DETERMINANTS OF POOR TREATMENT OUTCOME AMONG TUBERCULOSIS PATIENTS IN KILIFI COUNTY, KENYA: RETROSPECTIVE STUDY

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A thesis in partial fulfillment of the requirements for the Degree of Master of Public Health of Pwani University

May, 2016
DECLARATION

Declaration by the student

This thesis is my original work and has not been presented for a degree in any other University or any award.

Signature: ______________________ Date: 26/08/2016

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PS7/PU/2124/13

Declaration by the Supervisors

We confirm that the work reported was carried out by the candidate under my/our supervision. No part of this thesis may be reproduced without prior written permission of the author and or Pwani University.

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To the Almighty God, for His endless love, kindness, wisdom and grace that always abounds all the days of my life.
ACKNOWLEDGEMENT

I would like to thank The Almighty God for the good health during my studies and the working on this thesis. And for His mercies that endures forever.

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Finally, I extend my thanks to Kilifi County Department of Health and Sub County TB Coordinators for their unreserved cooperation during data collection.
ABSTRACT

In 2013, an estimated 9 million people developed TB and 1.5 million died from the disease. Many countries globally have adopted DOT strategy which addresses factors of poor treatment outcome at community and health facility level. Efforts to improve poor tuberculosis treatment outcomes are important aspects in evaluating the effectiveness of tuberculosis control program.

The objective of this study defined determinants of poor outcomes and the associated factors for these outcomes in a cohort of patients treated for TB in the County of Kilifi in Kenya.

The study was a retrospective analysis of routine programmatic data previously entered in an electronic TB data system called TIBU. Data for a cohort of patients treated for tuberculosis was obtained from all treatment centers in the seven Sub Counties. Patients were categorized as having *successful* treatment outcome if they were cured, had negative smear microscopy at the end of treatment and at least one follow-up test or if they had completed treatment. *Poor* treatment outcome is categorized as those with; failed treatment, remained smear-positive after 5 months while on treatment or had defaulted or died during treatment course.

Of the 4,772 patients with all forms of TB registered in Kilifi County between January 2012 and December 2013, 625 (13%) had a poor treatment outcome including death 219/625 (35%), treatment interruption or default 257/625 (41%) and failure 23/625 (3%). The risk factors found to be associated with poor outcomes were male gender, HIV-positive and the sub-county of diagnosis. Males had 38% higher risk compared to females, HIV-positives had 59% higher risk compared to HIV-negatives, and TB patients diagnosed at Kilifi County Hospital had in average 11% higher risk.

The study revealed that poor treatment outcome is associated with being male, HIV positive, being diagnosed with TB in the Kilifi County hospital and high rates of mortality. Strengthening strategies which target the risk groups including, those at a high mortality, among TB patients may improve treatment outcomes within Kilifi, Kenya.
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<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AFB</td>
<td>Acid Fast Bacilli</td>
</tr>
<tr>
<td>CLTLDC:</td>
<td>County Leprosy, Tuberculosis and Lung Disease Coordinator</td>
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<tr>
<td>DOT:</td>
<td>Directly Observed Treatment</td>
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<td>DOTS:</td>
<td>Directly Observed Therapy Short Course</td>
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<td>EPTB:</td>
<td>Extra Pulmonary Tuberculosis</td>
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<td>KNBS:</td>
<td>Kenya National Bureau of Statistics</td>
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<tr>
<td>MDR:</td>
<td>Multi Drug Resistant</td>
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<td>MOH:</td>
<td>Ministry of Health</td>
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<td>MOPHS:</td>
<td>Ministry of Public Health &amp; Sanitation</td>
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<td>NLTP:</td>
<td>National Leprosy and Tuberculosis Program</td>
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<td>NSP:</td>
<td>National Strategic Plan</td>
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<td>NTP:</td>
<td>National Tuberculosis Programme</td>
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<td>PPM:</td>
<td>Public Private Mix</td>
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<tr>
<td>SCLTLC:</td>
<td>Sub County Leprosy, Tuberculosis and Lung Disease Coordinator</td>
</tr>
<tr>
<td>SDG</td>
<td>Sustainable Development Goal</td>
</tr>
<tr>
<td>TB:</td>
<td>Tuberculosis</td>
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<td>WHO:</td>
<td>World Health Organization</td>
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<td>XDR:</td>
<td>Extensive Drug Resistant</td>
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OPERATIONAL DEFINITIONS

Absconded – A TB patient started on treatment did not turn up for more than two months.

Age – the number of years one had lived as at last birthday. Kenya National Bureau of Standards- KNBS, 2009.

Cured – A pulmonary TB patient with bacteriologically confirmed TB at the beginning of treatment who was smear-or culture negative in the last month of treatment and on at least one previous occasion.

Defaulted - TB patient started on treatment did not turn up for more than two months.

Death: TB patients who died during treatment and follow up, regardless of the cause of death.

Failure: Persistently positive sputum smears on or at the end of treatment or strongly smear positive patient at the onset of treatment who showed no improvement by the fourth month.

Noncompliance: Failure to appear at the health service for over 60 days after last treatment.

Not evaluated – A TB patient for whom no treatment outcome is assigned. These include cases “transferred out” to another unit as well as cases for which the treatment outcome is unknown to the reporting unit.

Out of Control – TB patient who was on treatment for at least 2 months or was lost to follow up.

Rural - a large and isolated area of an open country (in reference to open fields and not forests, etc.) often with low population density.

R- Statistical - Statistical tool used in this research to analyze the data.

R Group - An informal R-statistical interest study association made of students, colleagues and mentors of the school.
Sex - refers to condition or character or gender of being female or male.

**TB Treatment Success** – the sum of cured and or completed TB treatment.

**Transfer Out** - Patients were transferred to another health unit and final results of treatment are unknown.

**TIBU** – is a Kiswahili word meaning “treat”. It is a unique customized system developed in Kenya to specifically address challenges in data management and ensure tracking and monitoring of all TB patient data throughout the country. It is based on a two pronged approach that enables the TB program to easily access data for informed decision at all levels.

**Treatment complete** – A TB patient who completed treatment without evidence of failure BUT with no record to show that sputum smear or culture results in the last month of treatment and on at least one previous occasion were negative, either because tests were not done or results are unavailable.

**Urban** - is an area with increased density of human-created structures in comparison to the areas surrounding it and has a population of 2,000 and above. In this definition, urban areas include the following: Municipalities, Town councils, and peril-urban councils.
CHAPTER ONE
INTRODUCTION

1.1 Background

Tuberculosis remains a major cause of mortality among infectious diseases (Getahun et al., 2011). Tuberculosis occurs in every part of the world and remains to be one of the world’s deadliest communicable diseases (WHO, 2014b). World health organization (WHO, 2015b) confirm mortality reduction by 47% since 1990, with nearly all of that improvement taking place since 2000, when the Millennium Development Goal (MDGs) were set. In 2013, an estimated 9 million people developed TB and 1.5 million people died from the disease, 360,000 of whom were HIV-infected (WHO, 2014b). In 2014, 9.6 million people fell ill with TB, including 1.2 million people living with HIV. TB still ranks alongside HIV as a leading cause of death (WHO, 2015a). An estimated mortality reduction of 1.2 million (12%) of the 9.6 million people were TB/HIV-positive co-infected globally. The African Region accounted for 74% of these cases (WHO, 2015b).

