Tuberculosis in the Elderly: A Different Disease?

Thesis

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By

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Abstract

This analysis was done to determine whether tuberculosis (TB) in the elderly is a different disease. The patients at the Ben Franklin Tuberculosis Clinic (BFTC) were divided into two groups. The elderly group was all patients aged 65 and older, and the control group was all patients aged 25 to 49. The analysis was divided into two parts. In Part 1, information was collected from the medical charts of the elderly patients. In Part 2, chi-squares and a t-test were used to analyze differences between the elderly group and the control group. Differences were found in the areas of gender, race, country of origin, HIV status, Tuberculin skin test, sputum smear, sputum culture, microscopic exam of tissue, condition of abnormal lung x-ray, TB drug prescription, treatment completion, and length of treatment. Based on the number and type of differences, it was determined that TB in the elderly is a different disease.
Dedication

Dedicated to everyone who has helped me to finally get my master’s degree after four long years, including my research advisor, Dr. Wang, who was patient even though it took me two years to finish this project, my parents, Cathleen and Todd, who let me live at home after I ran out of money, and finally to all my professors who had to suffer with me in their classes.
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Fields of Study

Major Field: Public Health
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Chapter 1: Introduction and Literature Review

Introduction

Tuberculosis (TB) is a disease that largely affects young adults. However, the elderly remain one of the most vulnerable populations. The increased risk of developing TB for those immunocompromised by age is well-known. However, there have been mixed conclusions as to whether or not TB is a different disease in the elderly. If it is, elderly patients may need to be treated differently than younger adults. The purpose of this study is to discover if TB in the elderly is a different disease.

Literature Review

TB is a global problem. It remains one of the leading causes of death in Africa. In 2005, TB was responsible for 1.6 million deaths around the world.\textsuperscript{1} Due to the increasing TB crisis, the Centers for Disease Control and Prevention (CDC) has taken steps to target the elimination of TB. Through their efforts, the prevalence of TB has substantially decreased in the United States since 1993. In 2007, the number of cases of TB in the United States had dropped to 4.4 cases/100,000 from a high of about 26 cases/100,000 in 1992. In Ohio, the number had dropped even lower to 2.1 cases/100,000.\textsuperscript{2} However, in Franklin County, the incidence of TB increased to 7.8 cases/100,000 in 2004, which is well above the national average.\textsuperscript{3} This has been
attributed to the large number of foreign-born immigrants who reside in Franklin County. In 2006, 66% of the TB cases in Franklin County were found in foreign-born immigrants while 34% were found in US born residents of Franklin County.\textsuperscript{4}

Tuberculosis is primarily a disease that affects young adults in their most productive years. In the United States in 2006, 63% of the TB cases were among those ages 25 – 64.\textsuperscript{2} Due to the abundance of TB cases among young adults, much of the TB research has been focused on this age group. However, the elderly remain one of the most vulnerable populations and the incidence rates of active TB disease in this age group are higher than in any other age group.\textsuperscript{2} The increased risk of developing TB among those immunocompromised by age is well-documented.\textsuperscript{5} Moreover, it remains unclear whether TB should be treated differently in the elderly than in their younger adult counterparts. There have been many studies attempting to discover if TB in the elderly is a different disease, but the conclusions have been mixed. One study showed that radiologic findings in the elderly with TB are different from those in the younger adults.\textsuperscript{6} However, another study found no statistically significant differences between the two populations.\textsuperscript{7} This research study is being done specifically to determine if TB disease presentation, diagnosis, and treatment is different among the elderly of Franklin County, Ohio than the younger adult population.

TB in the elderly is different from TB in younger adults in a number of critical ways. A history of latent TB infection (LTBI) increases the risk for development of active TB disease in the future for any patient of any age.\textsuperscript{8} However, this is particularly significant for elderly patients, as the elderly have a significant risk of developing a reactivation infection of primary disease. That is, the patient was exposed to
Mycobacterium tuberculosis (Mt) when he was younger and developed an infection. The Mt mycobacteria remained in the lungs and remains dormant. This person has a latent infection (symptomless). However, when the patient became older and his immune system decreased, something triggered the bacteria to become active again, and he developed reactivation TB disease. According to an article in Clinical Infectious Diseases, 90% of TB cases among the elderly are attributed to reactivation TB. Second, elderly patients can develop a primary MTB infection from exposure to the bacteria in nursing home settings. Although, 80-90% of TB infection in the elderly occurs among the non-institutionalized, there is a 2-3 fold rate of incidence of active TB among nursing home residents. This could become a more significant source of disease as the elderly population continues to increase.

Residence in a long-term care facility may not be the only risk factor that is attributed to the elderly. There are many other risk factors that may be more or less attributable to the elderly than the younger adult population. There have been many studies attempting to discover various risk factors of TB, as well as certain target populations that may be more at risk for contracting the disease. However, there has not been much research in determining which risk factors apply to certain age populations. For example, country of origination has always been a significant risk factor for contracting TB. The spread of disease in the United States has been greatly attributed to the influx of immigrants from the 22 high TB-burdened countries. However, from 1991 to 1998, only 18% of immigrants were aged 45 or older. It seems likely, then, that country of origin will not be as significant of a risk factor for TB among the elderly population, as more of these patients will be life-long US citizens.
Along the same line, it is well-documented that an HIV-positive individual is much more likely to develop TB. In fact, 26% of the new TB cases in the US in 2000 were among those who were HIV-positive.\textsuperscript{12} The age of those diagnosed with HIV is also increasing. In 2005, nearly 20% of the new cases of HIV were diagnosed in those aged 50 or older.\textsuperscript{13} This, along with the fact that the current population of HIV-positive individuals is living longer and longer due to increased antiviral therapy, means that the population of HIV-positive patients is getting older. This leads to the conclusion that more and more of the newly-diagnosed TB cases among the elderly will be due to HIV.

