TUBERCULOSIS TREATMENT NON-ADHERENCE AND ITS ASSOCIATED FACTORS AMONG SCHOOL-GOING CHILDREN WITH TB IN MERU COUNTY, KENYA

BY

RHODA POLA KARISA

THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT OF THE AWARD OF DEGREE OF MASTERS OF SCIENCE IN FIELD EPIDEMIOLOGY SCHOOL OF PUBLIC HEALTH MOI UNIVERSITY

DECLARATION

This proposal is my original work and has not been presented to any otheruniversity/institution.

Signature ---------- Date……..

RHODA POLA KARISA

SPH/PGH/FE/09/2018

DECLARATION BY SUPERVISORS:

This proposal has been submitted to Moi University with our approval as universitysupervisors.

1. Professor Lameck Diero (PhD)

   Department of Medicine of Moi University

   Signature ---------- Date……..

2. Dr. Ahmed Abade (PhD)

   Department of Epidemiology and Medical Statistics (FELTP)

   Signature ---------- Date……..

DEDICATION

This thesis work is dedicated to my husband, Aloise Mwenda, and my darling kids Jayden and Harvey, who have been a continuous source of support and encouragement during the school course time of attempting to balance between school, job, and family life. This thesis work is also dedicated to my siblings and parents Mr. and Mrs. James Karisa, whose constant support and encouragement have been invaluable to me.

ABSTRACT

Background: Tuberculosis (TB) is still a significant threat to the health of the community in low- and middle-income countries. It was projected that 10 million individuals will get sick with tuberculosis in 2020 globally, with 1.1 million of these cases occurring in children. Children who are old enough to attend school are nonetheless at risk for tuberculosis because of risk factors such as contact with adult TB patients, overcrowding, and malnutrition. The severity of TB is also significantly increased in children. Adherence to treatment means taking medication as prescribed-right dose, right time, right way and frequency. It is vital to adhere to treatment in order to reduce further transmission of TB in the community, the development of medication resistance or even death. Meru county was placed second out of the 47 counties in terms of the TB burden in the year 2020. In addition, the county had the highest rise (181%) of drug-resistant TB cases in Kenya.

Objectives: To determine the prevalence of non-adherence to tuberculosis treatment and identifying the associated health system, clinical related, school related and socio-demographic characteristics among school-aged children with TB in Meru County, Kenya.

Methodology: Hospital-based cross-sectional research was carried out on children on TB treatment, aged 6 to 19 years old who were attending school in Meru County. The interviews were carried out at the facility level on treatment collection days in the facilities offering TB treatment. Participants were selected from the TB registers using a systematic selection method and the total number of patients in the sample was 207. A person was considered to be non-adherent if they failed to do any of the following: maintain all of their clinic visits, swallow their medications on a regular basis, or take the appropriate quantity of pills. A questionnaire was developed and it included socio-demographic, clinical, school-related, and health system characteristics was administered to the children and their care givers. The proportions were used to describe the categorical data, while mean and standard deviation were used to summarize the continuous variables. We estimated both the raw and adjusted odds ratios, as well as the 95% confidence interval. At both the bivariate and the multivariate levels, factors were deemed significant if they had p-values of less than 0.05.

Results: A total of 207 school—going children with TB were interviewed. The mean age was 14.5 years (S.D.=±4), females were 105 (50.7%) and 96 (46.4%) were found to be non-adherent. The adjusted odds of TB treatment non-adherence were 3.02 times higher (p-value=0.006) among those whose waiting time was more than 30 minutes and 15.04 times higher (p-value= 0.0001) among those who did not receive health education on TB. Other factors associated with non-adherence included being in secondary school, aOR=3.01 (p-value=0.0009) and not having someone reminding the patient to take treatment aOR=6.95 (p-value=0.0001).

Conclusion: The percentage of school-aged children in Meru County who did not take their anti-tuberculosis medication as prescribed was rather high. Long waiting times, not having received any kind of health education and not having a treatment supporter were key factors that contributed to non-adherence.

Recommendations: The distribution of TB health education messages to school-aged children who have TB, the assignment of a treatment supporter to secondary school students and the prioritization of school-aged children on TB clinic days in order to decrease waiting time are all things that this study recommends in order to improve adherence.

Table of Content

LIST OF ABBREVIATIONS

AIDs- Acquired Immune Deficiency Syndrome

COVID-19- Coronavirus Disease of 2019

DOT - Directly Observed Treatment

DR TB - Drug Resistant Tuberculosis

EPTB - Extra Pulmonary Tuberculosis

HIV- Human Immunodeficiency Virus

LTBI – Latent TB Infection

KNH- Kenyatta National Hospital

MDR- TB Multi resistant Tuberculosis

MTB- Mycobacterium Tuberculosis

TB - Tuberculosis

TIBU - TB Information Based Unit

WHO - World Health Organisation

LIST OF TABLES

List of Figures

ACKNOWLEDGEMENT

My thanks go out to Professor Lameck Dierro and Dr. Ahmed Abade, my thesis supervisors, whose insights and critiques were crucial to the development of this work. Thanks to your insightful feedback, I was able to refine my ideas, resulting in better work.

I'd also want to thank the Meru County Government and the Department of Health for letting me to access their data and get in touch with people who were being treated for tuberculosis.

In addition, I'd like to thank the staff at the Monitoring and Evaluation section at the National Tuberculosis (TB) and Leprosy Program for allowing me to access the TB data and the entire TB Program fraternity for providing a conducive environment for me to write this thesis report.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Back ground

Tuberculosis (TB), an infectious disease caused by the bacterium Mycobacterium tuberculosis, is a leading cause of death and a major contributor to poor health in many parts of the world. Before the COVID-19 pandemic, TB had been the leading infectious agent in terms of fatality rates, even surpassing HIV/AIDS. Extra pulmonary tuberculosis occurs when the TB bacterium spreads outside of the lungs and affects other parts of the body, such as the spine, the bone.

More than fifty percent of all instances of tuberculosis affect the lungs and is often referred to as pulmonary TB, while the remaining portion can occur in any other body organs besides the lungs. Tuberculosis may affect every organ in the body, with the exception of the nails, hair, and teeth. Coughing, fever, loss of weight, and night sweats are the four primary signs and symptoms that are most often associated with this kind of tuberculosis. Investigations that take place in a laboratory or on a radiograph may lead to a TB diagnosis being made.

When an infected individual exhales the TB bacillus into the air by behaviors such as coughing, sneezing, or even merely speaking with others, the bacteria that cause the sickness may move from one person to another and cause the illness. The minuscule droplets have the ability to float in the air for lengthy periods of time, at least thirty minutes. Tuberculosis is characterized by the growth of tubercles in the lungs and other tissues of the body, resulting in the presentation of symptoms including coughing, fever, night sweats, and a loss of body weight.

Although Mycobacterium tuberculosis (MTB) is the most frequent, human infection with M. bovis has dramatically reduced in industrialized nations as a direct consequence of the process of pasteurization. The chance of the germs being passed from one person to another might be influenced by a few different circumstances. Based on a study by Workie et al., 2021, the number of organisms discharged into the air, the number of organisms already existing in the air and the duration of an exposed person's breathing in this air are all factors to consider.

It was anticipated that there will be 10.0 million people throughout the world who will get infected with TB in 2020, with 12% of these affected being children. Out of these estimates, there were 1.3 million deaths estimated to occur among HIV-negative people, which is an increase from the 2019 total of 1.2 million. In the same year there were 157,903 cases of drug resistance TB that were diagnosed globally (Global Tuberculosis Report 2021, n.d.). Kenya notified 72,943 people who were diagnosed with tuberculosis, which was a 15% decrease compared to 2019, and of these, 7,491 (10.3%) were children. When compared to the number of children who were diagnosed with tuberculosis in 2019, this represented a decrease of 32 percent (Annual Report 2021 – National Tuberculosis, Leprosy and Lung Disease Program, n.d.).

Young children, especially those under the age of five, are more vulnerable to contracting tuberculosis (TB) from a family member or if the kid is exposed to the illness in an environment that is similar to the home. However, in a school setting, a student, teacher, or other person in the school who is infected with tuberculosis can unwittingly spread the disease. Most of the children below 2 years old are thought to get infected by a member of the household and on the other hand those who are above 2 years old most of them became infected in the community.(Narasimhan et al., 2013).

The risk of developing disseminated forms of TB like TB meningitis is higher in very young children than in older ones, according to research on the prevalence of TB in children's blood streams (Tuberculosis (TB) in Children - Health Encyclopedia - University of Rochester Medical Center, n.d.).

Social and behavioral risk factors, including smoking, drinking alcohol and indoor air pollution, have a significant role in determining the likelihood of infection after exposure to TB. External factors, or exogenous variables, may also have a role in the disease's severity. Transmission will be high in settings that are both congested and have inadequate ventilation; schools are one among the places that fall into this category. Most signs and symptoms appear within a year after the first exposure. There is an elevated risk of tuberculosis illness in children who get exposed to TB before the age of 5 years (Schaaf & Zumla, 2009).

In nations where there is a medium or high incidence of tuberculosis (TB), childhood and adolescent tuberculosis (TB) continues to be an increasing worrying issue (Pan et al., 2018). TB in children is a marker indicating recent transmission of tuberculosis, particularly those who are enrolled in school, it is a public health concern of particular relevance. School going children can be ashamed that they need to get treatment for tuberculosis and worried about what their acquaintances will think, particularly considering the fact that tuberculosis is frequently connected with HIV. Therefore, in addition to having access to the medications, school-going children may face stigma from their peers, which can cause them to not take their TB treatment seriously. This therefore calls for an urgent need to address the unique needs of adolescents.

The TB bacillus may be transmitted by the airborne route from an infected person to a person who is not afflicted. Because of this, it is possible for TB to spread rapidly in environments where a large number of people gather together, such as in schools, where

youngsters spend the majority of the daytime hours in class and the nighttime hours in boarding schools. All children with confirmed cases of TB must be identified and started on treatment as soon as possible to prevent the illness from spreading in schools. If we want these children to get the most out of their therapy, we need to keep an eye on them to make sure they finish the whole course of treatment.

New patients with tuberculosis must take a series of treatments for at least six months, and those with spinal tuberculosis, bone tuberculosis, or TB meningitis must take the drugs for a whole year. It is more common for newly diagnosed cases of TB to be more advanced. The treatment comprises of a shorter intensive phase that lasts for two months and includes a total of four drugs in a set dose combination. After this, patients take a combination of only two medications for a continuation phase that may last anywhere from four to 10 months. Because of the protracted nature of the therapy, the patient may lose interest or fail to follow their recommended course of action (Connolly et al. 2007). This behavior may result in prolonged infectiousness, drug resistance, recurrence, and even mortality. The fact that patients have a hard time sticking to their treatment plans has brought attention to the fact that adherence is a complicated behavioral problem. In order to enhance the results of therapy, it is necessary to have a better knowledge of the specific factors that either inhibit or encourage a patient's adherence (Adisa et al., 2021).

Adherence to treatment refers to the practice of taking all prescribed drugs for the full duration of treatment as directed by a physician. It also involves taking the medications that have been issued in the correct quantity and at the appropriate time each day during the whole of the course of therapy. Patients in Kenya who are undergoing treatment for tuberculosis are required to visit a health facility at least once per week while they are undergoing the intense phase of their therapy and once every two weeks while they are

in the continuation phase of their treatment. During this visit, the health care worker reviews the clinical progress of the patient, assess whether they took their medication from the last visit to the day of review, checks the patient's weight and adjust the dosage accordingly, issuance of medication to last the patient up to the next review date etc

An integral part of the patient-centered approach is the use of adherence evaluation and improvement of tools, as well as strategies for dealing with therapeutic non-compliance when it occurs. Each patient's situation calls for a unique approach and the patient and doctor must be in agreement on the appropriateness of any necessary interventions.

The health sector has the responsibility of ensuring that students who have been diagnosed with tuberculosis remain compliant with their treatment. The failure of a provider to maintain adherence to therapy is analogous to, for instance, failing to guarantee that a child receives the whole treatment; this may result in new transmissions, a worsening of the patient's health, the development of drug-resistant TB, and even death in extreme cases.

The degree to which a patient continues with their prescribed therapy is the single most important determinant of whether or not they will have favorable outcomes. To a considerable extent, the effectiveness of therapy for TB rests on the patient's adherence to the medication regimen that has been given, supposing that an adequate drug regimen has been provided. It is not a simple undertaking to achieve adherence, and this holds true for both the patient and the clinician.

Anti-tuberculosis medication regimens often include the administration of many treatments over the course of at least half a year to one year. As a consequence of this, it should not come as a surprise that, in the absence of adequate treatment support, a sizeable minority of TB patients either give up on their treatment before it has run its full course or are inconsistent in the manner in which they take their medications.

Treatment that lasts for such a long duration may be inconvenient for school-going children. However, if treatment for TB isn't finished, it may lead to longer periods of infectivity, less favorable results, and increased drug resistance. This will be a great health risk rendering the schools un safe for the children and also for the teachers and other staff in schools

The lack of adherence to tuberculosis treatment is a significant barrier to good results and as a result, a serious problem for tuberculosis management not just in Kenya but also worldwide. According to Wanyonyi et al. (2017), one of the most prominent causes of treatment failure, relapse, acquired drug resistance, and ongoing transmission of infection is an inability to finish the 6-month regimen that was provided to the patient. The World Health Organization has placed a strong emphasis on the need of providing patients with tuberculosis with direct observation therapy (DOT) in order to guarantee that patients continue to take their medication as prescribed. This ensures that each dosage of therapy is administered under the watchful eye of a medical professional or a responsible member of the patient's family. It has been observed that treatment success rates are greater in poor nations as well as industrialized countries since the implementation of DOT, which has led to excellent outcomes (Toczek et al., 2013).

The possibility for early intervention in the course of therapy will present itself if the many reasons that are likely to cause a patient not adhere to treatment are identified. Promoting adherence using a patient-centred approach is considerably more efficient use of resources than wasting time tracking down the persons who do not adhere to treatment. This involves ensuring patients have access to care, scheduling appointments at mutually convenient times, and offering a range of additional social and medical support. It is important to strike a balance between the patient's desire for convenience and the need for frequent medicine consumption and monitoring.

It is important that the delivery of pharmacological treatment be conceived of as a patient-centered process for each and every patient. This method has to be based not only on the requirements of the patient, but also on the physician and patient's mutual regard for one another. The objective of this method is to encourage and continue to maintain adherence to the protocol. Support for treatment should be age-appropriate, take into consideration any and all circumstances that can affect students' adherence, and make use of all available treatments and services (such as patient counseling and education). Additionally, the treatment assistance should be modified for the age group in question.

The level of adherence shown by patients is an essential component of successful treatment. At least ninety percent of patients who begin treatment under the auspices of the National TB, Leprosy, and lung disease program are expected to benefit from the therapeutic intervention provided by the program. This is something that can only be accomplished by guaranteeing a high level of treatment compliance. When there is an effective communication plan in place for patients who are starting new medications, this is something that can be done. Patients with tuberculosis may be cured of the disease if they use the prescribed medication for therapy in its whole and without interruption. However, there is a widespread issue with patients not taking their TB treatment as prescribed. Patients, their families and communities, as well as the medical professionals who are responsible for their care, all face challenges when treatment must be temporarily discontinued.

There is a paucity of data for research that have been conducted on variables related with treatment interruption in tuberculosis among school-aged children in Kenya who are currently receiving treatment for the disease. In 2020, the national treatment success rate was 85.2%, despite a 5.4% lost-to-follow-up rate. The rate of lost to follow up for

patients on TB treatment in Meru County was very high at 9.5%. The county also saw the highest increase in the number of people diagnosed with drug-resistant tuberculosis, which may have been caused by people not finishing their TB medication (DNTLDP Annual Report_2021_compressed. Pdf, n.d.).

Operational definition of adherence

According to the World Health Organization, "adherence" refers to "the degree to which the patient follows medical recommendations." This was assessed in two levels, the first level was being able to collect drugs from the health facility and second was whether or not the medications were taken in accordance with the doctor's instructions regarding dosage, timing, and frequency of taking the drugs as prescribed. To assess for drugs collection from the facility we reviewed the documentation of the scheduled clinic days on the TB treatment register versus the actual date of collection documented on the patients record card/ file. This was assessed from the time treatment was initiated up to the date the interview was conducted. Adherence was assigned to those who kept all their scheduled clinic days while non adherence was assigned to those who had variations between the scheduled dates of drugs collection and the actual date the drugs were collected.

To assess for taking drugs as prescribed in terms of number of tablets and on daily basis, this was done through self-reporting and was counterchecked with the weight-based dosing schedule. Taking the prescribed number of tablets daily was termed as being adherent while taking less or more tablet was termed non-adherent. Finally, those who did not skip their medication from the time treatment was initiated to the date of the interview were termed to be adherent while those who skipped their medication even for a single day were termed to be non- adherent.

The overall definition of being non-adherent was one who failed to do any of the following; keeping all clinic appointments or swallowing medicines on a daily basis or

taking the correct number of tablets. While anyone who was able to do all the above was assigned the final outcome of "being adherent"

This study was carried out to determine the percentage of school-aged children in Meru County who have tuberculosis and do not adhere to their prescribed medicine, as well as the characteristics that are linked with non-adherence in this particular demographic of patients. The results of this study will be utilized by the county and the country as a whole to put into place strategies that may increase adherence among school-aged children who are currently undergoing treatment for tuberculosis, leading to improved treatment outcomes and a reduction in the number of patients presenting with drug-resistant tuberculosis.

1.2 Problem statement

The level of adherence shown by patients is an essential component of successful therapy. Non adherence to TB treatment is likely to lead to development of TB drug resistance, further transmission of TB in the community and even death as result of the disease. This therefore means that adhering to treatment will result in the patient being cured or successfully complete their treatment. The patient's level of adherence to their prescribed medication is one of the most important factors determining whether or not they will have positive results from their treatment.

The school going children have a busy schedule in school that might lead to the children who have TB to forget to take their medication or even fail to come to the clinic to collect their medication. Most school schedules run from 8 a.m. to 5 p.m., which are the same operating hours for most hospitals offering TB treatment; in addition, most facilities close at 5 p.m. and do not operate on weekends. This makes it particularly difficult for school-aged children to adhere to their medication schedules. Furthermore, TB treatment is not offered in Kenyan schools' clinics, so a student with TB will have

to miss school once a week during the intensive phase and every two weeks in the continuation phase to pick up their medication.

