PULMONARY TUBERCULOSIS THERAPY OUTCOMES AMONG PATIENTS, ADHERENT OR NON-ADHERENT TO THERAPY AT THE INTENSIVE PHASE OF TREATMENT IN KAKAMEGA COUNTY, KENYA

BY

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTERS IN PUBLIC HEALTH, MOI UNIVERSITY

DECLARATION

Declaration by the Candidate

I declare that this research thesis is my original work which has not been presented for a degree accolade or publication in any other institution/university or for any award. No part of this thesis may be reproduced without the prior written permission of the author and/or Moi University.

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DEDICATION

This work is dedicated to my son, Jamie- Cray

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DEFINITION OF TERMS

Adherence: Refers to taking medication on time and keeping appointments for drug refills as scheduled by the clinical personnel (Stagg et al., 2020). In this study, the daily intake of medication for the first 56 days at 95% confidence level will determine adherence at the intensive phase of tuberculosis treatment.

Enabler's Package: Incentives by certain health programs that help in promoting health seeking behaviours.

Incidence: Defined as the number of new cases and relapse cases of TB that occur within a time period, usually a year.

Mortality: Defined as the number of deaths caused by TB within a given time period, usually a year.

Outcome: Treatment outcome refers to changes in the underlying situation reflecting the positive or negative effects on the patient's wellbeing. In this study, the outcomes included getting cured, treatment failure, death or getting lost to follow-up.

Prevalence: The cumulative number of tuberculosis cases at a given point in time.

Timing of Medication: Medically prescribed intervals for ingestion of drugs

Enhanced Adherence: To promote, educate, motivate and observe a patient taking medication to ensure it is done correctly and to completion

Recovery: After TB treatment completion, smear test is performed, and the patient put under at least 1-2 weeks observation. If the medical practitioner observes no signs of TB and the test is smear negative, the patient is considered recovered

Relapse: It is the regrowth of the same *Microbacterium tuberculosis* strain that caused the initial TB episode (Mirsaeidi & Sadikot, 2018). When a smear test turns positive after treatment completion and recovery, it is considered a relapse.

LIST OF ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
CDP	County Development Programme
CEC	County Executive Committee
CHMT	County Health Management Team
CHV	Community Health Volunteer
CSO	Civil Society Organization
CTLC	County TB and Leprosy Coordinator
DALY's	Disability Adjusted Life Years
DOTS	Directly Observed Treatment, Short Course
FDC	Fixed Dose Combination
GTB	Global Tuberculosis Program
HIV	Human Immunodeficiency Virus
IEC	Information Education and Communication
IREC	Institutional Research and Ethics Committee
ISTC	International Standards for Tuberculosis Care
KEPH	Kenya Essential Package for Health
KHIS	Kenya Health Information System Database
KPHC	Kenya Population and Housing Census

LTFU	Lost to Follow-Up
MDG	Millennium Development Goals
MDR-TB	Multi-Drug-Resistant Tuberculosis
MDT	Multi-Disciplinary Team
MOH	Ministry of Health/Medical Officer In-Charge of Health
MSF	Médecins sans Frontières
MTB	Mycobacterium Tuberculosis
NGO	Non-Governmental Organization
NTLD-P	National Tuberculosis, Leprosy and Lung Disease Program
NTP	National Tuberculosis Program
PLHIV	People Living with HIV/AIDS
RIF	Rifampicin
SAT	Self- Administered Treatment
SCH	Sub- County Hospital
SCTLC	Sub-County TB and Leprosy Coordinator
SDG	Sustainable Development Goals
VAS	Visual Analogue Scale
VCT	Voluntary Counseling and Testing
WHO	World Health Organization

ABSTRACT

Background: Tuberculosis (TB) therapy is delivered in two stages, an intensive and a continuation stages or phases. Treatment failure is the result of a futile intensive phase while relapse is the result of an unsuccessful continuation phase of therapy. The Tuberculosis Cohort Report of 2019 from the Kenya Health Information System (KHIS) Aggregate, indicated that of the 1,088 new tuberculosis cases enrolled for treatment in Kakamega County, 61 (5.6%) did not have the required smear test done after the intensive phase of therapy while 144 (13.2%) were unaccounted for after the same stage.

Objectives: To assess the association between adherence at the intensive phase and the treatment indicators, demonstrate the effect of adherence on treatment outcome and to identify the factors that contribute to non-adherence to TB treatment during the intensive phase.

Methods: The study utilized a comparative study design targeting 1,974 TB patients across 5 randomly sampled health facilities in Kakamega County. Systematic sampling was then applied to select 127 clients who adhered and 127 who did not adhere to TB treatment at the intensive phase. A data collection questionnaire and an interviewer guide were then employed for the collection of data. Descriptive statistics in terms of frequencies and proportions were engaged. Chi Square test (x^2) and logistic regression were performed to measure the association between adherence at the intensive phase and treatment indicators. The Odds and Risk Ratios were also determined.

Results: Out of the 254 clients enrolled, 45.3% were male while 54.7% were female. There was significant association of occupation and adherence at the intensive phase (x^2=7.8, p=.021). The same was also evident in the duration of treatment at the facility (x^2=254.0, p<.001). Of those who adhered to therapy in the intensive phase, 123 (96.9%) completed their continuation phase of therapy in the desired 4 months of treatment, while 81 (63.8%) of those who did not adhere to the intensive phase of therapy did not even get into the continuation phase of therapy. Considering the final outcome, 15 (11.8%) of those who did not adhere to therapy at the intensive phase died with none dying among those that adhered. The odds of treatment success were 18.569 greater for those who adhered to therapy at the intensive phase with a relative risk of 0.136 of either being dead or lost to follow-up.

Conclusion: Adherence to TB therapy at the intensive phase is hindered when one is not engaged in gainful employment. Once a patient is put on TB treatment, there should be constant linkage to the health facility for continuity in treatment. There is increased risk of death among those who do not adhere to therapy at the intensive phase.

Recommendations: The National, County and Sub-County TB Coordinators should have increased focus on TB patients who have been identified as unemployed or are not engaged in gainful employment so as to improve their adherence to prescribed therapy at the intensive phase. National Tuberculosis, Leprosy and Lung Disease-Program (NTLD-P) should streamline reporting mechanisms between facilities and allow a patient who is a distance away from the parent facility to pick their medication from an accessible facility.

TABLE OF CONTENTS

DECLARATION.....**ii**
DEDICATION.....**iii**
ACKNOWLEDGEMENT.....**iv**
DEFINITION OF TERMS.....**v**
LIST OF ABBREVIATIONS.....**vii**
ABSTRACT.....**ix**
TABLE OF CONTENTS.....**x**
LIST OF TABLES.....**xiv**
LIST OF FIGURES.....**xvi**
CHAPTER ONE.....**1**
1.0 Introduction.....1
1.2 Problem Statement.....8
1.3 Justification.....10
1.4 Research Question.....11
1.5 Objectives.....11
1.5.1 Broad Objective.....11
1.5.2 Specific Objectives.....11
CHAPTER TWO.....**12**
2.0 LITERATURE REVIEW.....12
2.1 Introduction.....12
2.1.1 Demographic Characteristics of Kakamega County.....14
2.1.2 Health in Kakamega County.....15
2.2 Adherence to Prescribed Tuberculosis Therapy at the Intensive Phase.....17
2.2.1 Adherence to Tuberculosis Treatment in Africa.....17
2.2.2 Adherence to Tuberculosis Treatment in Kenya.....21
2.2.3 Fixed Dose Combinations and Adherence.....23
2.2.4 Adherence Monitoring.....24
2.3 Effect of Non-Adherence to TB Therapy on Treatment Outcome.....25
2.4 Factors that Contribute to Non-Adherence to TB Therapy.....26

2.4.1 The Individual....26
2.4.2 Interpersonal Relationships....28
2.4.3 The Organization around TB Treatment....29
2.4.4 The Community....31
2.4.5 Public Policy....33
2.4.6 The Directly Observed Therapy Short-Course Strategy....34
2.4.7 The readiness for provision of TB services....35
2.4.8 Adherence and Responsibility....37
2.5 Conceptual Framework....38
CHAPTER THREE....41
3.0 METHODOLOGY....41
3.1 Study Area....41
3.2 Study Design....43
3.3 Study Population....43
3.4 Sample Size Determination....43
3.4.1 Key Informants....44
3.5 Sampling Procedure....45
3.6 Selection Criteria....46
3.6.1 Inclusion Criteria....46
3.6.2 Exclusion Criteria....46
3.7 Data Collection....46
3.7.1 Validity and Reliability....46
3.8 Data Management and Data Analysis....47
3.9 Dissemination of Findings....48
3.10 Ethical Consideration....48
3.11 Study Limitations....49
CHAPTER FOUR....50
4.0 RESULTS....50
4.1 Socio Demographic Characteristics of the Participants....50
4.2 Assessment of Treatment Adherence....53

4.2.1 Duration of Treatment at the Treatment Site 53
4.2.2 Kaplan-Meier's Survival Analysis in the Continuation Phase of Therapy 53
4.2.3 Co-morbidity Risk Factor 54
4.2.4 Treatment Entry 55
4.2.5 Means of Diagnosis 55
4.2.6 Treatment Follow-Up 57
4.2.7 The Continuation Phase 58
4.3 Effect of Adherence on Treatment Outcome 59
4.3.1 Smear Microscopy Results after the Intensive Phase 59
4.3.2 Outcome after the entire Treatment Period 61
4.4 Association between Adherence and Treatment Indicators 62
4.4.1 Association between adherence and the outcomes 62
4.4.2 Association between adherence at the intensive phase and treatment indicators at multivariate level 67
4.5 Reflections on Adherence to Therapy at the Intensive Phase of Treatment 68
4.5.1 TB Treatment Literacy and Adherence 68
4.5.2 Reasons Non-Adherence to TB treatment at the Intensive Phase 69
CHAPTER FIVE 72
5.0 DISCUSSION 72
5.1 Objective 1: Association Between Adherence at the Intensive Phase and Treatment Indicators 72
5.2 Objective 2: Effects of Adherence to TB Therapy at the Intensive Phase, on Treatment Outcomes 73
5.3 Objective 3: Factors Contributing to Non-Adherence to Tuberculosis Treatment during the Intensive Phase 75
5.3.1 Movement/changing of location during treatment period 75
5.3.2 Pill count 76
5.3.3 Patient feeling better 76
5.3.4 Stigma 76

5.3.5 Drug side effects 77

CHAPTER SIX 78

6.0 CONCLUSION AND RECOMMENDATIONS 78

6.1 Conclusion 78

6.2 Recommendations 79

REFERENCES 81

APPENDICES 92

Appendix I: IREC Approval Letter 92

Appendix II: NACOSTI Research License 93

Appendix III: Informed Consent Agreement 94

Appendix IV: Utoaji Idhini 95

Appendix V:Data Collection Questionnaire 96

Appendix VI: Interviewer Guide for Key Informants 99

Appendix VII:Plagiarism Awareness Certificate 102

LIST OF TABLES

Table 3.1: Administrative Units in Kakamega County 41

Table 3.2: Number of selected clients per facility 45

Table 4.1: Gender of the respondents 50

Table 4.2: Approximate distance from residence to health facility (n = 254) 51

Table 4.3: Occupation of the participants (n = 254) 52

Table 4.4: Duration of TB treatment at the facility (n = 254) 53

Table 4.5: Co- morbidity risk factor (n = 254) 55

Table 4.6: Type of patient (n = 254) 55

Table 4.7: Means of pulmonary TB diagnosis (n = 254) 56

Table 4.8: DOT Services (n = 254) 57

Table 4.9: Intensive phase- daily drug intake as observed by Health Care Worker or Treatment Supporter (n = 254) 58

Table 4.10: Continuation phase of therapy (n = 254) 59

Table 4.11: Smear result after intensive phase of therapy (n = 254) 60

Table 4.12: Outcome after treatment period (n = 254) 61

Table 4.13: Relationship between Adherence/Non-Adherence at the Intensive Phase and Final Treatment Outcome (n = 254) 62

Table 4.14: Relationship between Adherence/Non-Adherence and Test after Intensive Phase 62

Table 4.15: Relationship between Occupation, Adherence and Non-Adherence to the Intensive Phase (n = 254) 63

Table 4.16: Relationship between Occupation, Treatment Outcome and Non-Adherence to the Intensive Phase (n = 127) 64

Table 4.17: Relationship between Treatment Duration, Treatment Outcome and Non-Adherence to the intensive Phase (n = 127) 64

Table 4.18: Relationship between Type of Patient, Treatment Outcome and Non-Adherence to the Intensive Phase (n = 127) 65

Table 4.19: Relationship between Test after Intensive Phase, Treatment Outcome and Non-Adherence (n = 127) 65

Table 4.20: Adherence versus Outcome Crosstabulation 66

Table 4.21: Odds Ratio and Relative Risk 66

Table 4.22: Multivariate Analysis 68

LIST OF FIGURES

Figure 1.1: Rate of Defaulting by Month at 95% CI (Source: (Muture et al., 2011)) ... 7

Figure 2.1: Adapted Conceptual Framework for Factors Affecting Treatment Adherence 40

Figure 3.1: Map of Kakamega County (Kakamega County Development Profile, 2013) 42

Figure 4.1: Age Categories by Gender of the Participants 51

Figure 4.2: Survival Analysis in the Continuation Phase of Treatment 54

CHAPTER ONE

1.0 Introduction

Each year, millions of people around the world suffer from ill-health as a result of Tuberculosis which is categorized alongside the Human Immunodeficiency Virus as a prime cause of fatality the world over thus making it a significant global health issue (*UNAIDS*, 2015). As concerns single disease-causing agents mortalities throughout the globe, TB is prime, ahead of malaria and Human Immunodeficiency Virus, as indicated by a report by WHO in 2019 (WHO, 2019a). The year 2014 estimates for example, showed there were approximately 9.6 million new TB cases from which number, 5.4 million cases were men, 3.2 million others were women while 1.0 million cases children. Deaths related to TB were estimated at around 1.5 million (HIV-negative TB cases taking 1.1 million as 0.4 million got attributed to HIV-positive TB cases). The mortality audit of this number revealed that nearly 890,000 were adult males, 480,000 adult females while 140,000 were children. This number is concerningly high thus requires a Call to Action: TB can be completely cured when diagnosed in good time and the appropriate therapy administered (WHO, 2015).

Since the turn of the millennium, the pivot had been on the journey towards 2015 global targets that aimed at reduction in the burden of TB disease, contextualized by the Millennium Development Goals (MDGs). Target 6.c of the goals was geared towards making TB incidence fall. This also included halving TB prevalence and mortality rates in comparison to the 1990 levels. WHO facilitated the development and recommended an approach dubbed The Stop TB Strategy (Raviglione & Uplekar, 2006), between 2006–2015, as a means of achieving the set MDG targets. TB can be treated, cured and overly prevented. Despite all the steps taken prior to achieve these three outcomes, the TB incidence rate has not gone down (less than 2%) in the preceding years after the end

of MDG and subsequent transition into SDG, with over 4 million cases of missed opportunities either in diagnosis treatment (WHO, 2019a). The eradication of Tuberculosis remains one of the endearments of Sustainable Development Goal (SDG) III. This was constituted recently and is meant to address the short comings in TB care, with the inclusion of the community instead of concentrating more on decentralizing TB care at the health care facilities (Chebet et al., 2022).

TB is curable when therapy employs the first-line regimen of antibiotics that covers 6 months of treatment. Treatment non-compliance is a major threat to programs aligned the control and prevention of TB. Taking of over 90% of prescribed TB medication can result to cure, while over 95% indicates that a patient is 'highly adherent'. WHO defines treatment default by a patient as interruption in treatment for 2 or more months (WHO, 2019b). The rate of defaulting is therefore a structural mode of monitoring adherence (Nezenega et al., 2020). The risk of morbidity, mortality and drug resistance, both at the individual or community spectrum is increased by non-adherence to TB therapy.

Through the three-phase fluoroquinolone-based 4 month TB therapy regimens, it was revealed that adherence to TB treatment is a single element linked to treatment outcome (Vernon et al., 2019). Analysis of the meta-data from these trials showed non-adherence to be the single most potent element associated with unsuitable treatment outcomes. A number of countries have embraced the standard international guidelines in reference to TB diagnosis, treatment and monitoring, though most patients continue to get into programs that are not well organized and monitored (Danso et al., 2015). Non-compliance to TB therapy is more often than not associated with various levels of discontinued therapy, low quality of treatment medication, and at times the fact that health care workers wrongly prescribe TB medication (Enos et al., 2018). The ability

of patients or the population to define what TB is and how it is transmitted is quite important during the treatment course since considering the hierarchy of the rationale for not adhering to treatment the most common is patients not knowledgeable on the causes TB, its transmission and also its prevention. This in turn compromises the health-seeking behavior towards adherence to prescribed therapy (Mondal et al., 2014).

