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Human Immunodeficiency Virus and Homelessness Among U.S.-Born and Foreign-Born Tuberculosis Cases in Georgia

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Abstract

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MPH, Emory University, 2009

BS, Webster University 1997

Doctoral Study Submitted in Partial Fulfillment

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Abstract

According to the Centers for Disease Control and Prevention, tuberculosis (TB) is an infectious disease caused by bacteria and can easily spread in the U.S. and worldwide. TB infections in the U.S. have been much lower compared to other countries around the world in the last 40 years, but with the recent increase in an immigrant foreign-born population, there is a serious risk of the spread of TB. The goal of the study was to look into U.S.-born vs. foreign-born populations among TB/HIV/homeless cases in the state of GA from 2014 to 2018. The quantitative study was performed using secondary data from the CDC Online Tuberculosis Information System. Univariate Chi-square and multivariate regression analyses were done while using the social ecological model as theoretical framework. Findings show no evidence of the association between origin of birth, the odds of being foreign-born TB case in GA and HIV status, rather U.S.-born to be more HIV positive and homeless. There was no significant association related to sex and being foreign-born among HIV positive TB cases, and no significant association related to age groups in homeless TB cases. The study contributes to positive social change by improving treatment plans to eliminate TB in GA refuting the assumption that foreign born persons are more likely than U.S.-born persons to be HIV positive and homeless, thus reducing the stigma among the foreign-born population. These findings will benefit society and will result in immigrant friendly and less biased society for all.

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Section 1: Foundation of the Study and Literature Review

Tuberculosis Around the World

World Health Organization (WHO, 2020) has reported tuberculosis (TB) as one of the top 10 causes of death worldwide, with 1.5 million people who died from TB in 2018. The report also focused on 251,000 people who already had HIV and were more prone to TB infection as a result of their positive HIV status (WHO, 2020). The latest data from 2018 indicated how serious TB was as there were an estimated 10 million people who got sick from TB worldwide, including 5.7 million men, 3.2 million women, and 1.1 million children (WHO, 2020).

TB was first detected in humans in 5800 BCE (Barberis et al., 2017), while in 1882, Koch identified the tuberculin bacteria (*Mycobacterium tuberculosis*) as the organism that has caused increased mortality for humans over the centuries. The size of the bacteria is from 1.3 to 1.5 microns, and it is active at 37C within 3 to 4 weeks. Additionally, for the development of TB in humans, the required factors are tuberculin bacteria as the cause of disease, method of entrance in the human body, disease transmission from person to person, and the immunity of the human organism (Zutic et al., 2018). Because the most common method of infection (90%) is by airway (Zutic et al., 2018), TB continues to be the most infectious disease around the world. Despite the latest medical advances, particularly for people already infected with HIV or people with low socioeconomic status such as homeless people, TB remains a serious concern.

Mycobacterium tuberculosis and HIV infections are coendemic and are more susceptible to the progression of TB (Ayelign et al., 2020).

The WHO (2020) reported that HIV positive individuals are 19 times more likely to develop active TB. The risk of active TB is greater in individuals suffering from HIV and malnutritional homelessness, and, as a result, 2.3 million new TB cases in 2018 were attributable to malnutrition of the homeless globally (WHO, 2020).

The Pan American Health Organization (PAHO, 2020) stated that there were 289,000 estimated incident TB cases in the Americas, with an estimated mortality rate of 22,900, where 26% were a result of TB/HIV coinfection. Focusing on the United States, TB cases are the lowest compared to other parts of the world, and for that reason, the use of the Bacille Calmette Guerin vaccine is not recommended (PAHO, 2020).

According to the MMWR report, in 2019, there were 8,920 “provisionally reported” TB cases in the United States, at a rate of 2.7 per 100,000 persons -- up to 13 million of the estimated number of people in the United States living with a latent TB infection. The state of Georgia, for example, had an increase in the number of reported TB cases from 271 cases in 2018 to 301 cases in 2019, according to the Centers for Disease Control and Prevention MMWR Report (2019).

There was a time when TB was considered a worldwide pandemic (TB Alliance, 2020). When the spread of infectious disease occurs through human populations across a vast region, for instance, multiple continents and worldwide, it is referred to as a pandemic (TB Alliance, 2020). Researchers aim to understand how people might respond

to and cope with the threat of a global pandemic to reduce that threat (Arden & Chilcot, 2020). The Centers for Disease Control and Prevention (CDC) aims to protect Americans and the international community by providing health promotion, prevention, and preparedness and to broaden understanding (Mission et al., 2018) during any type of pandemic; the CDC continues to focus on TB.

Background Information on Immigrants in Georgia

Over the last 25 years, Georgia has become the 11th largest state in the nation, mostly due to immigration (Census Bureau, 2019). Moreover, there is one particular region of Georgia with a large immigrant population that has no means for TB prevention due to lack of funding. TB is a public health problem, especially among immigrants within the state of Georgia and particularly the immigrant community in the Clarkston community, where communities many challenges daily from a lack of access to healthcare, a lack of funding in the community, a prevalence of other diseases that can coexist with TB, such as HIV, and a lack of economic stability, adequate housing, and possible risk of homelessness (Guardian, 2017).

In order to understand the immigrant population in Georgia, it is first necessary to understand the history of Clarkston Community. It was named after the Director of the Georgia Railroad, Colonel W.W. Clark. According to the City of Clarkston website (2018), Clarkston owes much of its beginnings to the Georgia Railroad. Beginning in the 1830s, the Georgia Railroad began construction of rail lines that, by 1845, would eventually connect surrounding Atlanta towns, to include Clarkston, with the merchants

of Athens to outlets in Augusta and South Carolina. Originally called "New Siding" after Jake New, a Section Foreman who worked for the Georgia Railroad, the City of Clarkston was officially chartered by Governor Alexander H. Stevens on December 12, 1882. This community is an immigrant community with 31.8% of population being foreign born residents who settled close to the railroad to be well connected to other communities in GA (City of Clarkston, 2018).

General recommendations would be to increase funding for these communities and to implement cost effective preventive measures for TB among immigrants by creating small satellite clinics in the area where purified protein derivative (PPD) testing and other additional medical services could be provided. There are multiple stakeholders in the area that would be able to help and assist in the process.

The International Rescue Committee (IRC) and the World Relief organizations are involved with legal immigration to the United States. There is a standard process when legal immigrants arrive to complete required medical exams (IRC, 2020). One part of this process is to be tested for TB (PPD test and chest X-ray). Medical records are kept for each immigrant, the assurance that they do not have TB, and that there is no risk to others. However, there is opposition toward illegal immigrants where there is lack of this process in place (IRC, 2020). Public health law and policy plays a major role for many legislative representatives and their stakeholders with the legal powers at the state level as essential in TB prevention efforts (Goldberg, 2017). Additional stakeholders who are associated with this immigrant community are Save the Children Fund, the Global Health

Institute in collaboration with the universities in Georgia, such as Emory University, Georgia State University, University of Georgia in Athens, and many other smaller organizations and agencies.

Table 1

Immigrant TB Program Main Stakeholders' Analysis

Stakeholder	Interest/Position	Priority	Strategy
Georgia State Legislators	Supportive but concerned that won't be popular with public. Not convinced that pros outweigh cons. Values input of law enforcement.	High (high interest and high power)	Educate on pros and cons. Demonstrate support by law enforcement and communities.
International Rescue Committee (IRC)	Skeptical of value; believes will create more drug use	High (high interest and high power)	Convince law enforcement to be champion. Connect with law enforcement from jurisdictions with successful programs.

World Relief	Sees drug use as problem but concerned that program will create more drug use. Values input of law enforcement.	Medium (high interest and low power)	Educate via community meetings with supportive law enforcement present.

Additionally, there is an intersection of public health, public policy, and politics (Tarantola, 2019). Tarantola (2019) stated,

> In an ideal world, evidence of public health gains achievable through new approaches or technologies should inform public policy, should help shape political agendas in support of policy change, which should translate into law and regulations - and then to their application. The goal of this transformative process should be to yield the highest attainable health benefits to vulnerable individuals and communities and to society as a whole.

The latest CDC report 2020 indicated high numbers of TB cases among immigrants who recently arrived in the United States and the importance of preventing this type of disease from further spreading around the nation. These major findings show two types of TB infections, pulmonary and extra pulmonary TB (CDC, 2020). Pulmonary TB was the most common form of post primary disease from 1999 to 2001, and a total of 5,198 cases of TB were recorded among persons who had immigrated to the United States (CDC, 2020).

Treatment and Control of Tuberculosis

The WHO (2020) has urged countries around the world to take initiative in terms of TB control, prevention, and treatment as TB is a curable and preventable infectious disease, with an estimated 58 million lives saved through TB diagnosis and treatment between 2000 and 2018. They continue to recommend global TB control, the implementation to start TB strategy including six main components (WHO, 2020), which include the following:

- Using the Directly Observed Therapy Short course (DOTS) procedure
- addressing TB/HIV, MDR-TB and other challenges
- strengthening of TB health systems
- including all healthcare providers
- making patients and community aware of TB
- promoting research

DOTS contain five main components, as indicated by WHO (2020):

- political commitment
- case detection through quality assurance bacteriology
- drug supplies
- surveillance and monitoring systems
- TB treatment directly observed by monitors

Despite these DOTS strategies in place, multidrug-resistant TB (MDR-TB) remains to be a public health crisis and a health security threat. According to the WHO

(2020), there are an estimated 484,000 new cases with resistance to rifampicin, the most effective first-line drug, of which 78% had MDR-TB. Additional drugs used for TB treatment as part of DOTS methods are the following: Isoniazid (H), Rifampicin (R), Pirazinamid (Z), Ethambutol (E), and for 4 months recommended to take only two HR-Isoniazid and Rifampicin (WHO, 2020).

Additionally, there were an estimated 10.0 million new cases of TB globally, including 920,000 new cases in people living with HIV (USAID, 2019). The president's Emergency Plan for AIDS Relief is a passage of the legislation launched in 2003 that placed a heightened priority on U.S. and global TB efforts that continue to this day (U.S. Congress, 2020). The United States has global TB efforts coordinated under the international working group of the Federal Tuberculosis Task Force (a coalition of federal agencies involved in U.S. global and domestic TB efforts; USAID, 2019).

Problem Statement

According to the CDC (2018), TB is an infectious disease caused by bacteria that can be easily spread from person to person through the air. TB has been a persistent healthcare problem in many countries around the world for centuries. Most recently, due to an increased number of immigrants to the United States and drug-resistant TB, there have been more cases than prior to the beginning of the 21st century (CDC, 2018).

According to Tsang et al. (2020), the United States had 9,272-9,940 cases of TB reported annually from 2012 to 2016; the incidence rate was 2.9 to 3.2 cases/100,000 of the population. Most of these cases occurred among the foreign-born population and

caused the progression of remotely acquired latent TB infection. Tsang et al. stated, "World Health Organization TB rates are not representative of TB risk among expatriates in the United States and that TB testing prioritization in the United States might better be based on U.S. rates by country of birth and years in the United States."

Marks et al. (2019) reported that HIV will increase TB rates and TB-related health problems, but there is no difference comparing Black and White race in the United States. Gomez et al. (2019) studied homelessness and HIV in association with TB while considering innovative strategies when it comes to TB treatment in order to reduce TB cases. However, there is a gap in the literature and the need to perform more quantitative data analysis in order to have a better understanding in preventing future TB rate increases. Some of the challenges are the difficulties of tracking the development and surveillance of TB across the state of Georgia.

According to Salindri et al. (2018), who studied TB patients in the state of GA, targeting the right kind of stakeholders is important. Besides the stakeholders, I performed quantitative data analysis by looking into secondary data resources such as the CDC Wide-Ranging Online Data for Epidemiologic Research (WONDER) database and recommended the social policy changes to prevent future TB cases in the state of Georgia and across the United States.

Recommendation of specific policy changes would be needed for TB and HIV testing of all patients in the United States, specifically in Georgia, while TB monitoring/treatment would be done for those who might show a positive PPD skin test.

Patients who have HIV and TB with a smear negative test will show higher mortality while sputum collection and transport, directly observed therapy, monitoring for adverse events, tracing of people not completing treatment, as well as nutritional support and health education are needed to avoid mortality (Pathmanathan et al., 2017). In such cases, there is immunodeficiency present, which can trigger other chronic, infectious diseases and create a much bigger public health problem.

