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THE EFFECT OF ALTERNATIVE HOUSING SUPPORT FOR HOMELESS PERSONS WITH

TUBERCULOSIS IN FULTON AND DEKALB COUNTIES IN GEORGIA 2009- 2016

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ABSTRACT

THE EFFECT OF ALTERNATIVE HOUSING SUPPORT FOR HOMELESS PERSONS WITH TUBERCULOSIS IN FULTON AND DEKALB COUNTIES IN GEORGIA 2009- 2016.

By Ndubuisi K. Anyalechi

Introduction. Tuberculosis (TB) is a contagious infectious disease that has been a permanent challenge throughout human history. Mycobacterium TB (M. TB), the bacteria that causes TB has been present for over 70,000 years, and it currently infects nearly 2 billion people worldwide, with around 10.4 million new cases of TB each year. In 2017, 10 million people fell ill with TB, and 1.6 million died from the disease (including 300,000 people infected with the human immunodeficiency syndrome). While the rate of TB among the United States (US) homeless persons may be 20 times that of the general adult population, studies suggest that most urban homeless TB cases are attributable to ongoing transmission of TB within the homeless group. Since 1996, the State of Georgia TB Program has been housing homeless TB patients through the Alternative Housing Project (AHP) in partnership with the American Lung Association (ALA) to facilitate Directly Observed Therapy (DOT), ensure TB treatment completion, and prevent TB transmission in this population and the community.

Methods. The study is a quantitative retrospective study on homeless TB patients in the US between January 2009 and December 2016. The study aims: to analyze the effect of the AHP on TB treatment completion rates amongst homeless TB patients in Fulton and Dekalb Counties Georgia (FAD); to compare the FAD TB treatment completion rates amongst homeless TB patients

with national rates; and to determine the relationship of substance abuse to completion rates. Data for the 175 FAD TB patients participating in the AHP were obtained from the ALA and verified with the State Electronic Notification Disease Surveillance System (SENDSS). The data for the 2,549 homeless TB patients in the national group was obtained from the Centers for Disease Control and Prevention's National TB Surveillance System through the Wide-ranging On-Line data for Epidemiologic Research. Descriptive statistics were conducted on the patients in both groups, and Pearson's Chi-square was conducted to determine the relationship between AHP and completion rates; while the odds ratios and 95% Confidence Intervals were used to determine the relationship of substance use with completion rates and alternative housing and completion rates.

Results. Overall TB completion rates were higher in FAD (93%) when compared to national (85%). There was no significant relationship between substance use and TB completion for the FAD (0R 0.350 95% CI (0.121, 1.007)) and National (OR 1.103 95%CI (0.887,1.372) populations. There was a significant relationship AHP and TB completion (OR 2.278 95%CI [1.282, 4.049]).

Discussion. The available evidence of the effect of a structured intervention on treatment initiation, adherence and completion presented in this study suggests that AHP is an effective program in FAD and Georgia and can be replicated in other parts of the U.S. to improve the treatment outcome of homeless TB patients.

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Thank you, Lord, for your faithfulness.

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Chapter 1- Introduction

Overview

Tuberculosis (TB) is an infectious disease that usually infects the lungs but can attack almost any part of the body[1]. While the World Health Organization estimates that 1.8 billion people are infected with Mycobacterium Tuberculosis (M. TB)[2], the bacteria that causes TB, it is estimated that between 80-85 percent of TB cases occur in the lungs and this type of disease is referred to as Pulmonary TB (PTB)[3]. Although a preventable and treatable disease, TB causes more than a million deaths each year, and this ancient infectious disease, unfortunately, poses several challenges to both the individual who is infected and their community[4]. About 80% of tuberculosis cases in the United States are diagnosed by positive culture results for Mycobacterium tuberculosis, with more than 90% of those cases tested for susceptibility[5, 6]. Recommended treatment varies between 6-9 months for cases that are isoniazid and rifampicin susceptible, while cases of drug resistance TB can take between 18-24 months to treat[7]. Monitoring all patients receiving TB treatment is essential in TB management to assess their response to the drug treatment; regular monitoring also helps to ensure that patients complete their treatment[8].

In high-income and low-income countries alike, homeless people are at risk of TB. They are more likely to be exposed to TB bacteria due to their living conditions in hostel accommodation or settings where homeless people gather to sleep or socialize[9].

In the United States, it is the responsibility of the state and local health departments to prevent and control the spread of TB in communities[10]. Likewise, Fulton and Dekalb TB control and

prevention programs ensure that the chain of transmission of TB is interrupted by adopting three strategies that are focused on TB elimination. The first strategy is to identify active TB cases and link them to care, which entails finding and reporting persons who have TB, ensuring that they complete recommended therapy by directly observing them swallow the medications, and, in exceptional circumstances, using confinement measures. The second strategy is finding and screening persons who may have been exposed to an infectious individual with TB to determine whether they have TB infection or TB disease and equally providing them with appropriate treatment in the event of active disease. The third strategy aims at screening high-risk populations to detect persons infected or exposed to M. TB, who could benefit from therapy to prevent the latent infection from progressing to TB disease[10].

Scope of Problem with Homelessness

Most of the challenges of TB prevention and treatment stem from the issues around susceptibility and known risk factors that can be categorized into three broad sectors: individual biological factors (e.g., immunodeficiency states, diabetes), social and economic circumstances (e.g., crowding, poverty, poor nutrition), and environmental and institutional factors (e.g., silica dust, poor ventilation)[11]. For homeless patients, their vulnerability function in two major pathways: increased risks for exposure and infection and an increased risk for progression from infection to active disease[12].

Homelessness poses a severe barrier to treatment completion for TB control programs[13]. And to determine the effect of alternative housing on TB treatment completion rates, it is essential to understand the factors affecting these populations who are significantly exposed to health

problems and often faced with difficulties in accessing care[14]. Social and economic determinants of ill health must be appropriately addressed together with the adequate implementation of the specific interventions available today to combat those diseases that disproportionally affect these vulnerable populations[15]. As such, it becomes an important viewpoint to understand and document the role of social determinants of health and how it can affects the health outcomes of the least advantaged in the society[16].