Global set targets to be achieved by 2015 were incidence, prevalence and mortality. The 2015 Millennium Development Goal (MDG) of halting and reversing TB incidence was globally achieved in all six WHO regions and in most of the 22 high TB burden countries (HBCs). Worldwide, an estimated rate of 45% TB mortality cases fell between 1990 and 2013 and the TB prevalence rate fell by 41% during the same period (WHO, 2000). Only America and the Western Pacific Region have yet to achieve all three 2015 targets for reductions in TB disease burden (WHO, 2000). The South-East Asia Region also appears to be on track to meet TB targets. The African, Eastern Mediterranean and European Regions have reported declines but not fast enough to meet the targets (WHO, 2014b). Other reports indicates that Sub-Saharan Africa have the highest deaths among TB patients (Getahun et al 2013). In addition, a study by Dye and Borgdorff, (2010) report an estimated 17 million people infected with tuberculosis in Sub-Saharan Africa. Similarly, a study in Shinile town,
in Somali Regional State of Ethiopia reports that people are underserved in all forms of health care and suffer twice (OR = 2.3; 95% CI: 1.2 to 4.6) as likely to increase burden of TB (Tolossa et al., 2014). A study conducted in Southwestern Nigeria found mortality was ten times higher among smear positive patient than among smear negative patients (Babatunde, 2013). Another study in Northern Ethiopia found that, risk of poor treatment outcome was 2.5 (95% CI: 1.12-5.59) times higher among Pulmonary TB patients older than 40 years of age compared to those aged 15–40 years (Berhe et al. 2012).

Similarly, a randomized clinical trial study in Zambia and Malawi found that age [Adjusted OR=1.07; 95% CI (1.0–1.1); p-value= 0.001] was a strong risk factor for mortality (Ciglenecki et al., 2007). In a study conducted in Morocco report that, patients undergoing initial treatment for TB were at higher risk of a composite endpoint of failure, default, or relapse within two years if they were male (OR =2.29, 95% CI 1.10-4.77), since they failed to have sputum smear conversion to negative by 3 months of treatment (OR 7.14, 95% CI 4.04-13.2) or required hospitalization during treatment (OR 2.09, 95% CI 1.01-4.34) (Dooley et al., 2011). A study in Limpopo province, South Africa found death rate amongst TB patients was 13.6% (Mohammed et al 2010). In another study conducted in South Eastern Nigeria found males (16.2%) defaulted more than females (12.5%) and had treatment failure (3.2%) compared to their female counterparts (Dolly et al., 2015).

In Kenya, there has been a steady increase in the number of tuberculosis patients particularly since the early 90’s. This rising number of tuberculosis cases poses a major threat to the health and the economy of this country (Health, For, & Collaborative, 2006). WHO estimated that there were 120,000 new cases of TB in 2012 in Kenya (WHO, 2014b). National strategic plan for Kenya (NTLD, 2014) reports that, from 2003 to 2012, the proportion of new cases that were bacteriological confirmed ranged from 37.3-43.0% while the proportion of new extra pulmonary cases increased gradually since 2003. For the past ten years, the proportion of retreatment cases remained just below 10% of all notified cases.
(NTLD, 2014). Recently, Kenya has been rated 15th among the 22 high TB burden countries that collectively contributes 80% of global TB burden (Policy, 2012). It had been estimated that nearly 200 people die of the disease in Kenya every day (Policy, 2012). In this light, this current study investigated the factors associated with poor treatment outcome among tuberculosis patients in Kilifi County, Kenya.

1.2 Problem Statement

Poor treatment outcomes, including incomplete treatment carries a risk of development of failure, increased disease transmission, and increased morbidity and mortality (Vasankari et al., 2007). World health organization WHO, (2015) focus on zero deaths, disease and suffering due to tuberculosis. The associated challenges in TB treatment are non-adherence to treatment, treatment default, default and death (Dolly et al., 2015). Kenya ranks 15 of 22 countries with high tuberculosis burden notwithstanding effective and affordable TB treatment available in Kenya (WHO, 2012). Poor treatment outcome including: sputum smear negative diagnosis (OR 1.83; 95% CI 1.3- 5.51, =0.028), HIV positive status (OR 2.3; 95% CI 1.34-5.73, P= 0.002) , and positive sputum test result at 2nd month after initiation of treatment (OR 14.2; 95% CI 5.52-36.46, P< 0.001) were found to be predictors in Eastern Ethiopia study (Tariku et al., 2015).

A study in Abuja Nigeria report that TB HIV positive patients are three times more likely to have treatment failure and three times more likely to default, compared with HIV negative (Ofoegbu & Odume, 2015). TB killed 1.5 million people among these: 1.1 million were HIV-negative and 0.4 million HIV-positive (WHO, 2015b). In addition, HIV positive co-infection with TB contributes to poor treatment outcome particularly to patients residing in urban (OR = 2.4; 95% CI: 1.2 to 4.5) when compared to HIV negative persons with such a history (Mbithi, et al. 2016). Another study by Dolly et al found that 16.2% TB patients defaulted in South eastern Nigeria (Dolly et al., 2015). A study on gender difference in treatment outcome among women of reproductive age (15–49 years) in Kenya
found out that they were at a greater risk of having a poor TB treatment outcome than their male counterparts (Kosgei et al., 2015).

TB affects all age groups, but has its greatest toll on those above 15 years of age (Mohajan, 2014). There is paucity of TB poor treatment outcome in Kenya; hence data from other African countries are used as reference. Despite challenges faced during TB treatment, there seem to be no previous studies conducted to determine factors associated with poor treatment outcome of all forms of TB patients in Kilifi County, in Kenya.

1.3 Study Rationale and Justification

Tuberculosis is curable if patients with drug susceptible organisms are given enough uninterrupted therapy. Poor treatment outcome of TB have been reported from different high burden setting in Sub-Saharan Africa and Thailand (Abdelhadi et al., 2015; Amnuaiphon et al., 2009; Biruk et al., 2016). However, little is known about factors associated with poor treatment outcome. Determining the poor treatment outcome is one of the TB control in DOTS, Stop TB and End TB approaches. Consequently, this study has attempted to identify factors associated with poor treatment outcome in Kilifi County. Furthermore, no study has been done on poor treatment outcome of TB in Kilifi County, Kenya. Therefore, knowledge on these risk factors will have paramount importance for evaluation of the program and differentiate approaches to poor treatment outcome of TB.
1.4 Theoretical Framework

The foundation of a study is grounded upon the theoretical or conceptual framework, and that the framework guide and strengthens the study Mutai, (2000). In addition, McGaghie et al., (2001) alluded that conceptual or theoretical framework always underlies a research study even if the framework is not articulated. Theoretical framework establishes a cause and effects relationship between variables with the purpose of explaining and predicting phenomena, which Mutai (2000) stresses it is important to the researcher. Acknowledging this importance of conceptual or theoretical framework, the author developed the framework below.

![The Conceptual Framework](image)

**Figure 1: The Conceptual Framework**

The study variables were conceptualized to be predictor for poor treatment outcomes as defined by World Health Organization (WHO, 2013). The foundation for this study is based
on the conceptual framework where the outcomes of TB treatment are predicted by four independent variables as outlined in Figure 1. These include: category of patients (that is new, relapse, defaulter and failure), demographic (age, sex, and residence), type of TB (pulmonary or extra pulmonary) and HIV status (positive or negative). The variables within the framework selected for this study were identified in the literature as the common causes or determinants of poor outcome (Amnuaiphon et al., 2009; Babatunde, 2013; Vasankari et al., 2007). Demographics, category of patients, type of TB and HIV status suggests that the four variables (Figure 1) can predict outcome despite differences in other variables. The framework informed the selection of the specific variables from the TIBU data base to form the cohort for this study. The framework strengthened the analysis process by focusing on the four variables and also guided the analysis between variables for socio-demographic and category of TB patient. Presentation of the results was guided by the same four predictors as in framework. The interpretation of the results using this framework presented in the discussion helped to reveal an independent association with the study variable and the outcome. The framework therefore aimed to assist the study to identify if these four variables determined a poor outcome, which was the objective of the study.