Not only are there different risk factors for TB among the elderly, the disease is also different from a diagnostic perspective. Diagnosing TB among the elderly population tends to be more difficult than among young adults. The primary tool for diagnosing LTBI is the Tuberculin Skin Test (TST). A dose of tuberculin is injected intradermally into the skin. Those who have been exposed and infected with the mycobacteria are expected to have an immune response to the tuberculin antigen. This test is positive in about 70% of the adults diagnosed with active TB, but it is only about 30% positive among the elderly patients.\textsuperscript{6} This difference is attributed to the decreased immune function of people as they age. The immune system of an elderly person is not typically as active as the immune system of a younger adult. In 2001, a new test designed to improve the rate of true positives when diagnosing TB became available. This is known as the QuantiFERON-TB-2 Gold (QFT) assay. In a study published in \textit{Chest} researching the effectiveness of the QFT test on diagnosing TB in the elderly, it was found that 77% of the elderly patients with active TB were correctly diagnosed using
QFT. The QFT was found to be much more effective than the TST for diagnosing the elderly.¹⁴

Another reason it can be difficult to diagnose TB in the elderly is that it is often misdiagnosed as another disease. According to William Stead, TB often resembles pneumonia, bronchitis, lung carcinomas, or congestive heart failure with pleural effusion more than it resembles a typical TB infection.¹⁵ This is due to the atypical radiologic presentation of the disease in the elderly.¹⁶

Of the limited research that has been done on elderly TB, much of it has focused on the differences in the presentation of the disease between the elderly and younger adults. As stated previously, there have been mixed conclusions. In a study done in Chest, it was found that younger adults were significantly more likely to have fever and night sweats. The elderly were significantly more likely to present with miliary TB.⁷ The Journal of Korean Medical Science published an article stating that young adults were more likely to have fever and cough, and the elderly were more likely to experience weakness, dyspnea, anorexia, and mental change. The difference in the appearance of night sweats was not statistically significant.¹⁷ In several other studies, it was found that elderly TB patients suffered from very non-specific symptoms, such as fatigue, weight loss, and anorexia. This made it very difficult for doctors to correctly diagnose TB as these symptoms could be present in a number of different diseases.¹⁵,¹⁶

The last step in determining whether or not TB in the elderly is a different disease is to decide if it should be treated differently than TB in younger adults. Currently, the standard treatment for drug susceptible active TB disease is a six- to nine-month course of the antibiotics isoniazid (INH) and rifampin (RIF), and a two month course of
ethambutol (EMB) and pyrazinamide (PZA). According to Van den Brande, TB in the elderly should not be treated differently than it is treated in younger adults. An article in Clinical Infectious Diseases states that elderly patients are more likely to experience adverse reactions from the drug INH but does not recommend a different course of treatment. A separate study confirms that although elderly patients are more likely to experience hepatotoxic reactions from INH, they should not be treated with different drugs unless such reactions occur.

In order to determine whether TB in the elderly is a different disease, this study will examine TB in the elderly, age 65 or older, of Franklin County, Ohio.
Chapter 2: Agency Description

This project was done at the Ben Franklin Tuberculosis Clinic in Columbus, Ohio. The Ben Franklin TB Clinic, which is part of Columbus Public Health, serves people in Franklin County, Ohio that have either contracted TB or are at risk for contracting TB should they become exposed. Its primary mission is to control the spread of TB in Franklin County. The clinic provides TB screenings and Direct Observed Therapy (DOT) through the DOT Outreach Program. This program ensures that patients are compliant with their medication by sending a nurse out personally to the patient to deliver the medication.

As its primary mission is to control the spread of TB, one of the goals of the Clinic is to provide individualized care to each patient. This ensures that each patient is treated effectively and efficiently, and the patient is out of the contagious stage of TB as soon as possible. This is particularly important to elderly patients as many live in retirement communities or nursing home settings, where there is a 2-3 fold rate of incidence of active TB disease. The findings of this research project will be used by the medical staff of the Clinic, both doctors and nurses, to evaluate TB care effectiveness in the elderly population, and, if possible, to improve their overall care of the elderly TB patients at the Clinic.
Chapter 3: Evaluation of Research Design

The purpose of this research project was to determine if TB in the elderly is a different disease. Five questions were addressed in order to determine if there were any differences in the disease, and if so, where they were. The first question was to determine some basic descriptive statistics of both the elderly and control populations. The second question was to decide what the greatest risk factors for developing TB are in the elderly population. The third question was to determine what diagnostic issues apply specifically to elderly patients. The fourth was to see if there were any differences in the presentation of the disease, both symptomatically and radiologically. The final question researched in this analysis was to determine if the elderly are prescribed a different treatment for this disease. If differences are found in each of these four areas, it is likely that TB in the elderly is a different disease.

The elderly population used for this study was all the patients at the Ben Franklin Tuberculosis Clinic in Franklin County, Ohio aged 65 and older. The control population was all the patients at the Clinic aged 25 to 49. Much of the data used in this analysis was on file at the Clinic; however, there were a few questions in the research design that were not addressed on that file. This information was abstracted from each patient’s medical chart at the Clinic.

The original plan for the design of this project was to answer each question with a series of chi-squares that would compare the data from the elderly population with the
data in the adult population. Using a significance level of 0.05, if the chi-square was determined to be significant, there was a difference between the elderly and control population. Part of this design would involve pulling data from the charts of both the elderly and control populations. Unfortunately, due to time limitations, only the charts of the elderly patients were analyzed. Therefore, this section was separated from the rest of the analysis. Because there is no control population for this section, only very basic statistical analyses, such as counts, means, and standard deviations, could be done for each group of data. This is certainly not sufficient to answer any sort of statistical question, and any follow-up study will need to add an analysis of the control population.

Since the rest of the data was already on file at the Clinic for both the elderly and control populations, the chi-square was sufficient to analyze the differences between the two populations statistically. There were several limitations to the validity of this design. First, each data point on the file was entered by hand by the staff at the Clinic, and human error is a likely result of that. To counteract that as much as possible, each data point on the elderly patients was confirmed through a check of the medical chart that the data originally came from. This was hindered by the mislocation of approximately half of the charts. Many errors were found on the file from the charts that were located, so it is safe to assume that many errors are also present from the charts that were misplaced. It is impossible to know how those errors affected the outcomes of this analysis, and there is not a way to correct for these errors. Any follow-up studies should include a thorough check of the file from the missing charts, as well as a check of the file from the control population’s charts. This was not able to be accomplished in the time limit. Second, there were a few research questions where the population size was insufficient. When a
chi-square was attempted for these questions, one or more of the expected cells were less than 5. An exact test would be necessary to analyze these questions, and this test was not attempted.
Chapter 4: Methods

In order to verify that all the data found in the Clinic’s file of elderly patients was correct, a thorough check of all the medical charts was done. However, due to some organizational issues within the Clinic, only 36 charts out of 77 were located. The data on file for those patients with missing charts was assumed to be correct. For the patients with charts, discrepancies from the data on file were documented, and the file was corrected prior to analysis.