Tuberculosis is listed as one of the notifiable diseases under Part III of the Public Health Act CAP 242, Laws of Kenya, (Republic of Kenya, 2012) and has a significant association with poverty. Both the TB patient and their indirect relation can find themselves in a set of circumstances where the expenditures in treatment go up as earnings come down in what is otherwise referred to as a 'medical poverty trap'. Populations that are malnourished, are poor and ultimately exposed to overcrowding have a significant linkage to the eventuality of TB. This is to mean that TB cases occur highest in the developing countries and areas regarded as marginalized like shanties in cities. Social inequities like inter and intra migrations, drug and alcohol abuse, the scourge of HIV/AIDS among many, are a characteristic of marginalized societies in big cities and have a great influence in the rates of TB morbidity and mortality (WHO, 2019a). In other quarters, low levels of education, the occurrence of hunger, lack of proper shelter, logistical issues with transportation among very many, are socio-economic factors with significant effect to the adherence to TB therapy and by extension TB treatment outcomes (Córdoba-Doña et al., 2012); (Hargreaves et al., 2011). A study showed that the cost borne as a consequence of getting infected by TB in Kenya was at a median total of KSH 22,753 (US$ 350). In reference to the median household earnings before the disease onset, this figure was invariably inferred to almost equal a quarter of it. A number of patients have been known to dispose of assets or incur loans so as to offset expenses incurred due to ailment. About 85% of the

economic burden of individuals or their relations affected by TB is attributed to indirect costs as a result of reduction or loss of income, with an estimated median of KSH 19,123 (US$ 294). Productivity also decreases significantly as a consequence of TB illness. Patients of TB incur direct costs when they move to get refills or for follow-up sputum tests. Alongside this, nutrition, shelter, and the administration of drugs are contributors to direct costs. In relation to Direct Observation of Treatment (DOT), there are rare cases of attributable costs as most patients are assisted through treatment by family members. With HIV/TB co-infection, and mainly due to its high prevalence, the relative costs are mostly borne by the patient (Mauch et al., 2011).

Kenya has realized a decrease in TB/HIV co-infection rate from 60% in 2004 to 31% in 2015 (MOH, 2015). There was a further decline to 24% in 2020. However, these patients still realized poor TB treatment outcomes (80% treatment completion, 12% death and 4.2% LTFU) despite a high uptake of ART of 95%. (Ngari et al., 2023).
In 2016, NTLD-P and in relation to the drug resistance survey (DRS) of 2015 reported that the prevalence of MDR TB was 2.1 % and 0.7 % among relapse cases and new cases respectively (Ministry of Health (Kenya), 2016). The notified DR TB cases were 433 with corresponding 368 cases confirmed as resistant to rifampicin. 2.3% of MDR TB cases was attributed to children while the number of males was twice as much as that of females (Ministry of Health (Kenya), 2015).

The definitions linked to the measurement of adherence may either be process-oriented or outcome-oriented. Cure rate is an example of an outcome-oriented definition which makes use of treatment end-result as a marker of success. On the other hand, process-oriented markers employ intermediate variables e.g. appointment-keeping and pill count as measures of the level of adherence (Valencia et al., 2017). The correlation of

intermediate outcomes with the real prescribed quantities of medication taken to confer a definitive solution to the clinical management of TB is unknown (Sotgiu et al., 2015). Natural history will define the point of departure of adherence from non-adherence as the process that brings about achievement of the desired therapeutic outcome. The rationale of non-adherence in TB therapy still remains an empirical conundrum. As such, the focus needs to be on the conversion of definitive adherence to TB therapy into an empirical mode of monitoring both the timing and quantity of the drugs taken (Stagg et al., 2020); (Vernon et al., 2019).

WHO recommends that where appropriate, the optimized frequency of dosing for new pulmonary TB patients is daily, at the intensive phase of therapy. There is significant evidence that this helps in eliminating the attributable risk of treatment failure and the related acquired resistance to drugs (WHO & WHO, 2010). The most preferable course, therefore, is that new pulmonary TB patients are provided with a regimen comprising of 6 months of Rifampicin (2HRZE/4HR). During this time, either a trained supervisor attached to the health facility, a family member or guardian assists the patient in making sure the medication is adhered to, employing the DOTs strategy as recommended by WHO (Karumbi & Garner, 2015).

From the Kenya Tuberculosis Prevalence Survey of 2016 (NTLD, 2016), the estimation of the number cases of TB was deemed higher than earlier reported. A case notification rate of 158/100000 persons was reported with a caveat that almost half of those cases reported are missed every year (Enos et al., 2018). TB treatment in Kenya is free. However, the patient has to pay for some of the other TB services associated with its management such as chest X-rays. Nutrition, especially vitamin supplementation and

balancing of the diet are likewise important during medication thus augmenting the cost of TB care.

There was a steady drop in the number of notified cases of TB from 329 per 100,000 population in 2008, to an estimated incidence of 268 per 100,000 population in 2013 (KNBS et al., 2015). This sustained decline may have been attributed to the increased ART coverage and the likelihood of the 21% hitherto cases diagnosed with TB remaining un-notified as revealed by the TB inventory study (Tollefson et al., 2016). 83% of pulmonary TB cases from a total of 81,518 were notified in 2015. 45% of the pulmonary TB cases (36,817) were bacteriologically confirmed while relapse cases were 8% (6,776). The age band that bore most of the cases was 25 to 44 years with almost half attributed to this cohort while 8.5% were children (Ministry of Health (Kenya), 2015). The ratio attributed to males is considered disproportionate with elevated numbers in the 24 to 34 years category. People living in urban marginalized settings bear the biggest burden in Kenya.

Kenya as a country is highly dependent on passive case finding. Active case finding is usually carried out but is a rather targeted strategy applied at some departments within the health facilities and screening of high-risk populations like prisoners, members of key population and people living with HIV. Technological advancements in health have largely been welcomed in Kenya. This is exemplified by the taking on of Gene-Xpert MTB/RIF, which is a new and functional TB diagnostic which is mooted to make in-roads nationally and improve the overall output of bacteriological confirmation of TB and detection of drug resistant TB (Ministry of Health (Kenya), 2016).

Tuberculosis is ranked 4th among the leading causes of mortality in Kenya, at 6.3% of total deaths, and 6th when it comes to the leading causes of Disability Adjusted Life

Years (DALY's) at 4.8% (NTLD, 2019). The total number of TB cases reported in 2014 was 89, 294, 9.2% of whom were children. The public sector contributed 78% of the cases while 20.1% of cases were drawn from the private sector (Ministry of Health (Kenya), 2015).

A study found the rate of defaulting to be highest within the first two months of treatment, the intensive phase of therapy, more so during the second month, for the preferred 6 months regimen (Muture et al., 2011).

Figure 1.1 below shows the rate of defaulting on TB treatment by month for both the 6-month regimen and the 8-month regimen. It shows that though cumulatively, the numbers are high from the 3rd to 6th/8th month, the rate is higher during the first two months of treatment.

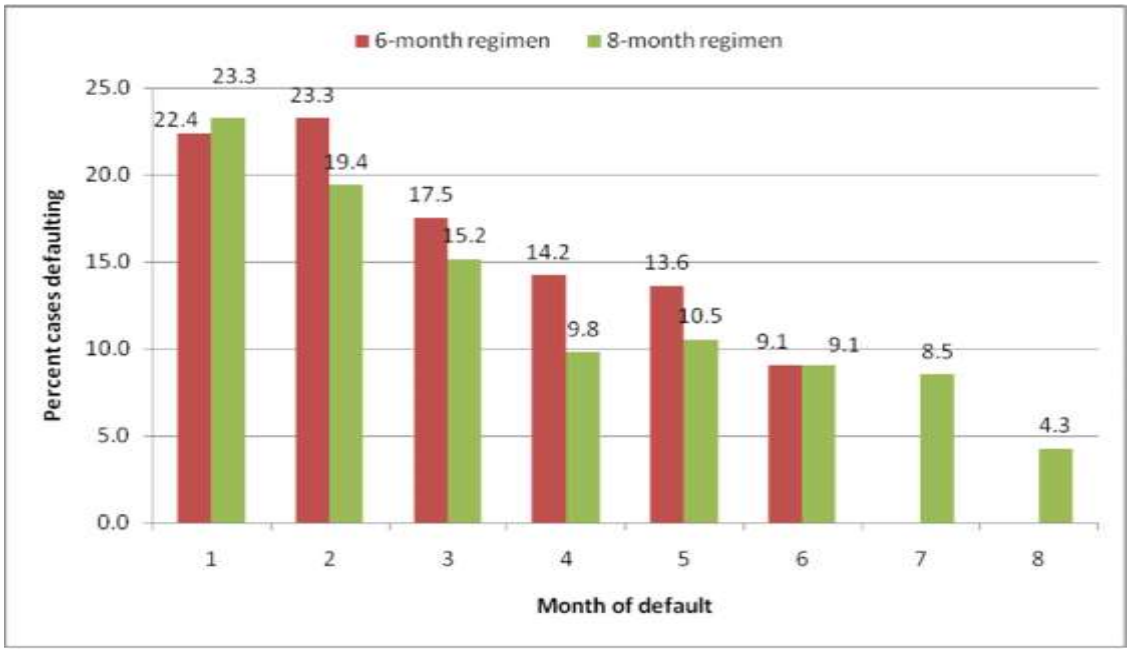


Figure 1.1: Rate of Defaulting by Month at 95% CI (Source: (Muture et al., 2011))

1.2 Problem Statement

In recent years, TB has continually received substantial attention as one of the prime contributors to the global burden of ill health. This is true, especially in low- and middle-income countries where its association with the occurrence of HIV/AIDS comes to the fore (Mbithi et al., 2014). Interventions geared towards improving the fidelity to treatment plans have been designed but still poor adherence to treatment TB persists. The major impediment to effective and lasting answers to TB treatment adherence remains the all-inclusive comprehension of the related barriers and facilitators (Munro et al., 2007). Through the years, DOTs has remained the main TB control strategy the world over, recommended by WHO (Gabriel & Mercado, 2011).

There is evidence that 90-95% of patients with pulmonary TB will have negative sputum or culture after 3 months application of multidrug treatment regimen. A positive sputum/culture at this stage will be considered as treatment failure. Therefore, successful navigation through the intensive phase is the basis for TB treatment success. The array of factors that contribute to treatment failure, which involve the prescription, the drugs being administered and the patients themselves, thus need to be addressed.

A study in Uganda showed the proportion of defaulting on anti-TB medication to be at 59% (Castelnuovo, 2010), while a study in Nairobi, Kenya showed the that poor adherence was highest within the initial two months of therapy. This rate was shown to decrease from the 3rd month through to the 6th/8th month (Muture et al., 2011).

The socio-economic status of the majority of the residents of Kakamega County was previously heavily supported directly or indirectly by the Mumias Sugar Company. Since its collapse, cash flow within the county has greatly declined, cane farmers have found it hard cater for their routine needs, some even shifting to maize or subsistence farming, the company workers were laid off, the bee-hive of activities that characterized

the Mumias Town and its environs have gone down almost making it a ghost town (Otenyo, 2019).

The Tuberculosis Cohort Report of the year 2019 from the Kenya Health Information System (KHIS) Aggregate, ranked Kakamega County 11th among the 47 counties of Kenya, in reference to new bacteriologically confirmed TB cases that had been enrolled on treatment during the same period. Among the 11 counties of the Western Region of Kenya, Kakamega was ranked 2nd, after Kericho County, by the same report which shows that there is a high disease burden in Kakamega County as far as the region is concerned.

Further analysis of this data showed that of the 1,088 new tuberculosis cases enrolled for treatment in Kakamega County, 5.6% (61) did not have the sputum smear microscopy test performed after the intensive phase of therapy conducted, which is a requirement before a patient is ushered into the continuation phase. Further, 13.2% (144) were unaccounted for after the same phase of treatment. This accounted for a total of about 18.8% of undesired outcome during the first two months of treatment.

These results do not bode well with WHO's End-TB Strategy which visualizes a state where the world would be void of TB, with zero mortality, disease infection and suffering due to the disease. The strategy was endorsed at the 67th World Health Assembly in the year 2014 (Uplekar et al., 2015), considering that an unsuccessful intensive phase of therapy leads to treatment failure.

1.3 Justification

There are studies that indicate that the risk of TB is quite high among populations living in poverty or low socio-economic status (Chebet et al., 2022) as is this case in Kakamega County.

The 18.8% posting of undesired outcome at the intensive phase is an indicator of non-adherence and is quite significant (Djouma, Noubom, Ateudjieu, et al., 2015). On overall, in reference the KHIS Aggregate report of 2019, this time considering the outcomes after the entire treatment period, out of the 1,088 new bacteriologically confirmed cases in Kakamega County, 853 (78.4%) had a smear negative test which meant that they were deemed cured, 6.4% (70) cases were reported to have died while 5.5% (60) cases were lost to follow-up.

There is strong evidence that daily intake of anti-tuberculosis medication enhances the elimination of cases of treatment failure and acquired resistance to TB drugs (WHO & WHO, 2010). It is a very tedious process for most patients. Nevertheless, it is the best way of ensuring that TB treatment is successful.

Since daily intake of drugs is the mode of the intensive phase of therapy, it is prudent to look at ways of improving the adherence in this phase as a basis of also improving adherence in the continuation phase thus conferring improvement to the success in treatment of Tuberculosis.

This study thus seeks to investigate TB treatment defaulters at the intensive phase, why they defaulted and the outcome when there is adherence to treatment at this phase.

1.4 Research Question

What is the impact of adherence to prescribed therapy on treatment outcome at the intensive phase of pulmonary TB treatment?

1.5 Objectives

1.5.1 Broad Objective

To determine the outcome of adherence to prescribed pulmonary TB therapy at the intensive phase of therapy.

1.5.2 Specific Objectives

1. To assess the association between adherence at the intensive phase and the treatment indicators.
2. To determine the effects of adherence to TB therapy at the intensive phase, on treatment outcome.
3. To identify factors that influence adherence to TB treatment during the intensive phase of therapy.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

Some key words can help describe adherence, for example persistence in a particular practice or tenet. This description appropriately aligns the tenacity with which the patient's behavior needs to correspond to the medication plan agreed together with the health care provider in sticking to a therapeutic regimen (Jimmy & Jose, 2011).

The causative agent for TB is the bacillus *Mycobacterium tuberculosis* which commonly targets the lungs, thus pulmonary TB, but can also get into other areas of the human anatomy thus causing extra-pulmonary TB. Disease surveillance indicates that TB is an airborne disease that can be spread through bacterial expulsion, for example through coughing. To get infected, just a very small quantity of these germs need to be inhaled into the lungs from where the bacillus finds its way through the blood to the different areas of the body (Sulis et al., 2014). Out of around 2-3 billion people that get infected with *Mycobacterium tuberculosis,* almost 5-15% get to develop the disease though other factors like infection with HIV might amplify this probability (WHO, 2015).

The upsurge of TB infections worldwide commenced in the 1980 era, which was synonymous with increase in HIV infections. This was ascribed to the fact that HIV weakens an individual's immune system, rendering it fragile against TB organisms. The correlation of TB to HIV is mutually fatal in that one drives the amplification of the other. Mortality audits the world over implicate TB among the prime reasons for death among people living with HIV. An individual suffering from both HIV and TB is considered to have Advanced HIV Disease (AHD) meaning the immune systems is

greatly predisposed to the risk for developing TB disease (WHO, 2013a) among other risks like:

i) Malnourished individuals,

ii) Persons suffering from diabetes,

iii) Persons with chronic liver disease,

iv) Persons with acute renal failure,

v) Individuals at the terminal stage kidney disease,

vi) Individuals on chemotherapy,

vii) Children who are under 5 years of age,

viii) TB patients within 2 years of relapse,

ix) People who use or inject drugs,

x) Smokers of tobacco,

xi) Persons with below 10% of ideal body weight and,

xii) The elderly

Sputum smear microscopy, which entails observation of the bacillus in samples of sputum under a microscope, is renown globally as the most preferred diagnostic though it was developed a little over 100 years ago (Desikan, 2013) With continual technological advancements however, more diagnostics have been realized especially where rapid molecular TB tests are concerned generally targeting bacteriological and drug resistance. This has garnered increased use in some countries where gradually, smear microscopy as a diagnostic is being replaced, though still being used in treatment monitoring. With increased laboratory capacity in some countries comes the possibility of diagnosing cases of TB using culture method which has widely been adopted as the reference standard as of 2011 (Tiemersma, 2011); (WHO, 2015).

Studies that came before anti-tuberculosis medications revealed that about 70% of persons with positive sputum smear results would not live beyond 10 years of diagnosis. Further analysis in this regard indicated that, still during this era, the death rate after 10 year period for those who had been diagnosed as culture-positive but their smear results were negative was 20% (Tiemersma et al., 2011).

The 1940s saw the invention and development TB drugs that became effective (Chakraborty & Rhee, 2015). The availability of Rifampicin, which is the most effective medication that is classified as first line, was realized in the 1960s. The regimen that has been recommended as first line includes four drugs, Rifampicin, Isoniazid, Pyrazinamide and Ethambutol, especially for the newly diagnosed cases which is administered for six months (WHO & WHO, 2010). Regular reports from WHO member states indicate an average therapy success rate of about 85%. MDR-TB on the other hand, a consequence of resistance to Rifampicin and Isoniazid, requires augmented treatment duration, augmented toxicity and drugs that are quite expensive with the recommended treatment from WHO being 20 months. Worldwide the success rate is still not high.

The year 2015 marked the terminal end of the eras that encompassed Stop TB as a strategy and MDG. This also signified the beginning of the 2015-2030 SDGs and Stop TB strategy eras and the start of a post-2015 development framework (2016–2030) of SDGs (Uplekar et al., 2015).