In Kenya, the level of treatment adherence among school-going children is not known; as a result, there are no set strategies to ensure that school-going children with TB are well taken care of to ensure that, once they are diagnosed with TB, they can get treatment that is favorable to their school schedule. Meru county recorded a 170% increase in drug resistant TB in 2020 (TB annual report 2021) and also was ranked the 2nd county in terms of TB burden countrywide. This therefore poses a risk for the entire community and also for those in schools where risk factors such as overcrowding, poor ventilation and malnutrition in schools are expected. The results of this study will be useful to the National Tuberculosis Program in the process of formulating policies that are focused mainly on the student population as a separate component of the overall population.

1.3 Justification

The National TB program targets to successfully treat 90% of all TB patients. For this to be achieved then the TB patient including those in schools must adhere to treatment as it is recommended by the health care worker. This entails coming to the health facility to collect their medication on the appointment days to ensure that they do not miss to take their treatment any single day. In addition, the TB patients should be able to take the right number of tablets according to the weight as per the prescription and finally, they should take medicines every day until the entire treatment course is completed i.e., 6 months or one year depending on the form of TB.

School going children are considered a key population because majority are in teenage and adolescent age groups. School going children can be ashamed that they need to get treatment for tuberculosis and worried about what their acquaintances will think, particularly considering the fact that tuberculosis is frequently connected with HIV.

Therefore, in addition to having access to the medications, school-going children may face stigma from their peers, which can cause them to not take their TB treatment seriously. This therefore calls for an urgent need to address the unique needs of adolescents.

It is important to understand the factors contributing to non-adherence among the school going children as these findings will help inform the TB program develop policy specifically targeting TB in schools.

Kenya has not done any studies to investigate levels of adherence to treatment and the related determinants among school-going children, despite the enormous advantages associated with patient adherence to TB therapy. As a result, the purpose of this study is to determine the degree of non-adherence within this particular group and to provide concrete solutions to fill any gaps that will inevitably be identified as barriers to adherence.

1.4 Research question

What is the level of TB treatment non-adherence and its associated factors among school going children with TB in Meru County 2019/2020?

1.5 Objectives

1.5.1 Broad objective

To assess the proportion of treatment non adherence and determine the factors associated with TB treatment non-adherence among school going children with in Meru County, Kenya.

1.5.2 Specific objectives

a) To determine the proportion of TB treatment non adherence among school going children with TB in Meru County.
b) To describe health system related factors associated with TB treatment non adherence among school going children with TB in Meru County.
c) To determine the clinical related factors associated with TB treatment non adherence

among school going children with TB in Meru County

d) To determine the school related factors associated with TB treatment non adherence among school going children with TB in Meru County

e) To determine the social-demographic factors associated with TB treatment non adherence among school going children with TB in Meru County

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter examines the manner of infection and transmission of tuberculosis, as well as the diagnosis of tuberculosis and multi-drug resistance TB, the reasons of non-adherence, social-demographic variables linked with TB treatment and elements related to the health system that are connected with TB treatment. In addition, a summary of the literature study is presented, and the gaps in existing research are outlined.

2.2 Mode of Infection and Transmission of Tuberculosis

When a person with pulmonary or respiratory tract tuberculosis makes an expiratory effort like coughing, singing, sneezing, or speaking, tiny airborne droplets called droplet nuclei are produced and inhaled into the pulmonary alveoli by a susceptible contact (David, 2004; Harries et al., 2004). In this way, M. tuberculosis is often dispersed. In the days before pasteurization, TB was also often spread by the ingestion of milk and other dairy products from animals that had been infected with Mycobacterium bovis. According to Rieder (1999) and Crofton (2009), this factor was responsible for a significant proportion of cases of M. bovis TB affecting children's gastrointestinal tracts. It is possible for Mycobacterium tuberculosis to invade directly via mucus membranes or cracks in the skin, however this only happens very seldom (David, 2004). In the case of pulmonary transmission, activities that result in the generation of aerosols, such as bronchoscopy, intubation, autopsy, or the manipulation of specimens in the laboratory (David, 2004), have the potential to put health care workers at risk, just as do expiratory efforts.

Once the liquid droplets carrying M. tuberculosis are released into the air, they quickly evaporate until they reach a critical size, at which point they continue to stay suspended in the air for a lengthy period of time and distributed throughout the air volume (Riley

and Nardell, 1989). Three thousand droplet nuclei are produced by a single cough. In order for transmission to take place, the nuclei of the droplets must be tiny enough to enter the alveoli that are located on the lung's perimeter. Tuberculosis can only be spread when infected people release the droplets into the air especially in a poorly ventilated space. According to Liipo et al. (1993) and Akhtar et al. (2000), there is a strong correlation between the degree of infectivity and severity of illness in the infectious source and the concentration of bacilli in the sputum as well as the amount of smear positive. Cases that test positive for TB on a heavy smear are more likely to spread the disease. According to Toman et al.'s research from 1979, a positive sputum smear has to include around 5000 bacilli per milliliter of sputum.

Therefore, the risk of transmission from a person with sputum smear-positive pulmonary TB is higher than that of a person with sputum smear-negative pulmonary TB but a positive sputum culture (Herna'ndez-Gardun o et al., 2004; Harries, 2004). In point of fact, while accounting for around half of all TB cases, those with a positive sputum smear are responsible for the vast majority (95%) of all TB transmissions (Rieder, 2002). According to Veen et al.'s research from 1992, the likelihood of tuberculosis transmission diminishes as the distance between the sputum smear positive TB patient and the contact increases.

In order for an infection to get established in the peripheral alveoli, the host immune response must be adequate. Either the bacilli are eradicated entirely or they acquire a latent tuberculosis infection (LTBI). According to David (2004), there does not seem to be any connection between the risk of infection and genetic variables. In vulnerable people, the chance of contracting tuberculosis (TB) is significantly increased when HIV is present. Other variables that increase the risk of infection include a young age, gender, prior exposure to M. tuberculosis, malnutrition, underweight, a disabling illness

such as chronic renal failure, cancer, silicosis, diabetes or gastectomy, and drug misuse (Crofton, 2009). Young age is another factor that influences the risk of infection. Only 10% of those who have not been infected with HIV will ever develop active TB illness if they are exposed to the virus.

The illness will manifest in around one half of these individuals during the first 12 to 24 months after infection, whereas the other individuals will do so throughout the course of their lifetimes. According to Crofton's study (2009), factors such as poor socioeconomic status, young age (below three years), advanced age, malnutrition, and concomitant illnesses all raise the chance of an infection developing into an active disease. According to David (2004), a person's annual chance of contracting TB goes up from 5% to 15% if they have HIV and are not taking antiretroviral medicine or have a low CD4 cell count. People living with HIV and have a high CD4 count are less likely to have clinical disease than their counterparts with a low CD4 count. Antiretroviral medication lowers the chance of dying from an existing infection, in addition to lowering the likelihood of the infection developing into an active illness. The severity of an illness, where it is located, how quickly it is treated, and how suitable the treatment is all have a role in determining the likelihood of mortality from that condition. If individuals with meningeal TB are not treated, it is certain that they will pass away (Crofton, 2009).

2.3 Diagnosis of Tuberculosis and Multi-Drug Resistant

Tuberculosis (TB) is diagnosed using a combination of patient history, a physical exam, a bacteriologic analysis, imaging studies, a tuberculin skin test (TST), and nucleic acid amplification tests. If you suspect someone has tuberculosis, one of the first things you should do is get their medical history. All potential risk factors for tuberculosis infection should be noted, as well as the onset and duration of symptoms including coughing,

weight loss, night sweats, lack of appetite, and chest pain. The definitive diagnosis of tuberculosis requires acid-fast bacilli to be shown in sputum smear preparations in a laboratory.

A tuberculin skin test may be given to the younger children who come with symptoms of tuberculosis but they are un able to produce sputum. The purpose of this test is to determine whether individuals have been exposed to the tuberculosis bacteria. The TB of skeletal tissues which also occurs commonly in children and persons with low immunity may also be diagnosed with the use of X-rays (David, 2004). According to Crofton (2009), the most essential signs of TB in terms of clinical diagnosis include a cough, a cough that is accompanied by sputum, weight loss, fever, and sweating. Coughing that has lasted for three weeks or more was shown to be the most sensitive symptom for identifying TB patients in a study that was carried out in Sudan by El-Sony et al. (2003) among patients who attended services for the diagnosis of PTB. Chest wall discomfort, shortness of breath, localized wheezing, frequent colds, weariness, and lack of appetite are some of the other general symptoms that should be looked for in the history. Those who show themselves to medical institutions later may have a greater number of symptoms than those who do so earlier. However, symptoms always present themselves gradually over the course of many weeks or months (Crofton, 2009). The patient's TB treatment history should be investigated thoroughly, including the duration of therapy, the outcome of treatment, the medication's source, and the types of medicines utilized. The patient might also be asked to turn over unopened medicine packages if it helps establish whether or not they were on monotherapy. A detailed medical history may assist detect suspected cases of drug-resistant tuberculosis in individuals who have failed previous TB treatment, have poor compliance, have recurrent TB, or have close contacts of MDR-TB cases. While a physical examination's

findings, such as vertebral collapse anomalies, might be useful, they are not necessarily conclusive in reaching a diagnosis (Crofton, 2009).

The diagnosis of tuberculosis using a chest X-ray has a high sensitivity in HIV-negative individuals; however, as HIV illness progresses, the sensitivity of the test decreases in HIV-positive patients due to a drop in the number of radiological abnormalities (Wood, 2007). According to Hatipoglu et al.'s 1996 research, high resolution computed tomography (CT) scanning has the ability to identify tuberculosis even with minor exudation and early bronchogenic dissemination. Detecting persons with a lower number of bacilli per milliliter of sputum is possible with clinical and x-ray diagnosis of TB, as reported by Akhtar et al. (2000). Unfortunately, tuberculosis symptoms are not diagnostically distinct from other chronic pulmonary disorders, especially in children (Schaaf et al., 1994; Lockman et al., 2003). This is particularly true for younger children like those in lower levels of education. Therefore, further tests, such as a sputum smear screening for acid-fast bacilli, should be performed on any patient who has had a cough for three weeks or longer. Multiple methods may be used to increase the diagnostic sensitivity for TB. The standard TB diagnostic approach in Nairobi, which includes taking a patient history, doing a chest X-ray, and submitting three sputum specimens for microscopy, was able to correctly identify 92% of culture-positive tuberculosis patients, as reported by van Cleeff et al. (2003). When diagnosing pulmonary TB in adults, a gene xpert test is the gold standard. It has a high degree of specificity in countries with a high TB incidence, can be completed in a short length of time, and also identifies the whether one has resistance to rifampicin or not (David, 2004; Wood, 2007). In the absence of a gene xpert test, sputum microscopy is readily available in the country and when done properly in settings with good microscopy, it can identify 83% of TB patients (Akhtar et al., 2000).

2.4 Causes of Non-adherence

Several studies have shown that patients' lack of adherence to their TB treatment is due mostly to two factors: behavioral factors, such as forgetting to take their medicine, and cognitive factors, such as being worried about the possibility for negative outcomes (Theron et al., 2015). Non-adherence was attributed to forgetfulness (30%), a lack of understanding about the diseases and treatment (9%), cognitive difficulties (34%), and 275 instances (42% of total) where no explanation was given by the participant. Research on the topic of medication adherence indicated that the inaccessibility and high cost of medicine contributed to a lack of patient and caregiver trust and support, in cases when the patient's primary language is not the same as the provider's, were reasons for non-adherence. Numerous studies have identified five major categories of characteristics that influence a patient's propensity to adhere to their treatment plan: economic, societal, medical staff/healthcare system, illness, therapy, and individual patient factors (Wares, Singh, Acharya, & Dangi, 2003).

One of the variables leading to the TB treatment gap is stigma, according to the results of a research on tuberculosis stigma in Zambia. Because of stigma, many TB patients avoid engaging in social activities and are reluctant to disclose details about their health to others, both of which delay their access to medical care and worsen their prognosis. In this particular instance, the patient's beliefs about the ailment, as well as society's beliefs, impacted their level of treatment compliance. According to the findings of this research (Kulkarni et al. 2013), a significant number of persons who have tuberculosis seek therapy from traditional healers prior to being examined at the hospital clinic.

In a separate piece of research conducted in Zambia, researchers compared persons with TB to normal people on a variety of characteristics, including employment and education, and found that epileptics had a far more difficult time finding work and getting an education. Epileptic youngsters missed a lot of school, and some of the

medications they were given actually lowered their IQs (Boru, Shimels, & Bilal, 2017). As a consequence of having to take their sick children to the hospital and care for them during atacks, parents and guardians lost valuable work time. Because of this, they risked losing their job. Children with epilepsy also missed more school than usual.

Only 189 (38%) of 502 tuberculosis patients who reported taking anti-TB medications actually had the TB drugs components identified in their blood samples, suggesting low adherence to medication, according to research conducted in Kilifi, Kenya, on risk factors associated with the tuberculosis treatment gap. The causes of the TB treatment gap were investigated in this study and majority of study participants were found that they were not getting treatment. Some people with TB don't take their medication as recommended because they don't live close enough to a health care facility; others don't take their medication because they believe traditional remedies may cure their condition instead of mainstream pharmaceuticals (Zegeye et al., 2019). One of the reasons for the disease treatment gap is the difficulty to reach a health care institution owing to the number of visits a patient is required to make to collect their medication.

Patients with tuberculosis who visited the Kenyatta National Hospital clinic had an average quality of life of 49.9%, whereas that of their normal control was 77.6%, according to study on the subject done at KNH. This demonstrated that persons with tuberculosis had poor self-esteem, which may prevent them from seeking appropriate therapy or from seeking alternative treatments out of fear of the opinions of other people. The research uncovered a lack of access to appropriate medical care and made recommendations for how to strengthen patients' empowerment in management across the whole treatment process, from diagnosis through management, as well as how to better meet patients' social requirements.

2.5 Social-demographic factors associated with TB Treatment

According to a study carried out by Seid and Metaferia (2018), advancing age was shown to be connected with patient delay in seeking care. This is most likely due to the fact that older persons are more inclined to engage in self-medication and go to private clinics. According to the findings of Negin et al.'s (2015) research, the percentage of patients whose treatments are successful drops as they become older.

2.5.1 Malnutrition

A failure to adhere to the prescribed TB treatment regimen is exacerbated by a lack of an appropriate diet. For instance, Ssewaya (2011) discovered that some patients, particularly those living in rural areas, had trouble swallowing their tuberculosis medications due to issues associated with a lack of food. According to Uldall (2004), malnutrition among tuberculosis patients is a problem that has to be addressed in African public health. In a similar vein, a demographic and health study conducted across eleven nations in Sub-Saharan Africa found that 10.3% of female patients were malnourished. Koethe et al. (2010) found that in Lusaka, Zambia, 9 percent of adult TB patients who had just started treatment were also severely malnourished. Patients who began antiretroviral therapy (ART) with a very low body mass index (BMI) had a significantly increased chance of dying within the first three months of treatment, while those with a normal BMI had the greatest improvement in their health. Patients being treated for tuberculosis (TB) who failed to gain weight in the first six months of therapy had approximately a 10-fold increased risk of dying. Finally, the majority of Kenyans in 2010 were found to be food insecure, with their salaries falling short of meeting their daily food needs (Kenya National Bureau of Statistics, 2012). Similarly, the Agency for International Development (2006) found that in Tanzania, over one-fifth (18%) of TB medication-using families did not have the financial resources to purchase a balanced meal to supplement their treatment. According to IRIN (2010), malnourished

persons are unable to reap the benefits of antiretroviral therapy since taking medication while one is hungry might cause a great deal of discomfort.

2.5.2 Stigmatization

In the context of a given social interaction, Veal (2006) argues that the word "stigma" refers to a socially stereotyped category construction in which some people are labeled as carriers of discredited traits. Disparities in labeling, association with undesirable traits, alienation from others and a lower social standing are the four elements that combine to form stigma. He thinks that a person must have something about them that is despised before they may be stigmatized. The ultimate cause of the stigma is the socially constructed and dismissed deviant nature of the dominant culture. Another difference made by Veal, (2006) is between a libelous person whose attribute is known and one whose attribute is unknown. He says that the former is the more common scenario. A person is said to have a stigma when they are seen as having undesirable characteristics that relate them to unfavorable stereotypes. In psychology, a stereotype is a preconceived view or belief about a person that is associated with a particular trait and is not founded on reason or real experience. Stereotypes are often used in social psychology. A common example of a stereotypical assumption is the notion that all patients are either sexually promiscuous or addicted to drugs. Another illustration of this would be the viewpoint that patients must be awful individuals who have brought their disease upon themselves by acting immorally. Any trait that brings shame to a person, whether it be their skin color, their handicap, or their gender, might be considered a stigmatized feature.

2.5.3 Cost of treatment

The means, such as financial resources and health insurance, that are necessary to get therapy are examples of enabling variables that have a role in treatment access and

retention. According to the findings of a research that was carried out by Ogunbodede (2004), the provision of medical insurance to undocumented children in Santa Clara County, California, in the United States was connected with substantial improvements in the children's health condition. Weiser et al. (2003) found that one of the primary obstacles to antiretroviral adherence in Botswana was financial restrictions. This was discovered in another research that evaluated barriers to antiretroviral adherence in Botswana. According to the findings of logistic regression, if the expense of treatment were no longer an issue, it was anticipated that patient adherence would rise from 54% to 74% (ibid). According to the findings of a research that Byakika-Tusiime and her colleagues (2005) carried out in Kampala, Uganda, a significant obstacle to adhering to TB medication is an individual's inability to obtain and maintain a steady supply of medication. 32% of the overall respondents reported forgetting to take at least 5% of their meds in the three days leading up to the survey, and 40% of the respondents missed at least one dosage of the TB treatments in the three months leading up to the study.