1.5 Study Objectives

1.5.1 Broad Objective

To determine factors associated with poor treatment outcome of all forms of TB patients registered between January 2012 and December 2013 at Kilifi County.

1.5.2 Specific objectives

i) To determine the demographic characteristics of patients enrolled for TB.

ii) To determine the treatment outcomes according to TB patient category.

iii) To determine risk factors associated with poor treatment outcomes.
1.6 Research Questions

i. What are the demographic characteristics of TB patients enrolled for treatment?

ii. What are the treatment outcomes of TB patients according to category?

iii. What are the risk factors associated with poor treatment outcomes?
CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction
This chapter covers the review of studies undertaken around tuberculosis: demographic characteristics, treatment outcomes and risks factors associated with poor TB treatment outcome.

2.2 Overview of Tuberculosis
Tuberculosis mostly affects young adults in their most productive years. However, all ages are at risk. The transmission of the bacteria is through infectious aerosolized droplet nuclei generated by coughing, talking, sneezing and singing. The ability to generate infectious aerosolized droplets nuclei is dependent on the infectivity of the patient with sputum smear positive (Dooley et al., 1992). TB presents with night sweats, low body temperature, weight loss and productive cough with blood staining. In HIV-infected persons with TB may have the classic symptoms of TB (e.g. productive cough, chest pain, shortness of breath, hemoptysis, fever, night sweats, and/or weight loss), many such patients have few symptoms or have symptoms that are even less specific (Sterling et al., 2010). TB is classified as either pulmonary or extra-pulmonary. Pulmonary tuberculosis refers to any bacteriologically confirmed or clinically diagnosed case of TB involving the lung parenchyma or the tracheobronchial tree while extra pulmonary tuberculosis refers to any bacteriologically confirmed or clinically diagnosed case of TB involving organs other than the lungs, e.g. pleura, lymph nodes, abdomen, genitourinary tract, skin, joints and bones, and meninges of the brain (WHO, 2013).

Since 1990, several key events have shifted global strategies to control TB, and global epidemiology has also changed. In 1995, the WHO branded Directly Observed Treatment, Short-course (DOTS) strategy that focused on political commitment with increased and sustained financing (WHO, 2009). In addition, case detection through quality-assured bacteriological, standardized treatment, with supervision and patient support and an
effective drug supply and management system was also among the components of DOTS. However, a study conducted in Homa Bay, Kenya found efficiency and feasibility of directly observed therapy (DOT) under routine program conditions was wanting (Fabienne et al., 2012).

In 2006, the Stop TB strategy was initiated which pursued high-quality DOTS expansion and enhancement; addressed challenges faced by TB and HIV co-infection, Multi Drug Resistant TB, strengthened health systems and engaged all health care providers, including private. Stop TB focused on empowering persons with TB and communities and promotes research on TB (Dirlikov et al., 2015). In 2014, the 67th World Health Assembly approved the WHO End TB Strategy, 2016–2035, which encapsulates broader approaches toward ending the TB epidemic as a major challenge to public health (Raviglione and Ditiu, 2013). The End TB, 2016-2035 stipulates integration of patient-centered care and prevention, bold policies and supportive systems and intensified research and innovation on TB programs (Dirlikov et al., 2015). The Global Plan to End TB 2016–2020 launched by the Stop TB Partnership has three fundamental targets called 90–(90)–90; which stipulates 90% of all people with TB are diagnosed and treated, 90% of the most vulnerable populations (children, people living with HIV, miners, addictive substance users, prisoners, the homeless, and migrants, and healthcare) in all countries (high- and low- income) are diagnosed and treated; and 90% of people diagnosed successfully complete treatment with services to ensure adherence and social support (Ntoumi et al., 2016). Similarly, the WHO End TB Strategy, approved by the World Health Assembly in May 2014, has its objective of ending the global tuberculosis (TB) epidemic by 2035, with a targets of reducing death rate by 95% (Lienhardt et al., 2016). In addition, the WHO’s End TB Strategy was established in parallel with the sustainable development goals in order to align set indicators and targets (Lönnroth & Raviglione, 2015).
2.3 Demographic characteristics, case category and TB classification

2.3.1 Age

Globally, age has been recognized to be an important risk factor for TB poor outcomes. This is supported by findings of studies done in Malaysia (Atif et al., 2014), India (Basa & Venkatesh, 2015), Thailand (Amnuaiphon et al., 2009) and Washington State in America (Horne et al., 2010). Studies in Africa, Northern Ethiopia (Berhe et al., 2012) found risk of poor treatment outcome was three times higher among PTB patients older than 40 years of age compared to younger ones aged 15–40 years, similar to another study done in Zambia (Ciglenecki et al., 2007). In these studies, increase in age (old) was a strong risk factor for mortality from tuberculosis. In addition, Adinma et al report that two thirds of TB patients who defaulted in Southern Nigeria were aged 30-37 (Adinma et al., 2016). Another study on factors influencing outcomes in tuberculosis patients found default rate was 9.8%, mortality rate 13.6%. Among those aged 2 years or younger (14%), 22–55 years (15%) and those aged 56 or more (16.5%); were likely to die than the other age groups (Mohammed et al., 2010). Conversely, a study in Kenya by Kosgei et al on gender differences in treatment outcomes among 15-19 years old with smear–positive pulmonary tuberculosis report age was associated with poor TB treatment outcome (Kosgei et al., 2015). Similarly, a study in Mombasa Kenya by Arentz et al on impact of smear microscopy results and observed therapy on tuberculosis treatment also report children less than 15 years old were four times more likely to die (RR 4.70, 95% CI 1.07–20.70) compared to other age cohort due to low immunity (Arentz et al., 2011).
2.3.2 Gender

A study in Brazil by Maruza et al on risk factors for default from the tuberculosis treatment in HIV infected individuals found sex was associated with poor treatment outcome (Maruza et al., 2011). A study by Asampong et al on health seeking behavior among electronic waste workers in Ghana found males considered cost and severity of the disease for seeking health care services (Asampong et al., 2015). In addition, Ii et al report that male were more likely to have positive sputum smear than females in Southwestern Uganda (Ii et al., 2014). Further, study on biological difference between the sexes and susceptibility to tuberculosis by Nhamoye bonde & Leslie report that immune response plays a role in TB infection (Nhamoye bonde & Leslie, 2014). A study in Morocco by Dooley et al on risk factors for tuberculosis treatment failure, default or relapse and outcomes of retreatment found male gender was four times OR 4.56 (95% CI: 0.96-20.7) more likely to have poor treatment outcome compared to females (Dooley et al., 2011). Similarly, a study in Southern region of Ethiopia on factors associated with poor treatment outcome found that males were less likely to have a successful outcome than females (Cuevas et al., 2010). In addition a study in Burkina Faso on risk factors for tuberculosis treatment also report that male were two times more likely to default from TB treatment (p value=0.006) (Bernard et al., 2015).

