived in a storage room on a farmer's property for the remaining months of her life. It seems logical to assume that self-isolation could easily affect a person living in these circumstances.

Unfortunately, self-isolation is something that patients suffering from tuberculosis still suffer from today. Men with active tuberculosis infections in Chennai, India undergo self-isolation and retraction from society due to their disease (Somma et al., 2008). One man said, "When I cough loudly, especially in front of others, I feel so embarrassed and feel a nuisance. I therefore stay away from work or other social groups" (as cited in Somma et al., 2008). It is difficult enough to be suffering from the disease itself, but patients themselves stigmatize the disease and isolate themselves from society because of it (Somma et al., 2008).

Self-isolation suffered by tuberculosis patients is no different in Chicago, Illinois. Patricia Kelley published an article entitled "Isolation and Stigma: The Experience of Patients with Active Tuberculosis" in 1999 that identified and analyzed some of the perceptions of tuberculosis that patients and surrounding community members have about the disease. She interviewed patients in Lawndale and Englewood, two low-income neighborhoods in Chicago, and her data identified that the way the disease is transmitted, allowing stigma to define themselves, and being secretive about their disease were all ways that tuberculosis patients coped with their disease (Kelley, 1999). These factors all resulted in or facilitated a patient's self-isolation.

One self-isolating factor that was noticed in tuberculosis patients was that the patients identified themselves as vectors. They knew that they could spread the disease to others, which caused the patients a significant amount of fear that they would spread the disease to their family members or others that they came in contact with. Kelley quoted one patient saying, “It is very important to me to know if I can give the disease to others. That’s why I don’t want to be around other people” (as cited in Kelley, 1999). Other patients left their homes or were sent away by their families because of their potential for spreading the disease to others in their households. Once again, this identifies the patient as a vector and elicits feelings of isolation in patients suffering from tuberculosis (Kelley, 1999). Therefore, a patient identifying himself or herself as a vector supports their self-isolation.

Additionally, feeling stigmatized can also lead patients to suffer from self-isolation. Patients identified that being stigmatized was one of the major problems that being infected with tuberculosis has caused them. One patient even said that they were a menace now that they were infected with tuberculosis. Patients suffer from self-isolation by allowing the stigma and perception of tuberculosis to dominate their self-image (Kelley, 1999). In turn, this results in patients isolating themselves.

The final factor that played a role in causing patients with tuberculosis to suffer from self-isolation is that patients with active tuberculosis infections often kept their disease a secret. Many patients avoid telling people that they were diagnosed. Interviewed patients mentioned that they would tell people that they had a lung problem instead of telling people that they have tuberculosis. These patients mentioned that people react negatively to an individual when they learn that a person has been diagnosed with tuberculosis. According to these patients, even the word tuberculosis is bad. Therefore, to avoid being stigmatized by others after telling them about

their diagnosis, tuberculosis patients withdraw into secrecy and isolate themselves (Kelley, 1999).

Self-isolation by tuberculosis patients is not unique to the low-income neighborhoods that Patricia Kelley studied in Chicago. Dodor et al. (2008) recognized that tuberculosis patients living in the Shama Ahanta East Metropolitan District of Ghana also suffered from self-isolation (p. 1051). These researchers noticed that secrecy, just like in Chicago, was one of the driving factors behind tuberculosis patients stigmatizing themselves. Patients in this district of Ghana hid their diagnosis from their family and friends. In order to effectively hide their diagnosis, tuberculosis patients would avoid interacting with their communities and being in public in general. The patients were afraid of being devalued by society if their peers were to learn about their diagnosis, so they stigmatized themselves and forced themselves into self-isolation (Dodor et al., 2008).

In Chicago and Ghana's Shama Ahanta East Metropolitan District, one of the driving forces that causes tuberculosis patients to suffer from self-isolation is fear. Fear presents itself in different ways in the patients interviewed at these two sites. The patients interviewed in Chicago were afraid of their disease as well as how they were perceived in the community. Patients were scared that they would spread the disease to their loved ones, and were afraid that they would be rejected and stigmatized by their community (Kelley, 1999). In Ghana, the patients were also afraid of being shunned by their community (Dodor et al., 2008). All of the cases that both of the studies recognize, show that fear plays a major role in causing patients to isolate themselves once they are infected with tuberculosis.



## Conclusion

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Tuberculosis has plagued humans for centuries. Beginning in ancient human civilizations in Africa, tuberculosis infections continue to persist despite incredible advances in antibiotic formulation, development of programs designed to address tuberculosis specifically, and numerous other intervention strategies. Considering that the inhabitants of twenty-two countries in the world are still considered to suffer from high burdens of the disease, the battle against tuberculosis needs to continue. It continues to be a disease that kills numerous people every year despite being both curable and preventative.

Because it is treatable and preventable, one should be dying from tuberculosis anymore. Keeping this in mind, it becomes necessary to answer the questions: why do people still suffer from tuberculosis and how can it be stopped? As seen throughout this thesis, there are many different intervention methods, ranging from specific medications to programs determining the support systems available for patients suffering from tuberculosis, used to treat tuberculosis that contribute to why people still suffer from the disease today. Combining these intervention methods with perceptions of tuberculosis that make it a metaphor for isolation results in many ineffective and inefficient treatment methods.