Over the years, many studies have been conducted on TB alone, but there was one study done on both TB and HIV in the state of North Carolina. Pearson et al. (2019) conducted a retrospective, cross-sectional study where about 300 employees were tested for TB and HIV in North Carolina, of which 22% were immigrants and foreign-born employees. Out of entire group studied, they were TB positive at 54% while U.S. born employees tested showed 12% TB positive results. The CDC (2018) reported a correlation between TB and HIV, and when these two diseases are combined, they can decrease life longevity. If a patient was untreated for a latent TB infection, the HIV infection contributed to the development of TB at a higher rate than for a patient who was not HIV infected.

Homelessness as a socioeconomic status (SES) predictor additionally complicates the situation and increases TB and HIV rates (CDC, 2018) due to a lack of proper hygiene and access to healthcare. For these reasons, I based this quantitative study on HIV and homelessness as an SES predictor, studying how it relates to TB cases in Georgia.

Minorities have the greatest burden of having TB, including the foreign-born population, while homelessness significantly impacts their SES in the United States (Khan et al., 2018). People who experience homelessness have a higher prevalence of comorbidities such as HIV infection, mental illness, and substance use disorders that also increase the risk of progression to TB in the United States (Khan el al., 2018).

Munn et al. (2015) used a homeless shelter in Washington state for the setting of their study and assessed risk factors for TB infection They determined that birthplace and the longevity of exposure had a predisposition to TB infection. However, there has been no research study done for the state of Georgia for the timeframe of 2014 to 2018, particularly looking into the correlation among TB, HIV, and homelessness. An extensive literature search did not reveal any published articles or evidence of this type of research being done for the state of Georgia.

Purpose of the Study

According to Soriano (2020), different ethnic communities should have multiple partnerships, promote equality, and engage diverse stakeholders where there is mutual understanding, respect, and established norms when it comes to TB/HIV prevention. The rationale for doing this type of quantitative research study was to determine the gap related to TB cases (U.S. born/foreign-born population) in the state of Georgia in relation to HIV status and homelessness. According to the CDC (2018), the homelessness condition increases the risk of TB and HIV infection, and there is a gap when it comes to the level of TB/HIV related to homelessness with the focus on the state of Georgia for the

last 5 years of quantitative data available. This has never been studied, and for that reason, the CDC (2018) is collaborating with many national public health organizations in order to improve screening, diagnosis, and treatment for people who are homeless. The CDC is also collaborating with local and state healthcare agencies to support homeless population. In recent years, the number of HIV cases has increased for the state of Georgia, and my focus was to determine the effect it would have on TB prevalence.

In order to support this rational even further, the correlation between TB and HIV and TB and homelessness was evaluated and researched for the purpose of having successful preventive measures and interventions at local and state levels for GA. Marks et al. (2019) stated that about half a million people immigrate to the United States along with about 160 million visitors each year, not to mention an unknown number of illegal immigrants. Because there is no way for illegal immigrants to be tested for TB or HIV and because they might be homeless for a while, there is no accurate number to report. Additionally, Marks et al. found that patient mortality due to HIV positive status was more prevalent in U.S. born population compared to the foreign-born population.

Research Questions and Hypotheses

Research Question (RQ)1: What is the relationship between the sociodemographic and clinical characteristics of the U.S. born and foreign-born population (origin of birth) in TB cases for the state of Georgia from 2014 to 2018?

$H1_0$: There is no relationship between the sociodemographic and clinical characteristics of U.S. born and foreign-born population (origin of birth) in TB cases for the state of Georgia from 2014 to 2018.

$H1_A$: There is a relationship between the sociodemographic and clinical characteristics of U.S. born and foreign-born population (origin of birth) in TB cases for the state of Georgia from 2014 to 2018.

RQ2: What is the relationship between HIV status in TB cases for the state of Georgia from 2014-2018?

$H2_0$: There is no relationship between HIV status in TB cases for the state of Georgia from 2014 to 2018.

$H2_A$: There is a relationship between HIV status in TB cases for the state of Georgia from 2014 to 2018.

RQ3: What is the relationship between homelessness in TB cases for the state of Georgia from 2014 to 2018?

$H3_0$: There is no relationship between homelessness in TB cases for the state of Georgia from 2014 to 2018.

$H3_A$: There is a relationship between homelessness in TB cases for the state of Georgia from 2014 to 2018.

My hypothesis was that origin of birth (U.S. born/foreign-born population), homelessness, and HIV status as independent variables would make a significant impact in TB cases for the state of Georgia during the time from 2014 to 2018. I believed that

with the increase in immigration, homelessness, and HIV rates, in recent years 2014 to 2018, TB cases would increase and there would be a significant difference for the state of Georgia. Further, adding more variables such as sociodemographic factors (age, race, and immigrant ethnicity/country of origin) and clinical characteristics made the study more interesting.

According to Munn et al. (2015), public health agencies should be working with homeless shelters and homeless population to help prevent TB, as these "congregate settings" can increase TB prevalence.

According to Burkholder et al. (2016), researchers have to rely on big data with no biases involved, at that time the focus should be on research questions and hypotheses for that particular study. Every research question has a predictor and an outcome variable to answer the specific research question. In RQ1, I predicted that with the increase in immigration, the origin of birth in TB cases in relationship with demographics and clinical characteristics of GA population would be significant in terms of impact from 2014 to 2018. In RQ2, I predicted that with the increase of HIV in TB cases, there would be a significant impact for the state of Georgia during 2014 to 2018. In RQ3, I predicted that with the increase of homelessness in TB cases, there would be a significant impact for the state of Georgia during 2014 to 2018.

Theoretical Framework

According to Creswell (2017), a researcher's selection of a theoretical framework and quantitative research design depends on the goals of the study and the literature

review. My quantitative research involved a deductive approach in that it was intended to test theory. The study's three research questions addressed three independent variables (origin of birth, HIV, and homelessness) in TB cases.

I applied a socioenvironmental framework to the study. From a socioenvironmental perspective, health is the product of social, economic, and environmental determinants. This framework provided incentives and created barriers to the health of individuals and communities, with the ultimate goal of reducing risks within the community (see Creswell, 2017).

According to the social ecological model (SEM), individual behavior is shaped on multiple levels, including the organizational, community, policy, interpersonal, and intrapersonal levels (Glanz et al., 2015). The rationale for using this specific theory was that it made it possible to show connections between the variables in a simple way.

Homelessness and HIV are variables directly affecting TB cases in the U.S. born/foreign-born population, and in order to shape individual behavior, organizations, communities, and state-level officials need to implement specific policies. In light of my personal and professional engagement and interest in TB, HIV, and homelessness, a socioenvironmental framework seemed to be the best option for this research. The socioenvironmental framework further developed my strategy from the beginning to the end of the implementation process, which was helpful in tracking and preventing TB in the state of Georgia.

Mobilize, assess, plan, implement, track is another framework that can be used to plan and evaluate public health interventions for immigrants within the state of Georgia where community engagement matters (Turin, 2020). According to Turin (2020), by engaging all stakeholders, there is more of a community engagement related effort that will assess all the needs of the community based on the resources available. It will further develop strategy from the beginning to the end of the implementation process.

Definition of Terms

DOTS treatment: Otherwise known as directly observed short course therapy is type of treatment used for TB. Medication used for TB treatment as a part of DOTS methods are the following: Isoniazid (H), Rifampicin (R), Pirazinamid (Z), and Ethambutol (E).

Georgia legislature representatives: A legislator is someone who can see the need for a new law or changes in an existing law and for that reason introduces a bill such as TB prevention among immigrants due to the potential that TB can be spread to other areas or all across the state of GA.

HIV: A type of virus that weakens a person's immune system by destroying important cells that fight disease and infection. There is no effective cure for HIV (CDC, 2018).

*Homelessness***:** The defined as the state of having no home (Oxford Dictionary, 2020).

International Rescue Committee (IRC): The organization responding to the world's worst humanitarian crises that helps people by providing daily essential clean water, shelter, health care, education, and empowerment support (IRC, 2019).

Mortality: The number of dead people within 1 year, represented per 100,000 people.

Multidrug resistant tuberculosis (MDR-TB): No effect on TB symptoms while subjected to multiple drugs used for TB treatment.

Pandemic: An epidemic of infectious disease that has spread through human populations across a vast region, for instance, multiple continents or even worldwide (CDC, 2018.)

Stakeholder: Someone who has a stake in the study and would be influential to make an impact. Stakeholders can be internal and external depending on their status on the project or within the organization.

TB surveillance: The organized and systematic collection, data analysis, and interpretation of TB data in order to determine TB patterns or trends at the same time when looking into HIV and homelessness in relationship with TB in the state of Georgia, especially when it comes to vulnerable population such as immigrants (CDC, 2020).

Tuberculosis (TB) prevalence: The total number of infected people.

World Relief: The organization that provides emergency relief and community-based solutions by assisting refugees and immigrants in the United States (World Relief, 2019).

Nature of the Study

The nature of the study was quantitative data analysis as I explored key study variables in TB cases such as origin of birth (U.S. born/foreign-born), HIV, and homelessness (independent variables) in order to determine the relationship between dependent and independent variables in the state of Georgia during a specific time from 2014 to 2018. I downloaded and used the latest version of SPSS to analyze TB cases in relationship with origin of birth /HIV/homelessness status for the state of Georgia taking into consideration demographics and clinical characteristics of the population. The SPSS tool was used to obtain the results by summarizing the numerical results with univariate Chi-square and multivariate logistic regression, including the following interpretation: measures of central tendency, measures of shape, normal distribution, and measures of dispersion (see Mishra et al., 2019). For example, measures of central tendency are appropriate tools for most samples, measures of shape can check for variables' normal distribution, measures of dispersion check for variability, and percentage calculated describes the sample within the population (Mishra et al, 2019).

Descriptive statistics and regressions analyses allowed me to further describe, assume, and report the relationship of TB cases with origin of birth/HIV/homelessness, including demographics and clinical characteristics of the population once quantitative data were analyzed, performing more robust complex statistical analyses. This helped me understand TB and HIV infectious diseases and how there can be better ways of TB and HIV prevention in the United States. By using quantitative analysis, I additionally

pinpointed different factors that impacted the population with TB/HIV status, TB/homelessness status, and TB/origin of birth and the relationship of all of these variables.

Literature Search and Justification for the Study

A literature search was performed using online resources such as PubMed, Google Scholar, and Medline. Key search terms included *tuberculosis prevalence*, *immigration/origin of birth, U.S. born/foreign-born population*, *HIV/AIDS*, *homelessness*, *multidrug resistant tuberculosis*, *TB/HIV coinfection*, *tuberculosis in the United States*, and *tuberculosis* in *Georgia*. This search provided me with the knowledge necessary to conduct the case study research on the subject of TB, HIV, and homelessness. I determined early in the search process that there were gaps in the literature on TB prevention in relation to origin of birth, HIV/AIDS status in relation to TB, and homelessness for the state of Georgia. Justification for this research was based on lack of results in terms of analyzing specific database CDC WONDER OTIS database, especially from 2014 to 2018.

Literature Background

The literature review was exceptionally important to assess any earlier research on TB and comorbidity related to HIV and homelessness as well as to understand the development of the disease over the years focusing on the state of Georgia in the United States.

Selected articles are described here that are related to the key topics of the literature review: TB, HIV, and homelessness. I reviewed this literature in an effort to determine what the differences were between U.S.-born versus foreign-born populations in the United States in relation to TB, HIV, and homelessness.

Researchers have found that HIV infection is linked to an increased risk of TB as well as TB-related mortality, especially in immigrants (Marks et al., 2019). Given the increased number of immigrants to Georgia and the United States and the understanding that TB can easily spread from person to person by air, TB prevention is an important goal (WHO, 2020). There are also TB disparities among HIV diagnosed U.S.-born Blacks and U.S.-born Whites where TB rate ratios were 6 to 7 times higher in U.S.-born Blacks compared to U.S.-born Whites (Marks et al., 2019). Marks et al. (2019) stated that Black TB patients had also much greater HIV prevalence compared to Whites.

Khan et al. (2018) further looked into minorities, including foreign-born populations, as they bear the greatest burden of TB infection. For these groups, Khan et al. found that homelessness significantly impacts their SES in the United States, which increases their risk to infectious diseases such as TB.

Nwana et al. (2019) stated that it is critical to focus on homeless populations and provide the right regimen for TB treatment, especially in cases of INH mono-resistant TB, the most common drug-resistant type of TB in the United States.

Shrestha et al. (2019) studied different transmission models in the United States. They suggested that Georgia could implement a local-level and state-level TB

transmission model like those in place in California, Florida, New York and Texas (Shrestha et al., 2019).

According to Tsang et al. (2020), rates of TB infection in the United States are 10 times higher among homeless individuals than among those who are not homeless. Moreover, homeless individuals who become infected with TB are less likely to complete TB treatment (Tsang et al., 2020). Those who are homeless are also more likely to be exposed to substance abuse (Tsang et al., 2020). TB outbreaks among homeless people represent an ongoing problem in the United States generally (CDC, 2018), as well as in the state of Georgia.