2.1.1 Demographic Characteristics of Kakamega County

The annual growth rate in Kakamega County is projected to be at 2.5%. The projected population figure by the year 2022 was 2,296,907. The County's work force projection was at 1,033,512 by the year 2018 comprising of 548,129 females and 485,383 males

with a further projection of 1,086,501 by the year 2020 and 1,142,207 for 2022 (County Government of Kakamega, 2018).

Gainful employment was flagged as a problem by the 2009 Housing Census as evidenced by 196,938 residents being reported as unemployed. Employment in the agricultural quarter stood at 756,711, the self-employed were 34,052 while the ones on wage employment were 2,554, not forgetting 54 apportioned to urban self-employment. Transport by 2-wheeled vehicles, *boda boda*, and cottage industries, *jua kali,* formed a comparably considerable number of the residents considered to be self- employed. Not to be left behind are those who are self-employed in the agricultural sector who majorly carried out planting, ploughing of land, bush clearing, weeding, harvesting and after harvesting activities. There are some who were engaged in forestry, construction of buildings, making of bricks and mining.

2.1.2 Health in Kakamega County

As of 2014, the county had 229 health facilities. There was one Comprehensive Teaching and Medical Institution, twelve Sub-County Hospitals, 58 Health Centers, 158 Dispensaries and one Educational Assessment and Resource Centre. Immunization of children (12-23 months) was at 62.2%. Births occurring at the health facilities were at 47%.

The Kenya Demographic Health Survey of 2014 showed that the number of people tested for HIV was 224,708, while 11,750 of PLHIV were on anti-retroviral therapy. Malaria cases were at 37, 657/100,000. The health personnel to public ratio stood at 48/100,000 nurses, 22/100,000 clinical officers and 7/100,000 doctors (KNBS et al., 2015).

The County is among the most populous when compared to other counties in Kenya. Outcomes from the 2016 TB treatment cohort indicated that the county had 81%

treatment success rate (the 8th lowest among the 47 counties of Kenya), 76% cure rate and 9% death rate (the 4th highest among the 47 counties of Kenya) (NTLD, 2016). However, the Health Sector Strategic Plan 2013-17 had been designed to address this situation given the County's high-density population and the high level of the poverty index which is at 51.3 % when compared to the country average of 45.9% while food poverty stands at 47% compared to the national average of 48% (County Government of Kakamega, 2014).

Lower respiratory tract infections, of which TB is one, are common health condition. Poor state of housing contributes to this high incidence (County Government of Kakamega, 2014).

There is overly a shortage of staff across all the different cadres at the health facilities. It is also reported that 51% of the total population resides beyond five-kilometer radius from the health facilities. Further, some facilities are not able to provide a complete array of essential services. There is an inadequacy or somewhat erratic commodity supply especially as regards non-pharmaceuticals, drugs and reagents used in the laboratory (County Government of Kakamega, 2018).

Handling of patients to confer safety is however a matter that is ensured by the continuous uptake of guidelines and formation of committees. However, there is still a long way to go in terms of infrastructure while governance is also a factor that requires improving upon.

On procurement, various health equipment that are basic, require maintenance and or replacement. More is still critically required e.g., weighing scales, microscopes, BP machines, among many others, with an upgrade of skills also required especially in Human Resources Management (County Government of Kakamega, 2018).

2.2 Adherence to Prescribed Tuberculosis Therapy at the Intensive Phase

A study conducted in Kenya (Muture et al., 2011) showed the rate of defaulters abandoning treatment was quite significant during first months of therapy and then decreased as the months went by. Considering patients who did not complete the entire course of therapy, 22.7% and 20.4% respectively were adjudged to have dropped within the first and second months of therapy, which indicates 43.1% in the intensive phase. A study in Malawi on the levels of treatment non-adherence showed that within the intensive phase, the attributable number of patients missing at least a day of therapy was 20.4%, with another 17.8% having interruptions of between 1–14 days and 2.7% clients experiencing interruptions of 15–29 days of therapy (Chirwa et al., 2013).

Most of the studies on TB treatment adherence have always considered the entire course of treatment than they have the two different phases.

2.2.1 Adherence to Tuberculosis Treatment in Africa

Reports from 2014 revealed that the regions with the highest number of new TB cases were the Western Pacific and South-East Asia, contributing 58% of new cases the world over. The most extreme burden was however experienced in Africa, where 281 cases per 100,000 population were reported as compared to a universal average of 133 cases per 100,000 population (WHO, 2016).

There is still a big challenge in Africa when it comes to surveillance and control of tuberculosis whose case weight is at 29% globally and 34% as regards the related deaths attributed to the disease. This is besides the fact that Africa contributes to about 11% of the world's population (Zumla et al., 2015).

In Malawi, a study revealed that cure from tuberculosis may be dependent on the phase of treatment when adherence to therapy became a problem. An adjusted analysis

indicated that TB patients missing below 15 days of treatment and/or 15-29 days of therapy would have a limited chance of being cured compared with those who adhered albeit not having a significant difference between the two groups. This could also be a factor of chance. The cure rate was 77% when considering those who had an interruption in treatment at the intensive phase of therapy as compared to the 93% posted for those whose therapy was interrupted at the continuation phase. This thus drives the point of importance of adherence at the intensive phase of therapy being very critical to cure (Chirwa et al., 2013).

Non completion of treatment is a characteristic of a good number of TB patients which consequently contributes to infectiousness getting prolonged, the onset of drug resistance, cases of relapse and eventually succumbing to death (Katana et al., 2022); (Gebreweld et al., 2018); (Hirpa et al., 2013). Adherence can be regarded as a complex behavioral concern when one considers the perspective of the difficulty expressed by TB patients that partake of a specific regimen, coupled with some factors like the impactful nature of HIV/AIDS and gender (Teferi et al., 2021) (WHO, 2017b).

The primary themes associated with adherence to tuberculosis treatment in Africa include a collection of tenets like knowledge attributes and practice, finances, the legal environment, TB treatment management system, personal and interpersonal characteristics, the side effects of medication and the associated community (Munro et al., 2007).

Improvements in the diagnosis and management of TB treatment are continuously and consultatively being made especially in the area of social-medical strategies like reducing the duration of therapy to six months which has improved the acceptability of the patients to treatment thus compliance. Additionally, there is a push to look into

associated strategies like the enablers package, the community as a facilitator to treatment, stabilizing the supply of drugs, introduction of public and private partnerships to help with the reduction of TB burden, looking into molecular combinations in fixed doses, having a practical approach to lung disease and establishing the Green Light Committee (GLC) (Asuquo et al., 2015); (Haileyesus et al., 2012); (Hamzaoui & Ottmani, 2012); (Lienhardt, 2011); (Atun et al., 2010); (Cramm et al., 2010); (WHO & WHO, 2010).

From Ghana, (Amo-Adjei & Awusabo-Asare, 2013) revealed that the concept of community treatment and care, which recognizes the power of society had played a massive role in tuberculosis control. With this model, the values of social capital were tapped into where patients were assigned a treatment companion who was a motivator and supervisor as the patient ingested their medication. This was a process that involved both the Health Care Worker and patient and greatly helped in the reduction of default to treatment.

Another strategy reported in the same study was the engagement of communities in stigma reduction programs. Stigma is a factor that has been found to affect both the patients and the health workers at the chest clinics (Dodor & Kelly, 2010). It had previously been regarded as punitive to be posted to a chest/TB clinic though the attitudes changed gradually by going through training programs where perceptions were demystified thus enabling health care workers properly attend to TB patients (Huq et al., 2022).

A study in a community from South Africa (Cramm et al., 2010) analyzed stigma among the main contributors to treatment default or adherence by TB patients.

Ghana, which is among the high burden West African countries had 13,978 reported as the number of new cases in 2018, a 32% incidence (Dogah et al., 2021). This has also contributed to a high prevalence rate in the region which necessitated the health governance coming up with a five-year strategic plan (2015-2020) whose main target was the clinical and community tuberculosis management and care with the vision of improving the outcomes of treatment. Though these initiatives have been put in place, there are records derived from the Volta Region that have highlighted TB cases as still being high with estimates of 60 per 100,000 in 2016 and 58.2 per 100,000 population in 2017 (Ohene et al., 2017). Furthermore, there might be an information gap in terms of the level of knowledge on TB infection, the rate of adherence and factors associated with adherence to TB therapy in the Ghana. As much as this has been reported, there was a study done in the Eastern Region of the nation that reported non-adherence to TB therapy to be 22% (Danso et al., 2015).

A study in Nigeria which generally relied on health facility or clinic-based DOT indicated that among the main reasons that were provided by patients for TB therapy non-compliance were the difficulty with accessing health facilities, the transportation costs related to clinical DOT and the pill burden (Adisa et al., 2021).

In Egypt as well as Burkina Faso, the consideration of individual attributes which include the period of treatment, knowledge of tuberculosis therapy, the worry of stigma, the effects of non-compliance to TB therapy and improper communication between patients and health care workers were implicated as drivers of TB therapy outcomes. Cigarette smoking and alcohol consumption have been reported by researchers as individual attributes influencing adherence to TB therapy (Méda et al., 2014); (Nour El Din et al., 2013).

Implementing DOTs in Ethiopia has been reported as exigent on both the healthcare provider and patient. In Addis Ababa, there were an array of reasons expressed by patients on the difficulties they faced because they had to make a daily facility visit amongst which were the distance covered either by walking or transportation which became an incurred cost and the severity of ailment during the period. This has led to restructuring of how DOTs is conducted, especially with less focus on daily DOTs during the initial phase of therapy (Fiseha & Demissie, 2015). Additional elements related to non-compliance have been highlighted by the latest review and included work commitments, the belief that one is cured especially after ingesting medication a few times, the perception of stigma, the absence of proper societal support, issues with finances aside from the ones related to TB therapy e.g. for basic needs, communication issues with health care providers which at times renders the patients feeling a little bit disrespected and the abuse of alcohol and some substances among many (Nezenega et al., 2020).

2.2.2 Adherence to Tuberculosis Treatment in Kenya

WHO reports Kenya among the nations with very high TB burden in the world (WHO, 2019a). TB is ranked fourth amongst the main causes of death in Kenya. This persists despite focused measures getting instituted throughout the course of the preceding 20 years by the country's leadership in conjunction with its development partners (KNBS, 2018). There was pre-tuberculosis prevalence survey carried out in 2015 which reported the incidence of TB as being 233 per 100,000 population. (WHO, 2016). Additional insights from the 2016 survey exercise revealed that among the adult population, the prevalence stood at 558/100,000 with the quantifiable male population doubling that of females. The other tier was rural versus urban infections rates which indicated it was high in urban areas (NTLD, 2016).

In Kenya, the knowledge attributed to how TB is transmitted is low despite of many a population having heard of tuberculosis. This was adjudged to be 87% of men and 84 % women having knowledge that tuberculosis is airborne, transmitted mainly through coughing (KNBS et al., 2015).

Kenya conducted a TB prevalence survey in the year 2015-2016, where out of the 63,050 cases enrolled into the study, 305 were bacteriologically confirmed cases. This places the prevalence rate at 4.8% (NTLD, 2016).

The main focus has been placed on TB case finding while placing less intercession on how to raise the rate of success of therapy. The patient outcomes in Kenya are defined on three standard levels which include treatment failure, loss to follow up or death. This continues to pose considerable challenges to prevention and management of TB in Kenya (WHO, 2017a).

A cross-sectional survey/study conducted by the NTLD-Program (NTLD, 2018) gave an indication of 35% as being the proportion of those on TB therapy that post non-adherence. Gender, especially male, side effects of medication, the unavailability of nutrition, the initial stage of therapy, the state of being HIV negative, old age, the likelihood of having extra-pulmonary tuberculosis, the unlikelihood of having a treatment companion and the costs incurred due to the transfer to and from the health facility were among the array of risks associated with non-adherence.

Special attention to the male population, re-strategizing on communication, advocacy and awareness creation by way of using social media for passing messages to the public thus expanding reach were some of the recommendations passed to the NTLD-Program. Digitalization should also infiltrate programing around TB with tracking and reminders sent via texts to patients of TB while also incorporating the element of Health

Systems Strengthening by bringing in nutrition programs to help mitigate and support patients with related challenges.

The NTLD-Program on its part, took up the mantle of ensuring there is considerable focus placed on early detection and relooking into the modus that can be set to make sure TB treatment is effective within populations. The standard is Kenya, as is in many other jurisdictions is the employment of the six-month known regimen for TB therapy which has for some time been considered the most effective method. This covers the appropriateness of the medication and the period required thus any factor that interferes, of which non-adherence is prime, really affects the effectiveness of therapy (Masini, 2018). NTLD-Program has thus put forth a feature of Directly Observed Therapy with 'short course' added to it to making it DOTs, which is geared towards improving a patient's compliance to therapy (Ahmad et al., 2018).

2.2.3 Fixed Dose Combinations and Adherence

Fixed Dose Combinations are meant to combine the active ingredients of the individual TB drugs into singular units such that a patient sees the ease with which treatment can be administered in an effort to improve their adherence to TB therapy (TB CARE I, 2014). Some of the avenues FDCs open up include improvement of patient perception and acceptance to TB treatment, reducing errors due to medication, reducing the pill burden and to some level, the impending costs (Albanna et al., 2013); (Manikandan, 2012); (Lienhardt, 2011); (Wu et al., 2015).

The use of FDCs is not entirely beneficial as exemplified the probable issues due to constitution. Research has raised some concerns around what active ingredient to attribute toxicity to in case there is occurrence of adverse drug reaction. There is also the issue of how to adjust the dosage when it becomes the next course of treatment.

Rifampicin is also not a very easy drug to manufacture which requires very stringent and specific measures taken during its processing. This is done so as to control its bioavailability and also to ensure the appropriate materials are used in its manufacture (Lienhardt, 2011).

After very intrinsic differential analysis of the pros and cons, WHO becomes a strong advocate for FDCs because it emphasizes the safety and due efficacy of medicine coupled with the elements that are directly dependent on the patient which will then have a direct effect on adherence (WHO & WHO, 2010). Where DOTs is not functional, FDCs can interject to ensure adherence to therapy and steer clear of resistance (Gallardo et al., 2016).

Under the MSF TB programs in Kenya, there has been a wide adoption Self-Administered Treatment (SAT) which place the patient at the center of the adherence model. This is quite similar to the Red Carpet Model which considers the patient as a Very Important Person (VIP) in seeking and management where tremendous support is accorded just so there is ownership from the patient's side on matters treatment (Nackers et al., 2012). SAT programs largely employ the utilization of FDCs for the same reasons of bringing down the number of ingestible pills and protecting the patient against drug resistance (Lim et al., 2021); (Lienhardt, 2011).

2.2.4 Adherence Monitoring

Regular adherence monitoring is essential in TB treatment but the issue becomes the availability of appropriate tools (Story et al., 2016). There are various tools employed by SAT programs like noting down of pill count and the routine collection, urinalysis especially when it comes to Isoniazid, the Visual Analogue Scales (VAS) and the administering of questionnaires. These tools have been deemed not comprehensive

enough considering they cover specific areas of treatment thus there needs to be a push to consolidate and properly evaluate them which will go a long way in the proper estimation of patient adherence to TB therapy (Leddy et al., 2023).

A study in Nandi County, Kenya, on factors associated with tuberculosis interruption in treatment stipulated that this had a close relationship with the time it takes the patient waiting in line before treatment, the patient's dire financial status and alcoholism. The study discovered that even though there was a considerable number of health facilities in the region, there were very few integrated TB sites within these facilities which then affected a number of TB management and control strategies that were further aligned to the effectiveness of the DOTs strategy. The successful fight against tuberculosis cannot just be realized through government structures alone thus other players like nursing homes, chemists and private clinics have to be brought on board which would act in bringing services closer to where the patients reside and ease the congestion of access to services at the government facilities and thus DOTs will be greatly expanded. There should be regular sessions at least each time a patient pays the facility a visit where different aspects of life that affect adherence are discussed like how treatment impacts the other members of the family and the community, why taking alcohol while on treatment is detrimental, financial literacy sessions to improve the socio-economic wellbeing and the importance of support, either peer to peer or by close family, relative or companion. (Wanyonyi et al., 2017).

2.3 Effect of Non-Adherence to TB Therapy on Treatment Outcome

Most recent reviews have cited the impediment to proper TB management as those that play into the patient's right to access medication that is of impeccable quality at the particulate good timing of diagnosis and/or the preventable measures are taken if not being subjected to treatment (WHO, 2020).

Many works have been written as to the convolution of this matter called treatment adherence when it comes to TB therapy because of the level of acceptance by the patient's system and the period of medication (Alipanah et al., 2018); (WHO, 2015). The estimation of compliance to TB therapy in developing countries is at 40% especially in Sub-Saharan Africa (Gugssa Boru et al., 2017).

Without proper adherence, there stands a risk of initial failure to therapy and the occurrence of multidrug resistant tuberculosis (MDR-TB), an extension to the infectiousness of the disease which will generally culminate to poor treatment outcomes (Alipanah, 2018). The extension of infectiousness may cause a serious health risk to other members of the community (Vernon et al., 2019).