The analysis done for this report is divided into two sections. For the first section, data was collected directly out of the medical charts of the elderly patients. This data had not been collected previously at the Clinic and was placed in its own file. The data collected for this portion included an analysis of the most common symptoms reported by elderly TB patients, common misdiagnoses made by medical professionals for these patients, regular medication usage, and average length of time TB medications were prescribed for these patients. The form used for the data collection is found in Appendix A.

The second section consists of a comparison study between the elderly patients and younger adults. For this analysis, elderly patients are defined as aged 65 or older, and the adult population is aged 25 to 49. Comparisons were done of descriptive statistics, which were gender, race, and major site of TB disease; common TB risk factors, which were country of origin, HIV status, previous TB diagnosis, homelessness,
and long-term care residence; TB testing, which included the TST (tuberculin skin test), sputum smear, sputum culture, and microscopic exam of tissues; radiologic findings; and TB treatment, which included TB drug prescription and length of time until treatment was deemed complete by a medical professional. All of this section was done using a chi-square analysis except the final comparison, which was length of time treatment time. Only the patients who completed treatment were used for this calculation, and it was done using a two-sample t-test. All the statistics were done using Microsoft Excel.
Chapter 5: Results

The results section is divided up into two parts. Part one will feature descriptive statistics of the elderly patients at the Clinic. All of the data from this part was collected directly from medical records. Part two will feature comparison statistics between the elderly and adult patients. The data used for this part was already on file at the Clinic.

Part 1

Symptom Analysis

As elderly with active TB disease are said to experience nonspecific symptoms, it is useful to perform an analysis looking at the most common symptoms reported by elderly TB patients in Franklin County. Those symptoms were cough (14 of 36 patients), shortness of breath (15 of 36 patients), and unexplained weight loss of more than five pounds (14 of 36 patients). Those three symptoms were experienced by a little over 1/3 of the patients whose charts were located. Approximately 1/6 of the patients experienced fever, fatigue, weakness, and vision change. The other symptoms were experienced relatively few times, as shown below in Table 1.
<table>
<thead>
<tr>
<th>Symptom</th>
<th>Number of Elderly Patients who Reported Symptom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>6</td>
</tr>
<tr>
<td>Cough</td>
<td>14</td>
</tr>
<tr>
<td>Sputum</td>
<td>3</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>1</td>
</tr>
<tr>
<td>Shortness of Breath</td>
<td>15</td>
</tr>
<tr>
<td>Loss of Appetite</td>
<td>3</td>
</tr>
<tr>
<td>Fatigue</td>
<td>5</td>
</tr>
<tr>
<td>Weakness</td>
<td>6</td>
</tr>
<tr>
<td>Stomach Upset</td>
<td>2</td>
</tr>
<tr>
<td>Rash</td>
<td>3</td>
</tr>
<tr>
<td>Joint Pain</td>
<td>2</td>
</tr>
<tr>
<td>Headache</td>
<td>2</td>
</tr>
<tr>
<td>Vision Change</td>
<td>5</td>
</tr>
<tr>
<td>Unexplained Weight Loss ≥ 5 lb.</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 1: Number of Elderly Patients Experiencing Various TB Symptoms

Common Misdiagnoses

As the elderly with TB are commonly misdiagnosed with other diseases, particularly pneumonia and lung cancer, the charts were analyzed for any other diagnoses before TB was discovered. Seventeen (47.2%) of the 36 patients were correctly diagnosed with TB, five (13.9%) were originally diagnosed with pneumonia, and six (16.7%) were originally diagnosed with lung cancer. Four (11.1%) of the patients had multiple misdiagnoses, and four (11.1%) were diagnosed with something other than pneumonia or lung cancer. This is shown in Figure 1.
Medication usage among elderly persons is very common. This can be a problem for TB patients as they may experience severe drug interactions with the TB medication. Of the 36 elderly patients, it was found that 26 of them were regularly taking other medications, both prescription and nonprescription, 8 were taking no other medication, and 2 had no information regarding medication usage. Removing the two patients without that information from the analysis, it was found that 76% of elderly patients were currently taking at least one medication on a regular basis. As elderly patients are sometimes prone to side effects from TB medications, each patient’s chart was checked for reports of severe symptoms requiring immediate discontinuation of one or more medications. Six elderly patients (16.7%) reported such symptoms.

To see how elderly patients are treated for TB in Franklin County, data was collected to see how long patients were on the most commonly prescribed TB

Figure 1: Distribution of Diagnoses of Elderly TB Patients
medications until their treatment was judged complete. The medications used in this analysis are isoniazid (INH), rifampin (RIF), pyrazinamide (PZA), and ethambutol (EMB). INH was prescribed for an average of 7.3 months with a standard deviation of 2.3 months, RIF was prescribed for an average of 7.1 months with a standard deviation of 2.1 months, PZA was prescribed for an average of 3.6 months with a standard deviation of 1.9 months, and EMB was prescribed for an average of 4.2 months with a standard deviation of 2.8 months. The results of this analysis are summarized in Table 2.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Average Length of Time (months)</th>
<th>Standard Deviation (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isoniazid (INH)</td>
<td>7.3</td>
<td>2.3</td>
</tr>
<tr>
<td>Rifampin (RIF)</td>
<td>7.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Pyrazinamide (PZA)</td>
<td>3.6</td>
<td>1.9</td>
</tr>
<tr>
<td>Ethambutol (EMB)</td>
<td>4.2</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Table 2: Average Length of Time on TB Medications for an Elderly Patient in Franklin County

Part 2

To look at the statistical differences between elderly and adult TB, five main categories were analyzed. These were descriptive statistics, including gender, race and site of TB disease; common TB risk factors, including country of origin, HIV, previous diagnoses of TB, homelessness, and long-term care residence; TB testing, radiologic findings, and TB treatment.
2a – Descriptive Statistics

Gender

Of all the elderly patients on record at the Clinic, 38 were male and 39 were female. Of the adult patients, 145 were male and 85 were female. This results in a chi-square value of 4.49, which corresponds to a p-value of 0.03. At an α significance level of 0.05, the elderly male to female ratio is significantly lower than the corresponding ratio in the adults.

Race

All of the TB patients under analysis could be classified racially as white, black, or Asian. Thirty of the elderly patients classified themselves as white, 29 as black, and 18 as Asian. Sixty-three of the adult patients classified themselves as white, 123 as black, and 43 as Asian. This corresponds to a chi-square value of 13.0 (p = 0.002). There is a significant difference in the proportions of race between the elderly patients and the adult patients with more white patients and less black patients among the elderly than expected.