Significance

The results of this quantitative research study provide more information on issues of TB and HIV and how to prevent an increase in the number of TB/HIV cases in the United States, particularly in the state of Georgia. Additionally, the results of this study can help the general public and various stakeholders by informing the development of much-needed social policy changes for preventing future TB/HIV cases, especially among homeless people who are struggling, without financial or medical security, to cope with HIV or TB. Georgia could implement local-level and state-level TB transmission models like those in place in California, Florida, New York and Texas (Shrestha et al., 2019). It is critical to focus on homeless populations and provide an effective regimen for TB treatment to members of this group (Nwana et al., 2019), especially in cases of INH

mono-resistant TB, which is the most common drug-resistant type of TB in the United States (Salindri et al., 2018).

This study may contribute to public health by increasing awareness of the gap between U.S.-born and foreign-born populations in the state of Georgia in relation to TB, HIV, and homelessness during the 2014 to 2018 period. According to Khan et al. (2018), the origins of disparities between U.S.-born and foreign-born groups are quite complicated and include differential exposure to TB, historical discrimination, lack of access to health care or high-quality care, lifestyles, and cultural practices among population groups. Quantitative data analysis of the CDC WONDER OTIS (online TB information system) database can also be helpful in further understanding these gaps and how to prevent future TB/HIV cases in Georgia and the United States.

This study has implications for positive social change, in that public health professionals, particularly epidemiologists, may draw from the findings in implementing preventive measures in order to decrease rates of TB, HIV, and homelessness not only in Georgia but also throughout the country. Social policy related changes could also be implemented in hospitals, healthcare centers, prisons, and homeless shelters. With this research study and focus on vulnerable population, future progress can take place to help immigrants be healthy, happy, and assimilate easier within the society.

Emerging of Multidrug Resistant Tuberculosis (MDR-TB)

TB has been a serious infectious disease spreading easily through the air from person to person, having no borders in the United States or around the world. It

particularly continues to be a major problem with the resistance to isoniazid and rifampin, two of the most effective TB drugs when used for TB treatment.

According to the WHO (2020), there were about 480,000 new cases and 210,000 deaths because of MDR or not effective TB treatment in patients. For that reason, there is a need for new TB medication in order to treat this infectious disease in much more effective way.

The CDC (2018) stated that "new treatments for multidrug-resistant tuberculosis are urgently needed." Active research for new drugs is taking place across the country and in many research laboratories, and major breakthroughs have taken place with the discovery of bedaquiline and delamanid (CDC, 2018). Initially, the issue of MDRTB surfaced as a result of drug misuse, raising some questions about the regulation process when it comes to TB treatment.

The following was recommended by the CDC (2018) to regulate the use of TB medication:

- expand and improve the capacity of "drug susceptibility testing"
- ban over-the-counter sale of TB medication
- ensure that only certified providers can prescribe new medication
- employ trained community health workers in rural communities
- use mobile technology for better TB detection and monitoring purposes

It is further recommended to strengthen laboratories and better monitor patients (WHO, 2020). There are national TB programs created to closely monitor patients

exposed to TB who are being treated using new TB medication to make sure there is no development of resistance (CDC, 2020). India and Brazil are taking the lead on some of these programs by engaging private practitioners and by providing incentives for doctors who deliver adequate TB treatment (CDC, 2020). Additionally, the use of technology and cell phones can be extremely helpful for improvement of TB and HIV treatments in these developing countries.

The WHO (2020) reported specific guidelines for what they call programmatic management of drug-resistant TB. They recommended collaborative TB/HIV activities if patients are diagnosed with both of these diseases:

- HIV testing and counselling for all TB patients (pulmonary and extra pulmonary)
- micro bacterial cultures and other more rapid tests
- anti-TB therapy to avoid mortality in patients with HIV
- regular treatment follow-up with a specialized team of medical experts
- effective infection control and monitoring during the treatment

HIV coinfection along with TB is a major challenge in terms of prevention, diagnosis, as well as the treatment of MDRTB. The CDC (2020) reported higher mortality rates in these patients.

The WHO (2020) also reported the latest data on the risk of developing TB, estimated between 16 and 27 times greater in people living with HIV than among patients without an HIV infection. For example, in 2015, there were an estimated 10.4 million cases of TB disease globally, including 1.2 million (11%) among people living with HIV.

Close to 60% (57%) of TB cases among people living with HIV were not diagnosed or treated, resulting in 390,000 TB-related deaths among people living with HIV (WHO, 2020).

Table 2

HIV-TB Coinfection Recommendations

Select HIV-TB Co-infection Recommendations*

Recommendation	Strength of Recommendation	Certainty in the Evidence
Among patients with HIV receiving ART, use the standard 6-month daily regimen for TB consisting of an intensive phase of 2 months of isoniazid (INH), rifampin (RIF), pyrazinamide, and ethambutol followed by a continuation phase of 4 months of INH and RIF for the treatment of drug-susceptible pulmonary TB.	Conditional	Very low
In uncommon situations in which HIV-infected patients do NOT receive ART during TB treatment, extend the continuation phase with INH and RIF for an additional 3 months (ie, a continuation phase of 7 months in duration, corresponding to a total of 9 months of therapy) for treatment of drug-susceptible pulmonary TB.	Conditional	Very low
Initiate ART during TB treatment. ART should ideally be initiated within the first 2 weeks of TB treatment for patients with CD4 counts <50 cells/μL and by 8-12 weeks of TB treatment initiation for patients with CD4 counts ≥50 cells/μL. Note: an exception is patients with HIV infection and TB meningitis.	Strong	High

Abbreviations: ART, antiretroviral therapy; TB, tuberculosis.
*Three of nine recommendations in the full guideline are shown.
Source: Adapted from: Nahid P, et al. *Clin Infect Dis*. 2016;63:e147-e195.

The recommendation for using ART therapy during TB treatment is critical for the duration of treatment when it comes to HIV-TB co-infection, (Nihad et. al.,2016) states the following “Going forward, the standard must be to start ART during TB treatment,” he says. “However, in uncommon situations, there may be various reasons why patients may not be initiated on ART.”

According to Nahid et. al. (2016), case management process will include patient education as well as counseling, field and home visits, patient reminders and incentives in order to complete TB/HIV therapies, as mentioned previously. The use of directly observed therapy (DOT) will also significantly make TB/HIV treatment successful. In directly observed therapy (DOT) for example, doctors will observe patients take each dose of medication during the 6-month course of therapy to ensure compliance with the use of medication. Further Nihad et. al. (2016) stated that "The evidence synthesized in the new guidelines on case management strategies offers a better appreciation for the very real value of patient education and counseling, DOT and other interventions to improve treatment success, and to reduce the risk of poor adherence and potentially unfavorable outcomes from treatment."

Tuberculosis in Migrant Populations

Many countries that had low-incidence of TB around the world, noticed re-emergence of TB or emergence of multidrug-resistant TB or even greater increase of TB in case of HIV co-infections (Prasad, Gupta & Banka, 2018). For numerous reasons, we need to be concerned about this infectious disease that case very easily spread from person to person and the medication regimen may not be as effective, as it used to be. It is interesting that we have seen many migrant populations moving around the world due to financial hardship, lack of food and water resources, wars, overall due to manmade and natural disasters, and with the migrant populations coming to low-incidence countries

such as the US in recent years, we are actively monitoring TB if there are any shifts and changes taking place across the country.

According to Prasad, Gupta and Banka (2018), systematic review can be completed by selecting multiple different research studies and these can be further extracted, tabulated, compared and synthesized through findings on immigration and TB infection "mutually reinforced and exacerbating stigma." In migrant populations, it can easily lead to loss of job, homelessness, not being able to have financial mean to survive without proper access to healthcare and appropriate TB treatment.

Based on this systematic research, it was determined that it is critical to understand specific migrant populations around the world, the view they may have regarding TB and some of the issues they face. Further, it needs to be considered place of birth, country of origin, migrant status, social, economic even legal when implementing and evaluating best appropriate TB regimen for migrant populations (Prasad, Gupta & Banka, 2018). "Management of MDR-TB/RR-TB is complicated, costlier, and challenging and is a concern for human health worldwide. It must be emphasized that optimal treatment of MDR-TB/RR-TB alone is not sufficient" (Prasad, Gupta & Banka, 2018).

European Union reports the same issues in many countries related to risk of TB and new migrant populations having an impact on this type of disease. According to Greenaway et al. (2018), the effectiveness and cost-effectiveness of screening for active TB was done among migrants in the European Union through another systematic review

completed. The results show the following based on the six systematic reviews, one report and three individual studies: “CXR was highly sensitive (98%) but only moderately specific (75%) with the yield of detecting active TB with CXR screening among migrants was 350 per 100,000 population overall but ranged widely by host country (110-2,340), migrant type (170-1,192), TB incidence in source country (19-336) and screening setting (220-1,720) and where CXR yield was lower (19.6 vs 336/100,000) and screening the numbers that were higher (5,076 vs 298) among migrants from source countries with lower TB incidence (≤ 50 compared with ≥ 350/100,000) according to Greenaway et al. (2018). It looks like cost-effectiveness was the highest among migrants originating from high (> 120/100,000) TB incidence countries (Greenaway et al., 2018).

In conclusion, active TB screening programs focusing on the migrants from high TB incidence countries “have the highest yield and based on the systematic review will be the most cost-effective with the heterogeneity of the estimates from the studies identified and the small number of studies addressing both the effectiveness and cost-effective of active TB screening in migrants limits the ability to provide precise guidance on which type of migrants to target, the best timing to screen or the optimal threshold of TB incidence in countries of origin” (Greenaway et al., 2018).

Table 3

Numbers Needed to Screen to Detect One Case of Active TB (Greenaway et al., 2018)

TB prevalence in country of origin/100,000	Yield of culture-confirmed active TB/100,000[a]	95% CI	NNS [b]	95% CI
50–149	19.7	10.3–31.6	5,076	3,175–9,709
150–249	166.2	140–194	602	514–714
250–349	133.5	111–158	749	631–903
> 350	335.9	283–393	298	254–353

Note. CI: confidence interval; CXR: chest radiography; NNS: numbers needed to screen; TB: tuberculosis.

[a] The yield of active TB detection in pre-arrival CXR screening programs for migrants by TB incidence in country of origin from Aldrige et al. [25].

[b] NNS = 1/mean prevalence of active TB found through CXR screening stratified by TB incidence in the country of origin.

Similar Research Studies in the United States

There were similar studies researched in many parts of the US looking into TB prevention among different racial/ethnic groups, treatment approach, TB throughout the history and in recent years emerging of new multidrug-resistant TB also known as MDR-TB. Just like within European Union, in the United States we have seen many different migrant populations cross the border. Screening of these migrant populations is common for legal migrants, and they are checked for variety of infectious disease, especially TB for the well-being of migrants and United States citizens, as well. While health

screenings can be common practice for legal immigrants, it is much more challenging to keep track on illegal immigrants and the success of being able to do healthcare screening is dependent on what type of resources we have available, as well as where the migrant populations are coming from according to Tsang et al. (2020). Tsang et al. (2020) further elaborates that due to most recent focus of the World Health Organization with regard to their continued elimination strategy, it is important to highlight diagnosing and treating of latent TB infections especially for migrant populations, and learning even more about multidrug- resistant TB emerging in recent decade due to increased migration not just in the United States, but also around the world.

"Due to greater exposure to *Mycobacterium tuberculosis* infection before migration, migrants moving to low-incidence settings can experience substantially higher tuberculosis (TB) rates than the native-born population. This review describes the impact of migration on TB epidemiology in the United States, and how the TB burden differs between U.S.-born and non-U.S. born populations. The United States has a long history of receiving migrants from other parts of the world, and TB among non-U.S. born individuals now represents the majority of new TB cases. Based on an analysis of TB cases among individuals from the top 30 countries of origin in terms of non-U.S. born TB burden between 2003 and 2015, it is described how TB risks vary within the non-U.S. born population according to age, years since entry, entry year, and country of origin Menzies et al. (2018).

Variation along each of these dimensions is associated with more than 10-fold differences in the risk of developing active TB, and this risk is also positively associated with TB incidence estimates for the country of origin and the composition of the migrant pool in the entry year (Menzies et al., 2018). According to Menzies et al. (2018), there are approximately 87 000 lifetime TB cases are predicted for the non-U.S. born population resident in the United States in 2015, and 5800 lifetime cases for the population entering the United States in 2015.