2.4 Factors that Contribute to Non-Adherence to TB Therapy

Treatment of tuberculosis is considered among the long-term therapies which is a multifaceted and may be determined by the intricacies of some aspects that are patient related, the placement of the health care workers and their code of assistance, the TB models put in place by its governance and the related economic and social dispensations (AlHewiti, 2014); (Chebet et al., 2022); (Krawiecka, 2014).

2.4.1 The Individual

This level entails the level of information, perception towards TB and the behavior of a patient or community around TB. A study done in South Africa (Kigozi et al., 2017) showed that most people do not have adequate knowledge on TB. Poor knowledge, attitude and practice on Tuberculosis have also been highlighted by some other studies that are related (Almalki et al., 2022) (Amare et al., 2022). Since TB has been there for long, there is a general level of knowledge on what it is and the fact that it can get treated. The understanding of how transmissible it is however, the interception of TB

and HIV/AIDS and the tenets around prevention has been considered elusive to the masses, further made difficult by some myths and misconceptions (Nezenega et al., 2020); (Bagchi et al., 2010). A study among the Maasai in Tanzania noted that the entrenchment of these beliefs along tribal and religious lines has made addressing them by organizing high level meetings and seminars futile (Boeting et al., 2010).

Traditional medicine has been known to be put into use but it is considerate of the symptoms of ailment and the fact that the practice has been existent in a particular community was before conventional medicines arrived at their settings. (Nezenega et al., 2020). Due to the fact that this targets symptoms rather than the disease itself, it has been adjudged to delay the presentation to the trained health care personnel thereby compromising the fundamental health of patients (Muture et al., 2011).

Studies, (Kazaura & Kamazima, 2021); (Mushtaq et al., 2010), have revealed that the knowledge score when it comes to TB is a characteristic of one's predisposition to education thus it circles around illiteracy, the female population, low income earners, those who dwell in rural areas and the youthful population. Myths and misconceptions, stigma and discriminations are some of the aspects that have been found to be impactful on interpersonal relationships relative to the patient, which would then contribute to poor treatment compliance and adherence (Ashaba et al., 2021); (Mbuthia et al., 2020). A study in China indicated that prevalence of mental issues among the sampled TB patients was quite high. The principal determinants of psychological distress included financial distress, the level of education, possibility of stigma, drug toxicity or adverse drug reactions, muscle frailty or general unfitness, the role of family in illness due to TB, the perception that the body would reject the medication and the requirement of a specialist to converse with about one's mental state. It therefore calls for advocacy and

awareness concerning the mental health of patients suffering from tuberculosis whence mitigation approaches need developing so as to improve the outcomes of treatment and improve a patient's quality of life during and after treatment. (Chen et al., 2021).

Another important factor to consider at individual level is the importance the patient as a unit of ensuring that the DOTs strategy works effectively in relation to health seeking behavior as a consequence of proper knowledge, demography and alleviation of beliefs that are harmful to a patient's health (Desale et al., 2013).

2.4.2 Interpersonal Relationships

This level involves the social network, or the people around the patient. A big part of modern medicine is the consideration of societal factors, in this case social determinants of TB. There is need therefore to consolidate resources that would be geared towards making programs that deal with tuberculosis control wholesomely stronger (Hargreaves et al., 2011).

This commitment has led to the formation of the WHO Commission on Social Determinants of Health which upon its inauguration tried to piece together the connectivity of the circumstances in which we are born, grow up and spend our life time and the models that are set up to deal with sickness determine the distribution of health amenities within the population (PAHO and WHO, 2021).

A patient suffering from TB might face psychological problems which might play a big role in the successful attempt to treatment, the unacceptance to treatment because of the feeling of isolation within the environment they are living, the feeling of being stigmatized because of their illness and the fear of a wide social distance with what would be considered current working relations (Van Hoorn et al., 2016). The first point

of contact for this patient, the family and friends, therefore becomes integral for successful treatment and recovery.

Sondra L. Chester reviewed 334 studies published between 1970 and 1993. Her results revealed that 86.5% of the studies showed that there was support for the hypothesis that there is a relationship between one's interpersonal relations and one's physical health. Studies have suggested that longevity, lower disease incidence, absence of pre-mature death, lengthened reproductive span, and compliance with medical treatment programs, for instance, are associated with the presence of interpersonal relationships, supportive relationships and marriage (Holt-Lunstad et al., 2010).

A study in India showed that a combination the media when used in amalgamation the individualized communications between people could unlock an important cog in line with the dispensation of effectual control of TB. (Arulchelvan & Elangovan, 2017).

There is a connection between recovery from illness, and both naturally occurring interpersonal relationships and experimental intervention. Greater success in treatment of tuberculosis and alcoholism, lower steroid dosage for asthma, more rapid recovery from heart attack and childbirth characterized by fewer complications, for example, are reportedly correlated with the nature of relationships provided (Holt-Lunstad et al., 2010). This support is however often accompanied by an increase in resources. There is someone to take you to the doctor, to pick up your prescriptions, and also do your shopping when you are ill. There may also be monetary support. For tuberculosis, there is additional observation when taking the pills.

2.4.3 The Organization around TB Treatment

The more the emphasis on clinical models of tackling the TB menace like medication and development of vaccines with their consequential success, the more the reports on

TB incidence and mortality not going down. There has already been a shift from Stop TB, a feature of MDGs, to End TB which came with SDGs which exemplifies the efforts being put to control TB but these proportions keep on rising especially in Sub-Saharan Africa and some parts of Asia (Uplekar et al., 2015). Eva Rehfuess, a scientist at WHO's Public Health and Environment Department asserted that even though disease has to be fought primarily with medication especially in the short-term, the risks to the disease have to be put into consideration to mitigate the long-term. These risks are a consequence of the society the sick person lives in thus there needs to be a multi-sectoral approach that pits the health sector with other sectors working in collusion for the alleviation of the disease (Schmidt, 2008).

A study in Malaysia argued that smoking plays a key role or rather, it is an exposure factor that might raise the risk of TB disease progression. It argued that carbon monoxide is a likely causative agent for TB and by smoking filling the body with a considerable amount of the compound, it predisposes the body to TB and further does not help with the treatment. Research has shown that naturally produced carbon monoxide in the body regulates apoptosis but smoking causes the latency of tuberculosis which in turn might trigger apoptosis (Khan et al., 2020). Latency in this case is described as the point where *Mycobacterium tuberculosis*, shifts from active infection to a drug-resistant dominant state. This is a global problem that results in tuberculosis escaping detection and treatment, thus contributing to the overall tuberculosis transmission.

Some of the effects of TB on a patient include weakening of the immune system and muscle wasting among others that mimic malnourishment. This albeit the fact that malnutrition is still regarded as a risk factor on population basis. One cannot verily

separate the effects that present due to malnutrition from those that present due to poor socio-economic conditions like insufficient medical care, wanting living conditions, insufficient income, among others (Turley et al., 2013).

So far there is not enough data that directly links the risk or occurrence of TB with the condition of malnutrition, so much so that there has not been a rigorous systematic review of related information for over 30 years. However, there is compelling evidence from some epidemiological studies that predisposition to TB due to critical malnutrition may stand a greater chance of developing the disease than when it is moderate or mild (Carwile et al., 2022).

2.4.4 The Community

Majority of the people who are often greatly affected by TB live in areas where access to government health facilities is a big problem. The TB transmission niche is vast from the most remote of rural areas to urban settings be they apartment blocks or the shanties in the slums, to school settings and to the most congested of workplaces. This then makes TB a problem of the collective, and thus community. Prevention efforts are better geared towards the community bearing in mind timely diagnosis and subjection to appropriate treatment is also part of prevention. Information is power and thus empowering the community with information helps conquer the last mile logistic of case detection and reporting and thus access to appropriate care which will eventually save more lives. (CORE Group, 2017).

The community model in TB treatment is meant to ensure that the duties involved for the successful therapy of a patient are shared with the support system in place; The support system is meant to reduce the burden that the patient carries by providing the motivational, supervision and psychosocial help required through the treatment journey

(Haileyesus et al., 2012). There is therefore need for national recognition of the community model which will pave way for the required strengthened reporting system between the community and the servicing health facilities thereby reducing lead-time in case detection, access to the appropriate diagnostics, treatment and the purposeful treatment monitoring that will finally yield better TB outcomes. (WHO & WHO, 2010). In reference to a review conducted by Amref Health Africa on the utilization of Community Health Volunteers (CHVs) between January and December 2016, there was marked improvement in the TB cases that were notified from 6% to 10%. These results were achieved through active screening of contacts from the household level by the CHVs who were attached to different treatment centers. The interventions within the community can take different structures but still there is need to have focal people within the community who have been appropriately invested in, enabled and empowered to carry out active case finding within their localities and constantly relay this information to their attached facilities which will greatly improve TB outcomes (Abongo et al., 2020).

Communication and advocacy have developed into a tool that can help bring a service where some thought it would never reach. There are Civil Society Organizations (CSO) and Non-Governmental Organizations (NGO) that are anchored within communities. These organizations might either have advocates or might help in creation of community advocates through who the plight of those affected by TB might be heard, for swift action by the governing authorities. Since they are engrained within the community, these organizations have been known to tailor make their interventions with the patient or community as the major stakeholder so that these interventions are totally absorbed and owned. These are aspects that can be tapped into in order to have

appropriate diagnostic pathways and treatment plans that would improve the outcomes of TB therapy (WHO, 2013b).

2.4.5 Public Policy

TB is a classified among communicable and further classified with the mode of transmission as airborne with the causative agent being the bacillus *Mycobacterium tuberculosis*. According to policy, persons infected with TB should be put on medication immediately because if the sneeze or cough and the person nearest to them inhales the bacilli, 10-14 people is the number that a singular person with pulmonary TB can infect in a calendar year (WHO, 2018).

For a long time, decades ago, TB was an affliction that generated a lot of fear even further exacerbated by the absence of cure. This fear has slowly been alleviated with the advent of working public health inventions that also include chemo-therapy. Still, the world has a long way to go when it comes to TB control (Uplekar et al., 2015). Every year, WHO releases estimates of the number of new cases of TB through its annual reports. Alarmingly, about 33% slip through without getting diagnosed and consequently they do not get treated. The most vulnerable populations are often the victims who slip through the cracks and as such, programs need to be streamlined to capture these populations that include the impoverished, persons who are advanced of age, persons living with HIV/AIDS, women and children. (WHO, 2022).

In Kenya, policies and advocacy, as regards TB control are a function of NTLD-P. The body is tasked with structural coordination of TB programs from the national level to the smallest administrative unit within the country. The program is also in charge of commissioning strategic partnerships whether sectoral or NGOs and guiding how they will work within the TB sphere. The supply chain logistics of TB commodity and equipment, advocacy and communication, management of data among other functional

modalities all fall under the docket of NTLD-P. Restructuring of Human Resources created the positions of coordinators at the County and Sub-County levels. These are hands-on personnel so see to it that TB services are properly integrated within their areas of jurisdiction going as far as being the custodians of TB data collected within their areas. The integration is effected by the personnel sitting in their respective Health Management Teams where the status of health and important decisions around them are made (Karumbi & Garner, 2015).

The number of health facilities providing TB services in Kenya were about 3,300 in 2014. From this number, those dispensing of diagnostics were about 1,800 with about 200 of them enabled to provide drug resistant TB services (Ministry of Health (Kenya), 2015).

2.4.6 The Directly Observed Therapy Short-Course Strategy

The managerial model of TB treatment was initially put into use in the 1970s courtesy of Dr. Karel Styblo who employed this model in an effort to improve TB case-finding and outcomes after treatment (Raviglione & Rieder, 2021).

The scale of the universal TB burden had to get a proper definition using targeted disease surveillance and comprehensive monitoring. It was at this point that Styblo's model was pulled into focus, interrogated, scrutinized and rebranded into Directly Observed Therapy Short Course, otherwise abbreviated as DOTs (Matteelli et al., 2018).

There are five aspects that make up DOTs:

1. Commitment to sustenance by governance
2. Sputum smear-microscopy employed in case detection especially self-reporting patients

3. Treatment duration standardized to six or eight months using a particular recommended treatment regimen DOTs would then be applied at least at the intensive phase of therapy.
4. Continuous and regularized supply of TB commodity to ensure no stock-outs
5. A strong reporting system with standardized reporting tools for data collection and summary for effective capture of TB related information

In recent times, treatment duration has been shifted from the 2-prong six- and eight-month period to the most preferred six-month period otherwise regarded as the short-course of TB therapy which is characterized by the administration of a cocktail of Isoniazid, Rifampicin, Pyrazinamide and Ethambutol. Direct observation on the other hand is conducted during the initial two months of therapy, patients are expected to ingest the right cocktail of drugs daily without fail, for 56 days.

With this model, every other person the patient is attached to is a stakeholder during the entirety of his/her treatment. This model bodes well with the aspect of community where everyone has to play their role with the end goal being successful treatment of the individual and control of TB within the community (WHO & WHO, 2010).

The assumption used on choice or regimen is on the basis of patient entry into treatment exemplified on whether it is a new case of TB or relapse case. What is referred to as standard regimen are mainly administered on new cases while the relapse cases may require a rethink due to the possibility of drug resistance. This will thus take a longer course (WHO, 2019b).

2.4.7 The readiness for provision of TB services

The notion that prevention is better than cure still alludes many but it is through proper preventive approaches diagnostic and treatment plans can mature into very effective procedures especially as concerns tuberculosis (Alene et al., 2019). The accessibility of

health facilities and their enablement to offer the desired TB aid also plays a big role in prevention (Asare-Akuffo et al., 2020); (Abayneh et al., 2020); (Dos Anjos Luis & Cabral, 2016). The achievement of this stage, especially in countries considered as developing has been curtailed by poverty amongst their populations (WHO, 2019a); (Tanimura et al., 2014); (Asare-Akuffo et al., 2020); (Dos Anjos Luis & Cabral, 2016); (Amenuvegbe et al., 2016)

Reports have been generated on the proportion of the world's population in dire need of access to health but still cannot. This same cohort is considered impoverished and it is considered that the levels of impoverishes keep on rising because of incurring high costs of seeking health care (World Bank and WHO, 2017). As a key model put in place to foster the achievement of the End TB grand design, WHO has fronted Universal Health Coverage which follows the advocacy efforts to endow as much health facilities as possible with the capability of offering quintessential TB services to the affected masses (WHO, 2019a); (Ministry of Health (Kenya), 2013).

TB services index varied significantly across counties. The counties with the highest rating are Kisii and Kwale Counties, both having a readiness index of 82%, while the lowest is Meru County with a readiness index of 38%. Kakamega County has 254 health facilities with a TB service readiness index of 69%.

In 2014, the USAID sponsored Tuberculosis Accelerated Response and Care (TB-ARC) in conjunction with NTLD-Program identified gaps related to the devolution of services (a function of the promulgated Kenyan Constitution of 2010). These gaps were occasioned by issues with transition whence the localization of TB activities from the national governance to get sequestered in the county governance had not yet been streamlined. This necessitated the need to ensure that there was efficient and sustainable

uptake of duties regarding activities in the control of TB by all the 47 counties thus the requirement to realign TB management and programming within the system, such as deployment of qualified officers, efficient TB commodity management and effective TB surveillance. This was done through employing diverse approaches that included case studies especially in the cost-share initiative, coordination and support of round table forums for county leaderships and zoning of counties for equity in effective coordination due to diverse county demographics (TB ARC, 2018).

2.4.8 Adherence and Responsibility

In most cases, DOTs carried out within the community may involve additional costs that may make it expensive either for the individual, the TB program or the institution involved. Be that as it may, there is concrete evidence that DOTs carried out within the community has higher treatment completion rates, cure rates, and sputum smear conversions after the initial phase of therapy (WHO, 2017a).

Ownership, be that in projects, programs or interventions is very key to the delivery of successful outcomes. It thus follows that allowing the patients to accept that they are sick and require assistance, encouraging and allowing them the choice of how they will be treated and letting other people into their lives to offer help in ensuring they are healed might go a long way in improving adherence to TB treatment (Shringarpure et al., 2023); (Munro et al., 2007). A study in Homabay (Nackers et al., 2012) and another one in Kilifi (Chebet et al., 2022) indicated that there are good adherence outcomes when employing self- administered treatment programs are employed.

In most cases the quintessential reason for not adhering to TB treatment by most patients is running out of medication. This has also been reported in other African countries (Mekonnen & Azagew, 2018). There is another reason for non-compliance

that is mostly relayed by patients is travelling away from the area of residence for work or some economic activity. This means that if these situations are properly managed, then good adherence can be achieved.

A study was conducted on the cost of TB treatment in Kenya (Kairu et al., 2021) where the main elements under consideration were the costs of radiology, outpatient care, DR-TB laboratory monitoring, TB diagnostic test, laboratory tests, inpatient care, contact tracing and community services. The two approaches, bottom-up (BU) and top-down (TD) were considered which allowed for comparison of unit costs. The study looked at the input in all the elements in terms of capital, consumables, overhead and staff costs. There was therefore minimal focus on the community model yet studies have shown that it yields comparably better outcomes (Adisa et al., 2021); (Nidoi et al., 2021).