Moreover, Arentz et al reports that over half of the TB patients in Mombasa were male (Arentz et al., 2011). However, results from the Second Kenya AIDS Indicator Survey reports that 42.0% of men with Tuberculosis and HIV at the National Level in Kenya had poor outcome (Mbithi et al., 2016). In addition another study in Kenya revealed that gender was identified as the main demographic factor predictive of sputum positivity after intensive phase of treatment (Maingi, et al., 2014).
2.3.3 Residence

A study in South Ethiopia reported that TB patients from rural areas had poor treatment outcome (aOR = 1.63, 95% CI: 1.21–2.20) compared to females (Gebrezgabiher et al., 2016). The finding is different from a study in Kassala state in Sudan which reports (65.1%) patients were from urban areas while (34.9%) were from rural areas (Abdelhadi et al., 2015). Additionally, Ukwaja et al reports that patients who received care at the urban public facility were associated with poor treatment outcome (aOR = 2.9, 95%CI: 1.9-4.4) (Ukwaja et al., 2016). Additionally, Cuevas et al reports that patients residing in urban areas had poor treatment outcome (20.9% vs 14.1%,p <0.001) compared to patients from rural Southern region of Ethiopia (Cuevas et al., 2010).

In Kenya, slum setting (residence) is associated with poor treatment outcome due to overcrowding that lead to transmission and a gap in TB knowledge among the private health care providers practicing in slum setting in Nairobi, Kenya (Chakaya et al., 2005).

In a spatial study on epidemiology of Tuberculosis in High Burden Counties of Kisumu and Siaya, Western Kenya, reports that TB mostly occur in urban due to population density (Sifuna, 2013).

2.4 TB treatment outcome

Initial empiric treatment of TB, is when a patient is put on a four-drug regimen: Rifampicin, Isoniazid, Pyrazinamide and Ethambutol. After two months of TB treatment, (for a fully susceptible isolate), Pyrazinamide and Ethambutol can be stopped. Isoniazid and Rifampicin are continued as daily or intermittent therapy for four more months, (Vasankari et al., 2007). In addition, standard first-line therapy for TB with a four-drug intensive treatment phase of two months, followed by four months of treatment with a two-drug regimen, is highly effective in patients with HIV infection–related TB (Sterling et al., 2010).
TB poor treatment outcome comprises of patients who die from any reason during the course of treatment, patients who transfer out, patients who are out of control and those whose treatment fail to clear *mycobacterium bacillus* after two months (WHO, 2014b). It is known that tuberculosis can be cured by regular intake of anti-tuberculosis drugs; with good adherence, however, tuberculosis continues to be a serious world public health problem (Fabienne et al., 2012). One of the greatest dilemmas and challenges facing most TB programmes is that of patients who do not complete their TB treatment for one reason or another (Vasankari et al., 2007).

A study by twenty two member states countries including Belgium, Denmark, Ireland, the Netherland, Norway, Sweden, United Kingdom in the European Union (EU) and European Economic Area (EEA) reported that, treatment success rate for all laboratory-confirmed pulmonary cases were 73.8%. Of these patients, 7.5% died while being treated for TB, 3.6% failed treatment, 7.0% defaulted, 3.5% were still on treatment at the end of the 12-month observation period and 4.4% had an outcome recorded as unknown or transferred (Manissero et al., 2010).

In 2013, 58% of the 4.9 million pulmonary TB patients notified globally were bacteriologically confirmed via a WHO- recommended test, including rapid tests such as gene X-pert (WHO, 2014b). TB is slowly declining each year and it is estimated that 37 million lives were saved between 2000 and 2013 through effective diagnosis and treatment (WHO, 2014a).

Although treatment success rates in the European Region have improved since 2011, they were still below average in 2012 at 75% (WHO, 2014b). WHO further reports that two out of six regions have achieved all three 2015 targets for reductions in TB disease burden (incidence, prevalence, mortality): the Region of the Americas and the Western Pacific Region. The South-East Asia Region appears on track to meet all three targets. Incidence,
prevalence and mortality rates are all falling in the African, Eastern Mediterranean and European Regions but not fast enough to meet targets (WHO, 2014b).

The highest incidence of TB and the highest number of deaths due to TB occur in Asia and sub-Saharan Africa, (Getahun et al., 2013). In addition, Getahun et al report that 2.36 (3.7%) died, 26 (0.4%) failed treatment, and 328 (5.1) defaulted in Addis Ababa, Ethiopia (Getahun et al., 2013). Tuberculosis remains a cause of mortality among infectious diseases (Getahun, et al., 2011). Besides, Woldeyohannes et al reports an increase of death rate and defaulter rate among TB patients from 2.9 to 5.4 % with average value of being 4.5 % (Woldeyohannes et al., 2015). A study on adherence of TB treatment in Homa Bay found that a proportion of (6.8%) had poor treatment outcomes including death, failure, and default (Fabienne et al., 2012).

A study aiming to find characterization of defaulters from tuberculosis treatment report that, 50 (17.7%) of patients who tested negative to the Acid Fast Bacillus (AFB) screening defaulted from TB treatment, compared to 52 (15.0%) of those who were AFB positive (Adinma et al., 2016). Recent study in Burkina Faso report that, sputum smear-positive after 2 months of treatment (OR=11.52; 95% CI: 5.18-25.60) were associated with poor outcome (Bernard et al., 2015).

Poor treatment outcome was found among age groups above 40 years 2.5 (95% CI: 12-5.59) times higher than those patients below 40 years (Berhe et al., 2012). In addition, poor treatment outcome was also found among the TB relapse, defaulters and failures compared new case (adjusted odds ratio =2.00, 95% CI:1.37-2.92), (Berhe et al., 2012). Additionally, Cuevas et al reports that reveal that, patients residing in urban areas had poor treatment outcome (20.9% vs 14.1%, p <0.001) than patients from rural in Southern region of Ethiopia (Cuevas et al., 2010).
2.5 Risk factors associated with poor treatment outcomes

Risk factors for TB described in high burden TB countries in the literature include: age, male gender, sputum smear positive at two months and initial sputum smear negative. A study finding in Ethiopia revealed that regardless of having successful treatment outcome; poor outcome factors that is death, default, and failure rates (3.4%, 0.5%, and 1.2%) were reported (Endris et al., 2014).

A study in northern Ethiopia among smear sputum positive reveal that, TB patients older than 40 years of age (adj. OR = 2.50, 95% CI: 1.12-5.59) were predictor for poor outcomes of TB (Berhe et al., 2012). Most TB cases and deaths occur among men (WHO, 2013). A study in Ethiopia reports that, being male is strongly associated with defaulting (11.9% vs 10.2%, p=0.04) compared with females (Cuevas et al., 2010). Equally, the proportion also varied with age, children <5 years and adults >65 years were positively associated to default (12.8% and 13.9% respectively).

Several studies in Eastern and Southern Ethiopia revealed that sputum smear negative diagnosis were one times higher (OR 1.83; 95% CI 1.3-5.51, =0.028) risk of having poor treatment outcome (Gebrezgabiher et al., 2016; Tariku et al., 2015). More so, HIV positive status (OR 2.3; 95% CI 1.34-5.73, P= 0.002) and positive sputum test result at 2nd month after initiation of treatment (OR 14.2; 95% CI 5.52-36.46, P< 0.001) were also found to be predictors of poor treatment outcome.

A study finding on characterization of defaulters from tuberculosis treatment reports that, 50 (17.7%) of patients who tested negative to the AFB screening defaulted from TB treatment, as against the 15.0% of those who were AFB positive (Adinma et al., 2016). Another study in Kassla state, Sudan reports that stopping treatment after feeling better and completing the intensive treatment phase was an important predictor of defaulting (Abdelhadi et al., 2015). The study further reports that sputum smear positive at month two were more likely to fail treatment (0.8% ); with an (aOR 1.68,95% CI 1.07-2.63), as by
Cuevas et al., (2010). In a study carried out in Addis Ababa Ethiopia, reports that, more than 75% death occur within eight month of treatment initiation (Getahun et al., 2011).