Major Site of TB Disease

The site of TB disease is classified as either pulmonary or non-pulmonary. Seventy-one percent (55/77) elderly patients had a primary TB diagnosis of pulmonary TB, while 23% (22/77) were diagnosed with TB in other areas. Sixty-seven percent (153/230) were diagnosed with pulmonary TB, and 33% (77/230) developed TB in other
areas. This results in a chi-square value of 0.636 (p = 0.4). Thus, the proportion of elderly patients with pulmonary TB is not significantly higher than the proportion of adult patients with pulmonary TB.

The results of Part 2a are summarized in Table 3.

<table>
<thead>
<tr>
<th></th>
<th>Chi Square</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>4.49</td>
<td>0.03</td>
</tr>
<tr>
<td>Race</td>
<td>13.0</td>
<td>0.002</td>
</tr>
<tr>
<td>Major Site of Disease</td>
<td>0.636</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Table 3: Summary of Chi-Square Results for Part 2a – Descriptive Statistics

2b – Common TB Risk Factors

Country of Origin

TB is far less prevalent in the United States than in most other countries, particularly African countries, where it remains a leading cause of death. In 2006, 66% of the TB cases in Franklin Country were found in foreign-born patients. Forty-four of the elderly patients were citizens of the United States, while 33 had citizenship in other countries. Of the adult patients, 67 were U.S. citizens and 163 were not. This results in a chi-square value of 19.6 (p < 0.001). There are significantly fewer foreign born patients among the elderly than expected. Country of origin is a more common risk factor for adults.
HIV Status

Immunocompromised individuals are at much higher risk for developing TB. The most common source of immunocompromization is HIV infection. Most patients are given an HIV test upon arriving at the clinic. However, a few are never given the test and many refuse to take the test for cultural reasons. Among the elderly patients, 34 were HIV negative, 1 was HIV positive, 18 refused the test, and 24 were never offered the test. Among the adult patients, 171 were HIV negative, 22 were HIV positive, 25 refused the test, and 10 were never offered the test. This results in a chi-square value of 56.8 ($p < 0.001$). There is a significant difference in the HIV status between the elderly and adult patients. Upon inspection, there are far fewer HIV negative patients among the elderly, and there are more patients who refused or who were never given the test than expected. HIV infection is a more common risk factor for adults.

Previous Active TB Diagnosis

A previous diagnosis of active TB increases the risk for TB infection in the future. Eight of the 77 elderly patients and 11 of the 230 adult patients had a previous diagnosis of active TB. This results in a chi-square value of 3.12 ($p = 0.08$). This p-value is not significant, so the proportion of elderly patients with a previous diagnosis of active TB is similar to that proportion in the adult population.
Homelessness

Homeless individuals are at greater risk for developing TB, due to the overcrowded and often poorly-ventilated nature of homeless shelters. There is a much higher risk of TB transmission in such areas.\textsuperscript{18} One of the 77 elderly patients and 16 of the 230 adult patients were considered homeless at the time of active TB disease diagnosis. This results in a chi-square value of 3.5 (p = 0.06). However, since one of the expected values for this test was less than five, the sample size is not large enough to come to an accurate conclusion.

Long-term Care Residence

For the purposes of this analysis, long-term care facilities include nursing homes, hospices, and psychiatric care facilities. Correctional facilities are not included in this calculation. Long-term care residences are similar to homeless shelters in their much higher risk for TB transmission. Although, 80-90\% of TB infection in the elderly occurs among the non-institutionalized, there is a 2-3 fold rate of incidence of active TB among nursing home residents.\textsuperscript{9} Seven of the elderly patients and one of the adult patients were residents of a long-term care facility. This results in a chi-square value of 17.0 (p < 0.001). However, since one of the expected values for this test was less than five, the sample size is not large enough for an accurate conclusion.

The results of part 2b are summarized in Table 4.
<table>
<thead>
<tr>
<th>Country of Origin</th>
<th>Chi Square</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV Status</td>
<td>56.8</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Previous TB Diagnosis</td>
<td>3.12</td>
<td>0.08</td>
</tr>
<tr>
<td>Homelessness*</td>
<td>3.5</td>
<td>0.06</td>
</tr>
<tr>
<td>Long-term Care Residence*</td>
<td>17.0</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Table 4: Summary of Chi-Square Results for Part 2b – Common TB Risk Factors

2c – TB Testing

TB Skin Test

The most basic TB test given is the Tuberculin Skin Test. It is based on the immune response of the recipient to the test. The higher the response, the larger the induration. This test has many disadvantages, particularly for the foreign-born and elderly populations. This test may not be valid in those who have received the TB Bacille Calmette-Guérin (BCG) vaccine, which many of the foreign-born cases will have been given. Recent BCG vaccine may cause a false positive TST result. It is also not as effective among the elderly population, as they have a much lower immune response than the younger population and so may not react to the test as expected and have a false negative TST result.6

Forty-eight elderly patients received a TST. Of those patients, 31 were classified as positive and 17 as negative. In the adult patients, 194 received the TST. Of those patients who received the test, 173 were positive and 21 were negative. This results in a chi-square value of 195 (p < 0.001). There is a significant difference among the proportions of positive, negative, and not given skin tests between the elderly and adult population.

* This indicates that at least one of the expected values in this chi-square was less than 5.
patients. There are far fewer positive and far more negative skin tests among the elderly patients than expected.

Sputum Smear

To test for the presence of pulmonary TB disease, many patients receive a sputum smear. The smear can be used to identify acid fast bacteria like *Mtb*. A positive sputum smear is often found among the most infectious cases of pulmonary TB disease. A sputum smear was given to 51 of the 77 elderly patients and 204 of the 230 adult patients. Of the elderly patients given a sputum smear, 20 were smear positive and 31 were smear negative. Eighty-nine adults were smear positive, and 115 were smear negative. This results in a chi-square value of 185 (p < 0.001). There is a significant difference in the proportion of positive, negative, and not given sputum smears between the elderly patients and the adults. After reviewing the distributions, there were less of both smear positive and smear negative patients among the elderly, and there were more elderly who did not receive a sputum smear than expected.

Sputum Culture

Another test done to observe the presence of *Mtb* is the sputum culture. Even if a sputum smear is negative, a patient may still be infected with TB. A mycobacterium culture is done to see if there is TB bacterial growth over time. Many smear negative cases will be culture positive. A sputum culture was done for 48 of the 77 elderly patients and 202 of the 230 adult patients. Of the elderly patients given a sputum culture, 31 of the cultures were positive and 17 were negative. Of the adults given cultures, 130
were positive and 72 were negative. This results in a chi-square value of 236 ($p < 0.001$). There is a significant difference in the amounts of positive, negative, and not given sputum cultures between the elderly and adult patients. A review of the distribution shows that there are less positive cultures in the elderly than is expected. There are also more elderly not given cultures than is expected.