Significance of TB Surveillance

TB surveillance by definition is the organized and systematic collection, data analysis and interpretation of TB data in order to determine tuberculosis patterns or trends at the same looking into HIV and homelessness in relationship with TB in the state of Georgia especially when it comes to vulnerable population such as immigrants (CDC, 2020). Based on the results of surveillance, TB control and prevention guidelines can be established with the ultimate goal to eliminate the disease. The World Health Organization (2020) has developed a universal surveillance method that categorizes TB in the following groups, as new cases, relapse cases, transferred in cases, treatment after default, and failure cases. On the other hand, the disease is classified into pulmonary TB smear positive, pulmonary TB smear negative and extra pulmonary TB and there are number of requirements to have in case of TB disease, such as tuberculosis treatment card, tuberculosis smear examination form and tuberculosis laboratory register according to WHO (2020).

Importance of Cost-Effectiveness Analysis for TB Prevention

Besides quantitative secondary data analysis, cost effectiveness analysis can also be performed with the goal to advocate for TB prevention in immigrants, homeless and people with co-infections such as TB/HIV. Cost effectiveness analysis is important to assist public health in determining the cost of health outcomes and the interventions (Bhattacharya, 2013). It can further help determine budget for immigrants, homeless and people with both infectious diseases TB/HIV in making some essential public health decisions.

Conducting the cost-effectiveness analysis on two interventions when it comes to TB:

- Healthcare system delay for patient diagnosis when it comes to TB
    - Immigrants may or may not have healthcare insurance and due to this cost of having insurance, there may be a delay in access to healthcare system and patient diagnosis related to TB.
- Patient delay for weeks when it comes to diagnosis and TB treatment
    - Once they are able to get healthcare insurance and the access of healthcare system, there might be lack of trust with the providers or the new healthcare system. For these reasons, we can see patient diagnosis or treatment of TB delays.

Cost effectiveness ratio is calculated as the ratio of the cost associated over the units of effectiveness. The cost and benefits can change for TB program depending on how

many people use the program. There are four basic steps to have for TB program interventions according to Haines et al. (2013):

1. Cost of TB treatment to be determined
2. Benefits of TB treatment to be calculated
3. Compare alternatives to TB treatment
4. Report and plan action for TB treatment

These interventions of TB treatment would be economically feasible, as there are number of local clinics and other stakeholders contributing to a good cause by offering their services.

Best long-term savings of the interventions would be that the sooner the immigrants are enrolled in healthcare programs and the sooner they start TB treatment, there are more long-term savings as a result of this intervention. Immediate enrollment can prevent long term negative effects (Haines et al., 2013). Potential health outcomes would be less TB prevalence and the risk of spreading the disease basically disease prevention vs. diseases treatment would save money in a long run. Decision tree modeling that was recommended by (Haines et al., 2013), is provided in real life context and as that it would be more effective.

Section 2: Research Design and Data Collection

This quantitative research study was based on the use of secondary data accessed from the CDC WONDER OTIS TB database from 2014 to 2018. I used federal government generated datasets and had enough data points over the years for the state of Georgia in the United States to evaluate the gap by comparing the U.S.-born vs. foreign-born population while examining HIV, clinical characteristics, and SES predictors such as homelessness and how it related to TB cases. There were some advantages of using a secondary dataset, such as easy access from a reliable source where it was possible to analyze data over a longer period of time to be able to analyze data at a state level. An additional advantage was that the dataset already contained collected and value coded data where bias was not present or insignificant. The secondary dataset from 2014 to 2018 became available in November 2019, and there were no articles available using the most current record via CDC WONDER OTIS dataset.

Quantitative research is critical when it comes to data analysis and the way a researcher could draw conclusions from these results or the research questions they ask (Creswell, 2017). According to Creswell (2017), it is necessary to establish validity in quantitative research as well as look at variables such as independent, dependent, or confounding.

Population and Study Variables

The population for this study was the U.S.-born/foreign-born population, particularly focused on the state of Georgia. There were multiple study variables that I

define and explain in more detail below and how they relate to TB infectious disease as my primary focus.

Origin of Birth (U.S.-Born vs. Foreign-Born Population) in Association With TB

Historically, going back to 1989, the foreign-born population in the United States had a higher TB prevalence and cases reported compared to the U.S.-born population (MMWR,2020). The rate of getting TB is 124 per 100,000 where foreign-born populations develop TB at a higher rate, especially within 5 years from their first entry to the United States (MMWR, 2020). MMWR (2020) published a plan in the 1990s to eliminate TB from the United States, with the priority to implement specific strategies to prevent TB in the foreign-born population with the higher rates of TB. A further report showed six foreign countries (Mexico, the Philippines, Vietnam, South Korea, Haiti, and the People's Republic of China) with a total of 3,000 cases (63%) of all the U.S. foreign-born populations with TB. Most of these TB cases in the United States take place among foreign-born populations because of no symptoms being present at the time of the medical exam prior to their entry to the United States. According to MMWR, this foreign-born population comes from countries previously mentioned where half or even more of adults are infected and are at high risk of developing TB; however, tuberculin skin test is the only available method for testing TB.

HIV/AIDS Status in Association With TB

According to the MMWR (2020), world TB data revealed a total of 8,920 TB cases reported in the United States (incidence = 2.7 cases per 100,000 persons) with a

1.1% decrease from the 9,021 cases in 2018 and the lowest number of U.S. cases reported since the start in 1953. The MMWR asserted,

> Increased diagnosis and treatment of latent TB infection remains essential for eliminating TB in the United States where approximately 862,000 reported TB cases occurred among persons living with human immunodeficiency virus (HIV) infection. In 2018, 1.8 million persons with HIV began TB preventive treatment (TPT), 88% increase in treatment initiation from 2017. It was determined that population with HIV are at much greater risk of getting TB disease, as well as those with TB/HIV would be at a very high risk of dying.

Additionally, the MMWR reported the occurrence of mortality numbers going down by improving TB and HIV program collaboration and integration by following the recommendations below:

- provide HIV testing to all patients with TB
- screen all persons with HIV for TB disease and co-infection regularly
- provide early TB and HIV treatment to all patients with TB and HIV

Every state is unique, and each state should look into their own data and analyze them to determine what kind of regimen or treatment would be the most effective in the case of HIV/TB coinfection while increasing both TB and HIV testing. There is still much to improve when it comes to TB/HIV testing as well as monitoring and evaluation of the treatment of these two infectious diseases.

Homelessness in Association With TB

According to MMWR (2020), TB outbreaks likely occur among the homeless, requiring more sustained and aggressive measures than before. It is also required to report any confirmed or suspected TB cases in the homeless population via an electronic data system for easier identification of TB cases (MMWR, 2020). As mentioned previously, any homeless person who might have TB symptoms should also be tested for HIV as there might be a greater risk to their health in case of HIV/TB coinfection. With all of these risks of potential coinfections and being in a homeless situation, the state might have to establish special kinds of shelters or housing for homeless populations with HIV/TB coinfection (MMWR, 2020). In case of HIV/TB coinfections, contact tracing can be done to identify infected individuals, including shelter or a new form of housing established for the homeless; the tuberculin skin test should be administered to staff too. People with positive tuberculin skin test results should be considered for preventive therapy according to the guidelines reported in MMWR and follow the specific recommendations as listed below:

- "The highest priority should be given to a) detection, evaluation, and reporting of homeless population who have current symptoms of active TB and b) completion of an appropriate course of treatment by those diagnosed with active TB."
- "The second priority should be screening and preventive therapy for homeless population who have, or are suspected of having, human immunodeficiency virus (HIV) infection."

- "The third priority should be the examination and appropriate treatment of population with recent TB that has been inadequately treated."
- "The fourth priority should be screening and appropriate treatment of population exposed to an infectious (sputum-positive) case of TB. Because contacts are difficult to define in a shelter population, it is usually necessary to screen all residents of a shelter when an infectious case is identified."
- "The fifth priority should be screening and preventive therapy for homeless population with known medical conditions that increase the risk of TB, e.g., diabetes mellitus."

Sampling and Source of Information

In this study, there were no human subjects involved as indicated previously only secondary data was used. The review by Walden University Institutional Review Board (IRB) was done in September 2020. IRB documentation was submitted to IRB committee. Since IRB approval did take place, I was able to determine target population size and there were no ethical concerns with the study prior to the IRB approval. Sampling strategy was to look into target population as this data was already value coded and for that reason there was no need to do sampling procedure. All three research questions were based on the population within the state of Georgia in the United States. Just to highlight the procedure for data collection, there was no data analyzed until the official IRB approval was in place.

Access to this secondary dataset through CDC WONDER OTIS database was public and open to anyone with internet connection. Simple access to quantitative data and retrieved through Google or any other search engine, relevant documentation was included on the website while the source of data is reputable, anonymous and confidential while it required appropriate essential variables for this study to be selected in the system.

Data Analysis Plan

Quantitative data analysis plan was to use SPSS statistical tool version 25 for data analysis that stands for Statistical Package for Social Sciences. Further for this statistical data analysis descriptive statistics, univariate Chi-square and multivariate logistic regression analyses were used in order to analyze and compare independent variables; origin of birth, HIV and homelessness in relation to TB cases in the state of Georgia considering sociodemographic and clinical characteristics of the population. There was Chi-square statistical data analysis performed for the purpose of testing my hypotheses due to having categorical variables within this type of dataset, but in order to make this study more robust had to do multivariate regression analysis as the most critical way to evaluate these relationships among different variables. Univariable regression was used as a screening method for deciding which variables to include in multivariable regression analysis.

Research Question (RQ)1: What is the relationship between the sociodemographic and clinical characteristics of the U.S. born and foreign-born population (origin of birth) in TB cases for the state of Georgia from 2014 to 2018?

$H1_0$: There is no relationship between the sociodemographic and clinical characteristics of U.S. born and foreign-born population (origin of birth) in TB cases for the state of Georgia from 2014 to 2018.

$H1_A$: There is a relationship between the sociodemographic and clinical characteristics of U.S. born and foreign-born population (origin of birth) in TB cases for the state of Georgia from 2014 to 2018.

RQ2: What is the relationship between HIV status in TB cases for the state of Georgia from 2014-2018?

$H2_0$: There is no relationship between HIV status in TB cases for the state of Georgia from 2014 to 2018.

$H2_A$: There is a relationship between HIV status in TB cases for the state of Georgia from 2014 to 2018.

RQ3: What is the relationship between homelessness in TB cases for the state of Georgia from 2014 to 2018?

$H3_0$: There is no relationship between homelessness in TB cases for the state of Georgia from 2014 to 2018.

$H3_A$: There is a relationship between homelessness in TB cases for the state of Georgia from 2014 to 2018.

Quantitative secondary dataset with selected variables from the CDC WONDER OTIS database were extracted and exported to Microsoft Office Excel spreadsheet where data cleaning and screening procedures were performed as necessary. In terms of threats

to internal and external validity, they were minimal due to using reliable secondary dataset from reputable federal agency such as the Centers for Disease Control and Prevention where strict protocols and procedures were in place related to anonymity, confidentiality of data collection, and system security of the servers.

Limitations, Challenges, and/or Barriers

At this point in research, it was quite clear of what other barriers would be evident. Since CDC WONDER OTIS database had publicly available secondary quantitative data generated by federal government, there was no partner site agreement or any type of agreement to sign or request. It was easier that way to request, download the dataset and work on exporting necessary data into SPSS for the purpose of quantitative data analysis. Technical issues took place at that time while transporting large dataset and moving it from one system to the next. It was challenging selecting appropriate statistical methods for these three research questions, but Walden University resources were available and used in the process.

Electronic reporting system was a good way to achieve rapid, centralized, and flexible internet-based reporting of data. There were also number of issues with this type of surveillance, for example; restricted budget for expenses associated with the maintenance, update of the electronic system, and lack of protection of sensitive information from hackers. It was critical to protect patient privacy or the integrity of these secondary data systems in place through the Centers for Disease Control and Prevention. There was always concern about secondary data use regarding source of data,

data collection process, data reliability and validity. Yet, there was no perfect surveillance system in place during this study and every type of surveillance system was unique in its own way whether we were looking into different datasets across the country, different states or different countries around the world.

Summary

Just to summarize as previously mentioned, this was quantitative research study using reliable and reputable secondary data from CDC WONDER OTIS database that was publicly available. The data was analyzed using SPSS statistical tool version 25 provided by Walden University where univariate Chi-Square and multivariate logistic regression testing was performed in order to test my hypotheses. Secondary data was collected from 2014 to 2018 in this database, and it was the most current available data from the website that was anonymous, confidential without any type of identifiers. Further, the results of quantitative data analysis were discussed in Section 3.