The recent economic downturn has increased the risk of homelessness, which has necessitated the need to focus on preventing TB in the homeless population[17]. Homeless individuals are at an increased risk of substance abuse, frequent incarceration, and human immunodeficiency virus (HIV) infection, which are also risk factors for TB[13]. And a lack of stable housing prevents homeless individuals to promptly address many of these health issues and prolonged disease diagnosis, such as TB[13]. There is also the risk of developing Multi-Drug resistant TB among those who have been previously diagnosed for TB and did not complete prescribed treatment(rifampicin, isoniazid, pyrazinamide, and ethambutol) due to their homelessness[18]. Although there is no universally agreed-upon definition of homelessness; however, in general, the homeless can be defined as persons who do not have customary and regular access to a conventional dwelling or residence[19]. The homeless population also represents a substantial risk group among U.S.-born TB patients, and ongoing efforts are needed to address TB cases in this high-risk population to achieve TB elimination[20].

Although homeless shelters and other inexpensive housing options for the homeless are vital to the survival of these persons, there is substantial potential for TB transmission in such facilities, especially in the winter when shelters are likely to be more crowded, and ventilation from the

outside may be diminished[21]. During recent years, public health authorities in the US have focused on TB control and prevention among persons experiencing homelessness, because many of the largest TB outbreaks have involved such persons in shelters and other inexpensive housing[20]. Treating TB infection and disease among persons experiencing homelessness is complicated by such factors as frequent relocation, comorbidities (e.g., mental illness and substance abuse), and mistrust of the health care system. Therefore, establishing partnerships among key stakeholders is essential for ensuring an effective, coordinated response and intervention[20].

Goal

The goal of my thesis is to evaluate the effect of the Alternative Housing Project on homeless tuberculosis patients' treatment completion rates in Fulton and Dekalb Counties, Georgia.

Hypothesis

According to the Georgia Department of Public Health, homeless Tuberculosis patients *will* complete Tuberculosis medications if enrolled in the Alternative Housing Program.

Specific Aims

1. Describe the public health prevention science around the Alternative Housing Project as it relates to TB prevention.

2. Analyze data from AHP participants and evaluate their progress in treatment and determine the association of other risk factors that can hinder the completion rate and increase the drop-out rate. E.g., substance abuse, joblessness, HIV

Significance of the study

Evidence-based public health interventions like the Alternative Housing Project (AHP) play an essential role in the overall health, longevity, and productivity of a community, as it aims at directly mitigating issues around TB treatment completion and compliance for homeless TB patients. AHP is designed to have a direct impact on improving quality of life, address homeless TB patient's health challenges, and provide an overall cost-benefit to TB control programs. The analysis presented in my study will further enhance the view of Public health decision makers, funders and the public in the advantage of developing a strong collaboration/partnership that will address a public health challenge like TB amongst homeless population.

Chapter 2- Literature Review

History of Tuberculosis

Tuberculosis (TB) is a contagious infectious disease that has always been a permanent challenge throughout human history[22]. Studies from Egyptian mummies dating back to 2400 B.C. show skeletal deformities typical of TB characteristic Pott's lesions and similar abnormalities are clearly illustrated in early Egyptian art[23, 24].

The first written documents describing TB, dating back to 3300 and 2300 years ago, were found in India and China, respectively, and the ancient Hebrew word schachepheth is used in the Biblical books of Deuteronomy and Leviticus to describe TB[22]. In the same period, in the Andean region, archeological evidence of early TB, including Pott's deformities, was provided by Peruvian mummies, suggesting that the disease was present even before the colonization of the first European pioneers in South America[22]. In ancient Greece, TB was well known and called Phthisis. Hippocrates described Phthisis as a fatal disease, especially for young adults, accurately defining its symptoms and the characteristic tubercular lung lesions[25].

In 1720, for the first time, the infectious origin of TB was conjectured by the English physician Benjamin Marten, in his publication "A New Theory of Consumption." Both terms consumption and phthisis were used in the 17th and 18th centuries until in the mid-19th century when Johann Lukas Schönlein coined the term "tuberculosis." In the 18th century in Western Europe, TB had become epidemic with a mortality rate as high as 900 deaths per 100,000 inhabitants per year, more elevated among young people. For this reason, TB was also called "the robber of youth[22]."

The explosion of the European population and the growth of large urban centers made Europe the epicenter of many TB epidemics[26], and by the first half of the 19th century TB incidence peaked; but due to improved sanitation and housing by the second half TB mortality had decreased[27].

Understanding of the pathogenesis of tuberculosis began with the work of Théophile Laennec at the beginning of the 19th century and was further advanced by the demonstration of the transmissibility of Mycobacterium TB infection by Jean-Antoine Villemin in 1865[22]. The identification of the tubercle bacillus as the etiologic agent by Robert Koch on 24 March 1882 marked a milestone in the fight against TB[26]. The 20th century brought a steady drop of morbidity and mortality due to TB, in the developed world, because of better public health practices, massive vaccination with Calmette-Guérin bacillus (BCG) vaccine and the advent of antibiotics such as streptomycin in 1944 and isoniazid in 1952[22, 28]. Shortly after the TB bacterium was identified in the late 1800s, a TB test was created; however, it was not until the late 1940s that an effective antibiotic for the treatment of TB was available[22]. In 1950, scientist Renee Dubos predicted that the TB bacteria would eventually develop resistance to antibiotics. And in 1956, strains of TB that were resistant to streptomycin, para-amino salicylic acid (PAS), and isoniazid (INH) was discovered in Great Britain and were eventually dubbed multi-drug resistant TB or MDR-TB[29].

TB Global Burden

TB disease is one of the leading causes of death globally, and the infection also found in every country of the world[30]. The history of TB is part of the history of humanity since TB is one of the oldest infectious diseases affecting humankind[26]. Mycobacterium TB (M.TB), the bacteria that causes TB, has been present for 70,000 years, and it currently infects nearly 2 billion people worldwide, with around 10.4 million new cases of TB each year[15, 22]. Almost one-third of the world's population are carriers of the TB bacillus and are at risk for developing active TB disease. One in every ten people infected with M.TB will become sick with active TB disease, and if untreated while they are contagious, each person with active TB is likely to infect at least ten to fifteen people through airborne transmission every year[15].

TB is also the leading killer among individuals infected with HIV; today, a quarter of million TB deaths are HIV-associated, with most of them in Africa[31]. TB has always been associated with a high mortality rate over the centuries, and in recent decades, it is estimated to be responsible for 1.4 million deaths in patients infected with the human immunodeficiency virus (HIV)[22]. In 2017, 10 million people fell ill with TB, and 1.6 million died from the disease (including 300,000 people with HIV), and in the same year an estimated 1 million children became ill with TB, and 230,000 children died of TB (including children with HIV associated TB)[32].