2.5 Conceptual Framework

Non adherence to TB therapy has been described in several ways including using the theory of collisions as an unavoidable outcome of the convolution between the clinical and social world of family and acquaintance (Ajema et al., 2020). There are a number of factors, whose interplay has been found to influence adherence to TB treatment. These can be classified into different levels such as individual level, interpersonal level, organizational level, community and public policy. These are ideally the same factors from which the DOTs strategy was modeled around. It is still not conclusive to many whether Directly Observed Therapy-Short Course is the powerful tool that properly serves the purpose for which it was designed (Otu, 2013). In many instances, the social ecological behavioral structure has been employed to help put these determinants of successful TB therapy into perspective. Further the structure gives insight of how to go about programing in social settings. Facilitating a domain that can allow the dynamics

of change is essential for the expression of healthy behaviors (Mazza-Stalder et al., 2019); (Pedrazzoli et al., 2017); (Hargreaves et al., 2011).

Non adherence to TB therapy leads to treatment failure, relapse and the emergence of drug resistant TB, all of which can hinder accurate case detection and timely notification (PAHO and WHO, 2021).

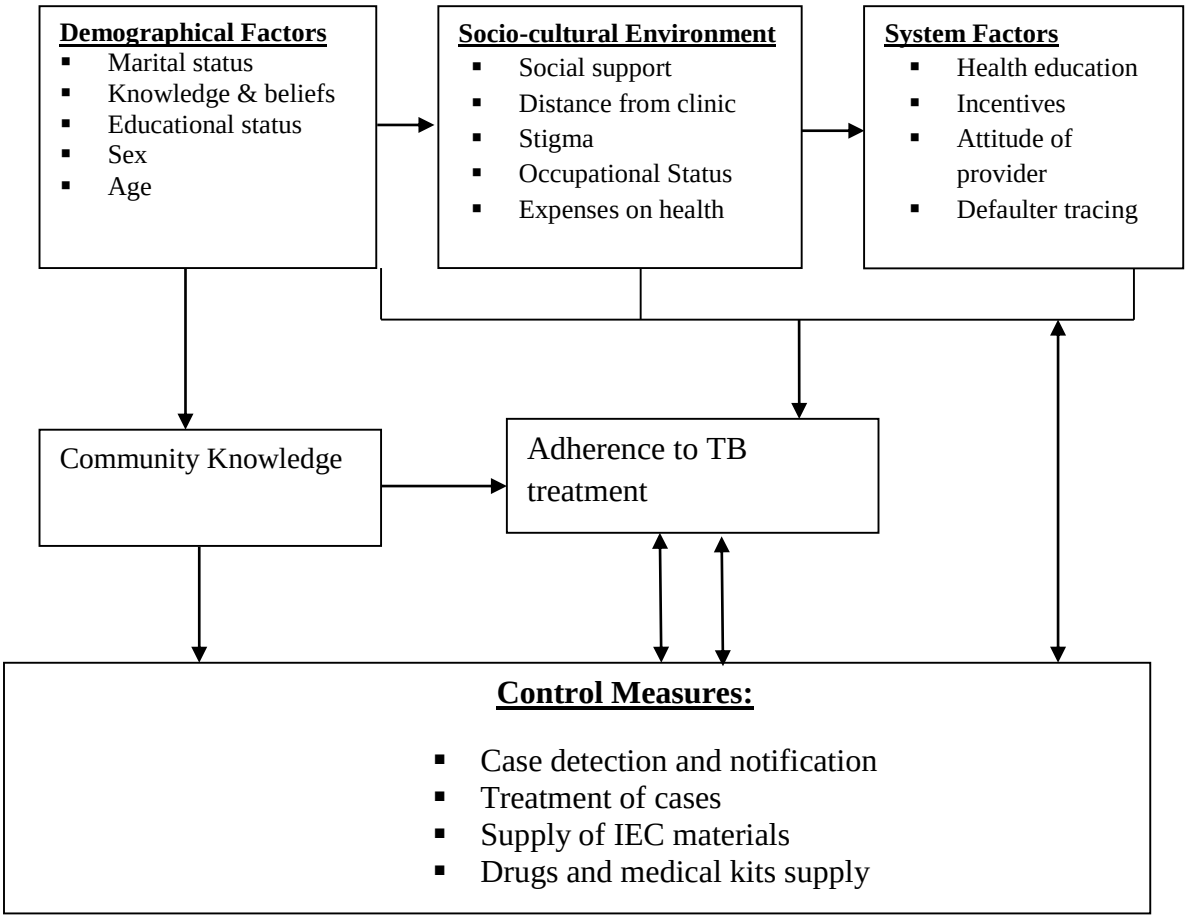


Figure 2.1: Adapted Conceptual Framework for Factors Affecting Treatment Adherence (Roura 2009)

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Area

The study was conducted in Kakamega County which is one of the counties in the western block of Kenya. It borders Bungoma County to the North, Nandi County to the East, Vihiga County to the South and Siaya County to the West. Its terrain spreads over an area of 3050.3 Km^2 (County Government of Kakamega, 2018). The rise in altitude experienced in the county is between 1,240 meters and 2,000 meters above sea level. Kakamega County has 12 constituencies, 12 sub-counties, 24 divisions, 72 locations and 233 sub locations. The table below shows the distribution of the divisions, locations and sub-locations per sub-county including the area covered per km^2. It also shows that administratively, the sub-counties double up as the constituencies.

Table 3.1: Administrative Units in Kakamega County

Sub-Counties	Constituencies	No of Divisions	No of Locations	No of Sub Locations	Area (Km^2)
Matungu	Matungu	1	2	13	275.8
Navakholo	Navakholo	1	3	10	175.1
Butere	Butere	3	7	25	210.5
Lugari	Lugari	1	4	8	265.8
Kakamega Central	Lurambi	2	6	12	244.5
Kakamega North	Malava	5	12	52	427.4
Likuyani	Likuyani	1	4	8	301.8
Kakamega South	Ikolomani	2	6	22	143.6
Mumias West	Mumias West	3	13	33	314.5
Khwisero	Khwisero	2	7	20	145.6
Mumias East	Mumias East	1	2	7	100.2
Kakamega East	Shinyalu	2	6	23	445.5
Total		**24**	**72**	**233**	**3050.4**

Source: (Kakamega County Development Profile, 2013)

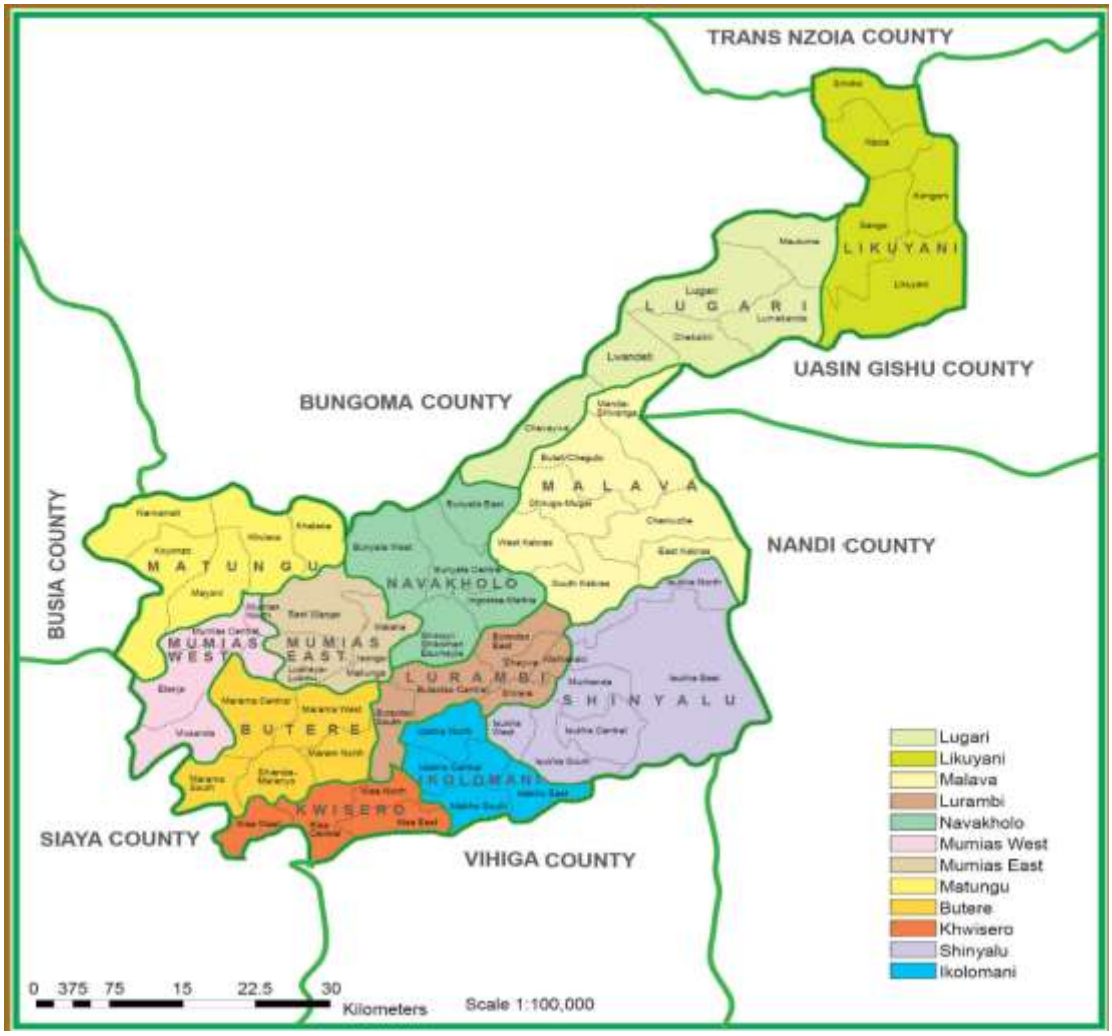


Figure 3.1: Map of Kakamega County (Kakamega County Development Profile, 2013)

As of 2014, the estimated population stood at 1,940,149. The county had 229 health facilities. There was one Comprehensive Teaching and Referral Hospital, 12 Sub-County Hospitals, 58 Health Centers, 158 Dispensaries and one Educational Assessment and Resource Centre. The health personnel to public ratio stood at 48/100,000 nurses, 22/100,000 clinical officers and 7/100,000 doctors (KNBS et al., 2015).

The site was selected because of the significant number of cases of defaulting to TB treatment. For example, of the 1,339 cases detected between January 2015 and July

2016, the number of defaulters to treatment was 179. Of the 229 health facilities in the area, about 165 of them offer TB services (Ministry of Health (Kenya), 2013).

3.2 Study Design

This was a comparative study that looked at adherence to tuberculosis treatment within the first two months, the intensive phase, in Kakamega County between January 2013 and December 2018. The key indicators measured included timing of medication in terms of days and kept clinic appointments for refills. Adherence was measured at 95% confidence level. Qualitative data was derived from key informant interviews with health care workers.

3.3 Study Population

The study targeted all patients with bacteriologically confirmed Tuberculosis at the health facilities in the county. The study focused on patients in the intensive phase of therapy. A report, (MOH, 2013), established that the prevalence of Tuberculosis in Kakamega County is 135 per 100, 000 people. The population of Kakamega County is 1,940,149. This indicated that the number of people with Tuberculosis in Kakamega County is 2,612.

3.4 Sample Size Determination

Since the study aimed at estimating the association between those who adhered to TB treatment at the intensive phase and those who did not, the sample size determination formula for dichotomous outcome was employed (Cochran, 1977).

$$n = \left[\frac{r+1}{r}\right]\frac{(\acute{p})(1-\acute{p})(Z_{\beta}+Z_{\alpha/2})^2}{(p_1-p_2)^2}$$

Where; n= sample size in the adherence group

r = ratio of cases that adhered to the intensive phase of therapy to the ones that did not adhere (1 will be used for equal number of the two groups)

ṕ = Average proportion exposed = proportion of exposed cases that adhered + proportion of exposed cases that did not adhere to the intensive phase of TB therapy/2. From a study in Nairobi (Muture BN, 2011), the proportion of non-adherence at the intensive phase was found to be 43.2%.

Z_β = Standard normal variate for power. In this case the power of 80% will be considered = 0.84

$Z_{\alpha/2}$ = Standard normal variate for the level of significance – 1.96

$p_1 - p_2$ = difference in proportion expected based on previous studies. p_1 is the proportion in those who adhered to treatment at the intensive phase while p_2 is the proportion in those who did not adhere to treatment at the intensive phase.

The study intends to detect an odds ratio (OR) of 2.0 or greater, thus:

$p_1 = \frac{ORp_2}{p_2(OR-1)+1} = \frac{2(0.43)}{0.43(2-1)+1} = 0.6$

Hence:

$$\boldsymbol{n} = 2\frac{0.515(1-0.515)(0.84+1.96)^2}{(0.6-0.43)^2} = 134$$

The population of patients, N=2,612, thus correction for a population of less than 10,000 is required.

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

Hence: $\boldsymbol{n} = \frac{134}{\left\{1+\frac{134-1}{2612}\right\}} = 127$

3.4.1 Key Informants

These were the healthcare providers in-charge, specifically nurses, of the chest clinics at the sampled facilities. Five healthcare providers were interviewed on non-adherence in their respective settings.

3.5 Sampling Procedure

Simple Random sampling was employed to select 5 level 4, secondary care facilities that closely manage TB patients. These facilities were: Butere Sub-County Hospital, St. Mary's Hospital (Mumias), Mukumu Hospital, Iguhu Sub-County Hospital and Malava Sub-County Hospital.

For the sampling frame, KHIS Aggregate records obtained between January 2015 and June 2017, a total of 1,974 TB patients were served across the 5 sampled facilities. Of these, 304 (0.15) were served at Butere SCH, 561 (0.29) at Malava SCH, 489 (0.25) at Mukumu Hospital, 282 (0.14) at Iguhu SCH and 338 (0.17) at St. Mary's Hospital, Mumias. Table 3 summarizes how the ratios obtained from these numbers have been used to distribute the sample size within the 5 strata.

Table 3.2: Number of selected clients per facility

Health Facility	Adhered	Did not adhere	Total
Butere SCH	20	20	**40 (0.15)**
Malava SCH	36	36	**72 (0.29)**
Mukumu Hospital	31	31	**62 (0.25)**
Iguhu SCH	18	18	**36 (0.14)**
St. Mary's Hospital (Mumias)	22	22	**44 (0.17)**
Total	**127**	**127**	**254**

The sample size, was proportionately allocated to the selected 5 facilities. Those who did not adhere and those who adhered to TB treatment formed the 2 strata for the study. At the health facilities, data of patients aged 18 years and above, from the TB treatment registers between January 2013 and December 2018 was obtained. This data was grouped into the two strata, after which unique identifiers were allocated. The unique

identifiers were then fed into an excel sheet with the 2 groups forming 2 different columns. The total number from each group at every facility was then divided by the corresponding number from the sampling frame so as to obtain the n^{th} number, which became the random number generator employed to pick the allocated sample. The outcomes of the selected samples were then compared.

Information from the registers and patient record cards was extracted using a structured Data Collection Questionnaire. A total of 127 cases of those who adhered to the intensive phase of TB therapy and 127 of those who did not was sampled.

3.6 Selection Criteria

3.6.1 Inclusion Criteria

Records of Pulmonary TB patients who were 18 years and above.

Health Care Workers at the chest clinics.

3.6.2 Exclusion Criteria

Patients aged below 18 years were excluded to control for self-consenting age and individual decisions around health care.

3.7 Data Collection

The study utilized a structured data collection questionnaire to extract information from the TB registers and patient cards while an interviewer guide was used for the key informants. One research assistant was recruited and trained on the survey objectives, data collection tool and the possible errors that may occur during data collection.

3.7.1 Validity and Reliability

A pilot study was conducted on 13 records of those who adhered to TB therapy at the intensive phase and 13 records of those who did not adhere, together with the Health Care Personnel in-charge of the chest clinic at Mumias Sub- County Hospital to test the reliability and validity of the data collecting instruments.

From the Data Collection Questionnaire, the recommended drug-intake schedule was re-adjusted so as to accurately capture the definition of adherence at the intensive phase of treatment as per the study.

The interviewer guide was also re-adjusted to ensure all questions were open ended so as not to limit qualitative responses.

3.8 Data Management and Data Analysis

Data was entered in SPSS Version 24 for analysis which was performed at 95% level of significance. Univariate analysis including descriptive, inferential and Kaplan-Meier survival analysis were performed. Chi- square was used at the bivariate level, to test for association between adherence at the intensive phase and the treatment indicators. Odds Ratio and Relative Risk was determined to measure the association between adherence and the outcome in terms of recovery, death or relapse. Regression was used for multivariate analysis. From the key informant interviews, qualitative data will be collected, coded, categorized, summarized and entered into NVivo version 12 from where analysis was done. The questionnaires and interviewer guides were safely and securely stored by the principal investigator.

3.9 Dissemination of Findings

The findings from this research will be published in a reputable scientific journal. PowerPoint presentations will be made at scientific conferences upon invitation, and also during oral thesis defense to the examiners, students and other interested audience. A written report (thesis) will be submitted to the School of Public health and County executive committee health through the County Health Management Team (CHMT), Sub-County Health Management Teams (SCHMT) and health facilities alike. Feedback of the findings of the study will be given to the NTLD-Program to aid in appropriate interventions.