**Microscopic Exam of Tissue**

If *Mtb* mycobacteria are present in someplace other than the lungs or a patient cannot expel sputum, a microscopic exam of tissue may be used to determine the presence of the bacteria. A tissue biopsy exam was given to 52 elderly patients and 110 adult patients. Of the elderly patients who received a tissue exam, 22 were positive and 30 were negative. There were 48 positive and 62 negative exams among the adults. This results in a chi-square value of 137 ($p < 0.001$). There is a significant difference in the amounts of positive, negative, and not given tissue exams between the elderly and adult patients. Upon review, it is found that there are more negative exams among the elderly and there are fewer exams given to the elderly than expected.

The results of Part 2c are summarized in Table 5.

<table>
<thead>
<tr>
<th>Test</th>
<th>Chi-Square</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB Skin Test</td>
<td>195</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Sputum Smear</td>
<td>185</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Sputum Culture</td>
<td>236</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Microscopic Exam</td>
<td>137</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Table 5: Summary of Chi-Square Results for Part 2c – TB Testing
Almost all TB patients are given a chest x-ray when they first come to the clinic. The x-ray is classified as either normal or abnormal. A normal chest x-ray shows no evidence of TB disease, while an abnormal x-ray shows damage caused by the disease. An x-ray was given to 75 of the elderly patients, ten of which were classified as normal. An x-ray was given to 226 of the adult patients, of which 50 were classified as normal. This results in a chi-square value of 3.13 (p = 0.2). There is no significant difference between the proportion of normal and abnormal x-rays between the elderly and adult patients.

The abnormal x-rays themselves are classified by type. There are three types of abnormal x-ray: cavitary, non-cavitary but consistent with TB, and non-cavitary and non-consistent with TB. Cavitary lesions are caused by necrosis of some of the tissue in the lungs. Individuals with cavitary TB are considered very infectious. Patients with no cavitary lesions but with lung damage typically seen in TB cases are classified as non-cavitary but consistent with TB. Patients with no lesions and with lung damage that is caused by a factor other than TB are classified as non-cavitary and non-consistent with TB. Of the elderly patients with an abnormal x-ray, 15 were classified as cavitary, 42 as non-cavitary but consistent with TB, and 8 as non-cavitary and non-consistent with TB. Of the adult patients with an abnormal x-ray, 51 were classified as cavitary, 106 as non-cavitary but consistent with TB, and 16 as non-cavitary and non-consistent with TB. This results in a chi-square value of 3.19 (p-value = 0.2). There is no significant difference in the proportion of cavitary, non-cavitary but consistent, and non-cavitary and non-consistent x-rays between the elderly and adult patients.
The abnormal x-rays are followed up, usually after two months and the end of TB treatment, and are classified as stable, worsening, improving, and unknown. An abnormal x-ray is classified as unknown if there are changes in the x-ray where it is unclear if they are a result of TB treatment. If the patient suffers from other lung conditions such as emphysema, it can be hard to classify any x-ray changes as being a result of TB or the underlying condition of emphysema. Of the elderly patients with an abnormal x-ray, 15 were classified as stable, 4 as worsening, 27 as improving, and 20 as unknown. Of the adult patients with abnormal x-rays, 36 were classified as stable, 6 as worsening, 118 as improving, and 8 as unknown. This results in a chi-square value of 33.1 (p < 0.001). There is a significant difference in the conditions of the abnormal x-rays between the elderly and adult patients. Upon further inspection, there are fewer x-rays classified as improving and more x-rays classified as unknown among the elderly patients than expected.

The results of part 2d are summarized in Table 6.

<table>
<thead>
<tr>
<th>Abnormal x-ray Type</th>
<th>Chi-Square</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest x-ray</td>
<td>3.13</td>
<td>0.2</td>
</tr>
<tr>
<td>Abnormal x-ray Type</td>
<td>3.19</td>
<td>0.2</td>
</tr>
<tr>
<td>Abnormal x-ray Condition</td>
<td>33.1</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Table 6: Summary of Chi-Square Results for Part 2d – Radiologic Findings
2e – TB Treatment

Initial Drug Prescription

Sixty-eight of the elderly patients and 228 of the adult patients were prescribed INH as part of their initial treatment regimen. This results in a chi-square value of 19.5 (p < 0.001). Sixty-nine of the elderly patients and 226 of the adult patients were prescribed RIF as part of their initial drug regimen. This results in a chi-square value of 11.5 (p = 0.001). However, for each of these tests, one of the expected values was less than 5. The sample size is not large enough to draw accurate conclusions concerning initial use of these drugs.

Fifty-nine of the elderly patients and 224 of the adult patients were prescribed PZA as part of their initial treatment regimen. This results in a chi-square value of 34.5 (p < 0.001). Elderly patients were prescribed PZA much less than expected. Fifty-five elderly patients and 219 adult patients were prescribed EMB as part of their initial treatment regimen. This results in a chi-square value of 34.0 (p < 0.001). Elderly patients are prescribed EMB far less than what was expected.

Treatment Completion

Fifty-three elderly patients and 209 adult patients completed therapy and were considered TB free. This results in a chi-square of 22.4 (p < 0.001). Elderly patients are much less likely to complete treatment than adults. The elderly patients who completed TB therapy were on treatment for an average of 239 ± 81.6 days, which is approximately eight months. The adult patients who completed therapy were on treatment for an
average of 285 ± 135 days, which is approximately 9.5 months. A t-test was used to compare the two means, which resulted in a p-value of 0.002. The length of time on treatment for the elderly and adult patients at the Clinic is not the same. The adult patients are treated for a longer length of time.

The chi-square results of Part 2e are summarized in Table 7.