Contrary to control and prevention efforts, global TB incidence is still growing at one percent per year, with higher rates occurring in Africa, but in another part of the world like the United States, these intense control efforts are helping to reduce or stabilize the incidence rates[33]. Interestingly, TB is treatable, but 5000 people are killed every day by the deadly disease; and if

left unchecked within 20 years, TB would kill an estimated 35 million people. Ninety-eight percent of TB death are in the developing countries affecting young adults in their most productive years; however, TB also affects the most vulnerable such as the poorest and malnourished globally[34]. Global TB burden sometimes needs to be determined in terms of incidence per capita rather than using absolute numbers. The incidence per capita rates will enable comparisons with other regions with similar rates and may subsequently provide true representation of TB global incidence.[35].

MDR-TB is a particular type of drug-resistant TB that refers to a person infected with bacterium resistant to two of the most critical TB drugs, isoniazid (INH) and rifampicin (RMP)[36]. The global burden of MDR-TB has recently increased by an annual rate of more than 20%[15] and the emergence of drug-resistant TB is often attributed to the failure to implement proper TB control programs and correctly managing TB cases[37]. According to the World Health Organization (WHO), approximately only half of all patients treated for MDR-TB achieved a successful outcome[38]. The number of people estimated to have had MDR-TB in 2016 was 600,000 with almost half of these cases (47%) found in India, China, and the Russian Federation[4].

TB in the USA

By the dawn of the 19th century, TB, or consumption, had killed one in seven of all the people that ever lived[39]. And by the early twentieth century, TB was the leading cause of death in the United States, and one of the most feared diseases in the world[22]. It was estimated that, at the turn of the century, 450 Americans died of TB every day, most between the ages of 15 and 44[40]. The disease was so common and so terrible that it was often equated with death itself[39].

Remarkably, from 1953 to 1984, the number of reported TB cases in the United States had declined at a rate of approximately 5% a year, from higher than 84,000 cases in 1953 to nearly 22,000 in 1984[41]. This decline was due primarily to public health intervention which focused on sanitation and proper hygiene[42]; Unfortunately, from 1985 to 1992, reported TB cases increased by 20% mainly due to the emergence of the HIV epidemic, cutbacks in public health infrastructure and treatment programs, increasing poverty, homelessness, the occurrence of TB in foreign-born persons from TB endemic countries and drug abuse[41]. The resurgence and increased TB cases in the USA were first pronounced when 3,811 TB cases in New York were also reported to have been co-infected with the Human Immuno-deficiency virus (HIV)[41]. Today TB and HIV are two catastrophic diseases affecting millions of people worldwide, and are considered to be a pandemic by the WHO[43]. Studies have found that the HIV pandemic has increased TB prevalence globally, but its impact has been highest in developing countries in Africa, Asia, and Latin America[30]. Currently, it is estimated that more than 675,000 people have died of HIV/AIDS in the U.S. since the beginning of the HIV epidemic[44].

Since 1992, a massive influx of federal funds and a renewed emphasis on TB therapy, prevention, and control again led to TB to decline in the United States [42]. In 2017, the Centers for Disease Control and Prevention (CDC) reported a total of 9,105 new cases of tuberculosis (TB) in the United States, representing an incidence rate of 2.8 cases per 100,000 population[45]. The case count decreased by 1.6% from 2016 to 2017, and the rate declined by 2.5% over the same period[46]. These decreases are consistent with the slight decline in TB seen over the past several years and reflecting the impact of a more aggressive approach to eliminating TB[45]. In the same year (2017), eleven states, the District of Columbia (DC), and New York reported incidence rates above the national average of 2.8 cases per 100,000. TB case counts were highest in California, Texas, New York (including New York City), and Florida, and together, these four states accounted for just under half of the total cases in the United States[45]. While in 2016, about 528 deaths in the United States were attributed to TB, representing an increase from 470 deaths attributed to TB in 2015[47].

CDC works with state and local partners to achieve the goal of TB elimination in the United States. One critical activity is collecting TB surveillance data to track national progress toward TB elimination and to inform TB prevention and control activities[46]. Health departments in the 50 states and the District of Columbia electronically report to CDC verified TB cases that meet the CDC and Council of State and Territorial Epidemiologists' surveillance case definition. Reported data includes the patient's country of birth, self-identified race, and ethnicity (i.e., Hispanic or non-Hispanic), HIV status, drug-susceptibility test results, and information on risk factors, including homelessness and residence in a congregate setting (i.e., long-term care or correctional facility)[46].

TB Overview in Georgia

Elimination of TB is defined as reducing TB disease incidence in the United States to less than 1 case per million persons per year[48]. Although TB incidence is decreasing, epidemiologic modeling by the U.S. CDC projects that the goal of TB elimination may not be attained in this century with the current rates of decline nationally[49]. TB is a reportable disease in Georgia, and cases must be reported electronically through the State Electronic Notifiable Disease Surveillance System (SENDSS), a secure web-based surveillance software developed by DPH, or by calling, emailing, or faxing a report to DPH[50].

In 2017, Georgia reported a total of 293 new TB cases, which represented a 3% decrease from 301 in 2016 with an overall TB case rate decrease of about 68% since 1991. According to the CDC, the TB case rate in Georgia has also decreased from 2.9 cases per 100,000 persons during 2016 to 2.8 cases per 100,000 in 2017, which is equal to the 2017 U.S. case rate[50]. This rate ranked Georgia as the 6th state with the most number of reported new cases in the U.S. and ranked 12th for the TB case rate (per 100,000 population) among the 50 reporting states[50]. All Georgia physicians, laboratories, and other health care providers are required by law to report clinical and laboratory-confirmed TB cases under their care to the Georgia Department of Public Health (DPH)[50]. Cases may be directly reported to a County Health Department, a District Health Office, or to the state TB program which is responsible for the systematic collection of all reported TB cases in the state. Timely reporting of TB cases enables the state TB program to assess the national TB indicators and offer the opportunity for public health staff at the district level to follow-up patients, administer directly observed therapy, and monitor TB treatment until completion[50]. As part of the process of interrupting the chain of TB transmission, public health

staff are equally required to evaluate, screen exposed individuals, and control TB outbreaks ensuring that each patient meets the required national TB indicators which are an essential part of the process and outcome measures for TB control programs in the United States[51]. These indicators are selected by CDC in cooperation with partners in state and local health departments[47]. And as part of TB elimination in Georgia, these indicators are assessed to determine the effect of prevention control measures put in place by the state TB program and the health departments[50].