A study in Kenya found that gender and age were the demographic factors predictive of sputum positivity after intensive phase of treatment (Maingi et al., 2014). Risk of active TB is greater in persons suffering from other conditions that impair the immune system. Once tuberculosis becomes clinically manifest, co-infection with HIV is generally associated with poor outcome (Walter et al., 2012). A study finding by Muture et al confirms HIV co-infection, history of previous default, male sex are associated with default (Muture et al., 2011). In addition, Arentz et al reports that one individual (0.6%) failed treatment, eight individuals (4%) died while on treatment and sixteen individuals (9%) defaulted in Mombasa, Kenya (Arentz et al., 2011). Further, Arentz et al., (2011) also found that initial negative sputum smear and HIV co-infection were three (RR 3.32, 95% CI 1.22–8.99) and four times higher (RR 4.61, 95% CI 1.69–12.59) risk of having poor treatment outcome in Mombasa.
CHAPTER THREE
MATERIALS AND METHODS

3.1 Introduction

This chapter describes the materials and methods used to conduct this study. It discusses research design, the variables, and the study area and study population that were employed in the study. Further, data collection procedure and data quality management including analysis procedures is presented. Finally, ethical issues and application consideration are then explained in this section.

3.2 Study Design

This was a retrospective audit of patients registered for TB treatment in all seven Sub-County centers i.e (Ganze, Kilifi North, Kilifi South, Kaloleni, Rabai, Malindi and Magarini) of Kilifi County.

The retrospective design was chosen because of its convenience and relatively low cost to execute. In the present study it was possible to review data covering two years within a short time and at a minimal cost. The seven Sub Counties were purposely selected, as they were coordinated by TB coordinators who were supplied with computers for data capture in their respective regions which is updated on daily basis especially for new patient or TB patients who come after interruption. The Sub County health facilities use standard National Tuberculosis and Lung Disease (NTLD) registers and record the patient case category, disease classification, type and dose of drugs provided, follow-up sputum smears and treatment outcome according to NTLD and World Health Organization (WHO) definitions (Cuevas et al., 2010).
3.3 Study Variables

Patients were categorized as having a:

i. **Successful treatment outcome.** This includes; cured (that is, negative smear microscopy at the end of treatment and at least one previous follow-up test) or if they had completed treatment with resolution of symptoms.

ii. **Poor treatment outcome.** This includes; failed treatment (that is, remaining smear-positive after 5 months of treatment), or had defaulted or died during treatment.

**Table 1: study operational variables, definition and scale**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 TB Treatment Outcome</td>
<td>What happens to patients during or after treatment?</td>
<td>Categorical- treatment success (cured + complete treatment), treatment failure (defaulted, died, transferred out.)</td>
</tr>
<tr>
<td><strong>Independent variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Age</td>
<td>The age of the patient as of day of birth in years, at the time of diagnosis</td>
<td>Age of patients on continuous scale</td>
</tr>
<tr>
<td>3 Sex</td>
<td>The biological sex of the patient.</td>
<td>Nominal scale with 2 categories of male and Female</td>
</tr>
<tr>
<td>4 Category of Patient</td>
<td>The grouping of patients according to treatment history.</td>
<td>Nominal scale with several categories:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. New</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Relapse</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>5</strong></td>
<td><strong>Type of TB</strong></td>
<td>The category of extension of tuberculosis (within the lung or to organs far from lung)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nominal scale with 2 categories: 1. Pulmonary TB: TB affecting the lungs 2. Extra pulmonary TB: This is TB of organs other than the lungs, such as lymph nodes, abdomen, genitourinary tract, skin, joints and bones, meninges, etc</td>
</tr>
<tr>
<td><strong>6</strong></td>
<td><strong>HIV status of the patient</strong></td>
<td>HIV ascertainment with the Retro check and counter checked by using a more precise ELISA test</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nominal scale, with categories; 1. HIV positive with TB 2. HIV negative with TB,</td>
</tr>
<tr>
<td><strong>7</strong></td>
<td><strong>Area of Residence</strong></td>
<td>Rural area: areas far away from the main town, with poor access to main town.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nominal scale, with 2 categories. The name of the place/town/village of residence of the individual, will determine if urban or rural residence.</td>
</tr>
</tbody>
</table>
3.4 Study Area

The study was done in Kilifi County which is located in the east coast of Kenya (Map in Figure. 2). The County has a total population of 1,244,420. The proportion of males is 48.8%, urban population at 26% and the population density is 98.7 persons per square kilometer. The key health indicators include HIV prevalence of 3.7%, fully immunized < 1 year is 78%. The doctor to population ratio is 1:48,000; nurses to population ratio are 1:2655; health facility to population ratio is 1:4,762. The main economic activity is fishing (NTLD, 2013).

3.5 How is TB Coordinated

The national TB surveillance system in Kenya (TIBU) is an electronic case based system that enables availability of real time information on all TB patients in the Country. Data is entered into an electronic tablet by sub County TB coordinators from TB facility registers during routine, monthly, support and supervision visits in the health facilities. The data is then electronically transmitted to the national database. This electronic system commenced in 2012, replacing the previous paper based system where the districts would on a quarterly basis aggregate all data from health facilities before transmission to the regional and national levels.
Figure 2 Map showing location of study area. The seven sub-Counties included in the study as: Ganze, Kilifi North, Kilifi South, Kaloleni, Rabai, Malindi and Magarini.
3.6 Study Population

The target population consisted of all TB patients (Pulmonary and Extra-Pulmonary), adults and children, new and re-treated, defaulted and whose treatment is completed, and all those transferred in and out. Transfer out were excluded from this study because their outcome was not known.

3.7 Data Collection

The study used the TIBU system database. TIBU meaning “treat medically” is a unique program developed by Iridium Interactive and launched in 2012 in Kenya (Fact sheet, 2012). It is used in Kenya by Division of Leprosy and Lung Disease (DLTLD) specifically to address weak program management of TB. The TB web based program is integrated with mobile technology. Once uploaded the data is immediately available for analysis and TIBU can generate cohort reports on case finding, treatment success, multidrug resistance (MDR) incidence and mapping of specific issues. TIBU is also linked with the National Health Information Systems, (DHIS) for data sharing. Since TIBU was created through a partnership between DLTLD, USAID Kenya, TB Care and Safaricom, it provides the ability to generate real time reports at any level. Cohort TB data was retrieved excluding names to ensure anonymity of the patients.

3.8 Data Analysis

The sampled dataset was imported into Microsoft Excel (version 2007) to ease preliminary data management and then to R-statistic (version 3.0.2) for analysis. This was on account of the fact that it was not possible to import the TIBU data directly into R.

Descriptive statistics were generated for age, sex, residence, type of TB patient, TB classification and the TB treatment zone and treatment outcomes. Logistic regression was used to test the association between treatment outcomes and demographic and clinical variables. The 95% confidence intervals and Odds Ratios (ORs) were reported as a measure of effect while $p$ value of <0.05 was considered statistically significant. Multivariate
analysis model was used to identify independent factors associated with a poor treatment outcome. Variables were entered into the model if their p value at univariate analysis was 0.1 or less.