2.5.4 Cost of transport to health facilities

Patients in Sub-Saharan Africa who are attempting to adhere to their TB drug regimen may be deterred by the cost of doing so, according to study by Tuller et al. (2010). Andersen (1995) notes that factors such as cost, distance from home, and length of wait time at the clinic all have a part in whether or not patients keep their scheduled doctor's appointments and renew their prescriptions. One's own or one's family's direct expenses are the money spent on medical care. These expenses might be for anything from medical care to transportation. When discussing the financial burden of tuberculosis, "indirect costs" refer to the time and money lost by both the patient and their caregivers due to the illness. Research by Rosen et al. (2007) in South Africa found that even when the price of medications was removed to make them accessible to the majority of TB

patients, the expense of transportation to health facilities remained a substantial barrier to adherence to treatments. Despite the widespread availability of TB treatment, this remained a problem. There is some data suggesting that the cost of transportation has a negative effect on adherence, especially for low-income TB patients. It has been shown that a rise in the cost of transportation to medical facilities not only reduces the use of health services, but also has a substantial role in deciding where persons go for treatment first. Charurat et al.'s (2010:3) study in Nigeria indicated that 22.9% of respondents recruited for TB medications were lost to follow-ups at 6 months, and 25.3% were lost to follow-ups at 12 months. The study was carried out in Nigeria. Patients with tuberculosis said that their inability to afford the fees of transportation to the health clinic was the primary reason that related to their failure to attend follow-up appointments. This shows that increasing the number of treatment access sites of care that are located inside communities in order to reduce the amount of time spent traveling may have a favorable influence on adherence.

2.5.5 Social support from health care-providers

It is important not to understate the impact that the clinic environment has on patients' ability to stick to their treatment plans. A number of aspects of the clinic, such as significant delays between visits, opening and closing hours, lengthy wait times, a lack of facilities like child care, privacy, and secrecy, and staff members who are unsympathetic or disrespectful, all work against patients' ability to stick to their treatment plans. On the other hand, effective communication, sufficient information about medicine, and a willingness on the part of the provider to engage TB patients in the decision-making processes all contributed to an extension of treatment. Patients with tuberculosis who are treated with TB drugs on weekends and holidays and who are happy with their prior experiences in the healthcare system are more likely to stick

with antiretroviral therapy (ART), as reported by Machtinger & Bangsberg (2006). The study's objective was to learn why certain TB patients weren't taking their prescribed drugs at the hospitals located in Moti Nagar and Nehru Nagar in Delhi, India. The study found that 117 out of 1786 (6.5%) patients at the Moti Nagar chest clinic and 195 out of 1890 (10%) patients at the Nehru Nagar clinic left before their treatment was complete. Inconvenient clinic hours and a lack of contingency plans for providing care in the case of a family emergency are just two examples of how the healthcare system falls short for patients, having trouble communicating with medical professionals, poor care and service at the medical center, and the most important variables in non-adherence were determined to be the treatment's inherent difficulty.

2.5.6 Social support from family members

Encouragement from a patient's family members to comply with the suggestions and prescriptions of their attending medical professional is an example of the kind of social support that is necessary for adherence. There is a social symbiotic connection between individuals and social institutions, in which both parties benefit from and are influenced by the other. The institution is a structural organization of social reactions that exemplifies the typical reaction of the society to a certain occurrence. It was established because of a particular incident. In an African setting that is focused on the concept of community, it might be challenging for people to express themselves outside of this social framework. Patients diagnosed with tuberculosis often get the majority of their social support from their families. In the context of African families, social support from other members of the family is a long-standing phenomenon that has gained increased significance with the onset of tuberculosis (TB). The tough economic realities have left many orphans and widows vulnerable, and tuberculosis patients are finding themselves under increased pressure to satisfy their treatment responsibilities. Because

of all of these and other considerations, it is necessary for the family to fulfill its traditional duty, which entails aiding its less fortunate members in overcoming the new problems. The Babukusu define the family in terms of matrimony, residence, and cooperative economics, as described by Wandibba (1997) in his chapter titled "Changing roles in the Bukusu family."

2.6 Social cultural factors associated with TB Treatment

The dual problems of postponing treatment and abandoning a treatment plan that has been given are the consequence of a complex set of factors. People's misunderstanding of the implications of tuberculosis symptoms, the cost of transportation to clinic services, the social stigma associated with tuberculosis, the high cost of medication, organizational issues with providing adequate follow-up services, and patients' perception of clinic facilities as being unwelcoming all contribute to the complexity (Rubel & Garro, 1992). These factors make the situation even more difficult.

2.6.1 Social isolation and stigma

The manner in which individuals respond to being unwell or suffering from a disease are inextricably linked to the larger social and cultural processes at play. The idea of stigma is helpful for analyzing some of the challenges that individuals who have illnesses such as tuberculosis face. According to Cremers et al. (2015), in spite of the fact that there is an effective treatment for tuberculosis (TB), patients still face a high level of social stigma in many regions of the globe. This is because of the disparaging status they get from their family and community as a result of their condition. According to Cremers et al. (2015), the strong connection that exists between HIV/AIDS and TB in many regions of the globe makes the social stigma more pronounced. Additionally, a person who has been diagnosed with tuberculosis may be forced into a type of social isolation, which may encourage distance in both family and

social relationships. According to Ylmaz and Dedel (2016), this might bring about a variety of impacts, such as guilt and acceptance, the worry of losing one's work or really losing one's employment, the dread of being infected, and social isolation. Understanding the synergistic impact of stigma and social settings requires an analysis of the different social problems that TB patients are forced to face. (Ylmaz & Dedel, 2016) Research carried done in Zambia, South Africa, and Kenya demonstrates that family members adhere to a variety of societal taboos, such as avoiding sharing food, cooking utensils, or bedding with TB patients. In order to combat tuberculosis, it is necessary to investigate local conceptions of the disease as well as cultural interpretations. According to Mason et al. (2015), dominant taboos may lose their power over time. According to Mason et al. (2015), TB clinicians and researchers can better navigate and contest the isolating practices that have a negative impact on health-seeking behavior and treatment compliance for treatable and unnecessary stigmatized TB disease if they learn to understand the social basis of stigma and social practices in any particular setting. A good change of tuberculosis treatment and prevention will result from addressing the larger social and structural causes that are responsible for the stigma that TB patients suffer.

2.6.2 Religion

Disease, according to the predominating magical-religious or ontological view of the time (Mulemi, 2014; Rumun, 2014), is caused by the intervention of supernatural powers, and its cure is contingent on divine will or holy ceremonies. Many people's discursive memories include religious understandings of health, and these understandings continue to have the same impacts that have been documented over many centuries. In addition, the concept of health based on religion continues to produce the same effects. According to the findings of another research (Diefenbach-

Elstob et al., 2017), it was shown that religion had an effect on treatment adherence in New Guinea. More specifically, it was found that possessing religious views and confidence in God increased treatment adherence. According to the findings of Noora et al.'s 2020 study, a prevalent practice among patients in Ghana is going to traditional healers as soon as they notice the first signs of tuberculosis. Patients diagnosed with tuberculosis often initially sought treatment from conventional physicians before coming to a medical center. According to Viney et al. (2014), there is a correlation between purchasing medications over the counter and delaying the beginning of tuberculosis therapy.

2.6.3 Cultural and traditional practices

Mbuthia et al. (2018) state that misunderstandings involving cultural beliefs of the origin of tuberculosis promote the adoption of alternative treatments such as traditional healers and herbalists rather than contemporary medicine. Sima et al. (2017) came to a similar conclusion, asserting that witchcraft, hard labor, and sexual overindulgence are some of the social and cultural elements related with a delay in TB treatment. According to Nyasulu et al. (2016)'s findings, cultural practices, traditional beliefs, and witchcraft are widely thought to be the cause of sickness, and they are a key contribution to non-adherence to TB treatment. The results of another study conducted in South Africa (Edginton et al., 2002) found that locals there thought that following cultural norms and adopting traditional medicine may help stop the spread of TB. By raising people's knowledge, it will be possible to combat such misconceptions and beliefs, which are often a factor of non-adherence and eventually high rates of tuberculosis transmission within communities, and the potential for the evolution of multidrug-resistant strains of the disease. (Mbuthia and colleagues 2018,).

2.7 Health System Related Factors Associated with TB Treatment

There has been a remarkable development in TB treatment over the past 10 years. WHO prioritizes reaching out to populations in need rapidly when new TB treatment drugs emerge (World Health Organization, 2014). The health system factors are several pillars namely, service delivery, resources which include human, time and monetary; commodities and drugs, leadership and governance, infrastructure and transport, health information and data collection (WHO, 2010). Weak health systems present many barriers to effective control of TB. Strengthening these pillars of the health system should give rise to positive system effects and this policy is among six components of the WHO Stop TB strategy (WHO, 2008). Review of medical records based on a population revealed that the average length of wait times at different levels of medical facilities resulted in different mean wait times. Medical centers, regional hospitals, and district hospitals had the longest mean wait times, followed by chest specialist hospitals, which had the shortest mean wait times. According to WHO (2016a), the death rates in chest specialty hospitals were the lowest, and effective treatment results were the highest. There are several factors which can cause delay in starting TB treatment drugs. They include poor road networks, lack of adequate surveillance systems, and inadequate diagnostic machine-like Gene Expert (Gebreweld *et al*., 2018; Weyer *et al*., 2013).

One of the major organizational factors that contributes to the loss of HIV/TB co-infected patients in Kenya's public health facilities is the frequent referral of patients to various service delivery points within the facility, such as counseling rooms, laboratories, examination rooms, pharmacies, TB and HIV clinics, and X-ray rooms, as noted by Sitineei (2007). Researchers (Burgos et al., 1998) discovered that patients were less likely to keep their clinic appointments if they needed a prescription filled

beforehand. Weiss et al. (2003) performed a study in Botswana and found that 30% of patients cited the need for frequent clinic visits as a reason for not following their treatment plan. According to Peterson et al. (2000), patients who feared being identified tended to avoid clinical examinations and medication refills. Adherence to TB medications can be affected by factors such as the clinic's location in relation to the patient's home or place of employment, the cost of traveling there, the length of time between appointments, the clinic's opening and closing times, the length of waiting times, the availability of services such as child care, the patient's right to privacy and confidentiality, and the attitude of the clinic's staff. According to a group of researchers (Kammann et al., 1999).

2.8 Empirical studies

A lack of commitment to tuberculosis treatment has a negative impact on the illness's control, since it allows the disease to continue to spread and also the development of multidrug-resistant tuberculosis, as well as treatment failure and fatalities. Therefore, it is essential for TB care and prevention to implement techniques that are both targeted and effective against the determinants of non-compliance with treatment (Kulkarni et al., 2013).

Adherence to tuberculosis therapy may be understood in a number of ways. Adherence is defined as the degree to which a patient continues to take prescribed medications even when they no longer have therapeutic benefits (Jin et al., 2008). The authors Jimmy and Jose (2011) state that there are more groups that may be classified as either main or secondary adherents. The major kind of non-adherence, as defined by Jimmy and Jose, is when patients do not even complete a fresh prescription, suggesting that they do not even bother to get their drugs from a health care facility. When prescriptions are completed, but the medicine is not taken as advised, this is an example of secondary

non-adherence.

A more comprehensive definition of adherence describes it as the consistent use of prescribed medicine and the maintenance of all scheduled follow-up medical visits in accordance with the directions that have been supplied (Jimmy & Jose, 2011). According to this concept, non-adherence might be defined as the skipping of even a single dose or a single follow-up appointment. Because the definition of treatment adherence varies based on the different studies that have been done worldwide, the finding might not be very comparable for the different researches that were carried out to investigate the levels, impacts, and variables related with non-adherence to treatment. In spite of the absence of a single, all-encompassing definition of adherence, a number of studies have highlighted the significance of comprehending the degree to which a population adheres to a course of treatment. In the battle against tuberculosis (TB), adherence is a very important factor. The degree to which individuals with tuberculosis take an active part in the management of their own treatment and the amount of contact that exists between patients and healthcare providers is reflected in treatment adherence.

The failure to comply with treatment protocols will bring significant impacts to patients. It has been shown that a patient, a program, and the community at large may all be negatively impacted when therapy is not adhered to. At the level of the individual, failure to comply with the prescribed medication may result in poor treatment outcomes such as death or relapse, the inability to effectively treat the condition, delayed sputum seroconversion of tuberculosis bacteria, prolonged treatment course and even the development of drug-resistant strains (Tesfahuneygn et al., 2015).

Non adherence also has an effect on the therapeutic outcomes at the community level and may play a part in the progression of the disease, which may lead to the emergence

of new infections in the community (Kulkarni et al., 2013) hence leading to economic and psychosocial affliction to family members living with a person with Tuberculosis. Relapse rates for tuberculosis patients who do not take their medicine as prescribed are much higher than those of individuals who do so (Azhar, 2012).

According to the research that has been conducted on the topic (Toczek et al., 2013), the percentage of people who do not complete their tuberculosis (TB) treatment regimen varies from as low as 1% in places with effective health systems to as high as 70% in regions with less effective health systems. According to research carried out in Delhi, India (Jaiswal et al., 2003), the typical amount of time that passes before a patient decides to stop receiving treatment for tuberculosis is six weeks, with a standard deviation of three weeks. On the other hand, research carried out in Kenya (Muture et al., 2011a) found that the majority of patients stop receiving treatment within the first few months of treatment. To put it simply, we are now in the intense phase. It is essential to have a solid understanding of the amount of time that elapses between the beginning of therapy and when patients begin to stop receiving it. Because of this, the technique for adhering to time-relevant criteria will be easier to modify. Non-adherence to TB therapy during the intensive phase has been linked to poor treatment results and an increased risk of mortality, making it an urgent matter to bring back non-adherent patients at this time (Suliman et al., 2022).

According to the findings of a research project that was carried out in Nairobi, Kenya, we discovered that non-adherence happened more often in the intense phase of treatment among male patients, patients who were underweight, patients who got care in public institutions, and patients who had family-based DOT (Masini et al., 2016). Some probable reasons of non-adherence include forgetting to take drugs, poor provider-patient relationship and communication, a lack of knowledge regarding TB

treatment, and a significant distance to the closest health centre. These reasons could also affect school going children who have a busy schedule and lots of activities during the day hence leading to non-adherence.

Different studies have assessed factors associated with TB treatment non-adherence among patients on TB treatment, however none has focused on school going children whose needs might be a bit different. However, this study compared how the factors varied between the general population and the school going children. Ibrahim et al. (2014) found that factors such as distance to treatment centres, smoking, patients' lack of knowledge about the length of time tuberculosis treatment takes, and the difficulty of communicating with health workers were all associated with patients' failure to adhere to treatment.

The problem of non-adherence to long-term treatments is multifaceted and is driven by the interaction of a number of various elements. The reasons that are linked to patients not sticking to their treatment plans may be broken down into the following groups: demographic factors, clinically related factors, health system related factors, and socially connected issues. Age and gender are two examples of demographic characteristics. Age and gender were two of the demographic parameters that were considered. A patient's HIV status, the kind of tuberculosis they have, the phase of therapy they are in, their dietary status, and whether or not they develop side effects are all clinically relevant considerations. Health system factors include distance to a health facility, transportation used to access the TB clinic, time spent on travelling to the facility, health care workers' attitude, availability of drugs and provision of health education from the health care worker. Social factors include having a treatment supporter, having someone to remind the patient to take medication, availability of food and facing any form of stigma

Non-adherence to therapy has been linked to factors such as male gender, age, alcohol and drug abuse, feeling better soon after starting treatment, a lack of knowledge, and financial difficulties (Kimani et al., 2021). Several societal and economic problems in Sub-Saharan Africa have been linked to low rates of TB treatment adherence. Low wages, inadequate social networks, inadequate education, monetary stress, and inaccessibility to necessary medical care all play a role. According to research (Dodor, & Afenyadu, 2005). Some of the patient-related variables that lead to treatment noncompliance in Kenya are as follows, as reported by Future et al. in 2011a: factors such as age, male gender, lack of education, lack of understanding of the need of treatment compliance, and social stigma.

Clinical variables were shown to be linked with TB treatment dropping out (Kigozi et al., 2017), including patients co-infected with HIV who are not on antiretroviral medication and patients who dropped out of treatment before. In Kenya, only a few studies have revealed additional clinical characteristics outside of routine data that are linked with non-adherence to treatment. These clinical factors include the severity of the condition. Tola et al. found that there are two categories that may be used to categorize the several characteristics that have been associated to a lack of adherence to TB treatment. These categories are as follows: refers to the individual as well as the whole health care system. Individual influences may be either socioeconomic or behavioral in nature (Tola et al., 2015).

Documented health care system-related factors that have been found from further studies include poor attitudes from the health care providers, negative attitude by the TB patients in regards to the treatment facility where they are collecting their treatment, stock out of TB drugs at the facility, inability to access health services for whatever reason, living closer to treatment center and waiting too long for services. (Muture et

al., 2011b)

There may be substantial regional variation in the factors that contribute to low compliance rates. According to research by Tesfahuneygn et al. (2015), forgetfulness, being away from home, the poor effects of anti-TB drugs, hospitalization, and difficulty to get to the hospital are the most common reasons for non-adherence to anti-tuberculosis treatment in Ethiopia. Effective communication has the potential to lower non-adherence rates, as shown by the same body of research by Tesfahuneygn et al. (2015).

According to studies conducted by Gebreweld et al. (2018) in India, the low percentage of TB patients who finish their treatment is mostly due to social stigma. Negative effects on tuberculosis control may be attributed, in part, to TB stigma, one of the social variables that contributes to this disease. Consequently, individuals in the DOTS program stop seeking therapy as a consequence of internalizing the community's dubious assessments. The DOTS program is essential for treating tuberculosis because of its fixed-dose combination tablets and fee exemption policy for anti-TB drugs in low-income districts. Despite the fact that TB treatment is provided at no cost to patients in Malaysia, early treatment dropout remains a major issue. As a result, the researchers behind this study believed that psychological variables, such as internal stigma, may play a part in this issue (Suliman et al., 2022).

According to the findings of a research that was carried out in India, adherence was related to being monitored by a member of the patient's family as well as paying a service charge(Alipanah et al., 2018). According to the findings, patients who had home visits and phone calls as part of their supervision were more likely to stick to their treatment plan. Lack of knowledge about the spread of tuberculosis and its treatment, as well as a lengthy commute to the nearest community health center, were shown to

be significant predictors of non-adherence in another research (Tang et al., 2015).