The State of Georgia began a TB prevention program in 1996, housing homeless TB patients through the Alternative Housing Project (AHP) in partnership with the American Lung Association (ALA) (Appendix iii). The American Lung Association is a non-profit health organization whose mission is to save lives by improving lung health and preventing lung disease through education, advocacy, and research. For more than a century, the American Lung Association has led the fight for healthy lungs and healthy air[39]. The primary goals of AHP included facilitating DOT, ensuring TB treatment completion, and prevent TB transmission in this population and the community.

AHP effectiveness is measured through patient completion rates. When a patient completes treatment within the program's specified completion time frame, it suggests that the program's process was effective in addressing the challenges of the TB homeless individual (Appendix iii) .

For an individual to be eligible for AHP, it must be demonstrated by the county that the homeless patient has had an unstable home environment for more than 12 months with evidence of active TB. Verification criteria for inclusion with active TB disease include one or more of the following:

positive culture, positive nucleic acid amplification test, positive smear, with an abnormal chest X-ray, or provider diagnosis with signs or symptoms (Appendix iii).

Hundreds of tuberculosis patients have utilized the Alternative Housing Program since 1996 (Appendix iii)[50], the Program uses inexpensive motels, trailers, duplexes, apartments, and houses in ensuring stable housing for the patients Appendix iii). The Health Departments provide Directly Observed Therapy (DOT) and transportation to TB and Ryan White clinic appointments (Appendix v). On July 1, 2005, the American Lung Association in Georgia (ALA) began to extend its services to provide housing services for non-infectious clients. The plan to place homeless patients in area housing requires frequent communication among ALA area hospitals and county TB Clinics. In addition to the formal agreements between ALA and rental establishments, letters of agreement are on file from all participating districts (Appendix v). These letters demonstrate a commitment to the Alternative Housing Program by each District TB Program. Monthly patient care reviews are mandatory to ensure that continuity of care is maintained, and other needed services are being provided. A designated Outreach Worker (ORW) provide DOT and patient follow-up (Appendix iii).

TB Cases in Fulton and Dekalb County, Georgia

In 2017, Georgia reported a total of 293 new TB cases, which represented a 3% decrease from 301 in 2016 with an overall TB case rate decrease of about 68% since 1991[50]. According to the CDC, the TB case rate in Georgia has also decreased from 2.9 cases per 100,000 persons during 2016 to 2.8 cases per 100,000 in 2017, which is equal to the 2017 U.S. case rate[46]. This rate ranked Georgia as the 6th state with the highest number of reported new cases in the U.S. and

ranked 12th for the TB case rate (per 100,000 population) among the 50 reporting states[47]. In the same vein, among the 159 counties in Georgia, four counties in the metropolitan Atlanta area reported the highest number of TB cases in 2017: DeKalb (66 cases), Fulton (42), Gwinnett (42), and Cobb (18). Interestingly, these four counties accounted for 57% of all TB cases reported in Georgia in 2017[50]. Amongst Georgia's 18 Health Districts responsible for public health in the state's 159 counties, DeKalb Health District had the highest TB case rate in 2017 (8.8 per 100,000), followed by the Albany District (4.9 per 100,000) and the Columbus District (4.4 per 100,000). Between 2013 and 2017, an average of 12 individuals reportedly died each year of TB in Georgia, with the highest number of deaths reported as 18 in 2016[50].

As TB incidence falls, TB becomes concentrated in particularly vulnerable groups, such as the poor, the homeless, migrants, people living with HIV/AIDS, people with harmful alcohol use, illicit drug users, prisoners, and other marginalized groups[52]. In other words, measuring the number of new cases occurring among these groups each year remains the best overall indicator of progress toward TB elimination[53]. In 2017, CDC reported risk factors associated with persons diagnosed with TB as follows: 19.9% reported having diabetes, 8.9% reported excessive alcohol use, 5.5% were co-infected with HIV (of TB cases with HIV test results reported), 6.7% reported using non-injectable drugs (1.2% reported using injecting drugs), 4.6% reported being homeless in the past year, and 3.1% were residents of correctional settings at the time of diagnosis[47]. These risk factors have also been identified as major contributory factors to the high incidence of TB in Fulton and Dekalb counties[50].

TB Burden and Homelessness

In the United States, 1% of the population experiences homelessness each year, but more than 5% of people with TB reported being homeless within the year before diagnosis[13]. Unfortunately, the increasing number of homeless individuals further complicates the fact that TB remains a challenging issue among the homeless population due to their unstable housing and limited access to health care[52]; and compared with the general population, homeless individuals have a higher risk for latent TB infection (LTBI) and progression to active disease[54]. As such, efforts to prevent TB transmission and disease among the homeless group in the United States remain essential to continued progress toward TB elimination. Although the number of TB cases among persons experiencing homelessness decreased between 1994 and 2010, the proportion of total TB cases that occurred among homeless persons remained stable, at 6%, and they were disproportionately represented in genotype clusters that suggested local transmission[13]. Despite the overall decline in tuberculosis (TB) incidence in the United States to a record low, outbreaks of TB among homeless persons continue to challenge TB control efforts[54].

In 2009, the Mississippi State Department of Health TB Program, assisted by the CDC and other agencies, contained the Jackson-area TB outbreak among homeless individuals[55]. The primary outbreak contributor were lack of periodic TB screening among homeless shelter clients, and the challenges identified to have hindered improved outcomes as part of containing this outbreak were specifically, inadequate attention to the societal problem of homelessness itself[55]. In another reported incidence, in January 2010, public health officials recognized an outbreak of TB after three overnight guests at a homeless shelter in Illinois received diagnoses of TB disease

caused by Mycobacterium tuberculosis isolates with matching genotype patterns. As of September 2011, a total of 28 outbreak-associated cases involving shelter guests, dating back to 2007, had been recognized, indicating ongoing M. tuberculosis transmission[54].

Confirmed or suspected TB in a homeless person should be immediately reported to the health department so that a treatment plan can be decided upon and potentially exposed persons located and examined[56]. Patients with TB should be counseled and voluntarily tested for human immunodeficiency virus (HIV) infection because TB treatment recommendations are different for HIV-seropositive and HIV-seronegative persons[56, 57].TB therapy should be directly observed (DOT) whenever possible[57]. Ensuring DOT may require the establishment of special shelters or other long-term-care arrangements for homeless persons with TB[56]. And due to the significance of TB among homeless persons, it is recommended by the Advisory Council for the Elimination of TB to suspect TB in any homeless individual with a history of fever and productive cough for more than 1-3 weeks[56].