3.9 Ethical Considerations

Ethical approval was obtained from the Research and Ethics Review Committee of Pwani University (Appendix 1); whereas approval to retrieve data from TIBU data base system was obtained from Kilifi County Department of Health Research Committee (Appendix 2).
CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter provides the results of the cohort study of TB patients within Kilifi County in Coastal Kenya. It addresses the following three questions:

4.2.1 Demographics, Category and Type of TB

Data of 4,772 patients with all forms of tuberculosis registered in Kilifi County for treatment between January 2012 and December 2013 were retrieved. Table 2 shows the demographics: Age, sex and residence, TB patient categories: new, return after default, sputum smear positive and negative, TB classification and treatment center. Of the patient category, 4,364 (91.4%) were categorized as new cases. Retreatment (Relapse, Failure Transfer in and Default) were 408 (8.5%) comprised of 15 (3.7%), smear negative relapse 178 (3.7%), smear positive relapse 91 (1.9%), return after default 79 (1.6%) relapse extra pulmonary 35/4,772 (0.7%) and treatment failure 15 (0.3%). Among TB classification, pulmonary tuberculosis (PTB) were 4,221 (88.5%) and extra pulmonary tuberculosis (EPTB were 551 (11.5%). Of the sub Counties, Malindi had the highest number of TB patients 1, 375 (28.8%). With regard to HIV status, 1,338 (28%) were positive as shown in Figure 3.
Table 2: Demographics, category and type of TB

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N (4772)</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age, years</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-4</td>
<td>368</td>
<td>7.7</td>
</tr>
<tr>
<td>5-9</td>
<td>164</td>
<td>3.4</td>
</tr>
<tr>
<td>10-14</td>
<td>164</td>
<td>3.4</td>
</tr>
<tr>
<td>15-24</td>
<td>692</td>
<td>14.5</td>
</tr>
<tr>
<td>25-34</td>
<td>1213</td>
<td>25.4</td>
</tr>
<tr>
<td>35-44</td>
<td>969</td>
<td>20.3</td>
</tr>
<tr>
<td>45-54</td>
<td>585</td>
<td>12.3</td>
</tr>
<tr>
<td>55-64</td>
<td>357</td>
<td>7.5</td>
</tr>
<tr>
<td>≥65</td>
<td>260</td>
<td>5.4</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2709</td>
<td>56.8</td>
</tr>
<tr>
<td>Female</td>
<td>2063</td>
<td>43.2</td>
</tr>
<tr>
<td><strong>Residence</strong></td>
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<td></td>
</tr>
<tr>
<td>Rural</td>
<td>1829</td>
<td>38.3</td>
</tr>
<tr>
<td>Urban</td>
<td>2943</td>
<td>61.7</td>
</tr>
<tr>
<td><strong>Patient category</strong></td>
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<td></td>
</tr>
<tr>
<td>New</td>
<td>4364</td>
<td>91.5</td>
</tr>
<tr>
<td>Failure</td>
<td>15</td>
<td>0.3</td>
</tr>
<tr>
<td>R- (Smear Negative Relapse)</td>
<td>178</td>
<td>3.7</td>
</tr>
<tr>
<td>R+ (Smear Positive Relapse)</td>
<td>91</td>
<td>1.9</td>
</tr>
<tr>
<td>Return After Default(RAD)</td>
<td>79</td>
<td>1.7</td>
</tr>
<tr>
<td>REP (Extra Pulmonary Relapse)</td>
<td>35</td>
<td>0.7</td>
</tr>
<tr>
<td>Transferred in</td>
<td>10</td>
<td>0.2</td>
</tr>
<tr>
<td>TB Classification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>PTB</td>
<td>4221</td>
<td>88.5</td>
</tr>
<tr>
<td>EPTB</td>
<td>551</td>
<td>11.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Center (sub county)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Kilifi South</td>
<td>678</td>
<td>14.2</td>
</tr>
<tr>
<td>Kilifi North</td>
<td>682</td>
<td>14.2</td>
</tr>
<tr>
<td>Ganze</td>
<td>216</td>
<td>4.5</td>
</tr>
<tr>
<td>Rabai</td>
<td>208</td>
<td>4.3</td>
</tr>
<tr>
<td>Malindi</td>
<td>1375</td>
<td>28.8</td>
</tr>
<tr>
<td>Magarini</td>
<td>615</td>
<td>12.9</td>
</tr>
<tr>
<td>Kaloleni</td>
<td>998</td>
<td>20.9</td>
</tr>
</tbody>
</table>

**Figure 3: Frequency distribution of TB According to HIV status**

Key: D-Done, ND-Not Done, Neg-Negative, Pos-Positive
4.2.2 TB Treatment outcomes

Among TB patients enrolled in this study 2,663 (56%) completed treatment, 1,484 (31%) were cured, while 625 (13%) had a poor treatment outcome including death 219 (35%), treatment interruption or default 257 (41%) and failure 23 (3%) as presented in Figure 4. Of the patient characteristics, males had 31% (OR 1.31; 95% CI: 1.10-1.56) higher risk of poor treatment outcome compared to females as shown in Table 3. Table 4 shows age, sex, HIV status and TB treatment Kilifi County hospital were risk factors of poor treatment outcome.

**Figure 4: Treatment outcome of TB for the total sample**

![Bar chart showing treatment outcomes]

**Key**

TO: Transfer out, C: Cure, D: Death, F: Failure, OOC: Out of control, TC: Treatment complete.
Table 3: Characteristics of patients by treatment outcome

<table>
<thead>
<tr>
<th>Age, years</th>
<th>Successful outcome (n=4147)</th>
<th>Poor outcome (n = 499)</th>
<th>OR (95%CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>320</td>
<td>48</td>
<td>1.08(0.62-1.89)</td>
<td>0.8965</td>
</tr>
<tr>
<td>5-9</td>
<td>144</td>
<td>20</td>
<td>1.00(0.52-1.94)</td>
<td>1</td>
</tr>
<tr>
<td>10-14</td>
<td>144</td>
<td>20</td>
<td>1.00</td>
<td>1</td>
</tr>
<tr>
<td>15-24</td>
<td>594</td>
<td>96</td>
<td>1.16(0.70-1.95)</td>
<td>0.6524</td>
</tr>
<tr>
<td>25-34</td>
<td>1063</td>
<td>150</td>
<td>1.20(0.62-1.67)</td>
<td>1</td>
</tr>
<tr>
<td>35-44</td>
<td>816</td>
<td>153</td>
<td>1.35(0.82-2.22)</td>
<td>0.2864</td>
</tr>
<tr>
<td>45-54</td>
<td>518</td>
<td>67</td>
<td>0.93(0.55-1.59)</td>
<td>0.9011</td>
</tr>
<tr>
<td>55-64</td>
<td>323</td>
<td>34</td>
<td>0.75(0.47-1.36)</td>
<td>0.4387</td>
</tr>
<tr>
<td>≥65</td>
<td>225</td>
<td>35</td>
<td>1.12(0.62-2.02)</td>
<td>0.8184</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex</th>
<th>Successful outcome (n=4147)</th>
<th>Poor outcome (n = 499)</th>
<th>OR (95%CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>2319</td>
<td>390</td>
<td>1.31(1.10-1.56)</td>
<td>0.0027</td>
</tr>
<tr>
<td>Female</td>
<td>1828</td>
<td>235</td>
<td>1.00</td>
<td>Reference</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Residence</th>
<th>Successful outcome (n=4147)</th>
<th>Poor outcome (n = 499)</th>
<th>OR (95%CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>745</td>
<td>86</td>
<td>1.00</td>
<td>Reference</td>
</tr>
<tr>
<td>Urban</td>
<td>340</td>
<td>539</td>
<td>13.73(10.58-17.83)</td>
<td>&lt;2.2e-16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient category</th>
<th>Successful outcome (n=4147)</th>
<th>Poor outcome (n = 499)</th>
<th>OR (95%CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td>3826</td>
<td>351</td>
<td>1.00</td>
<td>Reference</td>
</tr>
<tr>
<td>Relapse</td>
<td>217</td>
<td>52</td>
<td>2.61(1.89-3.60)</td>
<td>2.827e-09</td>
</tr>
<tr>
<td>After default</td>
<td>54</td>
<td>25</td>
<td>5.05(3.10-8.21)</td>
<td>2.361e-12</td>
</tr>
<tr>
<td>After failure</td>
<td>11</td>
<td>4</td>
<td>3.96(1.26-12.51)</td>
<td>0.0383</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TB classification</th>
<th>Successful outcome (n=4147)</th>
<th>Poor outcome (n = 499)</th>
<th>OR (95%CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smear positive</td>
<td>1552</td>
<td>261</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>------</td>
<td>-----</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Smear negative</td>
<td>2118</td>
<td>290</td>
<td>0.81(0.68-0.97)</td>
<td><strong>0.0278</strong></td>
</tr>
<tr>
<td>Extra -pulmonary</td>
<td>477</td>
<td>74</td>
<td>0.92(0.70-1.22)</td>
<td>0.6174</td>
</tr>
</tbody>
</table>

