Addis Ababa University

College of Health Sciences

School of Public Health /Health Economics

Cost-effectiveness Analysis of Multi Drug Resistant Tuberculosis at Treatment Initiative and Follow up Centers in Addis Ababa, Ethiopia

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Addis Ababa, Ethiopia

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Abstract

Background: Ethiopia is among 30 high burden TB, TB/HIV and MDR-TB country which account 80% all new TB case worldwide [55].According to2014 national drug resistant TB report the prevalence of MDR-TB was 2.3% and 17.8% among new and perversely TB treated case respectively. The data indicate that MDR-TB has been becoming a significant public health threat in the country. Significance of the study is to avoid the financial risk results from illness-related expenditures and identify the most cost effective intervention.

***Objective**: To analyze the cost-effectiveness of MDR-TB treatment in hospitals (treatment initiative center) and health centers (treatment follow up center).*

***Methods:** Full economic evaluation using markov model to provide relevant cost and effectiveness information. The study was in St. Peter specialized and ALERT Hospitals as treatment Initiated centers (TIC) and health centers or treatment follow up centers (TFC). A total sample of two hundred fifty five MDR-TB patients with age greater than 15, selected by using simple random sampling. The data are collected from the hospitals record and patients' interview after having an informed consent. Markov model, is created using TreeAge Pro Suite 2018 to analyze and estimate cost-effectiveness of the MDR-TB treatment at treatment Initiation and follow up centers (TIC and TFC). The Model also structured in five health states. The costs and effectiveness discounted for the base case at an annual rate of 3% at the time of study. The Probability and costs have one year cycle length and life time horizon. Data are checked for its completeness cleaned and analyzed with Markov model developed using TreeAge Software to estimate the Cost-effectiveness of the MDR-TB treatment. Effects are measured as Treatment Success Rate (TSR), treatment failure, death and disability-adjusted life-years (DALYs) averted. Costs are assessed societal perspective in the two major areas, patients and service providers. The escorts/care givers are excluded from the study due to non-reliability of data that could be found for the analysis.*

***Results:** The cost of MDR-TB treatment for HIV negative patients per TSR USD 8416.17 for TIC and USD 6,657.15 for TFC the Cost-effectiveness analysis depicted that both treatment centers (TIC and TFC) are cost effective in treating MDR-TB at the incremental cost-effectiveness ratio (ICER) of $1641 per DALYs averted. However, the study revealed that TFC (health center) is decidedly cost effective for the treatment of Tuberculosis's at the TSR of 88% to 94% if WTP threshold is define one GDP per capital per DALY averted in Ethiopia.*

***Conclusion:** The study also provides evidence that the costs of MDR-TB treatment is high specially at TIC than at TFC, however based on the results of the study analysis for MDR-TB treatment both are Cost-effectiveness option at less than 3 times GPD per capital per DALYs averted in Ethiopia and compares the treatment at initiation and follows up centers (TIC and TFC) centers TFC was less cost. .*

***Key terms:** Cost, effectiveness, Cost-effectiveness, MDR-TB Treatment, Treatment Centers*

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Abbreviations and acronyms

ALERT	All Africa Leprosy, Tuberculosis and Rehabilitation Training Centre
CEA	Cost-effectiveness analyses
CEACs	Cost-effectiveness Acceptability Curves
CM	Capreomycine
CS	Cycloserine
DALY	Disability-Adjusted-Life-Years
DOT	Directly Observed Therapy
DSTB	Drug susuciptible tuberclosis
E	Ethambutol
EVPI	Expected Value with Perfect Information
EVPPI	Expected Value of Partially Perfect Information
FMOH	Federal Ministry of Health
GDP	Gross Domestic Product
HBC	High Burden Countries
HCA	Human Capital Approach
HIV	Human Immununo Virus
ICERs	Incremental Cost-Effectiveness Ratios
LFX	Levofloxaciline
MDR-TB	Multidrug-Resistant Tuberculosis
MTB	Mycobacterium tuberculosis
NMB	Net Monetary Benefits
PSA	Probabilistic Sensitivity Analysis
QALY	Quality-Adjusted Life Year
SA	Sensitivity Analysis
SD	Standard deviation
TB	Tuberculosis
TFC	Treatment Followup Center
TIC	Treatment Initiated Center
TSR	Treatment Sccess Rate
USD	United States Dolars
WHO	World Health Organization
WTP	Willingness To Pay
XDR-TB	Extreemdrug-Resistant Tuberculosis

Chapter I: Introduction

1.1 Background

Tuberculosis (TB) has existed for millennia and remains as a major global health concern with TB deaths in 2015 1.4 million, and an additional 0.4 million deaths causes from TB disease among people living with HIV. It is reported that the number of TB deaths fell by 22% between 2000 and 2015, though TB remained as one of the top 10 causes of death ranking above HIV/AIDS worldwide in 2015. The report illustrated that Ethiopia is among 30 high burden TB, TB/HIV and MDR-TB countries which account 80% all new TB case worldwide [55].