Chapter 3- Methodology

Ethical Review

This study proposal received a waiver from the Emory University Institutional Review Board (IRB, Appendix i) and an exemption approval from the Georgia Department of Public Health (DPH, Appendix ii) IRB. This study was waived and approved by both entities because the data were collected and analyzed as part of routine TB surveillance, and the study was not considered research involving human subjects. The investigator had access to the data through the DPH's State Electronic Notifiable Disease Surveillance System.

Study Aim

This study aimed to analyze the effect of alternative housing provided by the American Lung Association (ALA) through the DPH funded Alternative Housing Project (AHP) on TB treatment completion rates amongst homeless TB patients in Fulton and Dekalb Counties Georgia (FAD). Also, the study aimed to compare the TB treatment completion rates amongst homeless TB patients with substance abuse between FAD and national rates.

Study Population

The 50 states and the District of Columbia report all verified TB cases to the Centers for Disease Control and Prevention (CDC) as part of the National TB Surveillance System [46]

The populations for this study are homeless TB patients who received alternative housing support in FAD and those who were reported as homeless to the CDC from all 50 states.

FAD population consists of homeless TB individuals who were enrolled in the alternative housing program and reported to the Georgia State Electronic Notifiable and Disease Surveillance System. The national population consists of homeless TB patients who were reported from the 50 states and the District of Colombia into the Centers of Disease Control and Preventions National TB Surveillance System.

An individual was considered to be homeless if the person lacked a fixed, regular, and adequate night-time residence during the 12 months before the initial diagnostic evaluation for TB. Also, the person was considered to be homeless if they had a primary night-time residence which was a publicly or privately operated shelter, an institution that provides a temporary residence, or a public or private building not designated for, or ordinarily used as, regular sleeping accommodation for human beings; or had no home or was alternating between multiple residences[13].

A total of 2,724 patients with treatment completion outcomes across the 50 states and 175 patients in FAD participating in the American Lung Association alternative housing project (ALA-AHP) between January 2009 to December 2016 were included in this study. District TB programs are responsible for entering treatment outcomes into the State Electronic Notifiable Disease Surveillance System (SENDSS). The DPH TB state program compiles all the data in SENDSS and sends it to the CDC National TB Surveillance System.

TB Treatment Completion Data

The DPH requires the ALA to report on the completion status of all patients enrolled in the AHP. The American Lung Association (ALA) reports the number of patients who complete the program on time, patients who complete the program later than expected, and the patient who does not complete the program.

Treatment failure risk factors such as substance use (e.g., alcoholism, illicit drugs) are additional variables collected on patients who complete or fail to complete their treatment through the AHP. Treatment completion is defined as completed treatment without evidence of treatment failure and record showing that sputum smear or culture results in the last month of treatment were negative[58]. Substance use was defined as anyone who indulged in use of illicit drugs that either stimulates (cocaine, amphetamines) or inhibits (heroine or sedatives – hypnotics) the central nervous system or cause hallucinogenic effects (such as marijuana or LSD) [59]. The AHP establishes separate time frames for patients to complete their treatment based on the recommendation from the district TB program to ensure clinical improvements. The DPH considers a patient to have completed their treatment if the treatment was completed through Directly Observed Therapy (DOT) within the established time frame and or remained in the program until treatment completion.

Data Analysis

Descriptive Statistics

The main variables analyzed for the 175 patients participating in the FAD AHP were: Enrollment status – individuals who meet criteria for homelessness and bacteriology findings consistent with

TB disease, treatment completion status, and substance use. The ALA provided the records of patients who had participated in the AHP program during the period under study. TB completion rates were calculated by adding the total number of homeless patients who completed treatment within the same period and dividing the sum by the total number of eligible TB patients considered to be homeless. The completion rates records received from ALA-AHP were verified in SENDSS for accuracy and completeness and exported into Microsoft Excel for analysis. National data from the CDC's Wide-ranging On-Line data for Epidemiologic Research (CDC WONDER) was reviewed for the same study. A total of 2,549 TB cases were found to have been reported as homeless TB cases. The CDC WONDER national data was exported into Microsoft Excel and categorized into the same three variables as the FAD data (enrollment status, treatment completion status and substance use).

The data in Microsoft Excel was exported into SPSS Statistics version 25 for windows for statistical analysis; all *p*-value was set at 0.05. A test of significance was conducted to compare the demographics of the study groups. Chi-square test of association was then used to determine the completion rates in the exposure groups (FAD and national); while the odds ratios and 95% confidence intervals were constructed to determine the association of substance use in the exposure group with completion rates and alternative housing and completion rates. A bivariate demographic analysis of each exposure group to the outcome (Completion Rates) was conducted to assess other factors that may be associated with completion rates

Results

A total of 2724 homeless tuberculosis (TB) patient records were reviewed for this study. Of these total records, n=175 were records of homeless TB patients in FAD and n= 2,549 were records for homeless TB patients nationally without the records from the state of Georgia treatment completion from January 2009- December 2016.

To identify possible differences between National & FAD, I compared various demographic characteristics between the FAD and National populations and conducted a statistical test of significance for this comparison. FAD populations had a significantly higher percentage of individuals born in the US and who reported substance use, than National populations. Generally, most of the disease sites were Pulmonary for both FAD and National with a higher percentage of Extrapulmonary disease site in FAD compared to National. In conclusion, in reviewing the demographics characteristics there was a significant difference for all demographic's characteristics, except for age and gender demographics characteristics of FAD compared to National (Table 1).

Furthermore, to determine the Tuberculosis completion rates between FAD and National with the relationship of substance use and TB completion rates, I conducted a Pearson chi square test and odds ratio analysis with 95% confidence interval. Overall TB completion rates were significantly higher in FAD 93% when compared to national 85% (Table 2). TB completion rates for substance users for FAD and National were 21% and 50% respectively. The odds ratios for the relationship between TB treatment completion and substance use in FAD (OR 0.350 [0.121, 1.007]) and national data (OR 1.103 [0.887, 1.372]) were not significant because the confidence

interval crossed one. In contrast, the odds ratio for the relationship between treatment completion for AHP and TB completion rates was greater than 1 and was significant (2.278 [1.282, 4.049]).

To compare FAD and national treatment completion rates, a retrospective analysis of TB treatment completion rates from 1993-2017 was conducted by reviewing Online Tuberculosis Information System (OTIS) data. In this analysis, before the introduction of alternative housing in 1996, Fulton and Dekalb, completion rates amongst TB homeless patients were lower than national completion rates. By 2003, both FAD and national completion rates were the same. However, by 2010, FAD completion rate was higher compared to the national rates, which plateaued. FAD reported a 10% increase in completion rates in 2015 and remained higher than the national rates to date (Fig 1).