### Centres

<table>
<thead>
<tr>
<th>Centre</th>
<th>Count</th>
<th>Events</th>
<th>OR (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ganze</td>
<td>183</td>
<td>33</td>
<td>1.01(0.67-1.52)</td>
<td>1</td>
</tr>
<tr>
<td>Kilifi North</td>
<td>562</td>
<td>120</td>
<td>1.20(0.92-1.56)</td>
<td>0.2</td>
</tr>
<tr>
<td>Kilifi South</td>
<td>570</td>
<td>108</td>
<td>1.06(0.81-1.39)</td>
<td>0.7075</td>
</tr>
<tr>
<td>Kaloleni</td>
<td>847</td>
<td>151</td>
<td>1</td>
<td>Reference</td>
</tr>
<tr>
<td>Rabai</td>
<td>173</td>
<td>35</td>
<td>1.13(0.76-1.70)</td>
<td>0.6095</td>
</tr>
<tr>
<td>Malindi</td>
<td>1250</td>
<td>125</td>
<td>0.56(0.44-0.72)</td>
<td><strong>8e-06</strong></td>
</tr>
<tr>
<td>Magarini</td>
<td>562</td>
<td>53</td>
<td>0.53(0.38-0.74)</td>
<td><strong>0.0002</strong></td>
</tr>
</tbody>
</table>

### 4.2.3 Risk Factors Associated with Poor Treatment Outcomes

Multivariable logistic regression revealed that after adjusting for other variables (Table 4), Males had higher risk of poor TB treatment outcome compared to female. Moreover, HIV positive patients had 58% higher risk of poor treatment outcome (OR = 1.58, 95% CI: 1.35–1.85) compared to HIV negatives and TB patients receiving treatment at Kilifi County Hospital had 12% lower risk of poor treatment outcome (OR = 0.88, 95% CI: 0.84–0.93) compared to treatment at private hospital. The factors significantly associated with poor treatment outcomes in the multivariate analysis included the following; male, HIV status and patients treated at Kilifi County Hospital as shown in Table 4.
### Table 4: Multivariate Analysis according to Predictors for poor TB outcome

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>ODDS RATIO</th>
<th>P-VALUE</th>
<th>95% CONFIDENCE INTERVAL(CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.998</td>
<td>0.957</td>
<td>0.943-1.056</td>
</tr>
<tr>
<td>Male</td>
<td>1.383</td>
<td>0.000</td>
<td>1.157-1.652</td>
</tr>
<tr>
<td>Type of TB</td>
<td>1.049</td>
<td>0.720</td>
<td>0.805-1.367</td>
</tr>
<tr>
<td>HIV status</td>
<td>1.586</td>
<td>0.000</td>
<td>1.352-1.859</td>
</tr>
<tr>
<td>Public/Private Hospital</td>
<td>1.015</td>
<td>0.872</td>
<td>0.842-1.223</td>
</tr>
<tr>
<td>Kilifi County Hospital</td>
<td>0.887</td>
<td>0.000</td>
<td>0.847-0.938</td>
</tr>
</tbody>
</table>
CHAPTER FIVE

DISCUSSION

5.1 Introduction

The chapter discusses the demographic characteristics, category and type of all forms of TB in Kilifi County and also reveals potential risk factors for poor outcome in relation to other studies and in relation to the strengths and limitations of the study design. A 2-year cohort analysis of pulmonary and extra pulmonary tuberculosis treatment outcome was conducted.

5.2 Demographics, Category and Type of TB

Determining TB poor treatment outcome as well as analysis of factors associated with poor treatment outcome is one of the major indicators for the assessment of the performance of TB program. In this study, TB patients with poor treatment outcomes, for all types of TB were 13% including death 35%, treatment interruption or default 41% and a failure rate of 3%. In addition, this study showed that patients at the extreme ages (0-4 and 54->65 years); male gender, TB patients residing in urban was also predictors of poor treatment outcome during univariate analysis. In the multivariate model, risk factors for TB and poor treatment outcome were male gender, HIV positive, and TB patients treated at Kilifi County Referral hospital.

5.3 TB Treatment outcomes

The finding of this study showed that patient category (New, Relapse, Transfer in, Defaulter and Failure) were associated with poor treatment outcome. One study in Nigeria reported that defaulting was found to be a significant risk factor for poor treatment outcome with default rate of 15.7% (Adinma et al., 2016). The present study reports default rate of 41% for Kilifi County. Among the poor TB poor treatment outcomes (death, failure and default/out of control) in this study; death rate was 35% higher compared to 25% a study by Babatunde (Babatunde, 2013), but slightly lower than Ethiopian, (Cuevas et al., 2010)
which report 404 (36.9%). Although age as a continuous variable was not associated with poor outcome in the present study, a 25% death rate among 15-24 years was found to be similar to a study by Arentz in Mombasa (Arentz et al., 2011) who also report as increased risk of death in individuals aged <15 years (RR 4.70, 95% CI 1.07–20.70). Old age was similarly strongly associated with poor treatment outcome in Finland (Vasankari et al., 2007) and Mayurbhanj District, Odisha in India (Basa & Venkatesh, 2015). Further to note, a study in South Africa, agrees with the present study that, older age was strongly associated with poor treatment outcome (Mohammed et al., 2010). Byng-maddick & Noursadeghi (2016) suggest that, this finding is explained by the elderly having less immunological protection and co-morbidities which contribute to the risk of *Mycobacterium* tuberculosis reactivation (Byng-maddick & Noursadeghi, 2016). Similar findings were reported in Southern Nigeria where it was reported that elderly patients had lower treatment success rates (68.9%) (Oshi et al., 2014). The study was consistent with studies in Nigeria, Ethiopia and Mombasa, Coastal Kenya that children less than 15 years and elderly were associated with poor treatment outcome (Adinma et al., 2016), (Cuevas et al., 2010) and (Arentz et al., 2011). The Nigerian, Ethiopian and similarly the Mombasa studies had strong evidence (Adinma et al., 2016) (Arentz et al., 2011) for poor treatment outcome.

This study showed that male sex were highly associated with poor TB outcome comprising of 125 (4.6%) death and defaulter /out of control 152 (5.6%). Although, this finding were in contrary to a study by Mugusi, (2009) who reported that, 40% female patients died. The finding that males are associated with poor treatment outcome than females, was supported by previous studies conducted by Senkoro et al., (2010), Li et al., (2014) and Nhamoye bonde & Leslie, (2014). This finding is explained by Asampong and colleagues (Asampong et al., 2015) in the health belief model. The health belief model (HBM), is a useful tool in understanding and predicting health care seeking behavior. The model proposes that health-related behavior depends on an individual’s perception of four critical
areas; severity of a potential illness, susceptibility to that illness, benefits of taking a preventive action and barriers to taking that action. The assumption therefore is that health seeking behavior is influenced by certain cognitive variables as well as established mechanisms to minimize the occurrence of disease within the social system (Asampong et al., 2015). HBM suggests that individuals are faced with alternative actions but usually choose one that is most likely to yield positive outcomes (Asampong et al., 2015).