Section 3: Presentation of the Results and Findings

To present the results and findings, secondary quantitative data were retrieved and imported into an Excel spreadsheet with all TB cases of U.S.-born and foreign-born populations for the state of Georgia in the United States from 2014 to 2018. TB cases were recorded by the GA Department of Public Health and shared within the CDC OTIS WONDER database system. Data were grouped by gender, age, race, country of birth, homelessness, clinical characteristics, and HIV status in an Excel spreadsheet and were then imported from an Excel spreadsheet into SPSS Version 25, where I completed statistical analysis such as descriptive data analysis, univariate Chi-square, and multivariate logistic regression testing.

Due to the CDC's reliable source of the secondary data collection, there was no concern of any particular threats to validity or reliability of this type of data being used and analyzed as part of my study. There were no personally identifiable patient information characteristics, and all the IRB requirements were followed in the process, with prior official IRB approval in September 2020.

My main focus was to study three independent variables: origin of birth, HIV, and homelessness and their relationship in all TB cases for the state of Georgia 2014 to 2018, focusing on sociodemographic and clinical characteristics of this population. In my secondary dataset, *N* equaled 1,518 patients who were positive for TB from 2014 to 2018 in the state of Georgia. Specific categorical variables were coded in SPSS, as appropriate. For example, origin of birth had two categories: U.S.-born and foreign-born. U.S. born

was coded as 1 and foreign-born was coded as 2, with all patients having positive TB status.

My proposal was officially approved in August 2020, and IRB approval was received early September 2020. At that time, I retrieved secondary quantitative data and used descriptive analysis, univariate Chi-Square, and multivariate logistic regression testing to analyze the data of U.S.-born and foreign-born TB cases in relationship with three independent variables, HIV and homelessness, sociodemographic, and clinical characteristics of the GA population. In the process of quantitative data analysis, the independent variables had a confidence level of 95% where statistics on all three variables were reported, and there was a positive correlation between these variables. It was important to support either the null or alternative hypothesis by performing statistical analysis such as univariate Chi-square and multivariate regression analyses.

Description of Study Population in Georgia

Table 4

Patients With TB in Georgia 2014-2018 and the Magnitude of the TB Incidence (New Case) Rates in Georgia From 2014-2018

Year	Cases	Percent of total	Rate per 100,000
2018	271	17.85%	2.58

2017	293	19.30%	2.81
2016	302	19.89%	2.93
2015	318	20.95%	3.12
2014	334	22.00%	3.32
Total	**1,518**	**100.00%**	**2.95**

Note. The Georgia TB Case Count: 1,518

a. TB incidence rate per 100,000, for the period studied: 2.95
b. The tuberculosis average annual incidence in Georgia per 100,000 person-years
c. The rate among US-born persons per 100,000 and the rate among non-US-born persons per 100,000
   [Rates are only available for national or state data when variables with population data are picked. Variables that support rates are Year, Age Group, Sex, Bridged Race / Ethnicity and State.]

Quantitative Data Analysis Results

RQ1: What is the relationship between the sociodemographic and clinical characteristics of US-born and foreign-born population (origin of birth) in TB cases for the state of Georgia from 2014 to 2018?

Table 5

Univariate Relationship Between Sociodemographic and Clinical Characteristics and TB Incidence Rates of U.S.-Born Persons and Non-U.S. Born Persons in Georgia

	U.S.-born (*n* = 780)	Non-U.S. born (*n* = 737)	*p*-value
Gender			
Male	535 (54.3)	451 (45.7)	0.0029
Female	245 (46.1)	286 (53.9)	
Age at diagnosis,			
<20	102 (71.8)	40 (28.2)	<.0001
20-29	72 (36.7)	124 (63.3)	
30-39	105 (36.6)	182 (63.4)	
40-49	106 (45.5)	127 (54.5)	
50+	395 (59.9)	264 (40.1)	
Race/ethnicity			
Asian or Pacific Islander, Non-Hispanic	25 (6.8)	341 (93.2)	<.0001
Black or African American, Non-Hispanic	543 (75.8)	173 (24.2)	
Hispanic or Latino	47 (19.4)	195 (80.6)	
White, Non-Hispanic	162 (87.1)	24 (12.9)	
Unknown	3 (42.9)	4 (57.1)	
Country of birth			
United States	780 (100)	0 (0)	<.0001
Other	0 (0)	507 (100)	
Mexico	0 (0)	119 (100)	
Vietnam	0 (0)	76 (100)	
Philippines	0 (0)	19 (100)	
Somalia	0 (0)	12 (100)	
Laos	0 (0)	4 (100)	
Injection drug user			
No	750 (51.4)	709 (48.6)	0.0003
Not Reported	16 (36.4)	28 (63.6)	
Yes	14 (100)	0 (0)	

Non-injection drug user			
No	643 (48)	696 (52)	<.0001
Not reported	16 (39)	25 (61)	
Yes	121 (88.3)	16 (11.7)	
Excessive alcohol use			
No	613 (47.7)	673 (52.3)	<.0001
Not reported	19 (39.6)	29 (60.4)	
Yes	148 (80.9)	35 (19.1)	
Homeless			
No	658 (48.1)	711 (51.9)	<.0001
Yes	120 (82.8)	25 (17.2)	
Unknown	2 (66.7)	1 (33.3)	
HIV status			
Negative	642 (49.6)	651 (50.4)	0.0015
Positive	84 (63.2)	49 (36.8)	
Not reported	54 (59.3)	37 (40.7)	
Correctional facility resident			
No	753 (51.2)	717 (48.8)	0.6511
Yes	23 (54.8)	19 (45.2)	
Unknown	4 (80)	1 (20)	
Previous TB diagnosis			
No	748 (52.1)	688 (47.9)	0.032
Yes	30 (39.5)	46 (60.5)	
Unknown	2 (40)	3 (60)	
Verification criteria			
Clinical case Definition	125 (44.8)	154 (55.2)	0.0019
Positive culture	566 (51.8)	526 (48.2)	
Positive nucleic Acid amplification test	14 (42.4)	19 (57.6)	
Provider diagnosis	71 (65.7)	37 (34.3)	
Unknown	4 (80)	1 (20)	
Site of disease			
Both	72 (51.8)	67 (48.2)	0.0003
Extrapulmonary	114 (40.6)	167 (59.4)	
Pulmonary	592 (54.2)	501 (45.8)	
Unknown	2 (50)	2 (50)	
Multidrug-resistant			
No	553 (51.8)	515 (48.2)	0.8814

Not applicable	211 (51)	203 (49)	
Not reported	11 (47.8)	12 (52.2)	
Yes	5 (41.7)	7 (58.3)	
Directly observed therapy			
Both	51 (45.5)	61 (54.5)	0.0019
Direct only	569 (53.3)	498 (46.7)	
Not applicable	152 (49.4)	156 (50.6)	
Not reported	8 (42.1)	11 (57.9)	
Self only	0 (0)	11 (100)	
Tested for isoniazid susceptibility			
No	11 (47.8)	12 (52.2)	0.9142
Not applicable	211 (51)	203 (49)	
Yes	558 (51.7)	522 (48.3)	
Tested for isoniazid & rifampin susceptibility			
No	11 (47.8)	12 (52.2)	0.9142
Not applicable	211 (51)	203 (49)	
Yes	558 (51.7)	522 (48.3)	
Completion of therapy within 1 year			
No	41 (53.9)	35 (46.1)	0.6793
Not applicable	238 (49.5)	243 (50.5)	
Not reported	18 (47.4)	20 (52.6)	
Yes	483 (52.4)	439 (47.6)	
Vital status			
Alive	748 (50.8)	723 (49.2)	0.0045
Dead	23 (82.1)	5 (17.9)	
Not reported	9 (50)	9 (50)	

Table 6

Univariate Logistic Regression for Odds of Being a Foreign-Born TB Case in Georgia Between 2014 and 2018 and Sociodemographic and Clinical Characteristics

Covariate	Level	*N*	Odds Ratio (95% CI)	OR *P*-value	Type3 *P*-value
Sex	M	933	0.66 (0.53-0.82)	<.001	<.001
	F	489	-	.	
Race	Asian or AIAN	357	13.02 (8.21-20.64)	<.001	<.001
	Black or African American	687	0.31 (0.24-0.41)	<.001	
	White	378	-	.	
Age groups	20-29	190	3.23 (2.00-5.21)	<.001	<.001
	30-39	272	3.11 (1.99-4.88)	<.001	
	40-49	229	2.32 (1.46-3.66)	<.001	
	50+	611	1.30 (0.86-1.96)	0.212	
	<20	120	-	.	
Homeless	Yes	141	0.18 (0.12-0.29)	<.001	<.001
	No	1281	-	.	
HIV status	Positive	132	0.56 (0.39-0.81)	0.002	0.002
	Negative	1290	-	.	
Diagnosis year	2015	297	1.07 (0.78-1.47)	0.683	0.172
	2016	285	1.08 (0.78-1.49)	0.645	
	2017	280	1.34 (0.97-1.86)	0.074	
	2018	250	1.41 (1.01-1.97)	0.045	
	2014	310	-	.	
AGE		1422	0.99 (0.99-1.00)	0.036	0.036

Table 7

Multivariable logistic regression for odds of being a foreign-born TB case in Georgia between 2014 to 2018 and sociodemographic and clinical characteristics

Covariate	Level	Odds Ratio (95% CI)	OR P-value	Type3 P-value
Sex	M	0.69 (0.52-0.91)	0.009	**0.009**
	F	-	-	
Race	Asian or AIAN	15.47 (9.58-24.97)	<.001	**<.001**

Covariate	Level	Odds Ratio (95% CI)	OR P-value	Type3 P-value
	Black or African American	0.30 (0.22-0.40)	<.001	
	White	-	-	
Age groups	20-29	5.18 (2.81-9.56)	<.001	**<.001**
	30-39	6.03 (3.38-10.77)	<.001	
	40-49	4.49 (2.47-8.18)	<.001	
	50+	1.76 (1.03-3.03)	0.040	
	<20	-	-	
Homeless	Yes	0.34 (0.19-0.58)	<.001	**<.001**
	No	-	-	
HIV status	Positive	1.05 (0.67-1.64)	0.836	0.836
	Negative	-	-	
Diagnosis year	2015	0.90 (0.60-1.37)	0.634	0.216
	2016	1.04 (0.68-1.57)	0.861	
	2017	1.46 (0.96-2.21)	0.074	
	2018	1.09 (0.71-1.67)	0.684	
	2014	-	-	

* Number of observations used = 1422.

Population with N=1518 had 771 U.S.-born and 747 foreign-born frequencies according to Table 5. Significance level is presented in Tables 6 and 7. When we have significance number less than 0.05 that means origin of birth variable from the research question #1 will predict and impact the other variable while supporting the alternative hypothesis "There is a relationship between the sociodemographic and clinical characteristics and U.S.-born and foreign-born population (origin of birth) in TB cases for the state of Georgia from 2014 to 2018."

According to multivariate logistic regression analysis for RQ #1, the association between U.S.-born and foreign-born population (origin of birth) or the odds of being

foreign-born TB case in Georgia and HIV status was not retained (Table 7) and diagnosis year. While adjusting for other variables sex, age, race and homeless with the p-value <0.005 where there was significance. Missing cases were not included in the analysis. Additionally, TB cases were presented by each year from 2014-2018 in Table 4.

RQ2: What is the relationship between HIV status in TB cases for the state of Georgia from 2014 to 2018?