Chapter 4- Discussion

The goal of my thesis was to evaluate the effect of the Alternative Housing Project on homeless tuberculosis patients' treatment completion rates in Fulton and Dekalb (FAD) Counties, Georgia and compare the FAD TB treatment completion rates to National TB completion rates among homeless persons. The results from this study showed that the TB treatment completion rates for FAD were higher than national; and substance use had no significant relationship with TB treatment completion rates for homeless patients in both FAD and national. More importantly, this study also presented a statistically significant result for the relationship between the alternative housing with TB treatment completion rates among TB homeless population in FAD.

One reason for the high TB treatment completion rates in FAD could be the introduction of alternative housing support in Georgia. Since 1996 Georgia Department of Public Health TB control program in collaboration with American Lung Association have been providing alternative housing support to homeless TB patients (Appendix iii). This partnership focused on the timely initiation and completion of TB treatment among homeless TB patients by ensuring that each patient is provided the necessary support needed during their TB treatment (Appendix v). Another hypothesis was that TB homeless patients in FAD were compliance with Directly Observed Therapy (DOT) due to the presence of stable housing provided by ALA. In a previous report on TB treatment among seronegative human immunodeficiency virus (HIV) patients with non-cavitary pulmonary TB, who were at risk of exposure to drug resistance TB, it was shown that DOT in combination with case management, could improve completion of TB treatment when risk factors associated with poor adherence were present [60].

A second result showed no statistically significant relationship between substance use and TB completion rates among homeless patients in both FAD and nationally. This finding contradicts the literature which states that illicit drug users have difficulty completing medical evaluations or adhering to treatment[61]. Also in another study of TB patients that reported substance use in United States, it was seen that patients who abuse substances remain contagious longer because of treatment failure[62]. One possible reason for this result could be the use of DOT to improve treatment adherence among TB patient who are in a rehabilitation program for illicit drug use. A related study, showed over 80% TB treatment completion among drug users in a methadone program[63]. This success was due to the optimization of the time during rehabilitation lessons for illicit drug use to coincide with when they received their TB medication, which invariable enhanced compliance to TB treatment overall [63].

Furthermore, it was seen in this study that FAD saw a steady increase in TB treatment completion rates for homeless person between 1993 and 2017 when compared to National rates. One possible reason for the steady increase in completion rate was the provision of stable housing, adequate case management and sustainable psycho-social support (e.g. food, clothes, support finding a job etc.) needed to encourage adherence and treatment completion. Evidence from a previous study among homeless young adults aged 18 to 23 who were recruited from a community drop-in center and indulged in substance use, suggested that when a homeless individual perceive a high level of social support, their ability to understand that current actions have an impact on the future increases [64]. In other words, this understanding motivates them to engage in positive health practices which will in turn keep them out of the streets and out of trouble in the long run. One of AHP main program's sustainability plan is providing social support

by routinely making sure that each patient has food, clean clothes and support finding jobs (Appendix iv).

Strengths

Data obtained from this study was acquired from two sources; the ALA for FAD data and the CDC's OTIS for national data. Data for FAD has been methodically collected since 1996 when the AHP was established in Georgia. The ability to utilize robust data from the specified data sources is a strength of this study because of the completeness, accuracy, and reliability of the data. The 21% and 50% treatment completion rates among substance users is a clear evidence of the quality of data obtained and analyzed in this study (Table 2).

Furthermore, each dataset assessed multiple variables in addition to completion rates. The variables included in this study were gender, age range, origin of birth, and substance use and assessment of multiple variables in this study offered a holistic view of other factors that may affect TB completion rates in the homeless population (Appendix vi).

Limitations

When comparing the AHP FAD data to national CDC OTIS data, one identified limitation is the lack of comparable programs to the alternative housing program. In addition, it is difficult to consider other preventative initiatives that other state and local health departments may be doing to decrease TB incidence in the homeless community. Moreover, the reduction in Federal funding for public health programs have limited the establishment of intervention programs like AHP in other parts of the country which would have enabled a fair program comparison.

Implications

The improved clinical outcomes of a homeless TB patient and the success to TB control program, in general, are dependent on the individuals taking the medication and completing the full course of treatment. The provision of stable housing and mitigating psycho-social issues among TB homeless individuals appears to be the key factors necessary to ensure decreased TB incidence among this population. Furthermore, the opportunity to partner with drug rehabilitation programs to deliver DOT should also be considered as critical components of strategies to address the tuberculosis epidemic in drug users.

Conclusion

The available evidence of the effect of a structured intervention on treatment initiation, adherence and completion presented in this study suggests that AHP is an effective program in FAD and Georgia and can be replicated in other parts of the U.S. to improve the treatment outcome of homeless TB patients.

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Tables and Figure

Table 1: Demographic distribution of homeless TB patients Fulton and Dekalb county, Georgia (FAD)

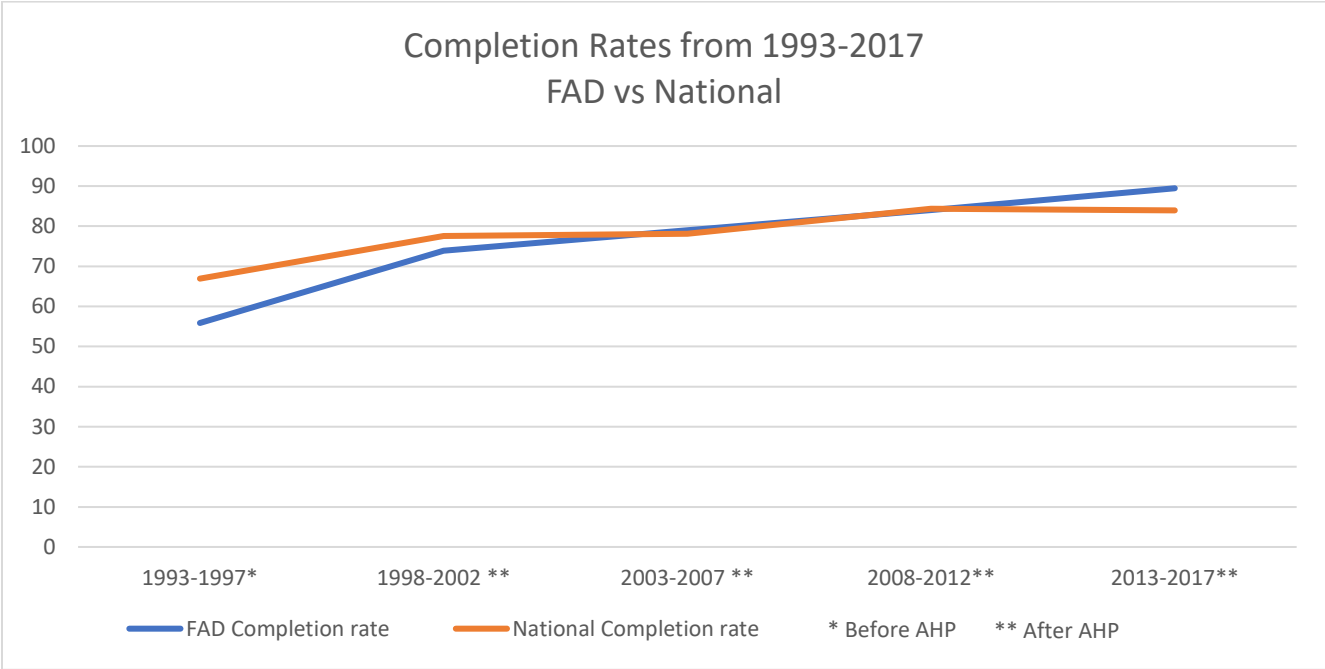**and Nationally (2009-2016) and statistical comparison of significance**