<table>
<thead>
<tr>
<th></th>
<th>Chi-Square</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial INH*</td>
<td>19.5</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Initial RIF*</td>
<td>11.5</td>
<td>0.001</td>
</tr>
<tr>
<td>Initial PZA</td>
<td>34.5</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Initial EMB</td>
<td>34.0</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Completed Treatment</td>
<td>22.4</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Table 7: Summary of Chi-Square Results for Part 2e – TB Treatment

* This indicates that at least one of the expected values in this chi-square was less than 5.
Chapter 6: Discussion of Results

Part 1

Part 1 of this research project involved various descriptive statistics of the elderly TB patients at the Clinic. This data was all collected by hand directly from the medical charts of the patients. The first portion of Part 1 was a symptom analysis, which was done in order to discover the most common symptoms experienced by the elderly TB patients at the Clinic. From the literature, it was found that many elderly TB patients experience non-specific symptoms, such as fatigue, weight loss, and anorexia (loss of appetite). Adults were found to experience the more classic symptoms of TB, including fever and cough. The most frequently reported symptoms by the elderly patients at the Clinic were cough, shortness of breath, and weight loss. Fatigue, fever, and vision change were not reported as often but still appeared to be common among the elderly patients. These findings mostly correlate with the literature findings, with a few major differences. The elderly patients reported both cough and fever as commonly experienced symptoms, however, these symptoms are said to be mostly experienced by adults. These findings could have been improved by a complete symptom analysis of adult patients in addition to the symptom analysis already done on the elderly patients. A statistical comparison could then be done to see which symptoms differ between the adult and elderly populations.
Because the elderly are said to experience non-specific symptoms, it can be very difficult for doctors to make a correct diagnosis of TB. Many of the symptoms reported by the elderly in the literature are also symptoms of more common diseases, such as pneumonia, bronchitis, or lung cancer. A correct diagnosis of TB is very important in controlling the spread of the disease. The sooner patients start treatment, the sooner that those patients are free of contagion and safe to the people around them. In Franklin County, less than half of the elderly patients (47.2%) were correctly diagnosed with TB on their initial visits to the doctor. The rest are misdiagnosed with other illnesses, with the most common being pneumonia and various types of lung carcinomas. There is much need for improvement by medical professionals in this area. Further education for doctors about TB symptoms in the elderly or having TB testing become more standard protocol should be researched in the future.

Tuberculosis is further complicated in the elderly due to the regular use of medications. According to the data analysis, 76% of the elderly patients at the Clinic report regular usage of medications other than their TB medications. Some medications can interfere with the effectiveness of TB medications and some may cause unforeseen drug interactions that may cause harm to the patient. Therefore, it is important for doctors to be aware that many elderly patients use regular medications and to try to ensure that no complications arise from interactions between their regular medications and their TB medications.

Although such complications are more likely to occur among elderly patients with TB, it is not recommended that elderly patients be treated for any more or less time than adults. The standard treatment for TB is a six to nine month course of isoniazid (INH)
and rifampin (RIF) a two month course of pyrazinamide (PZA) and ethambutol (EMB).
The elderly patients at the Clinic are treated for an average of 7.3 months for INH, 7.1
months for RIF, 3.6 months for PZA, and 4.2 months for EMB. The length of time on
the drugs INH and RIF correlate with the recommended course of treatment for these
drugs in the literature. However, the elderly patients at the Clinic are treated for longer
than the recommended course of treatment for PZA and EMB. It was difficult to
determine whether or not this increase is significant just based on an arithmetic average,
but it leads to further questions about possible causes. The limitation of this evaluation
was that no analysis was done on patients with drug-resistant TB for this project. If the
patients were known to have an INH or RIF drug resistance, those patients would be
treated with longer than average courses of PZA and EMB. This could potentially
explain the increased length of treatment with PZA and EMB.

Finally, all of the analysis done in this section was set back by the fact that half of
the medical charts for the elderly patients were missing. It can not be known how these
results may be changed if this information was included, and these results are therefore
subject to question. If these records are ever found, this analysis can be easily repeated
and the results adjusted accordingly. However, until that time, these results must stand as
they are.
Part 2

Part 2 of this research project was a comparison study between the elderly patients, aged 65 and older, at the Clinic and the adult patients, aged 25 to 49. This section was divided into five major categories: descriptive statistics, common TB risk factors, TB testing, radiologic findings, and TB treatment. Each category had one or more subcategories that were analyzed using a chi-square or student’s t-test.

There were a few surprising results found from analyzing various descriptive statistics for the patients at the Clinic. Three specific descriptive statistics were analyzed: gender, race, and the major site of TB disease. After using a chi-square to study the distribution of males and females for both the elderly patients and the adult patients, it was found that the ratio of males to females in the adults was nearly two to one, while that same ratio was approximately one to one among the elderly. This corresponded to a chi-square value of 4.49 and a p-value of 0.03. It is difficult to speculate why this may be, but it is quite interesting. The difference in the male to female ratios is unlikely to be caused by simple coincidence. This could imply that the source of TB infection is different for the elderly patients, which further implies that TB in the elderly could be a different disease.

The second descriptive statistic analyzed race among the elderly and adult patients at the Clinic. It was shown in this analysis that most of the adult patients are made up of immigrants, particularly Somalian immigrants. However, most of the elderly patients are United States citizens. Therefore, there should be more black patients and fewer white patients among the adult group. This was confirmed by the results of the
chi-square analysis of race, which showed that there were more white patients and less black patients in the elderly group than is expected (p = 0.002).

The last descriptive statistic analyzed the major site of TB disease. The patients were divided into two groups, those with pulmonary TB and those with non-pulmonary TB. The chi-square analysis showed that the proportion of pulmonary cases among the elderly is not different than the proportion of pulmonary cases among the adults. It also shows that there are more pulmonary cases than non-pulmonary. This result is not unexpected. Given that TB primarily causes lung infection, it makes sense that the majority of TB cases are pulmonary. There is also no evidence in the literature to suggest that the proportion of non-pulmonary cases would be different between age groups.

The second section of Part 2 was an analysis of common TB risk factors. The risk factors analyzed in this section were country of origin, HIV status, having a previous diagnosis of active TB disease, homelessness, and residence in a long-term care facility. The purpose of this section was to deduce which risk factors are more attributable to the elderly population. This data can be used to provide age-specific education about TB to areas where individuals with certain risk factors are prevalent.

The first risk factor analyzed was country of origin. TB is much less common in the United States that it is in other countries. Therefore, country of origin is a very significant risk factor, particularly if a patient is from one of the 22 high TB-burdened countries published by the World Health Organization. However, most of the immigrants coming into this country are less than 50 years old. Therefore, it was predicted that country of origin is a much greater risk factor for the adult patients at the Clinic. That prediction was confirmed in the results that the proportion of U.S.-born patients to
foreign-born patients among the elderly was much higher than that proportion among the adult patients (p < 0.001).