According to Theron et al. (2015), there is a correlation between not adhering to a treatment plan and experiencing psychological discomfort. Smoking, patients reporting improvement after a few months of treatment, patients living too far away from the health facility, and patients not having enough money to cover transportation costs have all been linked to non-adherence (Ibrahim et al., 2011). According to the findings of a research that was carried out in Peru, characteristics that were connected with non-adherence included the use of illicit drugs, the absence of an HIV test, the use of alcohol, being underweight, and not having finished secondary school (Lackey et al., 2015). Other characteristics that are connected with non-adherence include having an unskilled employment, belonging to a lower economic class, having a smaller family size, being a smoker, and being dissatisfied with the services provided at a health institution (Satti et. al., 2016).

It is necessary for a national TB program to have an awareness of the variables that impede individuals from sticking to treatment and those that aid in treatment completion in order to build an effective intervention strategy. This will allow the national program to improve the TB treatment results.

2.9 Summary of Literature Review and Research Gaps

From the research that has been done up to now, it is possible to draw the conclusion that the adoption of TB treatment is affected by a variety of factors that vary depending on the setting. In spite of the significant research that has been done on a global, regional, and local scale, it has been seen that the variables of this study have only been looked at in part and in isolation, which has led to the existence of conceptual gaps that need to be filled by this study. Successful treatment results for TB/HIV co-infected and TB patients in Nyando Sub-County were associated with factors like patient education,

support from health practitioners, and community participation, as reported by Achieng (2016). However, it was noted that they did examine the variables of this study separately, and they did use a variety of research methodologies, including a descriptive research design and a descriptive statistics approach; however, they did not adopt a cross-sectional research design, nor did they analyze data using the regression method in order to test the relationship between variables. Although Oyugi (2017) found that TB patients were not adhering to their therapies, they did find that patients who did stick to their TB therapy did so for a variety of reasons. The amount of time it took to finish the dose and the interpersonal elements of the social health professionals were two of the most important variables that led to the greatest cooperation of TB patients to comply with treatment. On the other hand, it was pointed out that the research did not evaluate the influence of clinical related, school related, and social-demographic characteristics linked with TB treatment non-adherence among children who attended school and had TB in Meru County.

2.10 Conceptual framework

The conceptual framework below displays the different factors that can be associated with non-adherence to TB treatment. The health system factors and clinical related interact and the same for social related factors and school related factors also interact especially for the children who are in boarding school.

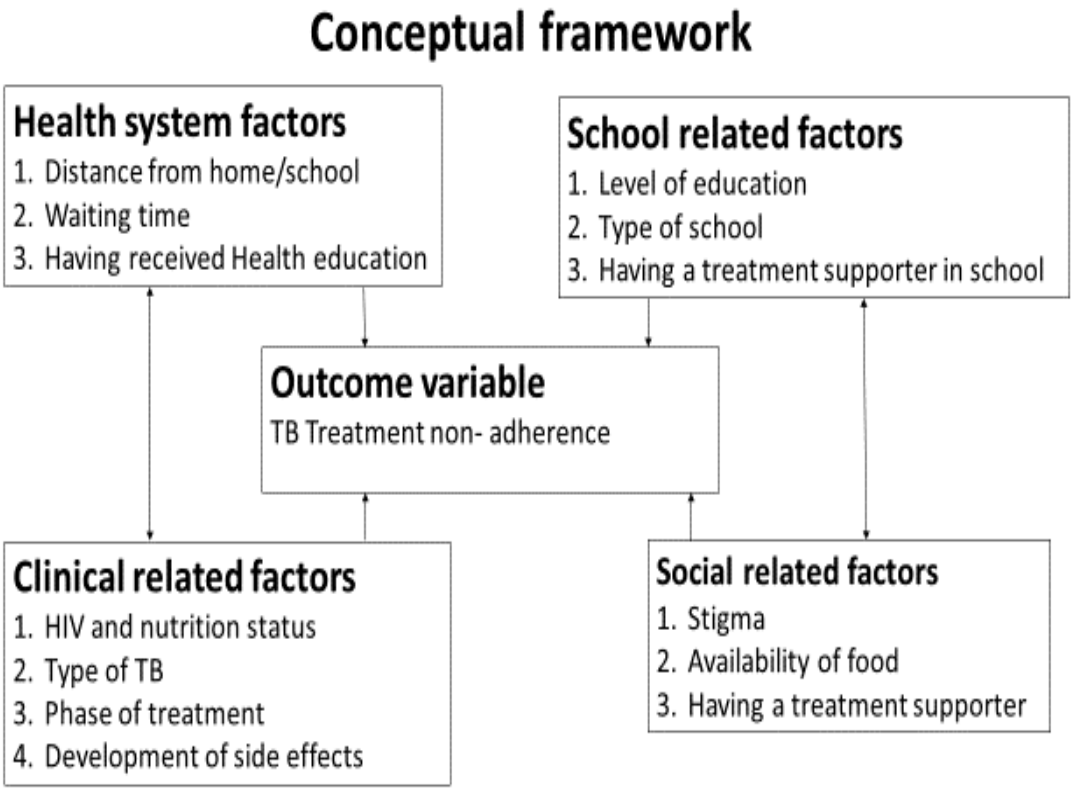

Figure 1: Conceptual Framework

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study population/ target population

This research was a facility-based cross-sectional investigation that targeted tuberculosis patients who were recorded in the tuberculosis registers of the chosen hospitals, who were still receiving treatment and were either in primary or secondary school. Patients who were in the intensive treatment phase as well as those who were in the continuous phase of treatment participated in the research. Only patients who had received treatment for TB for more than a month were considered for inclusion. The age used to estimate for these children was those between 6- 19 years. The questionnaire was administered to older children who came alone to collect their medication and also to parents/ care givers that brought their children to collect medication most of which brought the very young children.

Exclusion criteria

Children who had received therapy for less than one month and children who were diagnosed at the chosen health facility but subsequently moved to other facilities outside of the County for treatment follow up were not included in the study.

3.2 Study design

This was a hospital based cross-sectional study which entailed administering a questionnaire to school going children with TB and their caregivers who were collecting TB drugs from the selected facilities in Meru County.

3.3 Study area

The study was conducted in Meru County, which has 9 sub counties with an estimated population of 1,635,264 (KNBS 2009) and 30% of these are children who are in school (CIDP 2018- 2022). The County's TB case notification rate is 287/100,000 which is ranked among the top 10 Counties with a high TB burden in the country.

Meru has 498 facilities in total which are classified as follows; One county referral hospital, 23 sub county and mission hospitals, 39 health centers and 435 dispensaries and private clinics.

3.4 Sample size calculation

Sample size calculation was done using Cochrane's formula where z=1.96, p=0.09, q=0.91 andd=0.04. The proportion of TB patients between 6-19 years out of the total TB patients within the County (9%) was used as a proxy to estimate for the proportion of TB in school going children in the County. This proportion was gotten from TIBU system

$N= z^2pq/d^2$

$N= (1.96^2 \times 0.09 \times 0.91)/ (0.04)^2 = 197$

A non-response rate of 10% was included hence a sample size of 216 was arrived at. The non- response was to take care of any participant who was not willing to participate in the study.

3.5 Sampling technique

Meru has 9 sub counties and all the 9 sub counties were included for this study. The TIBU system, which is the National surveillance system that contains case-based data for all TB patients in the Country, was utilized to collect the sample frame for the patients from the specified institutions. Systematic sampling was then used to choose the cases to be interviewed. Data from TIBU was down loaded in excel and was filtered by age (The age between 6 and 20 years was used as a proxy for school going children). The TIBU system contains data from all facilities in the county as entered by the sub county TB coordinators who are supported to visit all facilities offering TB treatment.

In the systematic sampling we divided the number of patients in the sampling frame by our sample size to get the interval of selecting the patient to be interviewed (k^{th} interval).

The 1st unit was picked randomly between the 1st and the kth patient. For example, if our sampling frame (N) had 950 patients and our sample size (n) was 217 then we divided 950 by 217 to getour k (4th), then the random start (r) was selected between the 1st four patients and the rest wasat every 4th interval.

The children were then interviewed during their drug collection dates. TB treatment is usually given weekly for those on intensive phase of treatment and every two weeks for those on continuation phase until the 6 months treatment duration are over.

3.6 Data collection tools and procedures

For the purpose of gathering information from the patients, a structured questionnaire was used. The recall period was from the time treatment was initiated to the current date of the interview. Age, gender, type of tuberculosis, nutritional condition and HIV status were some of the data that were collected. In addition, the questionnaire was used to determine the frequency with which the students had skipped their medicine dosages between the beginning of treatment and one week before to the interview. The factors to be assessedincluded;

- Demographic factors - these were: age, and sex
- Clinical related factors - these were nutrition status, HIV status, type of TB, type of patient, phase of treatment, nutrition status, availability of a treatment supporter and development of side effects.
- Health system factors - these were: distance to a health facility, transportation used to access the TB clinic, time spent on travelling to the facility, cost of travelling to the TBclinic, TB clinic schedule, Health care workers attitude, availability of drugs, havingreceived health education from the health care worker and the waiting time (Time between the arrival to the health facility to the time medication was given and released

to go home)

- School related factors - these were: level of education, type of school e.g., Boarding or day school and having a treatment supporter in school.
- Social factors - these were: having a treatment supporter, having someone to remind youto take medication, availability of food and facing any form of stigma from the time they were diagnosed with TB. Facing stigma was assessed through self-reporting where the participant was asked if they had noted any change in behavior and relationship from the people who stay or school with them from the time they were diagnosed with TB.

The questionnaire was piloted in Tharaka nithi county which neighbors Meru County and the findings of the pilot were used to modify the tool

Operation definition of the term “adherence”

According to the WHO, "adherence" refers to "the degree to which the patient follows medical recommendations." This we assessed in two levels, the first level was being able to collect drugs from the health facility and second was whether or not the medications were taken in accordance with the doctor's instructions regarding dosage, timing, and frequency of use taking the drugs as prescribed in terms of dosage, time and on daily basis. To assess for drugs collection from the facility we reviewed the documentation of the scheduled clinic days on the TB treatment register versus the actual date of collection documented on thepatients record card/ file. Adherence was assigned to those who kept all their scheduled clinicdays while non adherence was assigned to those who had variations between the scheduled dates of drugs collection and the actual date the drugs were collected.

To assess for taking drugs as prescribed in terms of number of tablets and on daily basis, this was done through self-reporting and was counterchecked with the weight-based

dosingschedule. Taking the prescribed number of tablets daily was termed as being adherent while taking less or more tablet was termed non-adherent. Finally, failure to skip medication was termed to be adherent while having skipped drugs even for a single day was termed to be non-adherent. The definition for non-adherence was one who failed to do any of the following; keeping all clinic appointments, swallowing medicines on a daily basis and taking the correct number of tablets. While anyone who was able to do all the above was assigned the final outcome of "being adherent" Personal identifiers were removed and new unique IDs assigned to the data set for confidentiality.

3.7 Data analysis

Excel for Microsoft was used to clean the data, and Epi Info 7 was used for the analysis. In the case of continuous variables, measures of central tendency and dispersion were computed, and in the case of categorical data, frequencies and proportions were determined. The bivariate analysis was carried out and the crude Odds ratio and p-values were used to determine factors to be put in to the logistic regression table. The factors that had a p-value of 0.2 were put to the multi variate model using backward elimination approach. The factors that had a p-value of 0.05 were regarded as significant in this study. The results were presented in tables.

3.8 Study limitation

Since our target population was school going children on TB treatment who were visiting ahealth facility to collect their treatment, we anticipated to have a limitation where someone

else like a parent or a care giver comes to the health facility to collect the drugs for the childand fail to give the correct responses as far as adherence is concerned.

3. 9 Ethical considerations

Upon approval by the Review committee of Moi University, the research license was issued by National Commission for science, technology and innovations (NACOSTI) and we went ahead to seek for permission to collect the data from the County Health Department. Unique identifiers were used in place of personal identifier variables. Consent was sought from the parents/ care givers who brought their children years and for those who did not come with their parents or care givers, the health care worker who manages them provided consent on their behalf. Assent was sought from the children between the age of 12 to 18. The data was maintained in a password protected laptop and laptop secured under lock and key.

CHAPTER FOUR

4.0 RESULTS

4.1 Social- demographic characteristics of the school going children on anti TBs in Meru County, 2020/2021

A total of 207 school going TB patients were interviewed whose mean age was 14.5 years (±4 SD). Of these, 105 (50.7%) were female and 165 (91.7%) were Christians (Table 1). In addition, 162 (78.3%) had someone around them to remind them to take TB treatment, 66 (33.3%) faced stigma from the time the diagnosis of TB made and 162 (78.3%) could afford 3 meals and above in a day (Table 1).

Table 1: Social - demographic characteristics of the school going children on anti TBs in Meru County, 2020/2021

Variable	**Number**	**Percent (95% Confidence interval)**
SEX		
Female	105	50.72(43.7–57.7)
Male	102	49.28 (42.4–56.3)
Place-Sub County		
Buuri	60	29.41(23.3–36.2)
Igembe North	27	13.24(8.9–18.7)
Igembe south	21	10.29 (6.5–15.3)
Imenti North	9	4.41 (2.1–8.2)
Imenti South	6	2.94 (1.1–6.3)
Meru central	39	19.12 (14.0–25.2)
Tigania East	30	14.71 (10.2–20.3)
Tigania West	12	5.88 (3.1–10.1)
Religion		
Christian	165	91.7 (86.6–95.3)
Muslim	15	8.3(4.7–13.4)
Someone to remind the patient to take drugs		

Someone available	162	78.3 (72.0–83.7)
No one available	45	21.7 (16.3–28)
Facing TB stigma		
Facing TB stigma	66	33.3 (26.8–40.4)
Not facing TB stigma	132	66.7 (59.6–73.2)
Treatment supporter		
Available	171	83.8(78.0–88.6)
Not available	33	16.2 (11.4–22.0)
Number of meals per day		
3 and above	162	78.3 (72.01–83.7)
Less than 3	45	21.7 (16.3–28.00)

4.2 Health system related, school related and clinical related characteristics of the school going children on anti TBs in Meru County, 2020/2021

This study found out that 180 (87.0%) school going TB patients received health education from a health care worker at the time of treatment initiation, 156 (75.4%) reported that they spent less than 30 minutes before being attended to by a health care worker on clinic days (This was the period between the patients arrival to the health facility to the time they were issued with anti TBs and release to go home) , 189 (88.2%) said that they have never missed medication from the facility. On school related, 120 (58.0%) were in secondaryschool, 144 (69.6%) were in day school and 114 (59.4%) have not been allocated special timeby their schools to go and collect treatment during clinic days (Table 2).

Table 2: Health system related and school related characteristics of the school going children on anti TBs Meru County, 2020/2021

Variable	Number	Percent (95% Confidence I)
Distance to the facility		
5kms and below	147	71 (64.3–77.1)
More than 5kms	60	29.0 (22.9–35.7)
Waiting time at facility		
Less than 30 min	156	75.4 (68.9–81.1)
More than 30 minutes	51	24.6 (18.9–31.1)
Availability of medicine		
Not available	15	7.4(4.2–11.8)
Available	189	92.7 (88.2–95.80
Health education		
Not given	27	13.0 (8.8–18.4)
Given	180	87.0 (81.6–91.2)
School assigned time to collect treatment		
Time assigned	78	40.6 (33.6–47.9)
Time not assigned	114	59.4 (52.1–66.4)
Treatment support in school		
Available	57	29.2 (23.0–36.2)
Not available	138	70.8 (63.9–77.1)
Type of school		
Boarding	63	30.43 (24.3–37.2)
Day	144	69.6 (62.8–75.8)
Level of education		
Primary	87	42.03 (35.2–49.1)
Secondary	120	57.97 (50.9–64.8)

4.3 Assessment of level of adherence

Of the interviewed students 147 (71.0%) kept hospital appointments, 204 (91.5%) took the correct dosage as prescribed by the health care workers, 120 (58%) have never skipped takingmedicine and in overall 96 (46.4%) were not adherent to TB treatment (Figure 1).

Figure 2: Assessment of level of adherence, Meru County, 2020/2021

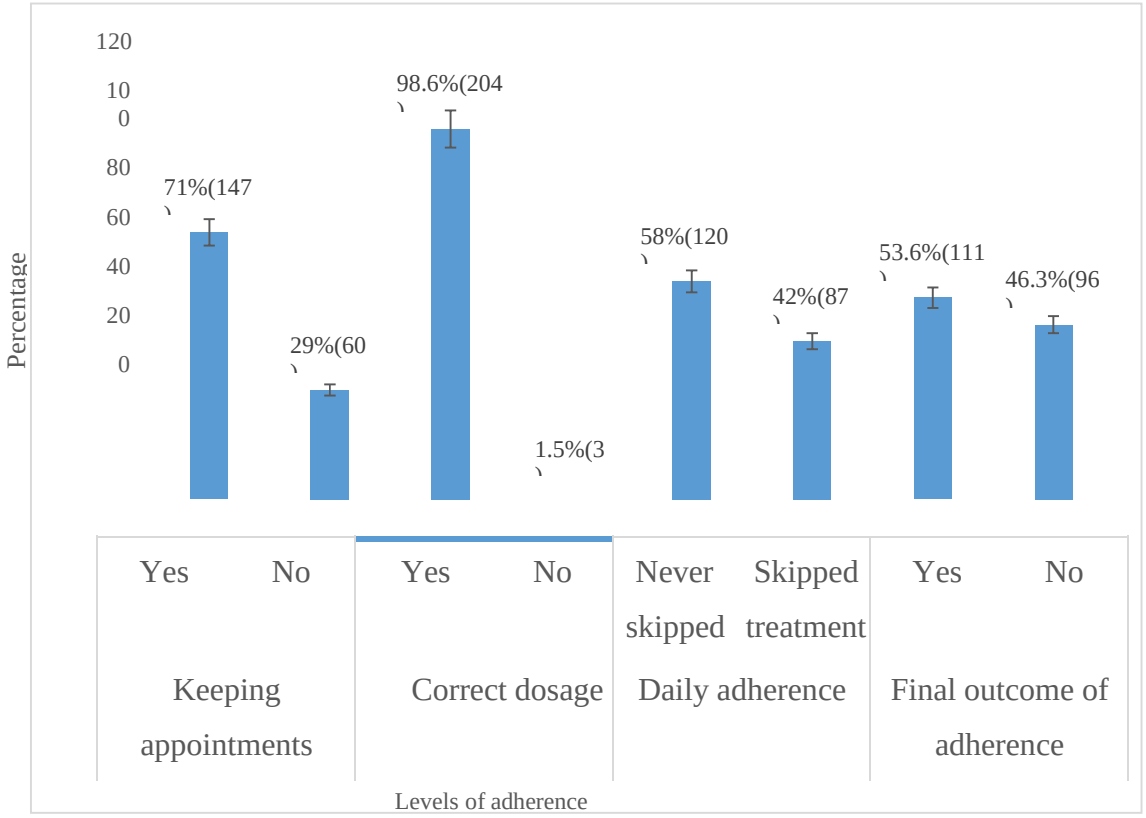

Figure 1: Proportion of respondents by level of adherence, Meru County, 2020/2021

Bivariate analysis was carried out on a two-by-two table and the crude Odds ratio and p-values were used to assess the association between non adherence to TBtreatment with selected health system related, school related, clinical related and socio-demographic factors among the school going children.