3.10 Ethical Consideration

Sessions with the Monitoring and Evaluation Manager at the County, the County TB Coordinator, The Sub-County TB Coordinators and the various health personnel were organized and conducted to systematically explain the aim of the study before gaining informed consent from the key informants. The information provided by the key informants was treated with the utmost confidentiality it deserved while upholding dignity and respect during data collection. Approval was sought from Moi University's Institutional Research and Ethics Committee (IREC) and obtained prior to the commencement of the Research (IREC/2019/171). Clearance and license to conduct the study (Ref No. 305483), was sought and obtained from the National Commission for Science, Technology and Innovation (NACOSTI). Permission to conduct the study in the County was sought from the Ministry of Health In-Charges of the respective sub-county hospitals.

3.11 Study Limitations

The patient data collected in this study was secondary data which was done using a structured data collection questionnaire. Due to this, verification of these records had to be conducted by cross-referencing the reports that were generated during the related time period. At least two health care personnel at the TB clinic had to be involved, to separately give insight on how the different indicators are captured in the health records just so as to ensure there was a standardized way of recording information into the health records tools.

CHAPTER FOUR

4.0 RESULTS

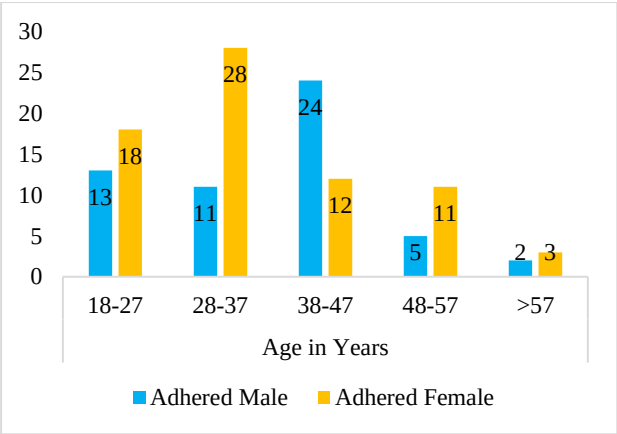
4.1 Socio Demographic Characteristics of the Participants

As shown in Table 4.1 below, there were 254 participants in the survey of which 45.2% (115) of the participants were male, 54.7% (139) were Female.

Table 4.1: Gender of the respondents

Gender	Freq.	Percent
Male	115	45.28
Female	139	54.72
Total	254	100.00

Figure 4.1 below, shows distribution of participants by age categories with 31.5% (80) aged between 18 and 27 years, 27.5% (70) aged between 28 and 37 years, 27.1% (69) aged between 38 and 47 years, 10.6% (27) aged between 48 and 57 years and 3.1% (8) of the participants were with age greater than 57 years.



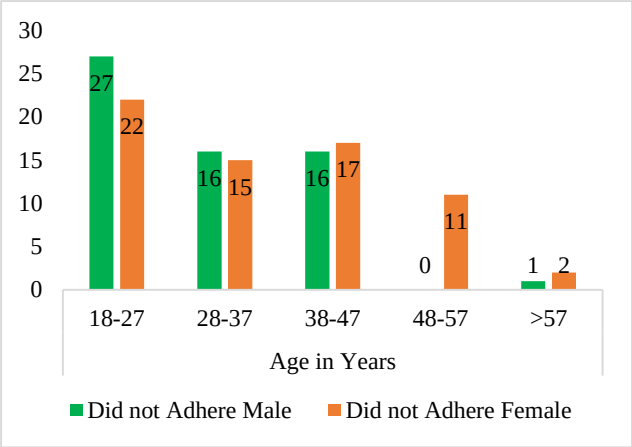


Figure 4.1: Age Categories by Gender of the Participants

There was a greater proportion of males out of the total number of males (34.70%) than the proportion of females out of the total number of females (28.7%) in age between 18 years and 27 years. This trend was also observed between 38 years and 47 years.

Table 4.2: Approximate distance from residence to health facility (n = 254)

		Adhered	Did not adhere	Total	Chi-Square
	<5 Kms	28	30	58	x^2 = 2.452
		22.0%	23.6%	22.8%	df = 3
	5-10 Kms	55	57	112	p = .484
		43.3%	44.9%	44.1%	
	11-15 Kms	33	24	57	
		26.0%	18.9%	22.4%	
	>15 Kms	11	16	27	
		8.7%	12.6%	10.6%	
Total		127	127	254	

In table 4.2 above, 22.83% (58) of the participants travelled less than five-kilometer distance to the health facility, 44.09% (112) who were the majority, travelled between 5 and 10 kilometers to the facility, 22.44% (57) travelled between 11 kilometers and 15 kilometers. 10.6% (27) of the participants travelled more than 15 kilometers from their respective residential areas to the health facility.

The chi-square test indicated that there was no significant difference at 95% level of significance in terms distance from the health facility between the patients who adhered to the intensive phase of therapy and the ones who did not (CI = .482-.502, x^2 = 2.452, df = 3, p = .484).

Table 4.3: Occupation of the participants (n = 254)

		Adhered	Did not adhere	Total	Chi-Square
	Salaried employment	31	24	55	x^2 = 7.770
		24.4%	18.9%	21.7%	df = 2
	Self employed	48	33	81	p = .021
		37.8%	26.0%	31.9%	
	Unemployed	48	70	118	
		37.8%	55.1%	46.5%	
Total		127	127	254	

From table 4.3 above, most of the participants were unemployed 46.46% (118), 31.89% (81) were self-employed, while 21.65% (55) had salaried employment. Comparison of the occupation status with adherence to the intensive phase of therapy shows that the proportion the unemployed participants who did not adhere to treatment is higher than the unemployed clients who adhered to treatment; a trend that was different with those in the salaried and self-employed status.

The chi-square test revealed that there was significant association at 95% level of significance in terms occupation, between the patients who adhered to the intensive phase of therapy and the ones who did not (CI = .017-.022, x^2 = 7.770, df = 2, p = .021).

4.2 Assessment of Treatment Adherence

4.2.1 Duration of Treatment at the Treatment Site

Table 4.4: Duration of TB treatment at the facility (n = 254)

		Adhered	Did not adhere	Total	Chi-Square
	1st month	0	4	4	$x^2 = 254.000$
	2nd month	0	25	25	df = 7
	3rd month	0	52	52	p < .001
	4th month	7	0	7	
	5th month	4	0	4	
	6th month	116	0	116	
	7th month	0	7	7	
	8th month	0	39	39	
Total		127	127	254	

In table 4.4 above, those who adhered to therapy at the intensive phase managed to stay in treatment for at least 4 months as compared to those who did not adhere to therapy at the same phase with 85% (108/127) falling off treatment by the third month. In general, 1.57% (4) of the participants lasted a month at the facility during treatment while 9.84% (25) sustained two months of treatment. 20.47% (52) of the participants accessed treatment within the duration of 3 months, 2.76% (7) were treated within the duration of four months while 1.57% (4) were treated within the duration of five months. The 116 clients (45.67%) of the total, who lasted 6 months of treatment at their respective clinics had all adhered to the intensive phase of therapy. Those who took longer than 6 months' treatment at the facility, took 7 months 2.76% (7) and others up to 8 months 15.35% (39) of TB treatment at the facility.

4.2.2 Kaplan-Meier's Survival Analysis in the Continuation Phase of Therapy

Figure 4.2 shows that 96.8% (123/127) of those who adhered to treatment in the intensive phase completed their continuation phase of therapy in the desired 4 months of treatment.

On the other hand, 63.8% (81/127) of those who did not adhere to the intensive phase of therapy did not even get into the continuation phase of therapy. 5.5% (7/127) of them

completed the continuation phase of therapy in 5 months' while 30.1% (39/127) completed the continuation phase of therapy in 6 months.

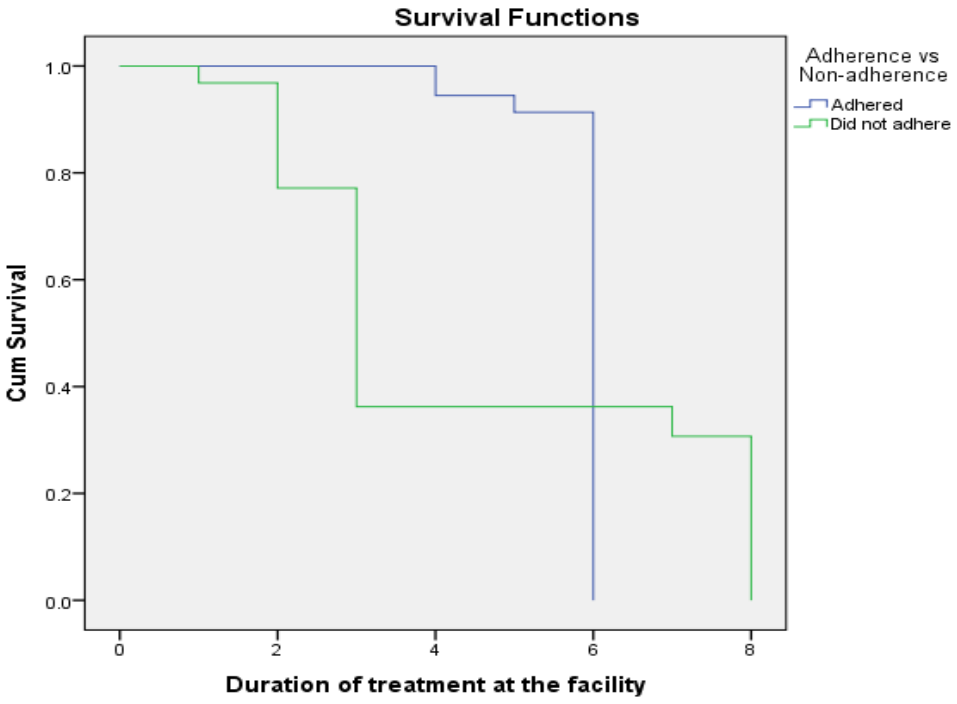


Figure 4.2: Survival Analysis in the Continuation Phase of Treatment

4.2.3 Co-morbidity Risk Factor

Hypertension, diabetes, alcoholism, smoking and cancer were among the co-morbidity risk factors that were considered. Alcoholism was the main co-morbidity risk factor high-lighted, affecting 9.84 % (25) of the total participants as shown in table 7. 44% (11) of the participants affected by alcoholism were male while 56% (14) were female. All the 25 had not adhered treatment at the intensive phase. Also, on the overall course of treatment, they were LTFU which thus indicates that alcoholism is among the major factors that influence adherence to TB therapy.

The chi-square test gave an indication of significant association at 95% level of significance in with alcohol as a risk factor, between the patients who adhered to the intensive phase of therapy and the ones who did not (CI = .05, x^2 = 27.729, df = 1, p < .001).

Table 4.5: Co- morbidity risk factor (n = 254)

		Adhered	Did not adhere	Total	Chi-Square
	Alcoholism	0	25	25	$x^2 = 27.729$
		0.0%	19.7%	9.8%	df = 1
	None	127	102	229	p < .001
		100.0%	80.3%	90.2%	
Total		127	127	254	

4.2.4 Treatment Entry

Of the sampled participants, 118 (49.6%) who adhered and 120 (50.4%) who did not adhere were new clients on TB treatment while 9 (56.3%) and 7 (43.8%) who did not adhere were relapse cases that were re-initiated into TB treatment as shown in table 4.6 below.

Table 4.6: Type of patient (n = 254)

		Adhered	**Did not adhere**	**Total**	**Chi-Square**
	New	118	120	238	$x^2 = .267$
		49.60%	50.40%	100.00%	df = 1
	Relapse	9	7	16	p = .605
		56.30%	43.80%	100.00%	
Total		127	127	254	

The chi-square test gave an indication of no significant difference at 95% level of significance on whether the patient was new or a relapse case, between the patients who adhered to the intensive phase of therapy and the ones who did not (CI = .399-.797, x^2 = .267, df = 1, p = .605).

4.2.5 Means of Diagnosis

Table 4.7 below shows that 49.4% (117) of the participants who adhered and 50.6% (120) who did not adhere were bacteriologically confirmed having acquired TB where their biological specimen was acquired, subjected to either smear microscopy, culture

or WHO-approved rapid diagnostics (such as Xpert MTB/RIF) and found positive. On the other hand, 58.8% (10) who adhered and 41.2% (7) who did not adhere were clinically diagnosed. Clinical diagnosis is described as a case where an individual fails to fulfill the standard criteria employed in bacteriological authentication but through the intervention of a trained clinician or medical personnel, is deemed to be having active TB and has thus been put on a full course of TB medication.

Table 4.7: Means of pulmonary TB diagnosis (n = 254)

	Adhered	**Did not adhere**	**Total**	**Chi-Square**
Bacteriologically confirmed	117	120	237	x^2 = .567
	49.40%	50.60%	100.00%	df = 1
Clinically diagnosed	10	7	17	p = .451
	58.80%	41.20%	100.00%	
Total	127	127	254	

From table 4.7 above, 92.13% of those who adhered to therapy at the intensive phase were bacteriologically confirmed pulmonary TB cases with 7.87% being clinically diagnosed. On the other hand, 94.49% of those who did not adhere to therapy at the intensive phase were bacteriologically confirmed with the resultant 5.51% being clinically diagnosed.

The chi-square test showed that there was no significant difference at 95% level of significance on whether a patient was bacteriologically confirmed or clinically diagnosed with TB, between the patients who adhered to the intensive phase of therapy and the ones who did not (CI = .308-.617, x^2 = .567, df = 1, p = .451).

4.2.6 Treatment Follow-Up

The Directly Observed Therapy, short course (DOTs), a well-known strategy that is worldwide recommended by WHO, was conducted by either Health Care Workers (HCW), Community Health Volunteers (CHV), and household members, friends and/or relatives.

From table 4.8 below, 42.3% (11) of those who adhered and 57.7% (15) of those who did not adhere had their treatment follow-up done by HCW, 54.5% (67) and 45.5% (56) who were the majority had treatment follow-up done by a CHV, while 46.7% (49) and 53.3% (56) had their DOTS was done by a household member, friend or relative.

Table 4.8: DOT Services (n = 254)

		Adhered	Did not adhere	Total	Chi-Square
	Health Care Worker	11	15	26	$x^2 = 2.066$
		42.30%	57.70%	100.00%	df = 2
	Community Health Volunteer	67	56	123	p = .356
		54.50%	45.50%	100.00%	
	Household member, friend, relative	49	56	105	
		46.70%	53.30%	100.00%	
Total		127	127	254	

The chi-square test gave an indication of no significant difference at 95% level of significance on whether the patient was either followed up by the health care worker, CHV or a household member or friend, between the patients who adhered to the intensive phase of therapy and the ones who did not (CI = .360-.378, $x^2 = 2.066$, df = 2, p = .356).

Table 4.9: Intensive phase- daily drug intake as observed by Health Care Worker or Treatment Supporter (n = 254)

		Adhered	Did not adhere	Total
	1-14 days	0	4	4
		0.0%	100.0%	100.0%
	1-42 days	0	35	35
		0.0%	100.0%	100.0%
	1-49 days	0	4	4
		0.0%	100.0%	100.0%
	1-56 days	127	0	127
		100.0%	0.0%	100.0%
	1-63 days	0	57	57
		0.0%	100.0%	100.0%
	1-70 days	0	18	18
		0.0%	100.0%	100.0%
	Over 70 days	0	9	9
		0.0%	100.0%	100.0%
Total		127	127	254

From table 4.9 above, those who took their drugs within the recommended 56 days, 127 (100%) were all adherent at the intensive phase of therapy. This also formed the basis of classification into the two groups of study. From the non- adherent group, 4 participants took their medication between 1-14 days, 35 between 1-42 days and 4 between 1-49 days. 59.1% (75) took their drugs for up to 70 days while 9 took their medication for over 70 days.

4.2.7 The Continuation Phase

After the intensive phase of TB therapy which happens during the initial 2 months, the patient gets into the continuation phase which by standards should be within 4 months. As evident from table 4.10 below, 31.89% (81/254) of the participants did not have a continuation phase of therapy. 1.57% (4) had their continuation phase for 2 months (3-4th month), 48.43 % (123/254), who were all adherent to the intensive phase of therapy, had the optimal continuation phase as per the required standard (3-6th month). 18.1%

(46) who were all non-adherent at the intensive phase went until the 8th month of treatment.

Table 4.10: Continuation phase of therapy (n = 254)

		Adhered	Did not adhere	Total
	No Continuation Phase	0	81	81
		0.0%	100.0%	100.0%
	3-4th Month	4	0	4
		100.0%	0.0%	100.0%
	3-6th Month	123	0	123
		100.0%	0.0%	100.0%
	3-7th Month	0	7	7
		0.0%	100.0%	100.0%
	3-8th Month	0	39	39
		0.0%	100.0%	100.0%
Total		127	127	254

4.3 Effect of Adherence on Treatment Outcome

4.3.1 Smear Microscopy Results after the Intensive Phase

After treatment in the intensive phase, smear microscopy is conducted to assess whether the patient still has active bacilli in their system.

"…It is within the TB treatment algorithm to assess the progress of treatment after a patient is done with the intensive phase. The patient card has a schedule for the daily intake of drugs during the 56 days of the intensive phase. The person handling DOTs is supposed to make sure that every day the patient intakes the drug is marked against the card. When the 56 days are entirely marked, the patient is subjected to smear microscopy…."