HIV-status was the next risk factor analyzed. It is a well-known fact that patients immunocompromised from HIV are at much higher risk for developing TB at some point in their lifetime. When the AIDS epidemic first arose, HIV was a risk factor that mostly affected adults. However, better antiviral drugs are allowing HIV-positive individuals to live much longer lives, and as a result, the HIV-positive population is getting older. Therefore, it is becoming a much more definitive risk factor for the elderly population. For the purposes of this analysis, HIV status was divided into four categories: HIV-negative, HIV-positive, refusal to take the test, and never offered the test. It was determined that the percentage of HIV-positive individuals was far lower among the elderly, and far more of the elderly refused to take the test or were never offered the test (p < 0.001). The biggest issue with these results is the high percentage of elderly who never take the test, whether they refuse it or are never offered it. As the population of HIV-positive individuals gets older, it will become more important for medical professionals to ensure that HIV tests are being given to everyone, including the elderly.

It seems obvious, perhaps, that having a previous diagnosis of active TB would increase the risk of developing TB in the future. However, it was predicted that this would be a greater risk factor for elderly patients. This was not confirmed by the analysis, which showed that the proportion of elderly patients with a previous diagnosis of active disease is not different than the proportion of adult patients with previous active disease. This analysis could have been improved by differentiating between those with a recent diagnosis of TB and those with an older diagnosis. With a more recent diagnosis,
the patient is more likely to have a relapse or recurrence where they have either not completed treatment or have developed a drug-resistant strain of infection. If either of these is the case, the new diagnosis of TB may not be a case of reactivation of infection but of ongoing infection.

Discussion of having a previous diagnosis of active disease naturally leads into discussion of reactivation TB. The difference between the two is that reactivation TB actually refers to latent infection, as opposed to an active one. Research has shown that the risk of reactivation TB is much greater among the elderly population. However, it is nearly impossible to research this as many patients are not aware that they were ever exposed to TB. Therefore, it can not be known exactly how many new cases of TB are the results of reactivation of old TB disease. Doctors should still be aware that it is a problem and take steps to control it.

The next two risk factors analyzed were homelessness and residence in a long-term care facility. These risk factors are similar, as close contact with other shelter or long-term care residents is common. This leads to a higher risk of TB transmission. Unfortunately, the sample size of the elderly group was not large enough to come to an accurate conclusion of whether or not these are risk factors. Once more patients enter the Clinic, their data can be added to the file and the calculations can be redone. It should also be mentioned that the Clinic only collects data about homelessness and long-term care residence at the time of TB diagnosis. Therefore, more patients may qualify for inclusion into these categories than are actually included. However, even if no conclusions can be drawn from this data, residents and employees of these facilities
should be aware of the increased risk and incorporate measures to control the spread of disease.

The third section of Part 2 was an analysis of the various types of TB testing that are commonly used, both to diagnose TB and to monitor progression of the disease. The TST is most often used to diagnose LTBI and can assist in the diagnosis of active TB disease. However, it has some disadvantages, particularly for elderly patients. The TST works by measuring the immune response of a patient to tuberculin antigen. The higher the immune response, the more likely the patient has TB. This is unfortunate for elderly patients, as immune response decreases with age. The TST becomes less effective the older the patient is. Therefore, it is expected that there will be more negative TST results among the elderly population. This was confirmed using a chi-square analysis. The proportion of elderly patients with a negative TST is far higher than the proportion of adult patients with a negative TST ($p < 0.001$).

The disadvantages of the TST have been known for quite some time. Just recently, a new test was developed in order to increase the number of patients that are correctly diagnosed with TB. This is known as the QuantiFERON-TB-2 Gold (QFT) assay. As this test is so recent, there was not a big enough sample size to do any sort of analysis as to its effectiveness in the Clinic. However, the results in the literature have shown that this test may be more effective than the TST for diagnosing the elderly. Therefore, regular use of the QFT should be implemented for patients. Further analysis can be done at a later time when more data is available.

The next three tests analyzed were the sputum smear, the sputum culture, and the microscopic exam of tissue. These tests are used to determine the infectiousness of
disease. If a patient is sputum smear positive, he is considered highly infectious and must stay in respiratory isolation. A positive sputum culture is much more common. A patient may be smear negative and culture positive and remain out of isolation. However, a patient must maintain culture negative status for a certain period of time to be considered disease-free for pulmonary TB. Sputum samples may not be obtainable from patients with non-pulmonary TB who cannot produce a cough. For non-pulmonary TB cases, the diagnosis may be based on the microscopic exam of tissue biopsy with specimen processed for acid fast bacilli (AFB) smear and culture, clinical symptoms, and radiological diagnosis.

Each test was divided into three categories: status positive, status negative, and status not given. The results of the analysis of the sputum smear concluded that the proportion of both smear positive and smear negative patients was lower among the elderly group, and the proportion of patients not given the smear was much higher (p < 0.001). This is a surprising finding because the proportion of patients with pulmonary TB in the elderly group is similar to the proportion in the adult group. Therefore, it would seem likely that the proportion of patients given a sputum smear would be similar in both groups. It is hard to speculate why this ratio is higher in the elderly, but it may be that elderly patients have a harder time expelling sputum or that they simply do not present with cough as an initial symptom of the disease. If either is the case, the proportion of patients not receiving a sputum culture should also be higher among the elderly patients. This was reflected in the results of the sputum culture analysis. There were many more elderly patients not receiving a sputum culture and far fewer with a positive culture than expected (p<0.001).
As previously stated, the microscopic exam of tissues is mostly given to those patients who have contracted extra-pulmonary TB. It has been shown in this analysis that the proportion of adults with extra-pulmonary TB is similar to that proportion among the elderly. Therefore, it is expected that the proportion of microscopic exams of tissue will be similar between the two groups. This was not reflected in the results which showed that the proportion of elderly patients given a microscopic exam was actually higher than in the adults (p<0.001). A patient may be more likely to receive a microscopic exam if a sputum sample was unobtainable for some reason. Because the proportion of elderly patients receiving a sputum smear and culture is lower than in adults, it could explain why the proportion of microscopic exams was higher.

The next area that was analyzed was the radiologic findings provided by chest x-rays given to the patients. Each x-ray was classified by group as either normal or abnormal. Normal x-rays show no evidence of damage from TB disease. Theoretically, a patient with non-pulmonary TB should not show lung damage from TB. Because the proportion of elderly patients with pulmonary disease is similar to that in adults, it was theorized that the proportion of normal x-rays between the two groups would also be similar. This was supported by the evidence. The analysis showed that the proportion of elderly patients with an abnormal x-ray was similar to the proportion of adult patients with an abnormal x-ray (p=0.2). Unfortunately, it is quite difficult to state that the only reason the normal/abnormal ratio is similar between the two groups is because the pulmonary/non-pulmonary ratio is similar. Twenty-two elderly patients were classified as non-pulmonary but only 10 patients had a normal x-ray. Similarly, 77 adult patients were classified as non-pulmonary but only 50 patients had a normal x-ray. The rest of
the patients must either have an abnormal x-ray from a condition unrelated to TB or must have both pulmonary and non-pulmonary TB. Multiple-area TB was not monitored during the course of this investigation, but abnormal x-rays unrelated to TB were mentioned.