For example, an instance in which a potentially beneficial treatment method could become ineffective due to perceptions surrounding tuberculosis is Directly Observed Therapy (DOT). The CDC recommends that a family member should not be the observer overseeing the patient taking their medication while enrolled in a DOT program. According to the CDC, if an observer is a family member they might be slightly more lenient with the patient (CDC, 2012c). However, studies have shown that one family member providing DOT for another family member is not always less effective than having someone else providing the therapy (Kabongo &



Mash, 2010). Therefore, having a family member provide DOT might be a more convenient solution for a patient receiving anti-tuberculosis drugs. However, when deciding who should oversee a patient taking their medication in a DOT program, the perceptions surrounding tuberculosis need to be considered. As previously mentioned, patients with active tuberculosis infections sometimes feel isolated from their families. This is especially applicable to women who feel estranged from their families, particularly their husbands, after being diagnosed. Therefore, having a family member provide DOT might not be most effective in this case. The overlap between treatment efficacy and perceptions associated with tuberculosis highlights the importance of evaluating what tuberculosis treatment methods will be most effective in a way that is both culturally relevant and case sensitive

Another example of the interplay between perceptions of tuberculosis and treatment methods used to combat the disease is the connection between patients not seeking medical attention and the isolation that patients with tuberculosis feel from their communities. As was previously mentioned, in some areas of the world, individuals are afraid to go to medical clinics when feeling ill because they are afraid of being diagnosed with tuberculosis. The diagnosis does not only incur physical discomfort due to the disease but also emotional discomfort because of the community's reaction to it. Often being diagnosed with tuberculosis causes patients to lose their jobs and be publically ridiculed. Therefore, regardless of how sensitive and advanced the machinery or health care workers are that can diagnose a patient with tuberculosis, the patients will not be seen if they do not seek medical attention. Once again, if the perceptions surrounding the disease were debunked, perhaps more patients would seek medical attention. The more patients that seek medical attention, the fewer contagious patients there will be thus hopefully decreasing transmission of the disease.

Although these connections between treatment methods and perceptions of tuberculosis are important to highlight, simply being aware of them does not eradicate tuberculosis. To decrease the incidence and prevalence rates of tuberculosis, attempting to eliminate the perceptions surrounding the disease could be a good place to start. One way to eliminate these perceptions is through educating communities about the way tuberculosis spreads and how long individuals are contagious for after beginning their medication. It is not my intention to sound paternalistic, and I realize that education does not solve all of the issues associated with tuberculosis. However, it could be a good place to start because many perceptions that result in tuberculosis being a metaphor for isolation are rooted in misconceptions about the disease. For example, even after a man living in Bangladesh is cured of tuberculosis, he is unable to come back to work. Perhaps if employers were reminded that after being treated patients are no longer contagious, individuals with active tuberculosis infections would feel less isolated from their communities because they could return to work after receiving treatment. In turn, this could then provide incentive for patients to seek medical attention when they suffer from symptoms associated with tuberculosis.

In addition to education, one of the most important areas of improvement that could reduce the incidence and prevalence rates of tuberculosis around the world is increasing the amount of contact tracing. Contact tracing is important because it allows healthcare facilities and workers to determine who might have been exposed to *M. tuberculosis* due to coming in contact with an individual suffering from an active tuberculosis infection. Once an individual is exposed to the bacteria, they are at risk for developing the disease themselves, becoming contagious, and spreading it to others. Although issues arise with indexing contact cases and deciding what should be done to clinically analyze an individual after they are identified as a contact, this

process could be extremely important in preventing the disease from infecting many more individuals (WHO, 2012a). By implementing effective contact tracing procedures, public health practitioners and healthcare workers can focus on preventing tuberculosis. Ideally, prevention methods would be so effective that tuberculosis incidence rates would decrease because no one is contracting it any more.

In conclusion, I recognize that this thesis only scratches the surface of tuberculosis's devastatingly far-reaching effects. Other factors related to tuberculosis that require further consideration are tuberculosis's effects on patients living in regions of conflict, who the best person to administer DOT is and what this means for tuberculosis treatment, and how drug toxicity can be regulated to effectively treat TB/HIV co-infections and multidrug-resistant cases of tuberculosis. Overall, there is not one way to treat tuberculosis that will be effective in all cultural contexts and for every individual case. Culturally sensitive and case specific treatment methods will most likely be the best way to battle this tragic disease. Combining individualistic treatment methods with debunking current perceptions of the disease will allow the medical field and communities all over the world to make significant strides in decreasing prevalence and incidence rates.

Although much needs to be done to eradicate tuberculosis, it is a necessary and worthwhile goal that the global community should strive for. Striving to rid the world of this disease will mean that less people will suffer the way my oma did upon losing her mother to tuberculosis. Seeing the sadness in my oma's eyes as she tells her mother's story still breaks my heart but behind the sadness exists a gentle strength. My oma was strong through her mother's death and has been strong through countless difficult times throughout her life since then. While sitting next to her after our long discussion about her life and my great-oma's illness, she pulls

out a book entitled “Illyatscha,” of which she is one of the co-authors. The Donauschwaben are proud of their heritage, and my oma continues to carry this pride with her every day of her life. She lived in a refugee camp for most of her early life, her mother died of tuberculosis, and she lost almost everything she owned. Many people would crumble at the weight of these difficult circumstances, but my oma did not. Instead, she chose to survive and now I have the pleasure of spending time with her. Talking about her mother was an emotional discussion, but our conversation slowly drifted into admiring the beauty of nature surrounding us on the porch of their condominium. My oma is an amazing woman, and I am proud to be her granddaughter. I am proud to be a Donauschwaben, and I will carry this pride with me throughout my life.



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