One-on-one interview, TB Nurse, Butere Sub-County Hospital.

Table 4.11 below indicates that out of the 73 who did not adhere but had a smear test conducted after the intensive phase of therapy, 18 (24.7%) had a negative smear result while the other 55% had a positive smear result. All the 127 who adhered to treatment at the intensive phase had a negative smear result.

"… What I have observed over the years working with TB patients is that most of those who take their medication as per prescription especially during the intensive phase are usually stable enough to finish their treatment within the intended six months of treatment. This is largely due to the messaging before the start of treatment where all parties involved with the patient's treatment are sat down and all expectations put on the table. These patients always end up cured of TB and it is my belief that it is because they got the messaging right…"

One-on-one interview, TB Clinic In Charge, Iguhu Sub-County Hospital.

It is important to note that those who test Smear +ve after the intensive phase are again subjected to further tests as their period for the intensive phase is extended. This is because at this particular point the patient is suspected to be having MDR-TB. Gene Xpert test can be conducted to determine whether they are resistant to Rifampicin. Culture of the bacterium is grown and subjected to different sensitivity tests to determine what drug the patient was resistant to, which will inform the next course of management.

If these tests come back negative, another Smear test is conducted at the end of intensive phase extension period before the patient is ushered into the continuation phase.

Table 4.11: Smear result after intensive phase of therapy (n = 254)

		Adhered	**Did not adhere**	**Total**	**Chi-Square**
	Smear +ve	0	55	55	x^2 = 190.938
		0.00%	100.00%	100.00%	df = 2
	Smear -ve	127	18	145	p < .001
		87.60%	12.40%	100.00%	
	Not done	0	54	54	
		0.00%	100.00%	100.00%	
Total		127	127	254	

The chi-square test gave an indication of significant association at 95% level of significance in terms of the smear result after the intensive phase of therapy, between the patients who adhered to the intensive phase of therapy and the ones who did not (CI = .05, x^2 = 190.938, df = 2, p < .001).

4.3.2 Outcome after the entire Treatment Period

Table 4.12: Outcome after treatment period (n = 254)

		Adhered	Did not adhere	Total	Chi-Square
	Cured (smear -ve)	116	46	162	x^2 = 84.533
		71.60%	28.40%	100.00%	df = 2
	Dead	0	15	15	p < .001
		0.00%	100.00%	100.00%	
	Lost to Follow-up	11	66	77	
		14.30%	85.70%	100.00%	
Total		127	127	254	

Table 4.12 above shows the outcome after treatment period. 63.78% (162/254) of the patients under study were cured from TB (tested smear negative). 5.91% (15/254) succumbed or died during different periods of treatment while 30.31% (77/254) could not be traced thus became LTFU.

The chi-square test revealed that there was significant difference at 95% level of significance in terms of the outcome after the entire treatment period, between the patients who adhered to the intensive phase of therapy and the ones who did not (CI = .05, x^2 = 84.533, df = 2, p < .001).

4.4 Association between Adherence and Treatment Indicators

4.4.1 Association between adherence and the outcomes

Table 4.13: Relationship between Adherence/Non-Adherence at the Intensive Phase and Final Treatment Outcome (n = 254)

		Adhered	Did not adhere	Total
Cured (smear -ve)	Freq	116	46	162
	%	91.3%	36.2%	63.8%
Dead	Freq	0	15	15
	%	0.0%	11.8%	5.9%
Lost to Follow-up	Freq	11	66	77
	%	8.7%	52.0%	30.3%
	Total	127	127	254

p < .001

When patients adhered to the intensive phase of therapy as shown in table 4.13 above, 91.34%

(116) of the patients were cured from TB, 8.66% (11) could not be traced back to treatment. But when patients do not adhere to the intensive phase of therapy as in table 4.13 below, 11.81 % (15) died, 36.22% (46) cured or tested Smear negative while 51.97% (66) could not be traced back to treatment.

When patients did not adhere to the intensive phase of TB therapy, 36.22% (46) of TB patients got cured from TB while 11.81 % (15) died. Compared with when patients adhere to treatment, the number of deaths were zero.

Table 4.14: Relationship between Adherence/Non-Adherence and Test after Intensive Phase

(n = 254)

		Adhered	Did not adhere	Total
Smear +ve	Freq	0	55	55
	%	0.0%	43.3%	21.7%
Smear -ve	Freq	127	18	145
	%	100.0%	14.2%	57.1%
Not done	Freq	0	54	54
	%	0.0%	42.5%	21.3%
	Total	127	127	254

p < 0.001

All the participants who adhered to TB treatment at the intensive phase received a smear test after the first two months of treatment and all the results were smear -ve, as depicted by table 4.14 above. This indicates that when there is adherence on intensive phase, the treatment outcome is more likely to be 100% Smear -ve when Smear Microscopy is conducted after the intensive phase.

When patients did not adhere to TB treatment during the intensive phase of therapy, 43.31% (55) of the participants had Smear +ve results, 14.17% (18) had Smear –ve results while 54 42.51% did not even get to go for the Smear Microscopy test.

Table 4.15: Relationship between Occupation, Adherence and Non-Adherence to the Intensive Phase (n = 254)

Occupation	**Adherence**		**Non-Adherence**	
	Freq.	Percent	Freq.	Percent
Salaried employment	31	24.41	24	18.90
Self Employed	48	37.80	33	25.98
Unemployment	48	37.80	70	55.12
Total	127	100.00	127	100.00

p < 0.001

Table 4.15 above, shows relationship between occupation and TB treatment adherence. 23.41% (31) of the participants who adhered to TB treatment at the intensive phase had salaried employment; so, did 37.8% (48) of the self-employed and 37.8% (48) of the unemployed.

55.12 % (70) of the unemployed participants defaulted to treatment in the intensive phase which hinted that unemployment plays a major factor in treatment adherence. 18.90% (24) of salaried participants and 25.98% (33) of the self-employed participants also did not adhere to treatment during the intensive phase of TB therapy.

Table 4.16: Relationship between Occupation, Treatment Outcome and Non-Adherence to the Intensive Phase (n = 127)

Occupation	Cured (smear –ve)		Dead		Lost to Follow-Up		Total	
Salaried employment	16	66.66%	0	0%	8	33.33%	24	100%
Self Employed	14	42.42%	0	0%	19	57.57%	33	100%
Unemployment	16	22.86%	15	21.42%	39	55.71%	70	100%
Total	46		15		66		127	

p < 0.001

From table 4.16 above, 21.42% (15) unemployed TB patients are more likely to die or succumb to TB. 22.86% (16) of unemployed TB patients got cured from TB. This clearly shows that unemployment is a factor that can affect adherence to treatment by TB patients. 66.7% (16) of TB patients with salaried employment, and who did not adhere to treatment at the intensive phase recovered/got cured from TB while 33.3% (8) were LTFU.

More than half of self-employed 57.6 % (19) and unemployed 55.71% (39) TB patients were also LTFU.

Table 4.17: Relationship between Treatment Duration, Treatment Outcome and Non-Adherence to the intensive Phase (n = 127)

Facility	Cured (smear –ve)		Dead		Lost to Follow up		Total
1 month	0	0%	0	0%	4	6.06%	4
2 months	0	0%	11	73.33%	14	21.21%	25
3 months	0	0%	4	26.67%	48	72.73%	52
7 months	7	15.21%	0	0%	0		7
8 months	39	84.78%	0	0%	0		39
Total	46		15		66		127

p < 0.001

In table 4.17 above, treatment duration at the facility has a part to play in the final treatment outcome. 73.33% (11) of TB who lasted 2 months in treatment died; 26.67% (4) of those who lasted only 3 months in treatment also died.

However, patients who persisted, despite not adhering to the intensive phase, and continued being on treatment at their respective facilities for a duration of 7 months 15.21% (7) and 8 months 84.78% (39) got cured.

Table 4.18: Relationship between Type of Patient, Treatment Outcome and Non-Adherence to the Intensive Phase (n = 127)

Patient	**Cured (smear –ve)**		**Dead**		**Lost to Follow up**		**Total**
New	39	32.5%	15	12.5%	66	55%	120
Treatment after LTFU	7	100%	0	0%	0	0%	7
Total	46		15		66		127

p < 0.001

In table 4.18 above, 32.5% (39) of the new patients who did not adhere to treatment during the intensive phase got cured, 12.5% (15) died while 55% (66) were LTFU. The patients who were LTFU but came back to treatment were more likely to recover from TB even when they did not adhere to treatment at the intensive phase.

Table 4.19: Relationship between Test after Intensive Phase, Treatment Outcome and Non-Adherence (n = 127)

Treatment	Cured (smear –ve)		Dead		Lost to Follow up		Total
Smear +ve	28	50.9%	12	21.81%	15	27.27%	55
Smear -ve	18	100%	0		0		18
Not done	0		3		51		54
Total	46		15		66		127

p < 0.001

Table 4.19 above shows the relationship between Smear test results and treatment outcome when patients do not adhere to treatment at the intensive phase of therapy. 50.9% (28) patients with Smear +ve result after the intensive phase got cured, 21.81% (12) died while 27.27% (15) were LTFU.

Those who persisted with the intensive phase even without adhering to treatment, finished, had a Smear –ve test continued with the treatment to the end (18) were all cured.

Table 4.20: Adherence versus Outcome Crosstabulation

	Outcome		**Total**
	Cured	LTFU/Dead	
Adhered	116	11	127
	91.3%	8.7%	100.0%
Did not adhere	46	81	127
	36.2%	63.8%	100.0%
	162	92	254

Table 4.20 above shows the crosstabulation that was used to calculate the odds ratio and relative risk values shown in table 4.21.

Table 4.21: Odds Ratio and Relative Risk

		95% Confidence Interval	
	Value	Lower	Upper
Odds Ratio for Adherence vs Non-adherence (Adhered / Did not adhere)	18.569	9.071	38.013
For cohort Outcome after treatment outcome = Cured	2.522	1.990	3.196
For cohort Outcome after treatment outcome = LTFU or Dead	0.136	0.076	0.242
N of Valid Cases	254		

From table 4.21 above, we see that the odds of TB treatment success are 18.569 (116 *x* 81)/ (46 *x* 11) times greater for those who adhere to treatment at the intensive phase than the ones who do not adhere to treatment. The risk of adhering to TB treatment at the intensive phase with the probable outcome of getting cured is 2.522 (91.3%/36.2%) while on the other hand the risk of adhering to TB treatment with the probable outcome being either dead or lost to follow-up is 0.136 (8.7%/63.8%). This means that when one adheres to treatment at the intensive phase, they are less likely to end up dead or lost to follow-up after the recommended or adjusted treatment period.

4.4.2 Association between adherence at the intensive phase and treatment indicators at multivariate level

There were 5 significant independent variables from Chi-Square analysis at bivariate level. These were all used to conduct multiple linear regression from where 3 out of the 5 variables remained significant: duration of treatment at the facility (B = .545, t = 5.139, p < .001, 95% CI .085 - .191)), smear microscopy result after the intensive phase of treatment (B = -.194, t = -3.565, p < .001, 95% CI -.230 - .066) and the treatment outcome (B = 1.070, t = 10.266, p = < .001, 95% CI .313 - .461).

The model showed that the independent variables have a significant association with adherence at the intensive phase of treatment (F (5, 248) = 38.782, p< .001), with 44% variance (R^2 = .439).

Table 4.22: Multivariate Analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	0.788	0.387		2.039	0.043	0.027	1.550
Patient's occupation	-0.005	0.032	-0.008	-0.167	0.867	-0.068	0.058
Duration of treatment at the facility	0.138	0.027	0.545	5.139	0.000	0.085	0.191
Co-morbidity risk factor	-0.083	0.045	-0.098	-1.822	0.070	-0.172	0.007
Smear result after the intensive phase	-0.148	0.042	-0.194	-3.565	0.000	-0.230	-0.066
Treatment outcome	0.387	0.038	1.070	10.266	0.000	0.313	0.461

Dependent Variable: Level of adherence at the intensive phase of treatment

4.5 Reflections on Adherence to Therapy at the Intensive Phase of Treatment

4.5.1 TB Treatment Literacy and Adherence

During patient initiation into TB treatment, the concerned HCW makes sure to involve the immediate family/companion and CHV if available in the initial adherence sessions before treatment commences. This was identified as the most important and hardest part of treatment and was integral to adherence especially at the start of treatment.

"… It is very important that patients understand their responsibilities towards their own recovery and what this means to the community and the people around them. As the clinical team, we also have to offer an avenue for something like supportive disclosure, just like how it is done in HIV. This allows for the patient to open up to a close relation or confidant, who can then commit to be a treatment supporter for the patient. First, a patient has to understand and accept that they have TB. Apart from that, as health care practitioners we understand from case management that routine

taking of medication is never easy for anyone thus one has to get all the support required…"

One-on one interview, TB Nurse, St. Mary's Mumias Hospital.

This also accentuates the fact that patient centered adherence strategies enable achievement of appropriate adherence to TB therapy (Nackers et al., 2012). The literacy sessions involved:

- Explaining the risk factors to everyone
- Make them understand the importance of treatment
- Explain the prescription over and over and clear any misunderstanding
- Give hope of recovery
- Identify a good treatment supporter

4.5.2 Reasons Non-Adherence to TB treatment at the Intensive Phase

There was a general observation by health care workers at the TB clinics that sticking to routine medication at the onset of treatment requires a lot of discipline from the patient and treatment supporter, who could either be a Health Care Worker (HCW), Community Health Volunteer (CHV) or a household member, friend or relative.

"… So long as there is discipline, vigilance and good-will, a patient can successfully navigate through the first two months of treatment, other factors notwithstanding…"

One-on-one interview, TB Nurse, Mukumu Hospital.

Some of the reasons highlighted by the key informants for non-adherence to TB treatment are closely related.

"… You find that some patients would be coming for treatment from very far away. This is their preference because they don't want people from around the area they come from to know about their TB status. As health care workers, we cannot turn

patients away or force them to seek treatment anywhere they don't want. In this kind of situation, we need to create a lot of trust because in these cases, the HCW ends up as the treatment supporter which means that at times, we have to go out of our way to keep contact with the patient, make sure there is fidelity in the patient taking medication as per prescription. Sometimes the patient might not be able to raise enough bus fare to come over observation and drug refill. At times as HCWs we go out of our way to facilitate this cost from our own pockets. We find ourselves also chipping-in to enable patients who cannot afford the necessary liver-function test, access the service…"

One-on-one interview, TB Nurse, Malava Sub-County Hospital.

The treatment course also bears a factor in default to TB therapy at the intensive phase. It is prudent for anyone taking medication to understand the science behind anti-microbial cycles for them to be aware that they need to take prescribed medication as per plan until completion. It is likewise important for the clinical to monitor adverse drug reactions and ways of mitigating them while keeping the treatment on course.

"… Before TB patients begin treatment, they often complain of a lot of pain due to the constant coughing. As they begin their treatment regimen at the intensive phase, their condition starts getting better. CHVs have reported cases where they have been turned away by patients who have just began their medication, feel better and thus assume they are healed. This is why it is important for patients to know that bacteria multiply under harsh conditions and that when drugs are introduced into their bodies, it creates harsh conditions for the bacteria. But then again at times it might be that the patient is experiencing side effects from the drugs like joint pains, peripheral

neuropathy, jaundice among others. As a facility we report Adverse Drug Reactions when it comes to this but still, we need to explain these as part of expectations during treatment, to the patient and their treatment support. The reactions might take some time and go away and this needs to come out clearly even before beginning the treatment…"

One-on-one interview, TB Nurse, Malava Sub-County Hospital.

"… Adult TB patients are supposed to take 4 tablets a day of the recommended TB regimen. Some patients find this a bit heavy for them and this might make them not adhere to treatment…"

One-on-one interview, TB Clinic In Charge, Iguhu Sub-County Hospital.

CHAPTER FIVE

5.0 DISCUSSION

5.1 Objective 1: Association Between Adherence at the Intensive Phase and Treatment Indicators

Considering literature from WHO, adherence as is described as “the extent to which the patient follows medical instructions”. These instructions are clinically standardized and adapted to in different settings. Low levels of adherence to TB treatment have been found to augment the risk of unsuccessful outcomes, including relapse, treatment failure, death and development and/or amplification of drug resistance (Hirpa et al., 2013).

Studies (Chirwa et al., 2013); (Muture et al., 2011) have showed that a high rate of defaulting occurs during the intensive phase of therapy, which is mostly attributed to the patient starting to feel cured and free of disease but this is a trend that ought not to be encouraged since these patients are probably carrying the active bacilli which they can readily transmit to a vulnerable member of the population.

A study in Poland showed that when it comes to those who do not adhere to TB treatment at the intensive phase, 59.3% of those who are unemployed are most like to default prescribed TB treatment or are not likely to adhere to TB treatment (Krawiecka, 2014). Results from this study show that 43.6% of salaried patients and 40.7% of the self- employed TB patients are also more likely not to be adherent to medication. For the salaried patients, this trend has been mainly attributed to movement and/or employee demand of physical presence which may hinder the observation of clinical appointments which thus affects drug intake (Chebet et al., 2022); (Adisa et al., 2021); (Nezenega et al., 2020).