Table 8

Relationship between HIV status in TB cases for the state of Georgia from 2014 to 2018 and sociodemographic and clinical characteristics

	HIV Negative (n=1,293)	**HIV Positive (n=133)**	**HIV Unknown (n=92)**	**P-value**
Gender				
				0.076
Men	843 (85.4)	93 (9.4)	51 (5.2)	5
Women	450 (84.7)	40 (7.5)	41 (7.7)	
Age at diagnosis,				
				<.000
<20	119 (83.8)	1 (0.7)	22 (15.5)	1

30-39	241 (83.7)	33 (11.5)	14 (4.9)	
40-49	190 (81.5)	39 (16.7)	4 (1.7)	
20-29	178 (90.8)	12 (6.1)	6 (3.1)	
50+	565 (85.7)	48 (7.3)	46 (7)	
Race/ethnicity				
				<.000
Asian or Pacific Islander	337 (91.8)	10 (2.7)	20 (5.4)	1
Black or African American	584 (81.6)	102 (14.2)	30 (4.2)	
Hispanic or Latino	207 (85.5)	12 (5)	23 (9.5)	
White, Non-Hispanic	161 (86.6)	7 (3.8)	18 (9.7)	
Unknown	4 (57.1)	2 (28.6)	1 (14.3)	
Country of birth				
				0.148
United States	634 (82.2)	84 (10.9)	53 (6.9)	5
Other	445 (86.9)	39 (7.6)	28 (5.5)	
Mexico	108 (88.5)	6 (4.9)	8 (6.6)	
Vietnam	72 (92.3)	4 (5.1)	2 (2.6)	
Philippines	18 (94.7)	0 (0)	1 (5.3)	
Somalia	12 (100)	0 (0)	0 (0)	
Laos	4 (100)	0 (0)	0 (0)	

Foreign Born				
				0.001
US born	642 (82.3)	84 (10.8)	54 (6.9)	5
Non-US born	651 (88.3)	49 (6.6)	37 (5)	
Injection drug user				
				<.000
No	1255 (86)	121 (8.3)	83 (5.7)	1
Not Reported	30 (66.7)	6 (13.3)	9 (20)	
Yes	8 (57.1)	6 (42.9)	0 (0)	
Non-injection drug user				
	1159			<.000
No	(86.6)	98 (7.3)	82 (6.1)	1
Yes	105 (78.4)	29 (21.6)	0 (0)	
Not Reported	29 (64.4)	6 (13.3)	10 (22.2)	
Excessive alcohol use				
	1096			0.000
No	(85.2)	109 (8.5)	81 (6.3)	9
Yes	160 (89.4)	19 (10.6)	0 (0)	
Not Reported	37 (69.8)	5 (9.4)	11 (20.8)	
Homeless				

				<.000
No	1178 (86)	104 (7.6)	87 (6.4)	1
Yes	112 (79.4)	29 (20.6)	0 (0)	
Unknown	3 (37.5)	0 (0)	5 (62.5)	
Correctional facility resident				
				0.045
Yes	36 (100)	0 (0)	0 (0)	6
No	1254 (85.3)	129 (8.8)	87 (5.9)	
Unknown	3 (25)	4 (33.3)	5 (41.7)	
Previous TB diagnosis				
				0.087
Yes	67 (90.5)	7 (9.5)	0 (0)	5
No	1223 (85.1)	125 (8.7)	89 (6.2)	
Unknown	3 (42.9)	1 (14.3)	3 (42.9)	
Verification Criteria				
				<.000
Clinical Case Definition	247 (88.5)	10 (3.6)	22 (7.9)	1
Positive Culture	933 (85.4)	100 (9.1)	60 (5.5)	

Positive Nucleic Acid Amplification Test	29 (100)	0 (0)	0 (0)	
Positive Smear	5 (100)	0 (0)	0 (0)	
Provider Diagnosis	79 (73.1)	20 (18.5)	9 (8.3)	
Unknown	0 (0)	3 (75)	1 (25)	
Site of disease				<.0001
Both	104 (74.8)	28 (20.1)	7 (5)	
Extrapulmonary	233 (82.6)	22 (7.8)	27 (9.6)	
Pulmonary	952 (87.1)	83 (7.6)	58 (5.3)	
Unknown	4 (100)	0 (0)	0 (0)	
Multidrug-Resistant				0.1826
No	910 (85.1)	99 (9.3)	60 (5.6)	
Yes	11 (100)	0 (0)	0 (0)	
Not Applicable	350 (84.1)	34 (8.2)	32 (7.7)	
Not Reported	22 (100)	0 (0)	0 (0)	
Directly Observed Therapy				0.0004
Both	100 (89.3)	7 (6.3)	5 (4.5)	

Direct Only	919 (86.1)	102 (9.6)	46 (4.3)	
Not Applicable	254 (82.2)	20 (6.5)	35 (11.3)	
Not Reported	10 (50)	4 (20)	6 (30)	
Self Only	10 (100)	0 (0)	0 (0)	
Tested for Isoniazid Susceptibility				
				0.134
No	22 (100)	0 (0)	0 (0)	7
Yes	921 (85.2)	100 (9.3)	60 (5.6)	
Not Applicable	350 (84.3)	33 (8)	32 (7.7)	
Tested for Isoniazid & Rifampin Susceptibility				
				0.134
No	22 (100)	0 (0)	0 (0)	7
Yes	921 (85.2)	100 (9.3)	60 (5.6)	
Not Applicable	350 (84.3)	33 (8)	32 (7.7)	
Completion of Therapy Within One Year				
				<.000
No	57 (75)	13 (17.1)	6 (7.9)	1
Yes	810 (87.9)	78 (8.5)	34 (3.7)	

Not Applicable	393 (81.5)	40 (8.3)	49 (10.2)	
Not Reported	33 (86.8)	2 (5.3)	3 (7.9)	
Vital Status				
	1272			<.000
Alive	(86.4)	128 (8.7)	72 (4.9)	1
Dead	11 (45.8)	0 (0)	13 (54.2)	
Not Reported	10 (45.5)	5 (22.7)	7 (31.8)	

Table 9

Univariable Logistic regression for odds of being a HIV positive TB case in the state of Georgia from 2014 to 2018 and sociodemographic and clinical characteristics

Covariate	Level	N	Odds Ratio (95% CI)	OR P-value	Type3 P-value
Sex	M	933	1.23 (0.83-1.81)	0.300	0.300
	F	489	-	.	
Race	Asian or AIAN	357	0.54 (0.25-1.19)	0.127	**<.001**
	Black or African American	687	3.33 (2.01-5.53)	**<.001**	
	White	378	-	.	
Age groups	20-29	190	8.02 (1.03-62.50)	**0.047**	**<.001**
	30-39	272	15.86 (2.14-117.49)	**0.007**	
	40-49	229	24.42 (3.31-180.10)	**0.002**	
	50+	611	10.14 (1.39-74.21)	**0.022**	
	<20	120	-	.	
Foreign Born	Yes	699	0.56 (0.39-0.81)	**0.002**	**0.002**

Covariate	Level	N	Odds Ratio (95% CI)	OR P-value	Type3 P-value
	No	723	-	.	
Homeless	Yes	141	2.96 (1.88-4.67)	**<.001**	**<.001**
	No	1281	-	.	
Diagnosis year	2015	297	0.76 (0.45-1.29)	0.310	0.258
	2016	285	0.90 (0.54-1.50)	0.673	
	2017	280	0.68 (0.39-1.18)	0.171	
	2018	250	0.52 (0.28-0.96)	**0.037**	
	2014	310	-	.	
AGE		1422	1.00 (0.99-1.01)	0.924	0.924

Table 10

Multivariable Logistic regression for odds of being a HIV positive TB case in the state of Georgia from 2014 to 2018 and sociodemographic and clinical characteristics

Covariate	Level	Odds Ratio (95% CI)	OR P-value	Type3 P-value
Sex	M	1.09 (0.71-1.65)	0.702	0.702
	F	-	-	
Race	Asian or AIAN	0.55 (0.25-1.24)	0.151	**<.001**
	Black or African American	3.34 (1.95-5.72)	<.001	
	White	-	-	
Age groups	20-29	8.42 (1.07-66.24)	0.043	**<.001**
	30-39	15.87 (2.12-118.57)	0.007	
	40-49	23.21 (3.12-172.76)	0.002	
	50+	9.15 (1.24-67.54)	0.030	
	<20	-	-	

Covariate	Level	Odds Ratio (95% CI)	OR P-value	Type3 P-value
Homeless	Yes	1.94 (1.16-3.25)	0.012	**0.012**
	No	-	-	
Foreign Born	Yes	1.15 (0.72-1.82)	0.556	0.556
	No	-	-	
Diagnosis year	2015	0.81 (0.46-1.41)	0.454	0.687
	2016	0.98 (0.57-1.70)	0.955	
	2017	0.76 (0.42-1.37)	0.365	
	2018	0.67 (0.35-1.28)	0.228	
	2014	-	-	

* Number of observations used = 1422.

Population with N=1518 with 1293 negative and 133 positive HIV cases, 48 not offered, 25 refused to report and 19 unknowns. These numbers were reported in Table 8. According to multivariate logistic regression analysis for RQ #2, there was no significant association related to sex, foreign-born and diagnosis year for adds of being a HIV positive TB case in Georgia from 2014 to 2018. While adjusting for other variables such as age, race and homelessness with the p-value <0.005 where there was significance (Table 10). Missing cases were not included in the analysis.

RQ3: What is the relationship between homelessness in TB cases for the state of Georgia from 2014 to 2018?

Table 11

Relationship between homelessness in TB cases for the state of Georgia from 2014 to 2018 and sociodemographic and clinical characteristics

	Homeless No (n=1,369)	Homeless Yes (n=145)	P-value
Gender			
Men	855 (86.9)	129 (13.1)	<.0001
Women	514 (97)	16 (3)	
Age at diagnosis,			
<20	135 (95.1)	7 (4.9)	0.0096
20-29	183 (93.4)	13 (6.6)	
30-39	269 (94.1)	17 (5.9)	
40-49	204 (87.6)	29 (12.4)	
50+	578 (88)	79 (12)	
Race/ethnicity			
Asian or Pacific Islander, Non-Hispanic	359 (98.1)	7 (1.9)	<.0001
Black or African American, Non-Hispanic	604 (84.6)	110 (15.4)	
Hispanic or Latino	230 (95.4)	11 (4.6)	
White, Non-Hispanic	170 (91.4)	16 (8.6)	
Unknown	6 (85.7)	1 (14.3)	
Country of birth			

United States	651 (84.7)	118 (15.3)	<.0001
Other	496 (97.3)	14 (2.7)	
Mexico	115 (94.3)	7 (5.7)	
Vietnam	73 (93.6)	5 (6.4)	
Philippines	19 (100)	0 (0)	
Somalia	12 (100)	0 (0)	
Laos	3 (75)	1 (25)	
Foreign Born			
US born	658 (84.6)	120 (15.4)	<.0001
Non-US born	711 (96.6)	25 (3.4)	
HIV status			
Negative	1178 (91.3)	112 (8.7)	<.0001
Positive	104 (78.2)	29 (21.8)	
Not reported	87 (95.6)	4 (4.4)	
Injection drug user			
No	1326 (90.9)	133 (9.1)	0.0011
Not Reported	29 (74.4)	10 (25.6)	
Yes	14 (87.5)	2 (12.5)	
Non-injection drug user			
No	1247 (93.2)	91 (6.8)	<.0001

Not Reported	29 (74.4)	10 (25.6)	
Yes	93 (67.9)	44 (32.1)	
Excessive alcohol use			
No	1188 (92.5)	97 (7.5)	<.0001
Not Reported	37 (80.4)	9 (19.6)	
Yes	144 (78.7)	39 (21.3)	
Correctional facility resident			
No	1339 (91.2)	130 (8.8)	<.0001
Yes	29 (70.7)	12 (29.3)	
Unknown	1 (25)	3 (75)	
Previous TB diagnosis			
No	1299 (90.6)	134 (9.4)	0.271
Yes	66 (86.8)	10 (13.2)	
Unknown	4 (80)	1 (20)	
Verification Criteria			
Clinical Case Definition	260 (93.9)	17 (6.1)	0.0535
Positive Culture	980 (89.8)	111 (10.2)	
Positive Nucleic Acid Amplification			
Test	29 (100)	0 (0)	
Provider Diagnosis	96 (88.9)	12 (11.1)	

Unknown	4 (44.4)	5 (55.6)	
Site of disease			
Both	126 (90.6)	13 (9.4)	<.0001
Extrapulmonary	272 (97.5)	7 (2.5)	
Pulmonary	967 (88.6)	125 (11.4)	
Unknown	4 (100)	0 (0)	
Multidrug-Resistant			
No	955 (89.6)	111 (10.4)	0.143
Not Applicable	379 (91.8)	34 (8.2)	
Not Reported	23 (100)	0 (0)	
Yes	12 (100)	0 (0)	
Directly Observed Therapy			
Both	105 (93.8)	7 (6.3)	0.0102
Direct Only	948 (88.8)	119 (11.2)	
Not Applicable	288 (94.4)	17 (5.6)	
Not Reported	15 (88.2)	2 (11.8)	
Self Only	13 (100)	0 (0)	
Tested for Isoniazid Susceptibility			
No	23 (100)	0 (0)	0.1392
Not Applicable	379 (91.8)	34 (8.2)	

Yes	967 (89.7)	111 (10.3)	
Tested for Isoniazid & Rifampin Susceptibility			
No	23 (100)	0 (0)	0.1392
Not Applicable	379 (91.8)	34 (8.2)	
Yes	967 (89.7)	111 (10.3)	
Completion of Therapy Within One Year			
No	66 (86.8)	10 (13.2)	0.0083
Not Applicable	448 (93.7)	30 (6.3)	
Not Reported	31 (81.6)	7 (18.4)	
Yes	824 (89.4)	98 (10.6)	
Vital Status			
Alive	1329 (90.5)	140 (9.5)	0.1223
Dead	24 (100)	0 (0)	
Not Reported	16 (76.2)	5 (23.8)	