The abnormal type x-rays were further classified by type and condition. The three types of abnormal x-rays were cavitary, non-cavitary but consistent with TB, and non-cavitary and non-consistent with TB. Since patients with evidence of cavitary lesions are considered highly infectious, it is important to note where these patients might come from. It would be useful for medical professionals to know if elderly patients are more likely to show evidence of cavitary disease, as this would imply that elderly patients are more likely to be contagious. The analysis, however, did not show any evidence that the proportion of elderly patients with cavitary lesions is higher than the proportion of adult patients with cavitary lesions (p = 0.2).

The three conditions of abnormal x-ray were stable, worsening, improving, and unknown. The analysis showed that the proportion of elderly patients with improving x-rays is less than the proportion of adult patients with improving x-rays (p < 0.001). This is unfortunate but not surprising. The immune system decreases in function as a person gets older. This leads to more frequent illness and slower healing time. The evidence that elderly patients have fewer improving x-rays may be a consequence of that slower healing time. Unfortunately, it also leads to the conclusion that TB may cause more extensive damage to the lungs of elderly patients due to delayed diagnosis or other factors, whereas it may not in younger adults. It is hard to be sure of this. On the other hand, it may be that the slower healing time of the elderly leads to slower improvement.
of the chest x-ray. It may be that further treatment will show further improvements on a chest x-ray. It is recommended that further research in this area is done by giving more regular chest x-rays to patients.

The final section analyzed in this study was TB treatment. Several areas were research in this section, including number of patients prescribed the four most commonly-used TB drugs and total length of treatment time. Since the vast majority of patients are prescribed both INH and RIF, there were not enough patients that were not prescribed these drugs to do an accurate analysis. However, it was shown that elderly patients are prescribed the two drugs PZA and EMB far less than younger adults. This may be due to the increased risk of side effects in elderly patients. They may be unable to take these medications. It could be that there is a more effective combination of TB medications that can be used to treat elderly patients. Further research in this area is required.

Part of determining the total length of treatment time involved removing the patients who had not completed treatment from the analysis. This was done in order to keep patients who were only treated for a very short period of time, due to death or some other factor, from skewing the results of the analysis. As it turns out, elderly patients are much less likely to complete treatment than adult patients (p<0.001). This is unfortunate because the consequences of a patient not completing TB treatment can be severe. The patient may continue to spread infection, so it is imperative that more effort be made to ensure that as many patients as possible complete treatment. The causes of incomplete treatment are monitored by the Clinic for all patients, however, they were not analyzed during this investigation.
After removing those patients that have not completed treatment from the analysis, it was found that elderly patients are treated for an average of 239 days, approximately eight months, with a standard deviation of 81.6 days. Adult patients were treated for an average of 285 days, approximately 9.5 months, with a standard deviation of 135 days. These standard deviations are large, and this is due to the individual nature of TB treatment at the Clinic. Each patient is treated as long as necessary. However, this difference of 1.5 months was shown to be statistically significant (p=0.002). According to the literature, adults should not be treated any differently than elderly patients. However, in Franklin County, they are actually treated longer.

Summary

The purpose of this project was to determine if the presentation, diagnosis, and treatment of TB in the elderly is different when compared to a younger adult population. Patients at the Ben Franklin Tuberculosis Clinic were divided into age groups. Elderly patients were defined as aged 65 and older, and the control population was made up of younger adults aged 25 to 49. Differences were analyzed in five different areas: descriptive statistics, TB risk factors, diagnostic tests, disease presentation, and TB treatment. If differences were found in all of these areas, it is likely that TB in the elderly is a different disease. Differences were found in all areas of analysis, and it is therefore concluded that TB in the elderly is clinically different.
References


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Appendix A: Data Collection Form

Gender: Male ___ Female ___

A) Place of Birth:
   Outside of the US Yes ___ No ___
   If Yes
      Where _______________________
   When Came to US _________

B) TB Risk Factors:
   Previous Diagnosis of TB Yes ___ No ___
   Current Smoker Yes ___ No ___
   Past Smoker Yes ___ No ___
   Travel to Endemic Location Yes ___ No ___

C) Symptoms:
   Fever Yes ___ No ___
   Cough Yes ___ No ___
      Sputum Yes ___ No ___
      Hemoptysis Yes ___ No ___
   Shortness of Breath Yes ___ No ___
   Loss of Appetite Yes ___ No ___
   Fatigue Yes ___ No ___
   Weakness Yes ___ No ___
   Stomach Upset Yes ___ No ___
   Vomiting/Diarrhea Yes ___ No ___
   Rash Yes ___ No ___
   Joint Pain Yes ___ No ___
   Headache Yes ___ No ___
   Vision Change Yes ___ No ___
   Hearing Loss Yes ___ No ___
   Unexplained Weight Loss Yes ___ No ___
      > 5 pounds Yes ___ No ___
### D) Testing:

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</tr>
<tr>
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<td>No ___</td>
</tr>
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<td></td>
</tr>
<tr>
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### E) Treatment:

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</thead>
<tbody>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Rifampin</td>
<td>Yes ___</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PZA</td>
<td>Yes ___</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethambutol</td>
<td>Yes ___</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Streptomycin</td>
<td>Yes ___</td>
<td></td>
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</tbody>
</table>

### Drug Side Effects that Prevented Taking of Medication

<table>
<thead>
<tr>
<th>Medication</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isoniazid</td>
<td>Yes ___</td>
</tr>
<tr>
<td>Rifampin</td>
<td>Yes ___</td>
</tr>
<tr>
<td>PZA</td>
<td>Yes ___</td>
</tr>
<tr>
<td>Ethambutol</td>
<td>Yes ___</td>
</tr>
<tr>
<td>Streptomycin</td>
<td>Yes ___</td>
</tr>
</tbody>
</table>

### Completed Full Treatment

<table>
<thead>
<tr>
<th>Completed Full Treatment</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Started</td>
<td>Yes ___</td>
</tr>
<tr>
<td>Date Stopped</td>
<td>Yes ___</td>
</tr>
</tbody>
</table>

### Death

Moved/Lost to Follow Up
Uncooperative
Unknown