	FAD	National	P Value
n	175	2549	
Origin of Birth U.S Born	86%	84%	<.001
Age Median (Range)	50 (45-54)	50 (45-54)	>.05
Substance Use (Yes)	91%	48%*	<.001
Disease Site			<.001
Pulmonary	84.2%	85.6%	
Extrapulmonary	8.3%	6.3%	
Both	7.4%	7.8%	
Gender			
Male	86%	84%	>.05

* 1.1% of national substance use population was not reported

Table 2: Relationships of Substance Use and Alternative Housing with TB Completion Rates

	VALUE
TB COMPLETION RATES	
FAD	93%
National	85%
TB COMPLETION RATES AMONG THOSE ENGAGED IN SUBSTANCE USE	
FAD	21%
National	50%
ODDS RATIO OF SUBSTANCE USE WITH TB COMPLETION RATE: OR (95%CI)	
FAD	0.350 (0.121, 1.007)
National	1.103 (0.887, 1.372)
ODDS RATIO OF ALTERNATIVE HOUSING (HOUSED/NO HOUSING [REFERENCE GROUP]) WITH COMPLETION RATE: OR (95%CI)	2.278 (1.282, 4.049)

Fig 1: Completion rate status before the implementation of AHP and after AHP

Completion Rates from 1993-2017
FAD vs National

Legend: FAD Completion rate — National Completion rate — * Before AHP — ** After AHP

Appendix i

January 23, 2018

Ndubuisi Kingsley Anyalechi
Rollins School of Public Health

RE: **Determination: No IRB Review Required**
       Title: *Impact of Alternative Housing support on TB cases.*
       PI: Ndubuisi Kingsley Anyalechi

Dear Ndubuisi:

Thank you for requesting a determination from our office about the above-referenced project. Based on our review of the materials you provided, we have determined that it does not require IRB review because it does not meet the definition of "research" with human subjects or "clinical investigation" as set forth in Emory policies and procedures and federal rules, if applicable. Specifically, in this project, you will evaluate the effect of the Alternative Housing Project on homeless tuberculosis patients' completion rates in DeKalb and Fulton Counties, Georgia. This study is not intended to produce generalizable results.

Please note that this determination does not mean that you cannot publish the results. This determination could be affected by substantive changes in the study design, subject populations, or identifiability of data. If the project changes in any substantive way, please contact our office for clarification.

Thank you for consulting the IRB.

Sincerely,

Sam Roberts, BA

Appendix ii

April 13, 2018

Ndubuisi Anyalechi
Communicable Disease Specialist Supervisor
DeKalb County Board of Health
440 Winn Way
Decatur, GA 30030

Project: 180403 - The Impact of Alternative Housing Support for Homeless Persons with Tuberculosis in DeKalb and Fulton Counties

Project Status: Exempt

Dear Researcher,

The DPH Institutional Review Board has determined that the above-referenced project is **exempt** from the requirement for IRB review and approval.

Reason:

Cat#4 - Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

This exemption applies only to the protocol described in your application. Any modification to this protocol may change the status of this project and may require IRB review and approval except where necessary to eliminate apparent immediate hazards to human subjects.

If you have any questions regarding this letter or general procedures, please contact the DPH IRB at irb@dhr.state.ga.us. Please reference the project # in your communication.

Best wishes in your research endeavors,

Brian Kirtland, Ph.D.

Appendix iii

Overview

The closure of the TB Unit at Northwest Georgia Regional Hospital (NWGRH) required public health to identify alternative housing for homeless patients discharged from acute care hospitals within the State of Georgia. These patients, some of whom are infectious, need stable housing in which to receive Directly Observed Therapy (DOT), meals and referrals for social services. Working in collaboration with Metro TB Task Force, the American Lung Association in Georgia (ALAG), Grady Health System and the Atlanta TB Prevention Coalition (ATPC), this plan addresses these public health needs for the statewide TB Program.

The Division of Public Health, TB Unit, Office of Infectious Disease, contracts with the ALAG to provide alternative housing (including meals, personal supplies, transportation [non TB clinic appointments are coordinated through sub-contracted vendors and MARTA tokens for non-infectious patients] and referrals for social services for the homeless TB patients). Through the contract with ALAG, the VP of Public Policy & Health Promotions, two Health Promotions Managers and a Patient Services Coordinator, manage this Program.

Hundreds of tuberculosis patients have utilized the Alternative Housing Program since 1996. The Program utilizes inexpensive motels, trailers, duplexes, apartments and houses. The Health Departments provide DOT and transportation to TB and Ryan White clinic appointments. July 1, 2005, American Lung Association in Georgia began to extend its services to provide housing services for non-infectious clients.

The plan to place homeless patients in area housing requires frequent communication among ALAG area hospitals, and county TB Clinics. In addition to the formal agreements between ALAG and rental establishments, letters of agreements are on file from all participating districts. These letters demonstrate a commitment to the Alternative Housing Program by each District TB Program. Monthly patient care reviews are mandatory to ensure that continuity of care is maintained and other needed services are being

ALAG/Housing Procedures 7-2015   3

provided. A designated Outreach Worker (ORW) provide DOT and patient follow-up.