Table 12

Univariable Logistic regression for odds of being a Homeless TB case in the state of Georgia from 2014 to 2018 and sociodemographic and clinical characteristics

Covariate	Level	N	Odds Ratio (95% CI)	OR P-value	Type3 P-value
Sex	M	933	4.93 (2.85-8.53)	**<.001**	**<.001**
	F	489	-	.	
Race	Asian or AIAN	357	0.38 (0.17-0.83)	**0.015**	**<.001**
	Black or African American	687	2.75 (1.73-4.37)	**<.001**	
	White	378	-	.	
Age groups	20-29	190	1.69 (0.59-4.86)	0.332	**0.001**
	30-39	272	1.44 (0.51-4.02)	0.490	
	40-49	229	3.20 (1.20-8.52)	**0.020**	
	50+	611	3.41 (1.35-8.62)	**0.009**	
	<20	120	-	.	
Foreign Born	Yes	699	0.18 (0.12-0.29)	**<.001**	**<.001**
	No	723	-	.	
HIV status	Positive	132	2.96 (1.88-4.67)	**<.001**	**<.001**
	Negative	1290	-	.	
Diagnosis year	2015	297	0.42 (0.26-0.67)	**<.001**	**<.001**
	2016	285	0.35 (0.21-0.58)	**<.001**	
	2017	280	0.23 (0.13-0.41)	**<.001**	
	2018	250	0.22 (0.12-0.41)	**<.001**	
	2014	310	-	.	
AGE		1422	1.01 (1.00-1.02)	0.094	0.094

Table 13

Multivariable Logistic regression for odds of being a homeless TB case in the state of Georgia from 2014 to 2018 and sociodemographic and clinical characteristics

Covariate	Level	Odds Ratio (95% CI)	OR P-value	Type3 P-value
Sex	M	4.59 (2.59-8.13)	<.001	**<.001**
	F	-	-	

Covariate	Level	Odds Ratio (95% CI)	OR P-value	Type3 P-value
Race	Asian or AIAN	0.73 (0.31-1.75)	0.485	**0.001**
	Black or African American	2.22 (1.34-3.68)	0.002	
	White	-	-	
Age groups	20-29	1.86 (0.61-5.65)	0.271	0.133
	30-39	1.44 (0.49-4.24)	0.511	
	40-49	2.63 (0.94-7.39)	0.067	
	50+	2.51 (0.96-6.57)	0.061	
	<20	-	-	
HIV status	Positive	1.90 (1.13-3.18)	0.015	**0.015**
	Negative	-	-	
Foreign Born	Yes	0.35 (0.20-0.62)	<.001	**<.001**
	No	-	-	
Diagnosis year	2015	0.37 (0.22-0.62)	<.001	**<.001**
	2016	0.31 (0.18-0.53)	<.001	
	2017	0.21 (0.11-0.39)	<.001	
	2018	0.22 (0.12-0.43)	<.001	
	2014	-	-	

* Number of observations used = 1422.

Population with N=1518 with 1369 not homeless, 145 homeless and 4 unknown cases for the state of Georgia from 2014 to 2018. According to multivariate logistic regression analysis for RQ #3, there was no significant association related to age groups (Table 13) for odds of being a homeless TB case in Georgia. While adjusting for other variables such as sex, race, HIV, foreign-born and diagnosis year with the p-value <0.005 where there was significance. Missing cases were not included in the analysis. Since these numbers are less than 0.05 that means according to data there is statistical significance to predict or impact on the dependent variable homelessness in TB cases

supporting the alternative hypothesis. There is a relationship between homelessness in TB cases in terms of origin of birth for the state of Georgia from 2014 to 2018. Null hypothesis is rejected in this particular case while alternative hypothesis is supported.

The analysis tables 5, 8, and 11 are derived from data calculated from CDC OTIS website online count calculations system (https://wonder.cdc.gov/TB-v2019.html); while tables 6, 7, 9, 10, 12, and 13 are derived from logistic regression of data received from GA Department of Public Health (GA DPH). In absence of complete raw data from GA DPH, regression analysis was done on limited variables.

Tables 5, 8, and 11 show distribution of socio-demographic and clinical factors stratified by predefined dependent variables such as origin of birth, HIV status, and homelessness. All p-values are tested based on Chi-square testing.

Univariable logistic regression performed in tables 6, 9, and 12 show odds ratios along with 95% confidence intervals and p-values for logistic regression tests for respective dependent variables and available independent variables from GA DPH data file.

Multivariable logistic regression 7, 10, and 13 show effect of primary independent variables in respective tables. OR p-value reflects significance at specific level [e.g., Asian vs White, Black vs White, where White is a reference category] while, Type-3 p-value shows significance at group level [e.g., Race as a factor for predicting dependent variable].

1. Table 7: While adjusting for race, age, homelessness, HIV status, and diagnosis year; a male with TB is 33% less likely to be born outside of the United States as compared to a female TB patient [0.66 (0.53-0.82), p=<.001] in state of GA during 2014 to 2018.
2. Table 10: While adjusting for gender, age, homelessness, origin of birth, and diagnosis year; an African American patient with TB is 3.3 times more likely to be HIV positive as compared to a white patient with TB. Similarly, an Asian patient with TB is 45% less likely to be HIV positive as compared to a white patient with TB.
3. Table 13: While adjusting for race, age, homelessness, HIV status, original of birth, and diagnosis year; a male patient with TB is 4.6 times more likely to be homeless than a female patient with TB.

Additionally, there are three bar charts 1, 2, and 3 below presenting comparison of the U.S.-born vs foreign-born population in bar chart #1 where we see more U.S.-born than foreign- born TB cases for the state of Georgia during 2014 to 2018.

Bar chart # 2 is presenting comparison of HIV negative, HIV positive and other cases labeled as 999. There were more HIV negative than HIV positive TB cases for the state of Georgia during 2014 to 2018.

Bar chart #3 is presenting comparison of homeless vs not homeless TB cases in the state of Georgia during 2014 to 2018.

Figure 1

Bar Chart 1 U.S.-Born/Foreign-Born

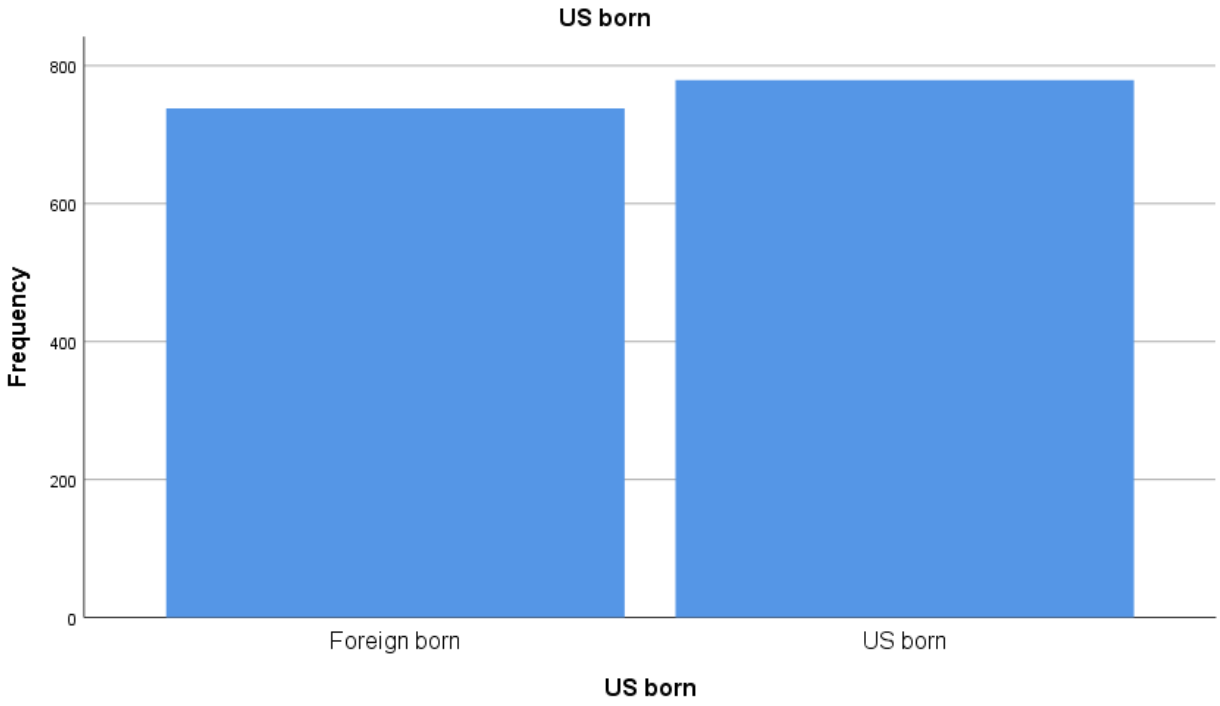


Figure 2

Bar Chart 2 - HIV

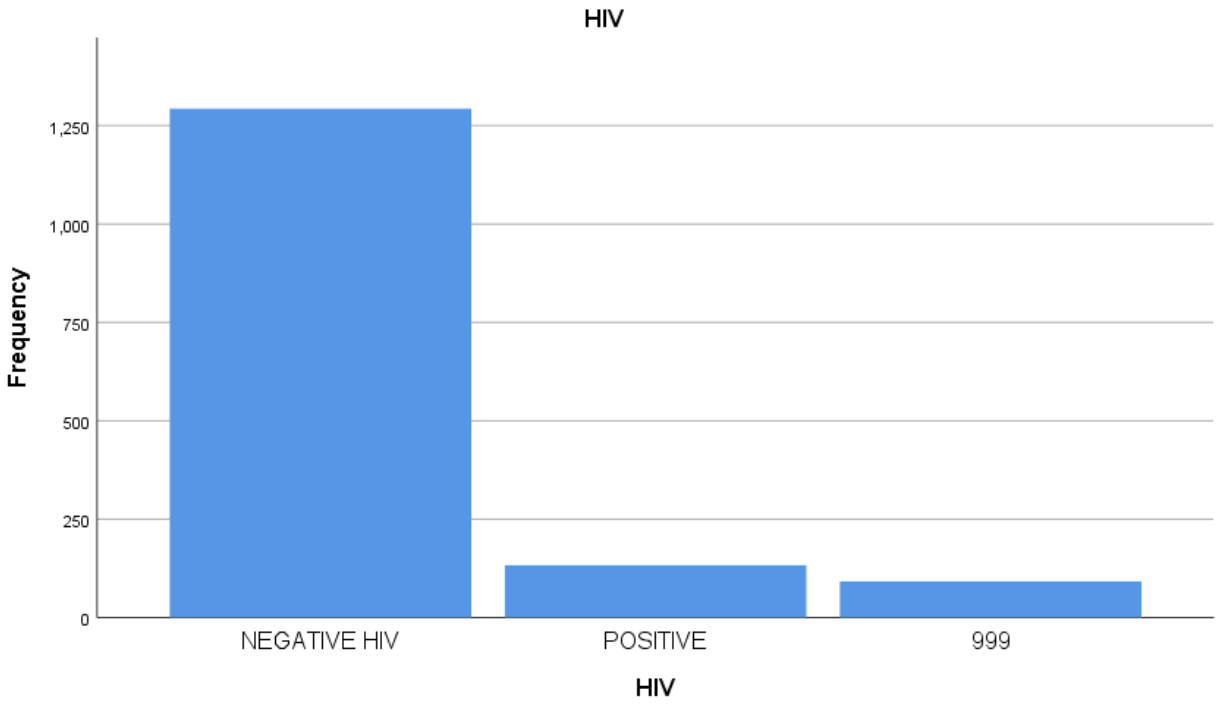
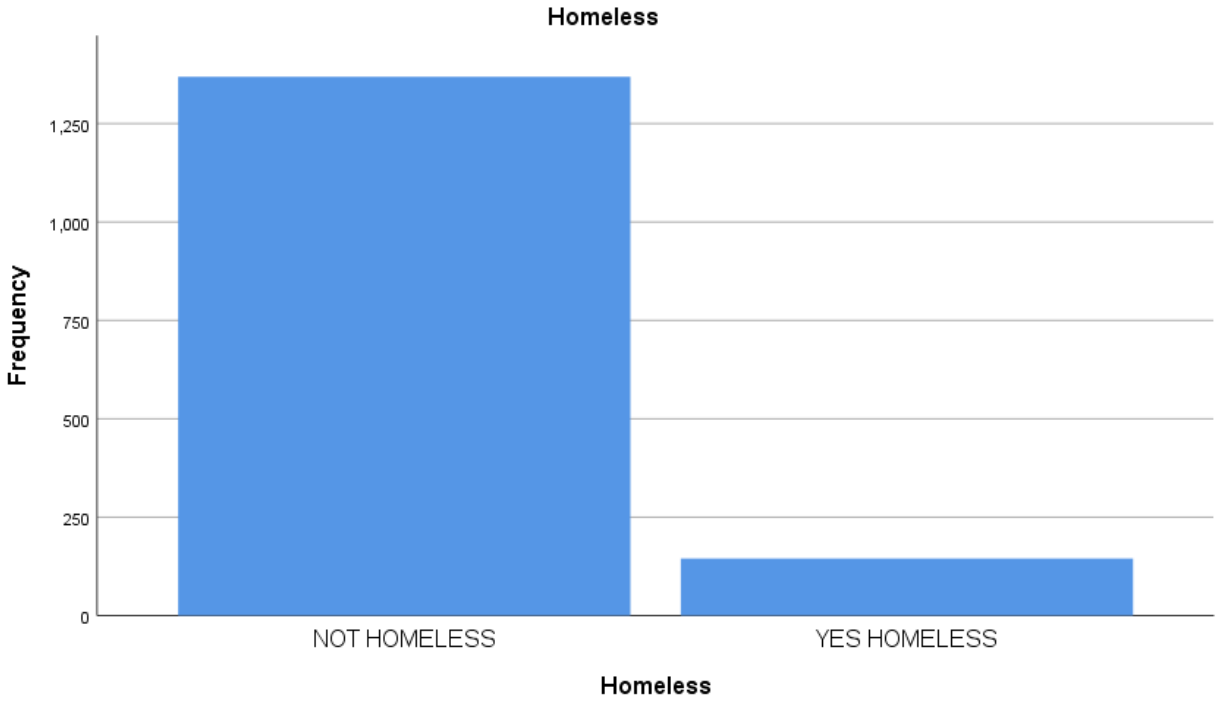