On the health system factors, the odds of non-adherence were 2.7 times among those who reported to wait for more than 30 minutes before being attended to (OR 2.71, CI

1.40–5.22,p-value 0.002) as compared to their counterparts and also those who had not received health education were 12 times more likely to be none adherent as compared to those who received health education (OR 12.0, CI 3.48–41.3, p-value 0.000001), while distance of more than 5 kilometers (OR 1.63, CI 0.89–2.98, p-value 0.11) was not statistically significantly associated with non- adherence (Table 3).

Table 3: Bivariate analysis of health system factors associated with TB treatment non adherence factors among school going children in Meru County

Variable	Non-Adherent	Adherent	Crude OR (95% CI)	P-value
Waiting time				
>30 Minutes	33	18	2.71 (1.40–5.22)	0.002
>30 Minutes	63	93		
Health education				
Not given	24	3	12.0(3.48–41.3)	0.000001
Was provided	72	108		
Distance				
> 5 Kilometers	33	27	1.63 (0.89–2.98)	0.11
<5 Kilometers	63	84		

On the clinical related factors (Table 4), the odds of non-adherence were 3.9 times higher among thosewho experienced side effects (OR 3.85, CI 1.66–8.96, p-value 0.001) as compared to their counterparts who did not experience any side effects due to the TB medications that they were receiving, while the nutrition status (OR 0.88, CI 0.50–1.54, P-value 0.65), HIV status (OR 0.55, CI 0.20–1.53, p-value 0.24) phase of treatment (OR 0.87, CI 0.49–1.56, p-value 0.65) and type of patient (OR 1.88, CI 0.68–5.21, p-value 0.22) were not associated with being non adherent.

Table 4: Bivariate analysis of clinical related factors associated with TB treatment non adherence among school going children in Meru County

Variable	Non-adherent	Adherent	Crude OR (95% CI)	P-value
Experienced side effects				
Experienced side effects	21	9	3.85 (1.66–8.96)	0.001
No side effects	60	99		
Malnourished				
Malnourished	36	45	0.88 (0.50–1.54)	0.65
Not malnourished	60	66		
HIV status				
Positive	6	12	0.55 (0.20–1.53)	0.24
Negative	87	96		
Treatment phase				
Continuation	60	75	0.87 (0.49–1.56)	0.65
Intensive	33	36		
Type of patient				
New	90	96	1.88 (0.68–5.21)	0.22
Previously treated	6	12		

The odds of non-adherence were 3 times higher among those who were in secondary school as compared to those who were in primary school (OR 3.01 CI 1.68–5.37, p-value 0.0002) while being in day school (OR 0.30, CI 0.16–0.56, p-value 0.0001) was found to be protective for non-adherence. There was no association between being non adherent and having a treatment supporter in school (OR 1.58, CI 0.85–2.94, p-value-0.15). (Table 5)

Table 5: Bivariate analysis of school related factors associated with TB treatment non adherence among school going children in Meru County

Variable	Non-adherent	Adherent	Crude OR (95% CI)	P-value
Level of education				
Secondary school	69	51	3.01 (1.68–5.37)	0.0002
Primary school	27	60		
Type of school				
Boarding school	42	21	3.33 (1.79–6.22)	0.0001
Day school	54	90		
Having a treatment supporter in school				
Available	30	27	1.58 (0.85–2.94)	0.15
Not available	57	81		

Finally, on social demographic related factors, the odds of non-adherence were 3.9 times higher among those who did not have a treatment supporter, (OR 3.94, 1.73–8.99, p-value 0.0006) as compared to their counterparts and 4.6 times higher among those who reported to have faced stigma (OR 4.6, CI 2.43–8.66, p-value 0.00001) was statistically significant. In addition, those who could not afford 3 meals and above in a day were more likely to be non-adherent (OR 2.91, CI 1.45-5.83, p- value 0.002) and those who did not have someone to remind them to take medicines were 12 times more likely to be non- adherent as compared to those who had someone to remind them to take medication (OR 12.0 CI 4.78-29.9, p-value 0.00001). From the social demographic related factors, it was only gender that was not statistically significantly associated with being non- adherent (Table 6).

Table 6: Bivariate analysis of social demographic factors associated with TB treatment non adherence among school going children in Meru County

Variable	Non-adherent	Adherent	Crude OR (95% CI)	P-value
Sex				
Female	63	42	1.69 (0.97–2.93)	0.06
Male	48	54		
Facing TB stigma				
Stigma	45	21	4.6 (2.43–8.66)	0.000001
No stigma	42	90		
3 meals and above per day				
Less than 3 meals	30	15	2.91 (1.45–5.83)	0.002
3 meals and above	66	96		
Having a treatment supporter				
Not available	24	9	3.94 (1.73–8.99)	0.0006
Available	69	102		
Someone to remind to patient to takemedication				
Not available	39	6	12.0 (4.78–29.9)	0.000001
Available	57	105		

In the multivariate logistic regression model, being in secondary school, waiting time

of morethan 30 minutes, not received health education and not having someone to remind the patient to take treatment maintained marginal statistical significance with being non- adherent to treatment among the school going children. The odds of being non adherent for these four factors were as follows: being in secondary school (aOR 3.01, CI 1.65–7.09, p- value 0.0009), waiting time of more than 30 minutes at the health facility (aOR 3.02, CI 1.37–6.66, p-value 0.006), those who did not receive health education in the course of treatment (aOR 15.04, CI 3.89–58.09, p-value 0.0001) and those who did not have someone reminding them to take their treatment (aOR 6.95, CI 2.64–18.28, p-value 0.0001) (Table 5).

Table 7: Multivariate analysis of factors associated with TB treatment non adherence among school going children in Meru County

Variable	Non-adherent	Adherent	AOR (95%CI)	P-value
Health system factors				
Waiting time				
>30 minutes	33	18	3.02 (1.37–6.66)	0.006**
<30 minutes	63	93		
Health education				
Not given	24	3	15.04(3.89–58.09)	0.0001**
Was given	72	108		
Clinical related factors				
Anti TBs Side effects				
Experienced	21	9	1.63 (0.38–6.81)	0.51
Not experienced	60	99		
School related factors				
Level of education				
Secondary school	69	51	3.4 (1.65–7.09)	0.0009**
Primary school	27	60		
Type of school				
Boarding school	42	21	1.62 (0.66–4.03)	0.29
Day school	54	90		
Social demographic factors				
Facing TB stigma				
Stigma	45	21	2.19 (0.92–5.24)	0.08
No stigma	42	90		
3 meals and above per day				
Less than 3 meals	30	15	1.06 (0.27–4.18)	0.93

3 meals and above	66	96		
Having a treatment supporter				
Not available	24	9	1.38 (0.23–8.26)	0.71
Available	69	102		
Someone to remind to patient to take medication				
Not available	39	6	6.95 (2.64–18.28)	0.0001**
Available	57	105		

CHAPTER FIVE

5.0 DISCUSION

According to the study, nearly half of the people who responded to the questionnaire did not adhere to the TB treatment. In addition, waiting times of more than thirty minutes, not having received any health education, being enrolled in secondary school, and not having someone to remind the patient to take their medication were statistically significantly associated with non-adherence to tuberculosis treatment among the school-aged children in Meru County.

In this study, a significant proportion of participants did not take their anti-TB medicine as directed. This is due to the study population was school going children who have a busy schedule leading to them failing in adhering to treatment. In addition, this was also attributed to the use of a stringent definition to adherence. When participants in our study failed to perform any of the following, we labeled them as non-adherent: maintain all clinic visits; take medications as prescribed; and take the right quantity of pills. Our rate of non-adherence was higher than the national average of 35% (TB Adherence Report - National Tuberculosis, Leprosy, and Lung Disease Program, n.d.), which was based on research conducted in 15 different counties by the National TB program. Another study conducted in the country among patients who were on TB treatment also showed lower proportions of patients being non adherent at 19 percent (Masini et al., 2016)

The non-adherence percentage identified in another study carried out in southern Ethiopia was 24 percent, which is still lower than that found by this study (Gube et al., 2018). Further, the study found that the findings of a study conducted on alcoholics in the northeastern region of Ethiopia, which found a non-adherent rate of 44%, were quite similar to our own. In 2015, a group of researchers led by Tesfahuneygn found that

Chongqing, a city in western China's hilly region, was the site of another research that found similarly high rates of non-adherence. Patients receiving TB therapy had a 36% non-adherence rate (Lei et al., 2016). Consequently, poor treatment results are expected to occur among the county's school-aged children due to these increased rates of non-adherence.

Those participants who were in secondary school had a higher likelihood of not adhering to TB treatment, in comparison to those who were in primary school. Because of this, it became clear that students in secondary schools, who are now teenagers, may have difficulties that are distinct from those faced by younger children, who are still heavily reliant on their parents and other adults for their care (Ngugi et al., 2020). Researchers in Northwest Ethiopia found that patients with a secondary education were four times more likely to stick with their tuberculosis treatment than those with a lower education level during the continuation phase of care (Gashu et al., 2021).

This poses a threat of treatment failure or possibly the development of medicine resistance among this group of students, which is consistent with the findings of a study from Uzbekistan that indicated adolescents had a higher risk of treatment failure due to non-adherence to therapy. Adolescents in the Uzbek research were more inclined to pursue unproven therapies, which increased the probability of treatment failure (Gadoev et al., 2015). While it is not clear why those in secondary school were found to be non- adherent, the study hypothesizes that the busy schedule among children in high school could be contributing to this.

People who waited for more than thirty minutes to be attended to at the medical facility on clinic days were shown to have a greater likelihood of not adhering to the treatment plan than people who waited less than thirty minutes. This was one of the findings of the research. They may believe that their treatment is not as essential and that they are

not appreciated by the health care professionals if they have to wait for a long period before obtaining help. In addition, long waiting time might discourage the patients from making subsequent return visits due to dissatisfaction of the delayed services. This might also lead to them not being adherent to their treatment, which can have serious consequences. The results of a study conducted in Kenya's Nandi County support this conclusion. Long wait times at the hospital were associated with worse treatment adherence, the research revealed. In a 2017 study (Wanyonyi et al. This is also true if one considers the results of a study conducted in the Hadiya Zone in southern Ethiopia. Patients with tuberculosis who waited less than 30 minutes had a 2.5-fold higher chance of adhering to their treatment plan compared to patients in the same group, as reported in a study ((PDF) Directly Observed Treatment Short-Course Compliance and Associated Factors among Adult Tuberculosis Cases in Public Health Institutions of Hadiya Zone, Southern Ethiopia, n.d.). Another study conducted in the Southern region of Ethiopia indicated that patients who were had to wait longer periods of time to get medical treatments were also at a higher risk of not following with their treatment plan. People in this situation had to wait far longer than others, in contrast to others who waited just a fraction of the time. Several researchers (Gube et al., 2018) confirm this. However, this conclusion ran counter to the results of a national survey conducted elsewhere in the country. According to the results of the research (TB Adherence Report - National Tuberculosis, Leprosy, and Lung Disease Program, n.d.), there was no correlation between length of time spent waiting and treatment non-adherence. The National Tuberculosis, Leprosy, and Lung Disease Program conducted the research for this publication.

In comparison to their counterparts who did get health education from health care personnel, those individuals who did not receive health education had a greater

likelihood of not adhering to the treatment plan. Patients should be given the opportunity to receive health education during the duration of their treatment. The findings of a recent study in China (Fang et al., 2019) support the idea that education about the importance of treatment adherence and the dangers of non-adherence should be among the many topics covered in this training. Knowledge of tuberculosis illness is a crucial element related with TB treatment adherence, as shown in that research, which is consistent with the present conclusion. Moreover, a study conducted in the Southern region of Ethiopia found that tuberculosis patients who are assisted by a health practitioner right from the start of their therapy are twice as likely to comply with the treatment as tuberculosis patients who are not assisted by such advice. The study was conducted to learn whether TB patients are more likely to follow treatment recommendations when they are not given such guidance (Bayu et al. 2016). Another hospital-based cross-sectional study in India found that among people with tuberculosis and HIV co-infection, those who did not receive any form of health education were more likely to not adhere to the treatment regimens that were prescribed to them. This study was carried out among individuals who were infected with both diseases (Sardar et al., 2010). This implies that if the patient does not get health education, which includes being taught about the negative consequences of the suspension of TB treatments, such as the development of drug resistance, then he or she may end up being non-adherent to the treatment regimen, which may result in the progression of tuberculosis to a more severe form.

In conclusion, the last variable that was found to be related with non-adherence to TB treatment among the school going children in Meru was the lack of someone to remind the patient to take their prescription. This component was shown to be connected with the fact that there was no one to remind the patient to take their medication. This

discovery stands in stark contrast to the results obtained by the National TB program throughout the course of their research project. Results from the TB Adherence Report by the National Tuberculosis, Leprosy, and Lung Disease Program showed that patients who reported no support for their therapy were 1.4 times more likely to remain on treatment than those who reported having household members as treatment supporters. This study's results are diametrically opposed to those of the other. Furthermore, these results ran counter to those of another study conducted in South Ethiopia, which found that having a treatment supporter had no effect on non-adherence to anti-TB medicine (Woimo et al., 2017). This may be because our research included only students with TB, whereas the other studies included patients from the general community. It's possible that the variations in outcomes might be attributed to the many populations that were tested.

The multivariate analysis did not discover any significant variables, despite the fact that several were shown to be important in the bivariate analysis. Furthermore, among school-aged children in Meru County who were diagnosed with tuberculosis, these factors did not serve as independent explanations for non-adherence to anti-TB medication. These variables were as follows: having suffered side effects, having to deal with stigma, eating less than three meals every day, being at a boarding school, and not having someone to assist them throughout treatment.

Having suffered from adverse effects, which, according to the findings of this research, had no correlation with non-adherence. This may be due to the fact that the children in the study had very minor adverse effects, which did not prevent them from complying with their therapy. However, the research did not go into the specifics of determining the exact side effects that really happened. This outcome was consistent with that of an investigation that had been carried out in South Ethiopia (Woimo et al., 2017). On the

other hand, the results of a research that was carried out in India shown that anti-TB medication side effects were substantially related with non-adherence (Vijay et al., 2010). A sufficient orientation must be provided to the patient and his or her treatment supporter of the potential adverse effects of the therapy, and patients must be promptly referred to a health care provider for corrective measures. The often-reported minor adverse effects might be effectively managed with the provision of appropriate instructions on medication intake, the provision of reassurance to patients, and timely symptomatic treatment before it results in discontinuation of therapy.

The fact that participants in this study had been subjected to stigma from those around them because of their disease was another characteristic that did not influence TB non-adherence. It's possible that this is due to the fact that these individuals are youngsters, and as such, they benefit from the strong support of their parents, care givers and maybe even their teachers, all of whom are assisting them in overcoming the stigma. However, a study conducted in China found that TB patients who rated their social stigma as high were less likely to adhere to treatment than those who rated their stigma as low (Yan et al., 2018). It is common knowledge to say stigmatized TB patients may avoid taking their medications or even fail to collect their medicines from the facilities to hide their condition from their acquaintances but this might be different among school going children.

5.1 Study limitation

This research was not without its share of caveats and restrictions. First, a retrospective investigation was carried out with the help of patient self-reporting to identify the characteristics that were linked with non-adherence. These findings are likely to be impacted by memory bias; nevertheless, we made an effort to control it by utilizing well-structured and thorough questionnaires and by applying a variety of questioning

approaches.

There other limitation for this study was that it did not capture adequate information on reasonsfor non- adherence. This would help in putting solutions to improving adherence among school going children.

A direct comparison of studies is made more difficult by the fact that the definition of adherence to anti-tuberculosis medication varies, as different studies assess the different levels of adherence to treatment. There are studies that focus only on coming to the hospitals for drug refills, others only focus on whether the patients are taking medication on a daily basis or not while this study put together all these levels of adherence.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The number of children with TB in Meru County who were school going and are on TB treatment but non adherent was high, and the factors that were strongly associated with non-adherence included those that were related to the health system and schools related factors. The fact that the patient did not receive any health education, the fact that the patient did not have someone to remind them to take their medication, the fact that the patient was attending secondary school, all of these factors were significant determinants of non-adherence to TB treatment among the school-aged children with TB in Meru County.

Other factors, such as having experienced adverse effects, being ostracized, eating less than three meals per day, and attending boarding school, did not reveal any statistically significant relationships with being non adherent to TB treatment.

6.2 Recommendations.

1. Children who are school going and are on TB treatment should be offered special support from the family members, from school and even from the health facility that they are collecting their treatment from in order for them to be able to adhere to their TB medication from the beginning up to completion of the treatment course.
2. On the waiting time, we recommend that Health care workers should prioritize issuance of drugs to school going children when they come for drug collection of the clinic days. In addition, the health care workers could give appointment days that are specific to the school going children like the weekends, hence avoiding the normal clinic days which might have a lot of patients to be reviewed. This can also include offering treatment on weekends, specifically to the school going children who are on TB medication.

3. Finally, provision of health education to TB patients in schools on their health and also about TB disease is one of the most effective ways to encourage them to continue with their prescribed therapy. When patients and the caregivers of these children are aware of the risks associated with not adhering to therapy, it will be simple for them to make educated choices and agree to get treatment in the manner that has been recommended.
4. The National TB program should put up a policy that every secondary school going child on TB treatment should be linked to someone either in school or at home or a counselor in the hospital to offer close support and treatment counselling to secondary school students on TB treatment to improve adherence. This can be done by linking the secondary school students to a counsellor that can address any challenges that the child is going through in the course of TB treatment. In addition, the child should be advised to identify someone in school especially for the ones in boarding institutions that he or she can easily open up to and also receive any form of required support while they are on TB treatment.