Many studies also found that sputum smear status at diagnosis was associated with a poor treatment outcome (Dooley et al., 2011; Waitt & Squire, 2011). The importance of this finding is that 87% of these cohorts were sputum negative based on passive case detection screening methods with smear microscopy methods. Furthermore, a study in The Netherland confirms that, 12.6% of the TB transmission is caused by patients with smear-negative pulmonary TB (Tostmann et al., 2008). Previous study by Swai, Mugusi, & Mbwambo, (2011) showed that, negative sputum smear status at diagnosis with manifestation of high respiratory rates, low eosinophil counts, mixed type of anaemia and the presence of cavities on X-rays were predictors for poor treatment outcome. The present study found smear sputum positive as a predictor for poor treatment outcome. A similar finding by Naini et al., (2013) found positive sputum smear was associated with poor treatment outcome.

Regarding co-morbidity, the present study showed that HIV positive TB patients have an increased risk of poor treatment outcome compared to HIV negative TB patients. Similarly, one study showed that TB/HIV coinfection was significantly associated with unsuccessful treatment outcome (Biruk et al., 2016). The poor treatment outcome in TB and HIV coinfection patients in this study could be related to pill burden, increase in adverse effect, drug-to-drug interaction, and immune reconstitution inflammatory syndrome. In their study, Sterling, Pham, & Chaisson, (2010) found out that negative HIV status and smear diagnostic methods accuracy is inadequate to detect TB due to lower pulmonary burden. In
a study conducted in Dar es Salaam revealed that, (72.8%) HIV positive sputum smear conversion rate was higher compared to (63.3%) HIV negative after two weeks of treatment (Senkoro et al., 2010). This finding is lower than the present study which reports HIV positive of 28%. A study by Fenner, (2012) reports 6.8% mortality among HIV infected patients slightly higher than 4.8% of the present study, (Fenner et al., 2012). This finding is explained by Arentz et al (2011) that defaulting from TB is associated with HIV co-infection. In addition, Assael (2013) explains that an increase in morbidity among TB and HIV infection contributes to poor treatment outcome. Further to note, Babatunde, (2013) expounds this disparity that high HIV co-infection and lack of consent for HIV testing during TB treatment imitation also leads to poor treatment outcome.

The finding that TB patients treated at Kilifi County Hospital had higher proportion with poor outcome compared to those in the other sub County health facilities could be interpreted in the context of the migrant nature of this population. The increased workload at the hospital also makes it difficult for the healthcare workers to monitor these patients closely. South Ethiopia reports similar findings (Shargie & Lindtjørn, 2005).

5.4 Strengths and limitations

Strength of this study was that the sub county treatment center nearly recorded results of all TB cases. The study was carried out under routine programme conditions, increasing the likelihood that the National Tuberculosis Program management will accept and utilize the findings to improve policy and practice with regard to management of poor treatment cases. The limitation of this study, being conducted as a retrospective, is the inability to elicit the views of the patients on poor treatment outcomes. As explained by Muture et al (2011) in their study that patients’ knowledge and beliefs about their illness, motivation to manage it and consequences of poor adherence interact to influence treatment outcome (Muture et al., 2011).
CHAPTER SIX
CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study identifies that despite recommended success rates and TIBU surveillance, mortality rates are increasing. Risk groups for poor outcome including males, HIV positive and those patients treated at Kilifi County Hospital are significantly at higher risk of TB treatment. TB strategies could improve treatment outcomes by targeting the following categories of patients: men, young adults, the aged, HIV positive, and Kilifi County Hospital. Results confirm the trend that mortality is increasing (from 2.7% in 2012; to 4.6% in 2013 among the risk groups).

6.2 Recommendation

This study underscores the need to identify interventions to target people with risk factors for poor treatment outcome including: men, HIV positive, and those patients treated at Kilifi County Hospital. In addition, effective strengthening of TB supportive supervision to all treatment centers, especially in Kilifi County Hospital.

6.3 Further research

I. Further research is required on why male are more likely to default than females.

II. What risk factors are associated with death among reproductive age group 25-34 years?
**REFERENCE**


Cuevas, L. E., Tumato, M., Merid, Y., & Yassin, M. A. (2010). Factors associated with


Lienhardt, C., Lonnroth, K., Menzies, D., Balasegaram, M., Chakaya, J., Cobelens, F., …


Maingi, D., Mutugi, M., Wanzala, P., Mutai, J., & Mwaniki, P. (2014). Determinants of Persistent Sputum Smear Positivity after Intensive Phase Chemotherapy among Patients with Tuberculosis at Rhodes Chest Clinic, Nairobi, 8(August), 2026–2034.


APPENDICES

Appendix 1: Approval from Pwani University Ethics Review Committee

CERTIFICATE OF ETHICAL APPROVAL

THIS IS TO CERTIFY THAT THE PROPOSAL SUBMITTED BY:

GEOFFREY G. KATANA

REFERENCE NO:
ERC/MSc/049/2014

ENTITLED:
Assessing treatment outcome among Tuberculosis patients in Kilifi County
a two - year retrospective study

TO BE UNDERTAKEN AT:
KILIFI COUNTY, KENYA

FOR THE PROPOSED PERIOD OF RESEARCH
HAS BEEN APPROVED BY THE ETHICS REVIEW COMMITTEE
AT ITS SITTING HELD AT PWANI UNIVERSITY, KENYA
ON THE 18th DAY OF DECEMBER 2014

CHAIRMAN

SECRETARY

LAY MEMBER
Appendix 2: Approval from Kilifi County Health Research Committee

THE COUNTY GOVERNMENT OF KILIFI
RESEARCH OFFICE, DEPARTMENT OF THE HEALTH SERVICES

Telephone: 0721627306
0721843015
0721359983
Email: langat.eva@gmail.com
aceobonyo@gmail.com
kazunguwilfred@hotmail.com

When Replying/Telephoning quote
REF: DOH/KLF/RESCH/VOL.I/27

P.O. BOX 519-10808
KILIFI, KENYA
Date 6 May 2015

Geoffrey G. Katana

Dear Sir,

RE: AUTHORIZATION TO CARRY OUT A STUDY IN KILIFI COUNTY

The research committee of Health, Kilifi County has received your request to conduct a study “Assessing Treatment Outcome among Tuberculosis patients in Kilifi County. A two - Year Retrospective study.”

After going through your proposal, the committee is glad to grant you an institutional authorization to proceed with your research. This however should be conducted within the expiry date of your ethical approval.

Upon completion of you research, you are required to submit a written report to the Kilifi County Research Committee (KCRC) detailing the findings, conclusion and recommendations of your study.

We wish you the very best as you conduct your research.

Regards,

Evaline Langat
Research Coordinator
KILIFI COUNTY HEALTH RESEARCH COMMITTEE
Appendix 3: Data Collection Tool

Demographic data

Age (0-4), (5-9), (10-14), (15-24), (25-34), (35-44), (45-54), (55-64), (>65)

Sex

- Female
- Male

Residence

- Urban
- Rural

Laboratory results (sputum/x-ray results)

- Positive
- Negative

Type of TB diagnosed

- Pulmonary
- Extra-pulmonary

HIV test Results

- Positive
- Negative

Treatment outcome

- Cured
- Completed treatment
- Died
- Failed
- Defaulted
- Transferred out