Procedures for Alternative Housing Program

Purpose:
Funds are provided by the Georgia Department of Public Health, TB Unit, to the American Lung Association in Georgia (ALAG) to provide assistance for temporary housing and to facilitate Directly Observed Therapy (DOT) to ensure completion of therapy among homeless TB patients.

Organizational Roles:

ALA in Georgia	Health District	Georgia DPH – TB Control Program
Provide technical assistance in locating appropriate housing for 18 health districts and contracts with housing vendors	Identify housing possibilities and work with ALAG to secure contracts, assess tuberculosis patients for housing placement and financial assistance	Consultation
Maintain weekly communication & conduct monthly case review with Health Districts	Maintain weekly communication & participate in monthly case review with ALAG	Technical Assistance
Participate/facilitate multidisciplinary team conferences to maintain patient continuity of care after hospital discharge	Provide directly observed therapy and TB medical management	Administrative Support
Establish goals that can be used to measure progress	Provide transportation to the TB, Ryan White and Infectious Disease clinics	Disburse Funds
Preserve and ensure lines of communications	Preserve and ensure lines of communications	Preserve and ensure lines of communications

Program:
I.   The Program will enable homeless TB patients to complete TB therapy by assisting with housing, meals, non-TB clinic transportation substance abuse/mental health referrals and DOT.

ALAG/Housing Procedures 7-2015   4

Appendix iv

✝ **AMERICAN LUNG ASSOCIATION**®
IN GEORGIA
                                                                    Alternative
Housing Program / HOPWA AID ATLANTA
SOCIAL SERVICES REFERRAL

Patient's Name:_____County/District:_____
Date of Birth:_____   Race:_____   Gender: Female Male
Previous/Current Address:_____
Address Was: Street   Shelter*   Abandoned Building   Family/Friends   Home
          *Name of Shelter_____
Reason for services:_____
Lab Status: (Must have lab work to process referral)
          Smear   Culture
Case   1+   2+   3+ 4+   No Growth   MTB   Atypical
                                    Type of specimen:_____
Suspect   1+   2+   3+   4+   Pending at _____weeks

Expected TB Completion Date:____/____/____   Site of TB_____
Chest x-ray Status:
          Abnormal   Normal   Date:____/____/____
HIV STATUS   **VETERAN**   **CLIENT ID#**

          Confirmed Positive   Confirmed Negative   ☐ Yes or ☐ No   _____
Physical Health Status   Healthy   Diabetes   Hypertension   Other
_____ **Mental Health Status**
Past Psychiatric History   Yes   No
Diagnosis (where, when, name of Doctor/Therapist) _____

Income Status:
          Employment (Where)_____ $_____   Can
          Patient return to work   Yes   No
          Food Assistance $_____   General Assistant $_____   SSI Disability
$_____
          TANF $_____
          Veterans Benefits $_____
          TOTAL MONTHLY INCOME $_____
Substance Abuse:
          Alcohol   Amphetamine   Cocaine   Crack   IV Drug
          Marijuana   Denied **Services**
Requested:
          Housing   Food   Funds for Rent/Utilities   Social Services
Anticipated move-in date:_____   TB Representative:_____
Date_____
****
For ALAG Use Only
          Approved   Denied _____ Signature and
                              Date
Move in Date:_____
All sections must be completed in its entirety to be processed.
It is the American Lung Association of the Southeast's (ALASE's) policy to ensure compliance with the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule by establishing sanctions for breaches of confidentiality. All employees are required to be aware of their responsibilities under ALASE privacy policies.

Veterans Benefits
TOTAL MONTHLY INCOME

Appendix v

American Lung Association
IN GEORGIA

Alternative Housing Program
PATIENT-PROVIDER THERAPEUTIC CONTRACT

The following is a statement of what is expected of each patient who agrees to accept temporary housing paid for by the American Lung Association in Georgia. Please read guidelines carefully and if you agree to abide by the conditions listed, please sign at the bottom.

1. Lodging will be temporarily provided for you during your treatment for TB. The length of time the room will be made available to you will depend on your medical needs, your cooperation and continued participation with follow-up provided by District Public Health.

2. During your stay, you are expected to keep your room clean and undamaged. At the end of your stay, you must remove all personal items and the room must be left in good condition. Neither the American Lung Association in Georgia, District Public Health, nor the residential facility will be responsible for personal items left after termination of lease.

3. You should have **no** visitors at any time.

4. If it is determined that you need food assistance, food vouchers/certificates may be made available to you so that your family or friends may purchase food for you.

5. You must remain in your room until District Public Health informs you otherwise. 6. Your outreach worker or nurse will visit with you once a day, usually in the morning. Other unannounced visits will be made.

7. Participation in Directly Observed Therapy (DOT) is required in order to stay at the residential facility. DOT will be provided to you by a designated health care professional. Failure to participate in a scheduled DOT session, may lead to the immediate termination of your room rental. As a part of your treatment, you may be transported from time to time to the Health Department for test, or to see physicians.

8. Use of illegal drug or other illegal activities by you and/or any guest(s) in your room will result in the immediate termination of your room rental.

9. Any behavior deemed detrimental and or inappropriate (determined by ALAG, the District Public Health and/or the vendor) to your health, the health of others or the property will result in the immediate termination of your room rental.

10. If your room rental is terminated due to inappropriate behavior by you or your guest(s) or by your inability to comply with DOT, you must return the room key immediately to the outreach worker, TB nurse or designated staff and vacate the premises.

11. If you are diagnosed as **not** having TB, you will be released from the Program within 48 hours.

12. ALAG will seek, when possible, to involve and educate family and friends in your aftercare so that they will have a better understanding of how to assist you while you are in the motel and later when you are able to find alternate housing.

Signature: _____ Date: _____

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ALAG/Housing Procedures 7-2015   19

ALAG/Housing Procedures 7-2015   20

Appendix vi

Table 3: Bivariate Demographic Analysis of Each Demographic Exposure to the Outcome (TB Completion Rates)

	FAD	NATIONAL
ORIGIN OF BIRTH (U.S BORN)		
Odds ratio (95% CI)	0.897 (0.851,0.946)	0.937 (0.686,1.280)
SUBSTANCE USE (YES)		
Odds ratio (95% CI)	0.350 (0.121,1.007)	1.103 (0.887,1.172)
gender (male)		
p-value	0.078	0.841
Odds ratio (95% CI)	0.335(0.095,1.186)	1.039(0.715,1.510)
DISEASE SITE		
P-value	<.001	<.001