REFERENCE

Adisa, R., Ayandokun, T. T., & Ige, O. M. (2021). Knowledge about tuberculosis, treatment adherence and outcome among ambulatory patients with drug-sensitive tuberculosis in two directly-observed treatment centres in Southwest Nigeria. BMC Public Health, 21(1), 677. https://doi.org/10.1186/s12889-021-10698-9

Alipanah, N., Jarlsberg, L., Miller, C., Linh, N. N., Falzon, D., Jaramillo, E., & Nahid, P. (2018). Adherence interventions and outcomes of tuberculosis treatment: A systematic review and meta-analysis of trials and observational studies. PLoS Medicine, 15(7), e1002595. https://doi.org/10.1371/journal.pmed.1002595

Annual Report 2020 – National Tuberculosis, Leprosy and Lung Disease Program. (n.d.). Retrieved 21 October 2021, from https://www.nltp.co.ke/download/annual-report-2020/

Azhar, G. S. (2012). DOTS for TB relapse in India: A systematic review. Lung India : Official Organ of Indian Chest Society, 29(2), 147–153. https://doi.org/10.4103/0970-2113.95320

Bayu, B., Lonsako, A., & Dadi, T. (2016). Directly observed treatment short-course compliance and associated factors among adult tuberculosis cases in public health institutions of Hadiya zone, Southern Ethiopia. Journal of Infectious Diseases and Immunity, 8, 1–9. https://doi.org/10.5897/JIDI2016.0157

Chimeh, R. A., Gafar, F., Pradipta, I. S., Akkerman, O. W., Hak, E., Alffenaar, J.-W. C., & van Boven, J. F. M. (2020). Clinical and economic impact of medication non-adherence in drug-susceptible tuberculosis: A systematic review. The International Journal of Tuberculosis and Lung Disease, 24(8), 811–819. https://doi.org/10.5588/ijtld.19.0754

Connolly, L. E., Edelstein, P. H., & Ramakrishnan, L. (2007). Why Is Long-Term Therapy Required to Cure Tuberculosis? PLoS Medicine, 4(3), e120. https://doi.org/10.1371/journal.pmed.0040120

DNTLDP_AnnualReport_2021_compressed.pdf. (n.d.). Retrieved 4 August 2022,

from https://www.nltp.co.ke/wp-content/uploads/2022/07/DNTLDP_AnnualReport_2021_compressed.pdf

Dodor, E. A., & Afenyadu, G. Y. (2005). Factors associated with tuberculosis treatment default and completion at the Effia-Nkwanta Regional Hospital in Ghana. Transactions of The Royal Society of Tropical Medicine and Hygiene, 99(11), 827–832. https://doi.org/10.1016/j.trstmh.2005.06.011

Fang, X.-H., Shen, H.-H., Hu, W.-Q., Xu, Q.-Q., Jun, L., Zhang, Z.-P., Kan, X.-H., Ma, D.-C., & Wu, G.-C. (2019). Prevalence of and Factors Influencing Anti-Tuberculosis Treatment Non-Adherence Among Patients with Pulmonary Tuberculosis: A Cross-Sectional Study in Anhui Province, Eastern China. Medical Science Monitor : International Medical Journal of Experimental and Clinical Research, 25, 1928–1935. https://doi.org/10.12659/MSM.913510

Gadoev, J., Asadov, D., Tillashaykhov, M., Tayler-Smith, K., Isaakidis, P., Dadu, A., Colombani, P. de, Hinderaker, S. G., Parpieva, N., Ulmasova, D., Jalolov, A., Hamraev, A., Ali, E., Boom, M. van den, Hammerich, A., Gozalov, O., & Dara, M. (2015). Factors Associated with Unfavorable Treatment Outcomes in New and Previously Treated TB Patients in Uzbekistan: A Five Year Countrywide Study. PLOS ONE, 10(6), e0128907. https://doi.org/10.1371/journal.pone.0128907

Gashu, K. D., Gelaye, K. A., & Tilahun, B. (2021). Adherence to TB treatment remains low during continuation phase among adult patients in Northwest Ethiopia. BMC Infectious Diseases, 21, 725. https://doi.org/10.1186/s12879-021-06428-6

Gebreweld, F. H., Kifle, M. M., Gebremicheal, F. E., Simel, L. L., Gezae, M. M., Ghebreyesus, S. S., Mengsteab, Y. T., & Wahd, N. G. (2018). Factors influencing adherence to tuberculosis treatment in Asmara, Eritrea: A qualitative study. Journal of Health, Population, and Nutrition, 37, 1. https://doi.org/10.1186/s41043-017-0132-y

Global tuberculosis report 2021. (n.d.). Retrieved 2 August 2022, from https://www.who.int/publications-detail-redirect/9789240037021

Gube, A. A., Debalkie, M., Seid, K., Bisete, K., Mengesha, A., Zeynu, A., Shimelis, F., & Gebremeskel, F. (2018). Assessment of Anti-TB Drug Nonadherence and Associated Factors among TB Patients Attending TB Clinics in Arba Minch Governmental Health Institutions, Southern Ethiopia. Tuberculosis Research and Treatment, 2018, 3705812. https://doi.org/10.1155/2018/3705812

Ibrahim, L. M., Hadejia, I. S., Nguku, P., Dankoli, R., Waziri, N. E., Akhimien, M. O., Ogiri, S., Oyemakinde, A., Dalhatu, I., Nwanyanwu, O., & Nsubuga, P. (2014). Factors associated with interruption of treatment among Pulmonary Tuberculosis patients in Plateau State, Nigeria. 2011. The Pan African Medical Journal, 17, 78. https://doi.org/10.11604/pamj.2014.17.78.3464

Jaiswal, A., Singh, V., Ogden, J. A., Porter, J. D. H., Sharma, P. P., Sarin, R., Arora, V. K., & Jain, R. C. (2003). Adherence to tuberculosis treatment: Lessons from the urban setting of Delhi, India. Tropical Medicine & International Health: TM & IH, 8(7), 625–633. https://doi.org/10.1046/j.1365-3156.2003.01061.x

Jimmy, B., & Jose, J. (2011). Patient Medication Adherence: Measures in Daily Practice. Oman Medical Journal, 26(3), 155–159. https://doi.org/10.5001/omj.2011.38

Jin, J., Sklar, G. E., Min Sen Oh, V., & Chuen Li, S. (2008). Factors affecting therapeutic compliance: A review from the patient's perspective. Therapeutics and Clinical Risk Management, 4(1), 269–286.

Kangethe, S., Kiplangat Arap Sang, R., & Ayiro, L. P. (2017). Patient factors which contribute to Non-adherence to TB treatment in Kericho and Nakuru counties of Kenya.

Kigozi, G., Heunis, C., Chikobvu, P., Botha, S., & van Rensburg, D. (2017). Factors influencing treatment default among tuberculosis patients in a high burden province of South Africa. International Journal of Infectious Diseases, 54, 95–102. https://doi.org/10.1016/j.ijid.2016.11.407

Kimani, E., Muhula, S., Kiptai, T., Orwa, J., Odero, T., & Gachuno, O. (2021). Factors influencing TB treatment interruption and treatment outcomes among patients

in Kiambu County, 2016-2019. PLOS ONE, 16(4), e0248820. https://doi.org/10.1371/journal.pone.0248820

Kulkarni, P., Akarte, S., Mankeshwar, R., Bhawalkar, J., Banerjee, A., & Kulkarni, A. (2013). Non-Adherence of New Pulmonary Tuberculosis Patients to Anti-Tuberculosis Treatment. Annals of Medical and Health Sciences Research, 3(1), 67–74. https://doi.org/10.4103/2141-9248.109507

Lei, X., Huang, K., Liu, Q., Jie, Y.-F., & Tang, S.-L. (2016). Are tuberculosis patients adherent to prescribed treatments in China? Results of a prospective cohort study. Infectious Diseases of Poverty, 5(1), 38. https://doi.org/10.1186/s40249-016-0134-9

Masini, E. O., Mansour, O., Speer, C. E., Addona, V., Hanson, C. L., Sitienei, J. K., Kipruto, H. K., Githiomi, M. M., & Mungai, B. N. (2016). Using Survival Analysis to Identify Risk Factors for Treatment Interruption among New and Retreatment Tuberculosis Patients in Kenya. PLOS ONE, 11(10), e0164172. https://doi.org/10.1371/journal.pone.0164172

Muture, B. N., Keraka, M. N., Kimuu, P. K., Kabiru, E. W., Ombeka, V. O., & Oguya, F. (2011a). Factors associated with default from treatment among tuberculosis patients in nairobi province, Kenya: A case control study. BMC Public Health, 11(1), 696. https://doi.org/10.1186/1471-2458-11-696

Muture, B. N., Keraka, M. N., Kimuu, P. K., Kabiru, E. W., Ombeka, V. O., & Oguya, F. (2011b). Factors associated with default from treatment among tuberculosis patients in nairobi province, Kenya: A case control study. BMC Public Health, 11, 696. https://doi.org/10.1186/1471-2458-11-696

Mzembe: Prevalence of Mycobacterium tuberculosis... - Google Scholar. (n.d.). Retrieved 1 August 2022, from https://scholar.google.com/scholar_lookup?journal=LSHTM&title=Prevalence+of+Mycobacterium+tuberculosis+infection+among+adolescents+in+rural+KwaZulu-Natal,+South+Africa&publication_year=2020&

Narasimhan, P., Wood, J., MacIntyre, C. R., & Mathai, D. (2013). Risk Factors for

Tuberculosis. Pulmonary Medicine, 2013. https://doi.org/10.1155/2013/828939

Ngugi, S. K., Muiruri, P., Odero, T., & Gachuno, O. (2020). Factors affecting uptake and completion of isoniazid preventive therapy among HIV-infected children at a national referral hospital, Kenya: A mixed quantitative and qualitative study. BMC Infectious Diseases, 20, 294. https://doi.org/10.1186/s12879-020-05011-9

Pan, D., Lin, M., Lan, R., Graviss, E. A., Lin, D., Liang, D., Long, X., Qin, H., Huang, L., Huang, M., & Chongsuvivatwong, V. (2018). Tuberculosis Transmission in Households and Classrooms of Adolescent Cases Compared to the Community in China. International Journal of Environmental Research and Public Health, 15(12), 2803. https://doi.org/10.3390/ijerph15122803

(PDF) Directly observed treatment short-course compliance and associated factors among adult tuberculosis cases in public health institutions of Hadiya zone, Southern Ethiopia. (n.d.). Retrieved 30 September 2021, from https://www.researchgate.net/publication/334131020_Directly_observed_treatment_short-course_compliance_and_associated_factors_among_adult_tuberculosis_cases_in_public_health_institutions_of_Hadiya_zone_Southern_Ethiopia

Sardar, P., Jha, A., Roy, D., Roy, S., Guha, P., & Bandyopadhyay, D. (2010). Intensive Phase Non-Compliance to Anti Tubercular Treatment in Patients with HIV-TB Coinfection: A Hospital-based Cross-Sectional Study. Journal of Community Health, 35, 471–478. https://doi.org/10.1007/s10900-009-9215-z

Schaaf, H. S., & Zumla, A. (2009). Tuberculosis E-Book: A Comprehensive Clinical Reference. Elsevier Health Sciences.

Suliman, Q., Lim, P. Y., Md. Said, S., Tan, K.-A., & Mohd. Zulkefli, N. A. (2022). Risk factors for early TB treatment interruption among newly diagnosed patients in Malaysia. Scientific Reports, 12, 745. https://doi.org/10.1038/s41598-021-04742-2

TB Adherence Report – National Tuberculosis, Leprosy and Lung Disease Program.

(n.d.). Retrieved 30 September 2021, from https://www.nltp.co.ke/download/tb-adherence-report/

Tesfahuneygn, G., Medhin, G., & Legesse, M. (2015). Adherence to Anti-tuberculosis treatment and treatment outcomes among tuberculosis patients in Alamata District, northeast Ethiopia. BMC Research Notes, 8, 503. https://doi.org/10.1186/s13104-015-1452-x

Toczek, A., Cox, H., du Cros, P., Cooke, G., & Ford, N. (2013). Strategies for reducing treatment default in drug-resistant tuberculosis: Systematic review and meta-analysis. The International Journal of Tuberculosis and Lung Disease: The Official Journal of the International Union Against Tuberculosis and Lung Disease, 17(3), 299–307. https://doi.org/10.5588/ijtld.12.0537

Tola, H. H., Tol, A., Shojaeizadeh, D., & Garmaroudi, G. (2015). Tuberculosis Treatment Non-Adherence and Lost to Follow Up among TB Patients with or without HIV in Developing Countries: A Systematic Review. Iranian Journal of Public Health, 44(1), 1–11.

Tuberculosis (TB) in Children—Health Encyclopedia—University of Rochester Medical Center. (n.d.). Retrieved 2 August 2022, from https://www.urmc.rochester.edu/encyclopedia/content.aspx?contenttypeid=90&contentid=P02548

Vijay, S., Kumar, P., Chauhan, L. S., Vollepore, B. H., Kizhakkethil, U. P., & Rao, S. G. (2010). Risk Factors Associated with Default among New Smear Positive TB Patients Treated Under DOTS in India. PLOS ONE, 5(4), e10043. https://doi.org/10.1371/journal.pone.0010043

Wanyonyi, A. W., Wanjala, P. M., Githuku, J., Oyugi, E., & Kutima, H. (2017). Factors associated with interruption of tuberculosis treatment among patients in Nandi County, Kenya 2015. The Pan African Medical Journal, 28(Suppl 1), 11. https://doi.org/10.11604/pamj.supp.2017.28.1.9347

Woimo, T. T., Yimer, W. K., Bati, T., & Gesesew, H. A. (2017). The prevalence and factors associated for anti-tuberculosis treatment non-adherence among

pulmonary tuberculosis patients in public health care facilities in South Ethiopia: A cross-sectional study. BMC Public Health, 17(1), 269. https://doi.org/10.1186/s12889-017-4188-9

Workie, M. G., Aycheh, M. W., Birhanu, M. Y., & Tsegaye, T. B. (2021). Treatment Interruption Among Drug-Susceptible Pulmonary Tuberculosis Patients in Southern Ethiopia. Patient Preference and Adherence, 15, 1143–1151. https://doi.org/10.2147/PPA.S307091

Yan, S., Zhang, S., Tong, Y., Yin, X., Lu, Z., & Gong, Y. (2018). Nonadherence to Antituberculosis Medications: The Impact of Stigma and Depressive Symptoms. The American Journal of Tropical Medicine and Hygiene, 98(1), 262–265. https://doi.org/10.4269/ajtmh.17-0383

Theron, G., Peter, J., Zijenah, L., Chanda, D., Mangu, C., Clowes, P., ... & Dheda, K. (2015). Psychological distress and its relationship with non-adherence to TB treatment: a multicentre study. BMC infectious diseases, 15(1), 1-12.

Kulkarni, P. Y., Akarte, S. V., Mankeshwar, R. M., Bhawalkar, J. S., Banerjee, A., & Kulkarni, A. D. (2013). Non. Adherence of new pulmonary tuberculosis patients to anti. Tuberculosis treatment. Annals of medical and health sciences research, 3(1), 67-74.

Wares, D. F., Singh, S., Acharya, A. K., & Dangi, R. (2003). Non-adherence to tuberculosis treatment in the eastern Tarai of Nepal. The international journal of tuberculosis and lung disease, 7(4), 327-335.

Boru, C. G., Shimels, T., & Bilal, A. I. (2017). Factors contributing to non-adherence with treatment among TB patients in Sodo Woreda, Gurage Zone, Southern Ethiopia: A qualitative study. Journal of infection and public health, 10(5), 527-533.

Zegeye, A., Dessie, G., Wagnew, F., Gebrie, A., Islam, S. M. S., Tesfaye, B., & Kiross, D. (2019). Prevalence and determinants of anti-tuberculosis treatment non-adherence in Ethiopia: a systematic review and meta-analysis. PloS one, 14(1), e0210422.

Negin, J., Abimbola, S., & Marais, B. J. (2015). Tuberculosis among older adults - time to take notice. International Journal of Infectious Diseases, 32, 135–137.

Seid, A., & Metaferia, Y. (2018). Factors associated with treatment delay among newly diagnosed tuberculosis patients in Dessie city and surroundings, Northern Central Ethiopia: a cross-sectional study. BMC Public Health, 18(1), 931-944.

Safwat, T., Abdel Fattah, E., & Soliman, A. (2019). Gender differences in pulmonary tuberculosis in Abbassia Chest Hospital. Egyptian Journal of Bronchology, 13(3), 408-415.

Samal, J. (2016). Health Seeking Behaviour among Tuberculosis Patients in India: A Systematic Review. JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH, 10(10), 1–6.

MoH-Kenya. (2017). The First Kenya Tuberculosis Patient Cost survey. (Issue). https://doi.org/10.1017/CBO9781107415324.004

Onazi, O., Gidado, M., Onazi, M., Daniel, O., Kuye, J., Obasanya, O., Odusote, T., & Gande, S. (2015). Estimating the cost of TB and its social impact on TB patients and their households. Public Health Action, 5(2), 127–131.

Wandwalo, E. R., & Mørkve, O. (2000). Delay in tuberculosis case-finding and treatment in Mwanza, Tanzania. The International Journal of Tuberculosis and Lung Disease, 4(2), 133–138.

Awoke, N., Dulo, B., & Wudneh, F. (2019). Total Delay in Treatment of Tuberculosis and Associated Factors among New Pulmonary TB Patients in Selected Health Facilities of Gedeo Zone. Hindaw Interdisciplinary Perspectives on Infectious Diseases, 18(3), 1-13.

Eltayeb, D., Pietersen, E., Engel, M., & Abdullahi, L. (2020). Factors associated with tuberculosis diagnosis and treatment delays in middle-east and North Africa: A systematic review. Eastern Mediterranean Health Journal, 26(4), 477–487.

Roberts, D. J., Mannes, T., Verlander, N. Q., & Anderson, C. (2020). Factors associated with delay in treatment initiation for pulmonary tuberculosis. ERJ Open

Research, 6(1). 0161-201.

Hinderaker, S. G., Madland, S., Ullenes, M., Enarson, D. A., Rusen, I., & Kamara, D. (2011). Treatment delay among tuberculosis patients in Tanzania: Data from the FIDELIS Initiative. BMC Public Health, 11(306), 1471–2458.