A study in Nairobi (Muture et al., 2011) posted 43.1% for defaulting at the first two months of tuberculosis treatment with 47.7% defaulting before bacteriological conversion. This study also posted almost similar results that showed that when patients do not adhere to TB treatment during the intensive phase, there would be a 43.3% likelihood of patients having a Smear +ve result when Smear Microscopy is conducted after the intensive phase of therapy.

5.2 Objective 2: Effects of Adherence to TB Therapy at the Intensive Phase, on Treatment Outcomes

This study has shown that from those who adhered to TB treatment at the intensive phase 91.34% were able to go through the continuation phase within the required standard 4 months with 100% cure rate. In comparison, a study in Malawi (Chirwa et al., 2013) showed that 93.4% of those who adhered to treatment at the intensive phase ended up cured.

A study in West Cameroon (Djouma, Noubom, Ngomba, et al., 2015) showed that when patients don't adhere to TB treatment at the intensive phase, 36.2% of TB patients are cured (smear –ve) from TB, 11.8% die or succumb to TB. However, 51.97% got lost on follow-up. These results were similar to a systematic review (Vernon et al., 2019) on the importance of TB treatment adherence clinical trials and its relevance in explanatory and pragmatic trials.

The study in Malawi (Chirwa et al., 2013) also showed that when patients are not adherent to TB treatment at the intensive phase only but are able to totally adhere to the continuation phase of treatment, 76.6% are more likely to be cured.

A study in Uganda (Nidoi et al., 2021) showed that unsuccessful TB therapy outcome posted at the highest wealth quintile was significantly lower compared the one posted at the poorest quintile ($p = 0.047$). This same study goes ahead to show that the odds of

unsuccessful treatment outcome (OR = 4.71, 95% CI 1.18–18.89, p = 0.029) were comparably higher among participants employed in the informal sector.

Similarly, this study found out that of those who do not adhere to treatment at the intensive phase and are unemployed, 21.42 % of the patients are more likely to experience death, 22.9% would get cured from tuberculosis while 55.7% would be lost to follow-up.

The study in Poland (Krawiecka, 2014) also indicated that there were more TB treatment interruptions among the unemployed who also posed a significantly higher risk of death. This clearly shows that unemployment is a major contributor to low levels of adherence to TB treatment.

The long duration of treatment regimen at disposal for both drug resistant and drug-susceptible Tuberculosis coupled with modest tolerability and the confounding complexities that accompany TB therapy present quite a formidable challenge to treatment adherence among TB patients (Teferi et al., 2021); (Alipanah et al., 2018).

Thus, duration of treatment at the facility has a part to play in the final outcome posted for a TB patient. The study shows 73.33% of those who did not adhere to the intensive phase of therapy and were on treatment at the facility for only 2 months died; the same goes for 26.67% of those who did not adhere to the intensive phase and were at the facility for only 3 months.

Even though a retrospective study in Kilifi (Katana et al., 2022) showed that relapse (re-treatment) is a predictor of poor outcomes, relapse cases in this study that were not adherent during the intensive phase of therapy somehow persisted and completed treatment and were all cured of tuberculosis disease.

There is association between heavy initial bacillary load and the situation when sputum smear fails to convert from positive to negative after the completion of the intensive phase of therapy (Djouma, Noubom, Ateudjieu, et al., 2015). This delayed change of smear status, or lack of it has further been associated with treatment failure and death. It thus then suffices to say that individuals posting heavy initial bacillary load warrant very close monitoring so as to ensure successful sputum smear conversion at the end of the intensive phase of therapy thus aiding in the prevention of unfavorable outcomes (Vernon et al., 2019).

From the study, those who did not adhere to treatment during the intensive phase, had a test after the same phase the result came back sputum smear positive, 50.9% (28/55) managed to complete the entire treatment and were all cured, 21.81% (12/55) died while 27.27% (15/55) were lost to follow-up. 49.09% (27/55) of this cohort lasted 2-3 months in treatment, of whom 44.44% (12/27) died while 55.56% (15/27) were lost to follow-up.

All the patients who did not adhere to treatment during the intensive phase but the test result after the same phase was sputum smear negative (18) were cured (100%).

5.3 Objective 3: Factors Contributing to Non-Adherence to Tuberculosis Treatment during the Intensive Phase

5.3.1 Movement/changing of location during treatment period

Some clients' work involves travelling a lot which might affect clinic visits and drug pick-ups. Some clients might begin treatment then relocate to an area far away from the facility where access to treatment becomes an issue. In some instances, some clients come from far off counties to access the facility. In this case consistency of access to treatment at the facility is not guaranteed hence contributing to non-adherence as also

evidenced by some other studies (Adisa et al., 2021); (Arulchelvan & Elangovan, 2017).

5.3.2 Pill count

Some clients have expressed difficulty with the number pills to partake (Gallardo et al., 2016); (Albanna et al., 2013); (Lienhardt, 2011). This is coupled with the fact that during the intensive phase of therapy, the medication is supposed to be taken daily, which requires one to have a calendar system that he/she adheres to (Muture et al., 2011). Health facilities try to link every patient with a treatment supporter to help in mitigating this (Abongo et al., 2020).

5.3.3 Patient feeling better

Once a patient takes medicine for some time, he/she starts feeling better (Chebet et al., 2022); (Amo-Adjei & Awusabo-Asare, 2013); (Munro et al., 2007). It was reported that once some patients feel better, they stop taking their medicine thus adherence is affected. Making patients understand the importance of completing drug intake even if they feel better is thus an important message driven home during initiation into treatment.

5.3.4 Stigma

TB in some quarters of the community is associated with HIV. This to some point is compounded by the fact that the TB clinic at the facility is next to the Comprehensive Care Clinic, where HIV services are offered (Adisa et al., 2021); (Cramm et al., 2010). Some TB patients even found themselves discriminated upon and associated with carriers of COVID-19 (Chebet et al., 2022). There is currently some community engagement to change this notion but it is still work in progress.

5.3.5 Drug side effects

The intake of anti-TB drugs by patients, like many medications come with their side effects. Among these side effects are:

- Red urine- a characteristic of Rifampicin
- Joint pains
- Jaundice
- Peripheral neuropathy

With proper management most patients overcome these side effects and adhere to treatment to completion but some do not (Manikandan, 2012); (Lienhardt, 2011).

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

- Adherence to prescribed therapy in the intensive phase of TB therapy is of utmost importance in the quest for successful final outcome of treatment. There is a strong relationship between non-adherence to TB treatment in the intensive phase and death (12% of those who did not adhere died). On the other hand, there was no death for those who adhered to treatment during the intensive phase of TB therapy.
- Adherence to TB treatment during the intensive phase leads to increased patient recovery. The results from the study show that, when patients adhered to TB treatment 91.3% of TB patients got cured from tuberculosis disease.
- The employment status of the patient plays an important role in the TB treatment uptake process and adherence. This study plus a couple others have shown that there is more treatment interruption among those who are unemployed than those employed. Further, the risk of death from TB is significantly higher in the unemployed than the employed.
- Alcoholism was the main co-morbidity risk factor highlighted by the study. From the study, all the participants who were affected by alcoholism ended up being LTFU which means that alcohol and general drug use should be monitored closely during the course of TB treatment.
- The study also concludes that TB patients who for a reason or the other do not stick to the standard process of drug intake during the intensive phase but persisted and continued being on treatment at their respective facilities for a

duration of 7 months 15.21% (7) and 8 months 84.78% (39) got cured. This was cumulatively 36.22% of those who did not adhere.

- In this study, 10.2% (26) of the patients were followed up by the health care worker, 14.3% (105), by a house hold member, friend or relative while the majority 48.4% (123) by Community Health Volunteers. The study thus concludes that the community model needs to be strengthened as a supplement to those who by design have to have contact with a patient of TB.

6.2 Recommendations

The study established that non-compliance to TB therapy does exist among the TB patients in Kakamega County thus recommends that measures should be taken to address this situation.

- Some patients travel a long way to access TB services. This might be because of the fear of stigmatization around the patient's area of residence or the absence of TB services at nearby health facilities. The community thus requires sensitization to help reduce elements of stigmatization of TB patients which might have a counter effect of improving disclosure and/or community case notification. NTLD-P should strategize to increase the number of health facilities offering TB case identification and treatment.
- This study recommends a care model for patients posting good adherence, especially for patients who are salaried employees and would travel to far distances for work where together with the attending HCW, an agreement can be made for the patient can carry extra dosage with them so that they do not miss their drug intake.
- Liaison between health facilities should also be improved which will allow a patient who is a distance away from the parent facility to check in for

consultation or pick their medication from the nearby accessible facility and this also reflects back at the parent facility.

- In most facilities, TB patients are required to pay for the liver-function test. Some patients are not able to afford this test thus the study recommends that MOH and by extension NTLD-P find a way to subsidize these tests or include them in NHIF/SHA for ease of access by TB patients.
- There are quite a number of studies that have looked at the general adherence to TB treatment but it still remains a high burden disease with gains to treatment almost proportionate to lag-phases or loses across the different time periods. Studies on the course of treatment have included systematic reviews that look at the applicability of FDCs and most of these were done in the early 2000's. This study thus recommends that faculties of Health Sciences encourage more studies that focus on periods during the course of treatment be conducted. This would be an avenue for health care providers to have pointers on what should be done at different periods during the course of treatment that would ultimately improve the treatment outcomes.

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APPENDICES

Appendix I: IREC Approval 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/2019/171
Approval Number: 0003452

13th November, 2019

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
13 NOV 2019
APPROVED
P.O. Box 4606-30100 ELDORET

Paul Nawiri,
Moi University,
School of Public Health.
P.O. Box 4606-30100,
ELDORET-KENYA.

Dear Mr. Nawiri,

COMPARISON OF THE OUTCOME OF PULMONARY TUBERCULOSIS THERAPY AMONG PATIENTS WHO ADHERE TO THERAPY VERSUS THE ONES WHO DO NOT, DURING THE INTENSIVE PHASE OF TREATMENT, A CASE OF KAKAMEGA COUNTY

This is to inform you that ***MU/MTRH-IREC*** has reviewed and approved your above research proposal. Your application approval number is ***FAN:0003452***. The approval period is **13th November, 2019 – 12th November, 2020.**

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 expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Sincerely,

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

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

Appendix II: NACOSTI Research License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **305483**

Date of Issue: **09/January/2020**

RESEARCH LICENSE

This is to Certify that Mr.. PAUL NAWIRI of Moi University, has been licensed to conduct research in Kakamega on the topic: COMPARISON OF THE OUTCOME OF PULMONARY TUBERCULOSIS THERAPY AMONG PATIENTS WHO ADHERE TO THERAPY VERSUS THE ONES WHO DO NOT, DURING THE INTENSIVE PHASE OF TREATMENT, A CASE OF KAKAMEGA COUNTY for the period ending : 09/January/2021.

License No: **NACOSTI/P/20/3140**

305483

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.

Appendix III: Informed Consent Agreement

1) **Principal Investigator**

My name is **Paul Nawiri**. I am a graduate student in the School of Public Health, Moi University, studying Masters in Public Health. I am undertaking a research study titled; "Comparison of the outcome of Pulmonary Tuberculosis therapy among patients who adhere to therapy versus the ones who do not, during the intensive phase, a case of Kakamega County"

The procedure will entail collecting data from TB registers and patient cards between January 2009 and December 2018. Although the study will not benefit you directly, it will provide information that will help in improving the treatment and management of TB in the community.

It is also important to note that:

- There will be no risks involved in the course of the study.
- All information gathered in the study will be confidential.

I kindly request your cooperation and consent.

Appendix IV: Utoaji Idhini

2) Mpelelezi Mkuu

Jina langu ni Paul Nawiri. Mimi ni mwanafunzi katika Kitivo cha Afya ya Umma, katika Chuo Kikuu cha Moi. Nasomea Shahada ya Uzamili. Natazamia kufanya uchunguzi wa kimasomo nikiangazia matibabu ya ugonjwa wa Kifua Kikuu (Tuberculosis)

Utaratibu wa uchunguzi huu utahusu kukagua habari Fulani kutoka kwenye vitabu vinavyonakili habari za wagonjwa wa kifua kikuu. Uchunguzi huu hautakuletea wewe kibinafsi manufaa ya hapo kwa hapo lakini utawasaidia wauguzi na washika dau wote wanaohusika na ugonjwa huu katika jamii, kuboresha matibabu na huduma husika.

Ni vizuri pia kujua ya kwamba:

- Hakuna hatari yoyote inayohusishwa na uchunguzi huu.
- Habari zote ambazo zitachukuliwa na uchunguzi huu ni za siri.

Naomba ushirikiano wako tafadhali.

Appendix V:Data Collection Questionnaire

Investigator…… Date …….

ID Code. …… Facility ……

SECTION A: SOCIO-DEMOGRAPHIC INFORMATION

1. Sex
   - Male ☐
   - Female ☐
2. Age in years?

   18-27 years ☐ 28-37 years ☐

   38-47 years ☐ 48-57 years ☐ 58 years and above ☐
3. Approximate distance from residence to health facility?

   < 5 Kilometres ☐ 5-10 Kilometres ☐

   10-15 Kilometres ☐ > 15 Kilometres ☐
4. Patient Occupation
   - Salaried employment ☐
   - Self employed ☐
   - Unemployed ☐

SECTION B: INFORMATION ON TB

1. Duration of TB treatment at the facility
   - 1 month ☐ 2 months ☐
   - 3 months ☐ 4 months ☐
   - 5 months ☐ 6 months ☐
   - 7 months ☐ 8 months ☐

1. Frequency of drug refills during the first 2 months of treatment?
   - Weekly ☐

- Fortnightly (after 2 weeks) ☐
- Monthly ☐

2. Co- morbidity risk factor

- Diabetes ☐
- Hypertension ☐
- Smoking ☐
- Alcoholism ☐
- Cancer ☐

3. Type of patient

   New ☐ Treatment after LTFU ☐

   Relapse ☐

4. Means of Pulmonary TB diagnosis

   Bacteriologically confirmed ☐ Clinically diagnosed ☐

5. DOT by:

   Health Care Worker ☐ Community Health Volunteer ☐

   Household member, friend, relative ☐ Not Done ☐

   Intensive phase- daily drug intake as observed by Health Care Worker or Treatment Supporter (Tick as appropriate)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16	17	18	19	20	21	22	23	24	25	26	27	28
29	30	31	32	33	34	35	36	37	38	39	40	41	42
43	44	45	46	47	48	49	50	51	52	53	54	55	56

6. Continuation phase of therapy

Month of Tx	3	4	5	6	7	8	9	10	11	12
Refill										

SECTION C: OUTCOME OF THERAPY

7. Smear result after 2 months of treatment

   Smear +ve ☐ Smear -ve ☐

8. Outcome after treatment period

- Cured (smear –ve) ☐
- Treatment Failure (smear +ve at 5/8 months, MDR)
- Dead ☐
- Lost to Follow up ☐

Appendix VI: Interviewer Guide for Key Informants

Facility……...

Position/role in the Chest Clinic 1. Supervisor ☐

2. Service provider ☐

A: Introduction

Thank you for sparing some time to have this interview with me.

My name is _____and I am a student at Moi University. I am doing a study on adherence to anti- TB medication in Kakamega County and would therefore like to ask you a few questions in that regard. I want to assure you that your responses will be treated with utmost confidentiality.

B: Interview Guide

1. What TB services does your facility offer?

2. What is the preferred regimen at the facility?

3. What is your take on implementation and release of TB guidelines?

a) How often do the new guidelines get released?

b) What is your take on the uptake of these guidelines?

4. What would necessitate levying charges to TB patients at the chest clinic?

5. Describe your engagement with the community in view of follow- up of TB patients

6. During the 6 months that a patient is on TB treatment, at what period does most of defaulting occur?
    a) During the first two months
    b) From the third to sixth month
7. What, in your opinion are the reason(s) for this trend?

8. Describe the efforts, if any that have been put in place to address this trend?

9. How do you compare management of a TB patient in the intensive phase versus the continuation phase in terms of,
    a) The adherence sessions?

    b) Planning for the patient?

10. Describe the outcomes of patients who successfully go through the intensive phase as compared to those who don't.

11. What kinds of training do homecare givers receive?

12. Briefly describe how you relate with the homecare givers?

13. Please assess the role of having homecare givers in the outcome of TB patients

    a) Very effective
    b) Effective
    c) Mildly effective
    d) Not effective

14. What are your reasons for your answer (in 13 above)

15. What are your suggestions on the improvement of this system in Kakamega County?

Appendix VII:Plagiarism Awareness Certificate

SR320

ISO 9001:2019 Certified Institution

EDU 999 THESIS WRITING COURSE

PLAGIARISM AWARENESS CERTIFICATE

This certificate is awarded to

PAUL M. NAWIRI

SPH/PGH/26/10

In recognition for passing the University's plagiarism

Awareness test for Thesis: **PULMONARY TUBERCULOSIS THERAPY OUTCOMES AMONG PATIENTS ON THE INTENSIVE PHASE OF TREATMENT IN KAKAMEGA COUNTY, KENYA**
With a similarity index of 1% and striving to maintain academic integrity.

Awarded by:

Prof. Anne Syomwene Kisilu
CERM-ESA Project Leader Date: 5/10/2023