Figure 3

Bar Chart 3 - Homeless



Section 4: Application to Professional Practice and Implications for Social Change

Public health efforts should be focused on the homeless population in the United States, particularly in the state of Georgia, because the research problem was focused on this state, as well as on HIV and TB regular testing for the most impact to reduce the level of poverty and the infection rate when it comes to TB and HIV. These types of interventions, for example affordable housing for homeless and easily accessible clinic centers for TB/HIV, are the best recommended ways to achieve the reduced number of homeless and TB/HIV positive patients.

Sociodeterminants of health have indicated that certain populations are at a much higher risk of chronic, infectious and other diseases compared to some other populations. In particular, the HIV positive and homeless population are extra prone to contracting infectious disease such as TB. In the United States, there has been a low prevalence of TB among the U.S.-born population, but there is a higher prevalence for the U.S. foreign-born population (immigrants). For example, there was a jump of about 4% in 1990 to about 11% in 2010 (Marks et al., 2019). The challenge with this significant increase is that TB is an airborne infectious disease that can easily be transferred through the air from one infected person to another. Over the years, the United States has seen an increase in immigrant population as well as in the homeless population; thus, it is imperative to find a solution to the increasing rates of TB in the United States.

My current interest in TB/HIV and homelessness continues because GA is my home state, and there was a gap and unknown/unavailable records of TB cases and

differences between the U.S.-born vs. foreign-born population in GA from 2014 to 2018, taking into consideration sociodemographic and clinical characteristics of the population.

I used three research questions to illustrate the relationship between the dependent and independent variables. Using the latest SPSS Version 25, statistical quantitative data analysis was performed, and the data were presented in Section 3 of the manuscript. Section 4 addresses the discussion of the results of statistical analysis with the relevant recommendations based on the research done.

Interpretation of the Findings

There were three dependent variables (origin of birth, HIV, homelessness) in TB cases with three hypotheses. There is a relationship of TB cases based on origin of birth and differences between the U.S.-born and foreign-born population for the state of GA from 2014 to 2018. All alternative hypotheses were accepted while the null hypotheses were rejected due to calculated *p* values where the origin of birth was defined as the actual outcome variable in TB cases. According to initial findings using Chi-square analysis, I determined that U.S.-born TB cases were more likely to have HIV positive status compared to foreign-born TB cases where there was no significance related to HIV status for the state of GA from 2014 to 2018. Next, using multivariate logistic regression analysis findings, I further evaluated the relationships among different variables, including origin of birth, HIV, homelessness, and clinical characteristics in TB cases.

Comparing these initial findings according to Chi-square analysis, I found that U.S.-born TB cases were more likely to be homeless compared to foreign-born TB cases

in the state of GA between 2014 and 2018. The number of TB cases was greater for the U.S.-born population vs. the foreign-born population from 2014 to 2018 in GA.

On the other hand, multivariate logistic regression analysis revealed that homelessness was strongly associated with origin of birth in TB cases for GA. For example, I found that a male with TB was 33% less likely to be born outside United States as compared to a female TB patient in state of GA between 2014 and 2018 (Table 13). A Black patient with TB was 3.3 times more likely to be HIV positive as compared to a White patient with TB. Similarly, an Asian patient with TB was 45% less likely to be HIV positive as compared to a White patient with TB. Furthermore, a male patient with TB was 4.6 times more likely to be homeless than a female patient with TB.

The results of this research support the SEM theoretical framework on which the study was based. Homelessness directly affects TB cases in the U.S.-born/foreign-born population by shaping individual behavior. Thus, organizations, communities, and state-level officials need to implement specific policies at local and state levels in GA. As mentioned earlier, in light of my personal and professional engagement and interest in TB, HIV, and homelessness, a socioenvironmental framework was the best option for this research. A socioenvironmental framework can be used to continue to develop strategies in the implementation process that can be helpful in tracking and preventing TB in the state of GA. In my summary of findings, I further discuss populations of groups most affected.

The alternative hypotheses were supported and presented below:

$H1_A$: There is a relationship between the sociodemographic and clinical characteristics of U.S. born and foreign-born population (origin of birth) in TB cases for the state of Georgia from 2014 to 2018.

$H2_A$: There is a relationship between HIV status in TB cases for the state of Georgia from 2014 to 2018.

$H3_A$: There is a relationship between homelessness in TB cases for the state of Georgia from 2014 to 2018.

Summary of Findings

Quantitative data analysis indicated a total number of TB cases (N = 1,518) for a period of time from 2014 to 2018 with 987 males and 531 females included within the secondary dataset. There were more males infected with TB than females. In terms of race, the dataset showed 717 Blacks, 417 Whites, and 366 Asians for the same time period of 2014 to 2018 in the GA where the rates remained stable. My particular focus was on the foreign-born population in GA from 2014 to 2018 where the top 10 countries of origin of birth were 122 from Mexico, 115 from India, 78 from Vietnam, 49 from Ethiopia, 31 from Guatemala, 29 from Burma, 24 from Nigeria, 19 from Honduras, 19 from Korea, and 19 from the Philippines.

For positive HIV cases who were also TB positive, 83 cases were U.S.-born while 49 were foreign-born. The origin of birth for these 49 who were both TB and HIV positive included 10 from the continent of Africa, three from Central America, and two from Asia. Homeless status for this particular group was much more closely analyzed.

For example, out of 145 homeless cases within this secondary dataset, there were 116 HIV negative cases and 29 HIV positive cases. These 29 cases were TB positive, HIV positive, and homeless at the same time. Homeless status in these 145 cases included 118 U.S.-born and 27 foreign-born patients.

While adjusting for race, age, homelessness, HIV status, and diagnosis year, a male with TB was 33% less likely to be born outside United States as compared to a female TB patient in GA from 2014 to 2018, as presented in Table 7. While adjusting for gender, age, homelessness, origin of birth, and diagnosis year, a Black patient with TB was 3.3 times more likely to be HIV positive as compared to a White patient with TB. Similarly, an Asian patient with TB was 45% less likely to be HIV positive as compared to a White patient with TB, as presented in Table 10. While adjusting for race, age, homelessness, HIV status, original of birth, and diagnosis year, a male patient with TB was 4.6 times more likely to be homeless than a female patient with TB.

As a result of this study, I determined that there are more HIV positive and homeless TB cases in the U.S.-born population in GA, compared to the foreign-born population. This result may help to reduce social stigma when it comes to immigrants.

Limitations

When it comes to HIV status out of total number of TB cases (N=1518), there were 48 not offered HIV testing, 25 refused and 19 with unknown HIV status. Total number of these cases who were not offered HIV testing, refused to test for HIV and for

whatever not specified reasons were unknown cases whether they had or did not have HIV could impact our study.

Additional limitation was regarding the overall challenge to keep track of TB cases in the state of Georgia for immigrant population from 2014-2018 due to political climate. What this means is that there are many immigrants who may not have legal status in the United States, either for that reason or other reasons lack healthcare insurance, or do not ask for any medical assistance even in case they get sick. According to Tarantola (2019), the reason why immigrants are hesitating to test for TB/HIV or adhere to any treatments are partially due to social stigma. Many also come from poverty and do not have any preventive measures when it comes to their health. These TB cases could well be underreported for foreign-born population.

This study did explore additional characteristics of the study participants or cases for example sociodemographic and clinical characteristics to make the study more robust and look into different relationships with all the other variables, but the secondary dataset CDC WONDER OTIS did not have all the secondary data available to export into Excel spreadsheet. Multivariate logistic regression analyses were conducted, but for RQ#1 there were some limitations in terms of secondary data available through the website. The findings could not be generalized to other populations in other states across the United States based on the state of Georgia results.

Another major limitations and gaps in research were the ability to perform even more robust quantitative data analysis using additional statistical methods based on what

secondary dataset was retrieved at this time. Due to current pandemic, there was a major delay and lack of communication with the appropriate agencies to get additional information regarding the dataset. Under normal circumstances, the level of communication and flow of information and data can be strengthened for any future studies in this area.

Implications for Social Change

According to Tarantola, (2019), social change is associated with some development issues in developing countries to where in early 1990s it became not only an issue in developing countries but a global issue around the world. Latest studies indicate social change has gone through transformation to where income, productivity and gross national product (GNP) continue to be part of human development and communication is the key aspect of any social change (Tarantola, 2019).

Based on my research on social change aspects, healthcare workers and community leaders can improve communication when it comes to TB, HIV and homelessness in the state of Georgia regardless of origin of birth. There is social stigma around the world when it comes to TB, HIV and homeless status and many of patients are ashamed of the status and challenges they are facing. Society as a whole need to be more accepting and supportive for their family, friends or strangers who are coping with these issues.

Lastly, local, state and federal government can provide additional funding and other resources in fighting these infectious diseases such as social workers who could

provide emotional support, reassure patients with TB and HIV there is less stigma associated with these diseases and there is always “helping hand” in their difficult journey to get better.

Recommendations for Action and Future Studies

This study shows the importance and significance of studying origin of birth in TB cases and how they can impact HIV status, homeless status for the state of Georgia from 2014 to 2018. The findings might be of interest for local, state and federal government where resources could be identified and used in the state of Georgia. There are also differences between the counties in the state of Georgia, as some counties will have more and some less of immigrants vs. U.S.-born population map distribution across the state of Georgia. As mentioned earlier in the limitation section, there should be further research that explores characteristics of study participants or cases such as demographic, clinical, and/or social with the information on exposures, potential confounders and measures of central tendency as well as multivariate analyses to be performed.

Conclusion

Infectious disease such as TB has been around for centuries, but it keeps re-occurring and in some cases is becoming so drug resistant that more research would have to be done even in the United States. As one of the most advanced countries when it comes to medicine and medical treatments, United States still has many TB cases and it was surprising to find out more US-born TB cases will also be more likely homeless in

the state of Georgia from 2014 to 2018 compared to foreign-born TB cases. Additionally, in these TB cases, U.S.-born populations will more likely be HIV positive compared to foreign-born population in the state of Georgia looking at the same secondary data from 2014 to 2018. State of Georgia needs to rely and invest more on public health professionals, local and state agencies to reduce the level of poverty by building affordable housing for homeless and mini clinics for regular HIV/TB testing in order to prevent spread of these infectious diseases. These HIV/TB testing centers could be easily accessible and offer free of charge testing for vulnerable populations. According to MMWR (2020), TB incidence rates should be reported in automatic centralized system for tracking purposes to further evaluate contacts of TB patients, same way of HIV or homeless in TB cases in order to achieve the national goal of TB elimination.

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