Stuurman, A. et. al., (2016).Intervention for improving adherence to treatment for latent tuberculosis infection: a systematic review. BMC Infect. Dis. 16:257. Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4897858/

WHO. (2008). Contributing to health System Strengthening Guiding Principles for National Tuberculosis Programmes (No. 1; 2008). Geneva: WHO

WHO. (2016a). Chest Radiography in Tuberculosis Detection: Summary of Current WHO reccomendations and Guidance on Programmatic Approaches. Geneva: WHO WHO (2013). Global tuberculosis report 2013. Geneva: World health organization

Gebreweld, F. H., Kifle, M. M., Gebremicheal, F. E., Simel, L. L., Gezae, M. M., Ghebreyesus, S. S., Mengsteab, Y. T., & Wahd, N. G. (2018). Factors influencing adherence to tuberculosis treatment in Asmara, Eritrea: A qualitative study. Journal of Health, Population and Nutrition, 37(1), 017-032.

Weyer, K., Mirzayev, F., Migliori, G. B., Van Gemert, W., D'Ambrosio, L., Zignol, M., Floyd, K., … & Raviglione, M. (2013). Rapid molecular TB diagnosis: Evidence, policy making and global implementation of Xpert MTB/RIF. In European Respiratory Journal, 42(1), 252–271.

David, L. (2004). Control of communicable diseases manual 18th edn. Washington, D.C: American Public Health Association.

Rieder, H. L. (1999). Epidemiological Basis of Tuberculosis Control. 1st edn. Paris: IUATLD.

Ssewaya, A. (2011). Sustaining adherence to antiretroviral therapy among HIV and AIDS patients in Uganda. Unpl. PHD Thesis. Amsterdam Institute for Social Science Research (AISSR).

Uldall, K.K., K. Palmer, K. Whetten and C. Mellins, C. (2004). Adherence in people living with HIV and AIDS, mental illness, and chemical dependency: A Review of the literature. AIDS Care, 16: 71-96.

Koethe, J.R., A. Lukusa, J. M. Giganti, B. H. Chi, K. N. Christopher, M. I. Limbada, Y. Banda, and J.S. A. Stringer (2010. Association between weight gain and clinical outcomes among malnourished adults initiating antiretroviral therapy in Lusaka, Zambia. Journal of Acquired Immune Deficiency Syndrome, 53:507–513.

Veal, J.A. (2006). Research methods for leisure and tourism: A practical guide. Englewood Cliffs, New Jersey: Prentice Hall.

Ogunbodede, E. (2004). HIV and AIDS situation in Africa. International Dental Journal, 546: 352-360.

Byakika-Tusiime, J, Crane, J.H. Oyugi, K. Ragland, A. Kawuma, P. Musoke, and D.R. Bangsberg (2009). Longitudinal antiretroviral adherence in HIV+ Ugandan parents and their children initiating HAART in the MTCT-Plus family treatment model: role of depression. Available at http://www.ghdonline.org/uploads/Byakika-Tusiime2009.pdf . Retrieved on 12th April, 2016.

Tuller, D. M., D. R. Bangsberg, J. Senkungu, N.C. Ware, N. Emenyonu and Sheri D. Weiser (2010). Transportation costs impede sustained adherence and access to HAART in a clinic population in South Western Uganda: A qualitative study. AIDS Behavior, 14:778–784.

Rosen, S., M. Fox and C. Gill (2007). Patient retention in antiretroviral therapy programs in Sub-Saharan Africa: A systematic review. PLoS Med, 298:1691-1701.

Charurat, M., B.R. Oyegunle, A.Habib, E. Eze, P. Ele, I. Ibangas, S. Ajayi, M.Eng, P. Mondal, U. Gebi, E. Iwu, M. Etiebet, A. Abimiku, P. Dakum and J.W.Farley (2010). Patient retention and adherence to antiretrovirals in a large antiretroviral therapy programme in Nigeria: A longitudinal analysis for risk factors. PLOS

ONE, 5: 1-8.

Machtinger, E.R. and Bangsberg, D.R. (2006). Adherence to HIV antiretroviral therapy. Available at http://hivinsite.ucsf.edu/InSite?page=kb-03-02-09. Retrieved on 30th May, 2013.

Jaiswal, A., V.Singh, J.A. Ogder, J.D.H. Porter P.P. Sharma R. Sarin, V.K. Arora and R.C.Jain (2003). Adherence to tuberculosis treatment: Lessons from the urban setting of Delhi, India. Tropical Medicine and International Health, 8: 625-633.

Appendices

Appendix I: Questionnaire

Part 1: Patient Identifier

1. Patient serial number:_____Date:_____Time: _____
2. Sub County TB number: _____
3. Name/Initials of interviewer: _____
4. Where informant available: Relationship to the case
   □Mother □Father □Brother □Sister □Uncle □Aun
   □Other (specify) _____
5. Contacts of the respondent _____

Part I: Demographic information

6. Sex □Male □Female
7. Age (in years): _____
8. County__Sub County:_____Name of health facility: ____
9. Religion: □Islam □Christian □Hindu □African tradition □Others (Specify) _____

Part 2: Patient related factors

10. Type of Tuberculosis: □Pulmonary Bacteriologically confirmed □ Pulmonary clinically diagnosed
    □Extra pulmonary
11. Type of patient □ New □Previously treated
12. Current Phase of treatment □ Intensive □ Continuation
13. HIV status: □Positive □Negative □Unknown
14. Nutrition status: □Normal □ underweight □Over weight

15. Do you have a treatment supporter? □ Yes □No If yes specify who_____
16. Have you experienced any form of side effects from the medication you are taking for TB? □Yes□No

Part 3: School related factors

17. Level of education: □ Primary school □Secondary school
18. Type of school you are: □Day school □Boarding school
19. Has your school allocated you some specific time to come and collect your medication? □ Yes□No
20. Do you have a treatment supporter in school □ Yes □No? If yes specify who _____

Part 4: Health system factors

21. Approximately how far is your school/ home from this health facility
    □ within 1 km □2-5kms □ Over 5kms
22. How often do you collet your drugs from the health facility □ Daily □Weekly □Every two weeks
    □Once a month □ Don't know
23. Do you have a specific day of collecting your treatment? □ Yes □ No if yes specify _____
24. When you collect drugs from the health facility, what time of the day are you expected to be at thefacility to pick drugs? □ Any time □ Morning hours □ Afternoon hours □ Don't know
25. How long does the facility take to serve you? □ Less than 30minutes □ Between 30mins to 1 hour □more than one hour
26. How much does it cost you to come to the hospital (one way)? □ No cost □Less than 50 shillings
    □Between 50-100shillings □ More than 100 shillings
27. How can you describe the attitude of the health workers who serve you in this hospital? □Friendly □Unfriendly
28. Have you ever visited the hospital for drug collection and failed to get you medication □ Yes □No

29. Did you ever receive any health education messages about TB treatment□ Yes □ No

Part 5: Social related factors

30. Do you have any person reminding you to take medication? □Yes □No
31. How many meals do you take per day? □One □Two □Three □More than 3
32. Have you experienced any form of stigma from the time you were diagnosed with TB? □Yes □No

Part 6: Assessment of adherence to TB treatment

33. How often do you take your medication □Daily □ alternate days □ Once a week □ Once a month □Other, Specify_____?
34. On estimation how many days you have failed to take your medication? □None □one day
    □ More than one day
    If the patient has ever missed taking their medication what are the reasons for this?
    ……
    ……..
35. How many anti TB tablets do you take in a day? *(Confirm with the prescription given per patient'sweight),* Does it march with the prescription □Yes □No
36. What time do you take your medicine? □Any time of the day □Specific time of the day (document the time)
37. Has the patient ever failed to keep his/ her appointment? (Verify this with the TB appointment card and the TB register) □Yes □No
38. What suggestions/ recommendations would you give to help us improve your adherence to treatment regarding drugs collection at the health facility? □ Allow treatment to be collected on weekends □ Allow treatment to be collected in school □Allow treatment to be collected beyond class time hours

Appendix II: Schedule of activities

Activity	January	February	March	April	May	June	July	August	Septemb	October	November	December	January
Protocol preparation and development of tools													
IREC approval and clearance													
Training of research assistants													
Pre-testing tools													
Data collection													
Data entry, cleaning & analysis													
Report writing													
Dissemination													

Appendix III: Budget

Item	Unit Cost-KSH	Number of Pax	Number of days	Total costs
Training				
Investigators allowance	3000	1	4	12,000
Research assistants Lunches	2000	2	3	12,000
Stationery	300	2	3	1,800
Printing of data collection tools	5000	1	3	15,000
Data collection process				
Transport for R. assistants	1000	2	40	80,000
Lunches for R. assistants	1000	2	40	80,000
Investigator's accommodation	3000	1	40	120,000
Investigator's transport	1000	1	2	2000
Thesis Printing and Binding	2000	10	1	20000
Dissemination	2000	20	1	40000
Total				382,800

Appendix IV: Consent form

Consent for Assessment of level of TB treatment adherence and its associated factors among school going children with TB in Meru County, Kenya

A. Introduction/Background

My name is Rhoda Pola, a student of Moi university undertaking a Masters course in Field Epidemiology. I invite you to be in this research study. Please ask a question if there is anything you don't understand.

TB is an airborne disease that that can affect anyone in the community including school goingchildren. It presents with the following symptoms; cough, fever, weight loss and night sweats.Through this study we hope to understand more about the level of TB treatment adherence and its associated factors among school going children with TB in Meru County.

B. Purpose

The purpose of the research study is to help us understand how school going children with TB adhere to treatment and the various factors that can affect your treatment adherence.

C. Procedures

If you agree to be in the research study, we will ask you some questions about life and health.We will ask you a few questions regarding your TB treatment, we will also look at your TB record appointment and record cards. There are no samples to be collected or any procedures to be done.

D. Risks and discomforts

There are no foreseeable benefits or dangers to you in this study.

E. Benefits

Adhering to TB treatment is beneficial to an individual and the community at large as it will result to better treatment outcomes hence reducing further transmission, development of drug resistance TB and worsening of symptoms leading to death.

Understanding the level of TB treatment adherence and the various factors that affect treatment adherence will help usdevelop measures that will help improve adherence among other school going children diagnosed with TB.

F. Confidentiality

I would like to assure you that the study records will be kept private and physically secure from unauthorized access. I will not record your name on my records instead I will use abbreviations. The results of this study will be presented to Moi University, National TB program and Field Epidemiology Training Program as a group not as individual results and that names will not be included.

G. Right to refuse

You are free to choose to be a part of this research study. Even if you agree to be in this studyand in the course of interview you feel otherwise you may stop at any time

H. Persons to contact

If at any time, you have questions related to this study, you may contact Ms. Rhoda Pola,Principal Investigator for this study on 0723022406.

I, the undersigned, do hereby consent to participate in this study whose nature, purpose andobjectives have been fully explained to me. I was given an opportunity to ask questions, all of which have been answered to my satisfaction and that I have chosen to participate. I am aware that participation is voluntary and that there are no consequences of withdrawing from the study. I have been informed that all data provided will be used for the purposes ofthe study only.

Name of the respondent…….……Date……

Name of the investigator…….. Signature…….. Date…….

Appendix V: Assent form

Assent for Assessment of level of TB treatment adherence and its associatedfactors among school going children with TB in Meru County, Kenya

Introduction/Background

My name is Rhoda Pola, a student of Moi university undertaking a Masters course in Field Epidemiology. I invite you to be in this research study. Please ask a question if there is anything you don't understand.

TB is an airborne disease that that can affect anyone in the community including school goingchildren. It presents with the following symptoms; cough, fever, weight loss and night sweats.Through this study we hope to understand more about the level of TB treatment adherence and its associated factors among school going children with TB in Meru County.

Purpose

The purpose of the research study is to help us understand how school going children with TB adhere to treatment and the various factors that can affect your treatment adherence.

Procedures

If you agree to be in the research study, we will ask you some questions about life and health.We will ask you a few questions regarding your TB treatment, we will also look at your TB record appointment and record cards. There are no samples to be collected or any procedures to be done.

Risks and discomforts

There are no foreseeable benefits or dangers to you in this study.

Benefits

Adhering to TB treatment is beneficial to an individual and the community at large as it will result to better treatment outcomes hence reducing further transmission, development of drug resistance TB and worsening of symptoms leading to death.

Understanding the level of TB treatment adherence and the various factors that affect treatment adherence will help usdevelop measures that will help improve adherence among other school going children diagnosed with TB.

Confidentiality

I would like to assure you that the study records will be kept private and physically secure from unauthorized access. I will not record your name on my records instead I will use abbreviations. The results of this study will be presented to Moi University, National TB program and Field Epidemiology Training Program as a group not as individual results and that names will not be included.

I, the undersigned, do hereby assent to participate in this study whose nature, purpose andobjectives have been fully explained to me. I was given an opportunity to ask questions, all of which have been answered to my satisfaction and that I have chosen to participate. I am aware that participation is voluntary and that there are no consequences of withdrawing from the study. I have been informed that all data provided will be used for the purposes ofthe study only.

Name of the respondent…….……Date……

Name of the investigator ……... Signature……... Date…….

Appendix VI: List of the patients selected to be interviewed per selected facility

County	Sub County	Health Facilityselected	Year	Sector	Patient Name	Patient Supporter Name
Meru	Igembe South	Nyambene District Hospital	2021	Public	Francis Mwenda Mbiti	Mwiti
Meru	Igembe South	Nyambene District Hospital	2021	Public	Patrick Mutethia Mutura	.
Meru	Igembe North	Kawiru Dispensary	2021	Public	Joses Michubu Isaiah	Morris mwiti
Meru	Igembe South	Maua Methodist Hospital	2021	Private	Jackson Gitonga Gichunge..	Esther
Meru	Igembe South	Nthambiro Dispensary	2021	Public	Sabina Karimi .	Benard mwasikula
Meru	Igembe South	Nyambene District Hospital	2021	Public	Lucy Nkatha Mwenda	Mwenda
Meru	Imenti South	Kieni Kia Ndege Dispensary	2021	Public	Leonard Kirimi Mucheke	Emily kinanu
Meru	Igembe South	Nthambiro Dispensary	2021	Public	Janet Kamathi James	James mwandiki
Meru	Tigania West	Aina Onlus	2021	Private	Edwin Mugiira .	.
Meru	Tigania East	Mulika Dispensary	2021	Public	Fredrick Mugambi Gichunge	Sis
Meru	Igembe North	Mutuati Sub-District Hospital	2021	Public	Charles Ayub Aciuru	Florence kananu
Meru	Igembe North	Mutuati Sub-District Hospital	2021	Public	Boniface Kaberia Mburuku	Lenah mukami
Meru	Tigania West	Mbeu Sub-District Hospital	2021	Public	Ernest Muriuki .	.
Meru	Buuri	Kibirichia Sub-district Hospital	2021	Public	Joseph Kimathi Mwirigi	Lilian kimathi
Meru	Igembe South	Kangeta Health Centre	2021	Public	Rodgers Gitonga Gachui	Martha
Meru	Imenti South	Mitunguu Medical Services	2021	Private	John M'arithi M'nchani	.
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Wilson Nguru M'amikwa	Jediel muthuri
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Doris Kawira Murugu	Gladys mwiriki
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Kelvin Mwenda Mugaa	Jerica ngugi
Meru	Igembe South	Kalamene Dispensary	2021	Public	Salesio Gitonga Miriti.	Josphat
Meru	Igembe South	Kalamene Dispensary	2021	Public	Gilbert Gitonga Maoka	.
Meru	Imenti North	Kiburine Dispensary	2021	Public	Mairutha Nahson Mutembei	,
Meru	Imenti North	Igoki Dispensary	2021	Public	Josphat Murithi Mukiri	Richard muketha
Meru	Imenti South	Kanyakine District Hospital	2021	Public	Martin Murungi Kibiti	James kibiti
Meru	Igembe South	Nthambiro Dispensary	2021	Public	Ruth Kagwiria .	George
Meru	Igembe South	Nthambiro Dispensary	2021	Public	Ephantus Mwika Paul	Cecilia
Meru	Igembe South	Nthambiro Dispensary	2021	Public	Viscola Kaguri .	Lorna kaari
Meru	Igembe South	Nyambene District Hospital	2021	Public	Eric Muriira Muratha	Harriet
Meru	Igembe South	Nyambene District Hospital	2021	Public	Ronald Muriithi Muroki	Teresia
Meru	Igembe South	Nyambene District Hospital	2021	Public	Ratanya Mugambi Kinyaki	Patrick
Meru	Igembe South	Nyambene District Hospital	2021	Public	Juniour Bwayo .	Teresia
Meru	Imenti North	Meru District Hospital	2021	Public	Morris Magirii Kaimenyi	,
Meru	Imenti North	Chugu Dispensary	2021	Public	Marcella Gaceri Muriuki	,
Meru	Imenti North	Chugu Dispensary	2021	Public	Ezekiel Bundi Anampiu	,
Meru	Imenti North	Kiburine Dispensary	2021	Public	Daniel Kubania Rukwaru	,
Meru	Tigania West	Miathene District Hospital	2021	Public	Leakey , Mbeeria	Timothy murathani
Meru	Tigania West	Miathene District Hospital	2021	Public	Lydiah Kendi Mugambi	.

Meru	Tigania West	Mweronkaga Dispensary	2021	Public	Silas Kathure Merethu	.
Meru	Tigania West	Mweronkaga Dispensary	2021	Public	Precious Makena .	Sarah mbigaigu
Meru	Tigania West	Kunene Dispensary	2021	Public	Paul Mutethia Ruth	Ruth nkatha
Meru	Imenti South	Kanyakine District Hospital	2021	Public	Francis Mutuma Muthuri	.
Meru	Tigania West	Uringu Health Centre	2021	Public	Esther Kawira .	.
Meru	Imenti South	Mitunguu Dispensary	2021	Public	Mary Kendi Daniel	.
Meru	Imenti South	Mitunguu Dispensary	2021	Public	David Muriungi Mukiri	.
Meru	Imenti South	Mitunguu Dispensary	2021	Public	Stanley Mwenda Mbaka	.
Meru	Tigania West	Mituntu Cottage Hospital	2021	Private	Masila James Sele	.
Meru	Tigania West	Mituntu Cottage Hospital	2021	Private	Wallace Njoroge Maina	.
Meru	Igembe South	Akachiu Health Centre	2021	Public	Josphine Kanyua Kirichia	Jonah
Meru	Igembe South	Akachiu Health Centre	2021	Public	Seberina Kaloki Kingori	Joseph
Meru	Igembe South	Akachiu Health Centre	2021	Public	Agnes Gakii Ntomungania	Lilian
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Penina Karimi Njeru	Dennis munene
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Stanley Murithi M'ikiome	.
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Abigael Kendi Mutuma	Glory kinya
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Silveria Makandi Peter	Diana daughter
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Joshua Mugambi M'mwari	Judy
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Erick Mwiti Meme	.
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Stanford Mutwiri Japhet	Makena kinanu
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Jediel Kijogi Guantai	Beatrice kirianki
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Timothy Murega Kathukumi	.
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Purity Mukiri Mugambi	Jamlick mutembei
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Lewis Mutai Mugambi	Eunice
Meru	Tigania West	Miathene District Hospital	2021	Public	David Mwenda Koome	.
Meru	Tigania West	Mweronkaga Dispensary	2021	Public	Joel Gichubiri Simba	Jacob mugambi
Meru	Tigania West	Uringu Health Centre	2021	Public	Alice Gacheri Mururu	Justus kianira
Meru	Igembe North	Athirunjine Runjine Dispensary	2021	Public	Erusto Gikundi Michubu	Jesca
Meru	Igembe North	Muuru Dispensary	2021	Public	Fredrick Mutuma Nkunja	Jackline gakii
Meru	Igembe North	Mutuati Catholic Hospital	2021	Other Faith Based	Rispher Kathoni Mugambi	,
Meru	Igembe North	Mutuati Catholic Hospital	2021	Other Faith Based	Nanis Kathomi Mugambi	.
Meru	Igembe North	Mutuati Catholic Hospital	2021	Other Faith Based	Fridah Muthoni Mati	.
Meru	Tigania West	Mituntu Health Centre	2021	Public	Samson Muthuri Mwongera	Duncan munene
Meru	Tigania West	Limauru Dispensay	2021	Public	Joseph Gacharaki Kirea	Laibuni ntabari
Meru	Buuri	Ruiri Rural Health Demonstration Center	2021	Public	Emis Gatwiri Moses	Cate
Meru	Buuri	Ruiri Catholic Health Centre	2021	Private	Erick Mugambi .	.
Meru	Buuri	Ruiri Catholic Health Centre	2021	Private	Judith Kananu Kaaria	.

Meru	Buuri	St. Theresa Kiirua Hospital (Kiirua)	2021	Private	Kennedy Marangu Mutegi	Joseph maore
Meru	Buuri	St. Theresa Kiirua Hospital (Kiirua)	2021	Private	Christine Karimi Murithi	Jane teresa
Meru	Buuri	St. Theresa Kiirua Hospital (Kiirua)	2021	Private	Daniel Mugendi Mwenda	Winnie makena
Meru	Buuri	St. Theresa Kiirua Hospital (Kiirua)	2021	Private	Caroline Kinya Gitonfa	Purity kananu
Meru	Buuri	St. Theresa Kiirua Hospital (Kiirua)	2021	Private	Andrew Mutuma Weru	Lucy karimi
Meru	Buuri	St. Theresa Kiirua Hospital (Kiirua)	2021	Private	John Gitinga Mati	Mati kariuki
Meru	Igembe South	Kangeta Health Centre	2021	Public	Pamela Kathure Kubai	Jerusha
Meru	Igembe South	Kangeta Health Centre	2021	Public	Naftali Mugambi Ntoburi	Francis
Meru	Igembe South	Kangeta Health Centre	2021	Public	Mbaabu Ntoimunya .	Fridah
Meru	Igembe South	Kangeta Health Centre	2021	Public	Breda Mukami Kennedy	Mercy
Meru	Buuri	St. Theresa Kiirua Hospital (Kiirua)	2021	Private	Doreen Kendi Gerald	john mwiti mbabu
Meru	Buuri	Ruiri Rural Health Demonstration Center	2021	Public	Washington Chanja Kabari	Nancy karwitha
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Joseph Mutugi Mbijiwe	Marion makena
Meru	Imenti South	Consolata Hospital (Nkubu)	2021	Private	Duncan Gituma M'mugambi	Moses kiambi
Meru	Imenti South	Consolata Hospital (Nkubu)	2020	Private	Josphat Mugute M'mwarania	.
Meru	Buuri	Timau Sub-District Hospital	2020	Public	Caroline Makena Mwiti	Patricia wanjiru
Meru	Buuri	Timau Sub-District Hospital	2020	Public	Omondi Otieno .	Brenda mwikali
Meru	Igembe South	Kangeta Health Centre	2020	Public	Morris Gitonga Ncubiri	Kathambi
Meru	Igembe South	Nyambene District Hospital	2020	Public	Julius Koome .	Lilian
Meru	Igembe South	Kangeta Health Centre	2020	Public	Florence Kinya Ezekiel	.
Meru	Imenti South	St Ann Hospital	2020	Private	Justus Kaburu Guantai	Simon guantai
Meru	Imenti South	St Ann Hospital	2020	Private	Evelyne Wanja .	.
Meru	Tigania West	Mbeu Sub-District Hospital	2020	Public	Francis Kirema Kamani	Janet nthama
Meru	Tigania West	Mbeu Sub-District Hospital	2020	Public	Gerald Muchena Ithai	.
Meru	Tigania West	Mbeu Sub-District Hospital	2020	Public	Patrick Mburunga Murungi	.
Meru	Tigania West	Mbeu Sub-District Hospital	2020	Public	Anthony Mwika Thiaine	.
Meru	Imenti South	Kanyakine District Hospital	2020	Public	Joseph Mugaa Muthamia	.
Meru	Tigania West	Aina Onlus	2020	Private	David Kimathi Kirigia	.
Meru	Tigania West	Aina Onlus	2020	Private	Duncan Munene Isack	.
Meru	Igembe South	Nyambene District Hospital	2020	Public	Feisq Abdi Ahmed	Mohammed awaa
Meru	Igembe South	Nyambene District Hospital	2020	Public	Titus Kathomi Kinyua	Stephen mwendia
Meru	Igembe South	Nyambene District Hospital	2020	Public	Abigael Ntinyari .	Lilian
Meru	Igembe South	Nyambene District Hospital	2020	Public	Festus Mutua Mutabari	Naomi
Meru	Igembe South	Nyambene District Hospital	2020	Public	Antony Muchiri Kamotho	Esther
Meru	Igembe South	Nyambene District Hospital	2020	Public	Stephen Ratanya Kaberia	Mary
Meru	Igembe South	Nyambene District Hospital	2020	Public	Gladys Kathure Mutunyi	Kirimi
Meru	Igembe South	Nyambene District Hospital	2020	Public	Dennis Muthee Benard	Sabina
Meru	Tigania West	Aina Onlus	2020	Private	Duncan Munene Isaac	.
Meru	Imenti South	Kionyo Dispensary (Imenti South)	2020	Public	Nelly Ntinyari Kimathi	.
Meru	Igembe South	Nthambiro Dispensary	2020	Public	Moses Mbaabu Kiriinya	Doris
Meru	Igembe South	Antubetwe Njoune	2020	Public	Vincent Muriithi Faith	Faith
Meru	Imenti South	Consolata Hospital	2020	Private	Lawrence Mutugi	Doreen

		(Nkubu)			Irangu	
Meru	Buuri	Naari Health Centre	2020	Public	Jacob M Materi	Susan mukami
Meru	Buuri	Naari Health Centre	2020	Public	Nicholas Mutuma Kiogora	Payrucjia
Meru	Igembe South	Maua Methodist Hospital	2020	Private	Mungathia Ndethi Nkirumbi	Susan
Meru	Imenti South	Mitunguu Medical Services	2020	Private	Flavio Muthuri Mutugwa	Caroline kinanu
Meru	Imenti South	Mitunguu Medical Services	2020	Private	Justus Kaburu Guantai	.
Meru	Igembe South	Antubochiu Dispensary	2020	Public	Josphat Kamanja Mwithalii	.
Meru	Igembe South	Antubochiu Dispensary	2020	Public	Joseph Mutua Muroki	Fred
Meru	Imenti South	Mitunguu Medical Services	2020	Private	Daniel Kimathi M'murithi	.
Meru	Imenti South	Mitunguu Dispensary	2020	Public	Damaris Mwiendi Kagendo	Mother kagendo
Meru	Imenti South	Consolata Hospital (Nkubu)	2020	Private	Miracle Wanja Gitonga	Gitonga father
Meru	Imenti North	Kiburine Dispensary	2020	Public	Eliud Cokera Murithi	,
Meru	Imenti North	Methodist University	2020	Private	Aziel Munene Martin	Martin
Meru	Imenti North	Methodist University	2020	Private	Roy David Adera	,
Meru	Imenti North	Meru District Hospital	2020	Public	Bridget Karamuta Marangu	,
Meru	Imenti North	Gitoro Dispensary	2020	Private	Solomon Mwiti Murungi	Morris kirimi
Meru	Imenti North	Gitoro Dispensary	2020	Private	M'gaiti M'mwereria M'mwereria	,
Meru	Imenti North	Gitoro Dispensary	2020	Private	Caleb Kinoti Gikundi	,
Meru	Imenti North	Gitoro Dispensary	2020	Private	Esther Nchugune M'turuchiu	,
Meru	Imenti North	Kianjuri Dispensary	2020	Public	Samson Kinyua Henry	,
Meru	Imenti North	Meru District Hospital	2020	Public	Betty Wairimu Muthoni	,
Meru	Imenti North	Meru District Hospital	2020	Public	Priscilla Kananu Henry	Caroline
Meru	Imenti North	Meru District Hospital	2020	Public	Elias Musangi Mathiu	,charity
Meru	Imenti North	Meru District Hospital	2020	Public	Amos Mutembei Munene	Kananu rebecca
Meru	Imenti North	Gakoromone Dispensary	2020	Public	Geofrey Miriti Antony,	,
Meru	Imenti North	Kianjuri Dispensary	2020	Public	Joseph M'kirimania M'achaunia	Rosemary
Meru	Imenti North	Gakoromone Dispensary	2020	Public	James Munyoki Kyalo	,
Meru	Tigania West	Ncooro Dispensary	2020	Public	Sarah Kanario Nabea	Irene karimi
Meru	Meru Central	Cottolengo Mission Hospital	2020	Private	Charles Mugatia Stephen	Kiambati
Meru	Igembe South	Thamare Dispensary	2020	Public	Abed Ntonja Mbiko	Gladys
Meru	Igembe South	Kiraone Dispensary	2020	Public	Kennedy Kirimi Robert	Robert
Meru	Igembe North	Laare Health Centre	2020	Public	Julius Munyambu Kairiama	.
Meru	Igembe North	Kathelwa Dispensary	2020	Public	Jeremiah Ntarangwi Naituli	,
Meru	Igembe North	Machungulu Dispensary	2020	Public	Dorcas Mwende Joseph	,
Meru	Igembe North	Laare Health Centre	2020	Public	Frankline Mugendi Lubetaa	Kaari
Meru	Igembe North	Laare Health Centre	2020	Public	Morris Mukaria Ntongai	Joanina kithaka
Meru	Igembe North	Muuru Dispensary	2020	Public	Titus Ntongai Mlikiara	.
Meru	Igembe North	Kiani Kia Etama Dispensary	2020	Public	James Mwendia Jeremiah	,
Meru	Igembe North	Laare Health Centre	2020	Public	Mark Mutharimi Murithi	M 'itumbiri
Meru	Igembe North	Laare Health Centre	2020	Public	Kenedy Marangu Mutegi	Esther gacheri
Meru	Igembe North	Laare Health Centre	2020	Public	Caroline Kiende Lubetaa	Roseline kaari
Meru	Igembe North	Laare Health Centre	2020	Public	Caroline Kendi Lubetaa	Roseline kaari
Meru	Igembe North	Kawiru Dispensary	2020	Public	Lucy Kendi Meme	,

Meru	Imenti South	Kirogine Dispensary	2020	Public	Zakayo Muriungi M'mwobobia	Fransiska ngugi
Meru	Tigania West	Mutionjuri Health Centre	2020	Public	Evans Kipkorir Ngetich	Amos rop
Meru	Igembe North	Kaelo Dispensary	2020	Public	Carol Kathure Jennifer	,
Meru	Igembe North	Kaelo Dispensary	2020	Public	Agnes Makena Kobia	,
Meru	Igembe North	Laare Health Centre	2020	Public	Dennis Munene Kainga	,
Meru	Igembe North	Muuru Dispensary	2020	Public	Peter Mwiria Kairis	Felix kaimenyi
Meru	Igembe North	Machungulu Dispensary	2020	Public	Triposa Karambu Kaundu	Ronald kirimi
Meru	Igembe North	Athirunjine Runjine Dispensary	2020	Public	Dennis Muthee Benard	Sabina kaleo
Meru	Igembe North	Kathelwa Dispensary	2020	Public	Ann Kajuju Titua	.
Meru	Igembe North	Theere Health Centre	2020	Public	Frankline Murithi Ntoiti	,
Meru	Igembe North	Theere Health Centre	2020	Public	Charles Mugendi Theuri	,
Meru	Igembe North	Theere Health Centre	2020	Public	Japhet Gichunge M'kiunga	,
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Salesio Gatwiri ,	,
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Shadrack Mwiti Liria	James karithi
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Sharon Kinya Rose	Rose mukethi
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Douglas Mungathia Kamai	Geofrey kamae
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Agnes Muthoni Kaberia	Daniel kaberia
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Eliud Muthomi Mungathia	Jeniffer kajuju
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Saweria Nkatha Mugambi	Jackson mugambi
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	M'amunyaki M'mweti Francis	.
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Hussen Ahmed Mohammed	,
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Peter Mwiti Koome	Margret thirindi
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Andrew Mutethia M'imantara	Kaluluma
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Mukami Jelinda Ntongai	Mukuchia
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Mary Kalayu Nkunja	Sarah kanario
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Leonidah Karugi Kobia	,
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Damaris Kanocia Julius	Jacinta
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Joseph Kiulio Kirichi	Catherine nkatha julius
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Silas Kirimi John	.
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Juliana Mugure Mbaabu	,
Meru	Tigania East	Kiguchwa Dispensary	2020	Public	Julia Mwendwa John	.
Meru	Tigania West	Limauru Dispensay	2020	Public	Martha Karuta Mutethia	.
Meru	Tigania East	Giithu Dispensary	2020	Public	Johana Muchomba .	.
Meru	Buuri	Timau Sub-District Hospital	2020	Public	Franchis Murijo ,	Sharon murijo
Meru	Buuri	Timau Catholic Dispensary	2020	Private	Francis Gitonga Ndegwa	Flora karimi
Meru	Buuri	Naari Health Centre	2020	Public	Raphael Mugambi Kirimi	Lilian kinya
Meru	Buuri	St. Theresa Kiirua Hospital (Kiirua)	2020	Private	Comfort Ntinyari Kanja	Purity kawira
Meru	Imenti South	St Ann Hospital	2020	Private	Eliud Muthomi Kiugu	Nicholus mugendi
Meru	Imenti South	Consolata Hospital (Nkubu)	2020	Private	Zakary Muthukumi Gitonga	.
Meru	Imenti South	Consolata Hospital	2020	Private	Francis Mwiti Nkaabu	Catherine

		(Nkubu)				wife
Meru	Imenti South	Kirogine Dispensary	2020	Public	Fredrick Mputhia Nyamu	.
Meru	Imenti South	Consolata Hospital (Nkubu)	2020	Private	Fridah Kawira Magaju	Edith
Meru	Igembe South	Nyambene District Hospital	2020	Public	Charles Mugendi Kirichia	Zakayo
Meru	Igembe South	Nyambene District Hospital	2020	Public	Jacob Mugambi Kiburi	Beatrice
Meru	Igembe South	Nyambene District Hospital	2020	Public	Triposa Karambu .	Beatrice
Meru	Igembe North	Kathelwa Dispensary	2020	Public	Reuben Mugambi Kiulio	,
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Jacob Mugambi Kiburi	Lawrence kithure
Meru	Igembe North	Theere Health Centre	2020	Public	Lewis Mwirigi Kiburi	Zakayo
Meru	Igembe North	Mutuati Sub-District Hospital	2020	Public	Robert Gikundi Kaimuri	.

Appendix VII: IREC Letter

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
COLLEGE OF HEALTH SCIENCES
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2020/119
Approval Number: 0003662

4th September, 2020

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
04 SEP 2020
APPROVED
P. O. Box 4606-30100 ELDORET

Rhoda Pola Karisa
Moi University,
School of Public Health,
P.O. Box 4606-30100,
ELDORET- KENYA.

Dear Ms. Karisa,

ASSESSMENT OF LEVEL OF TB TREATMENT ADHERENCE AND ITS ASSOCIATED FACTORS AMONG SCHOOL GOING CHILDREN WITH TB IN MERU COUNTY, KENYA

This is to inform you that ***MU/MTRH-IREC*** has reviewed and approved your above research proposal. Your application approval number is ***FAN: 0003662***. The approval period is **4th September, *2020 – 3rd September, 2021.***

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***MU/MTRH-IREC***.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***MU/MTRH-IREC*** within 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***MU/MTRH-IREC*** within 72 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***MU/MTRH-IREC.***

Prior to commencing your study; you will be required to obtain a research license from the National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and other relevant clearances. Further, a written approval from the CEO-MTRH is mandatory for studies to be undertaken within the jurisdiction of Moi Teaching & Referral Hospital (MTRH), which includes 22 Counties in the Western half of Kenya.

Sincerely,

DR. S. NYABERA
DEPUTY-CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc CEO - MTRH Dean - SOP Dean - SOM
Principal - CHS Dean - SON Dean - SOD

Appendix VIII: NACOSTI Letter

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: 515124

Date of Issue: 15/September/2020

RESEARCH LICENSE

This is to Certify that Ms.: RHODA Pola POLA of Moi University, has been licensed to conduct research in Meru on the topic: ASSESSMENT OF LEVEL OF TB TREATMENT ADHERENCE AND ITS ASSOCIATED FACTORS AMONG SCHOOL GOING CHILDREN WITH TB IN MERU COUNTY, KENYA for the period ending : 15/September/2021.

License No: NACOSTI/P/20/6647

515124

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.