The national anti-tuberculosis drug resistance survey report, among 804 newly diagnosed tuberculosis (TB) cases, between 2003 and 2005 showed that 1.6% of new cases and 11.8% of retreatment cases in Ethiopia to be resistant to at least isoniazid and rifampicin or developed MDR-TB [18]. Treatment of patients with MDR-TB is much more difficult and costly than from drug susceptible cases. The treatment of MDR-TB strategies worldwide are subjected to recurrent argument. The suggested standard MDR-TB treatment should continue for a minimum of 20 months and at least 18 months after the patient becomes culture-negative. Chronic MDR-TB patients with extensive pulmonary disease may require the treatment for 24 months or longer [18].

The previous studies depicts that MDR-TB is a major public health problem and mainly affects economically productive age group of the population and males [6]. They recommend Rapid and advanced diagnostic tools along with strong treatment and follow -up strategies[30].Studies further commented that MDR-TB treatment cost data are limited [28, 64, and 66]. The study, therefore, aims to fill the gap by performing cost-effectiveness of MDR-TB treatment relative to health outcomes in St. Peter Specialized hospital and ALERT(TICs) and the health centers (TFCs) providing follow up TB/MDR-TB services in Addis Ababa. Treatment costs are measured in monetary units and its effectiveness is estimated in a single natural unit of the health intervention [45]. The findings of the study are crucial for efficient and effective treatment and control of MDR-TB.

1.2 Statement of the problem

MDR-TB is a big public health problem in low resource countries including Ethiopia because it is more difficult and costly to cure. It is resistance to the two most important and effective "first-line" drugs, rifampicin and isoniazid, which are preferred option for treatment. MDR-TB must be treated with second-line drugs which are less effective, more expensive. Furthermore, diagnosis is difficult, especially in poor resource countries; diagnosis may take anywhere from 6-16 weeks and requires sophisticated lab equipment. In Ethiopian context, Gene xpert MTB/RIF is the preferred method considering the Suitability for use at health facility level, the rapid turnover time of results, and Minimal need for expertise & infection control precautions.

However, Line probe Assays and conventional DST techniques will continue to be used at reference Laboratory [18]. Though, the cost of drugs for treating the average MDR-TB patient is 50-200 times more than normal TB [68]. In 2015, WHO estimated that 6200 (1.2%) out of 520,000 (100%) MDR-TB cases in Africa existed in Ethiopia. Due to this fact, MDR-TB has been framed as a pressing public health problem in Ethiopia [61].Ethiopia is among 30 high burden TB, TB/HIV and MDR-TB countries which account 80% all new TB case worldwide [55]. It also states that there is insufficient information about MDR-TB trends in Ethiopia. Among them, only three countries (Rwanda, Tanzania and South Africa) have information on the XDR-TB proportion among MDR-TB cases and concluded that there is insufficient information about MDR-TB trends in Africa, particularly in Ethiopia [61].

Treatment outcomes of MDR-TB on the other hand are important indicators in effectiveness and performance [35]. Researches revealed that, cure rate for cohorts of patients treated according to WHO guidelines was 76% in Tomsk oblast and 61% in Estonia. The death rate in Tomsk oblast before WHO guidelines were adopted was high, at 67%, and the remainder of patients (17%) failed treatment. It takes at least three times longer time to cure and higher overall mortality rate than drug-susceptible TB [66]. Low treatment success rates also mean high rates of default, treatment failure and death. Consequently, such outcomes lead to a prolonged treatment periods and increased cost, increased rate of transmission of the bacteria and high incidence of morbidity and mortality [55]. TB prevalence in Ethiopia has been reduced by far though its burden continues with no/limited sign of incidence improvement.

Most TB transmissions occur between the appearance of coughing and a few weeks after the initiation of treatment. The longer TB patients stay in the community without being diagnosed and treated, the higher will be the spreading of TB bacteria and it will be worse if the case is MDR-TB. Besides, lack of information on drug resistance TB worsens MDR-TB control situation and impede planning of surveillance and activities of the national TB programmers. Current estimates of MDR-TB cases in many African countries including Ethiopia are based on mathematical modeling rather than actual studies. If studies are done, they are limited by restricted study design and not representative of the general population, reveal that the drug resistance problem in is expected to be high [61].

Therefore, it is evident that urgent initiation & implementation of comprehensive and methodologically sound surveillance studies are now needed to gauge true extent of TB drug-resistant problem, treatment plan and cost-effectiveness of the treatment. Besides, MDR-TB has emerged to be a serious threat to community health in Ethiopia. It develops due to poor treatment with inadequate drugs or irregular drug intake an infection with a resistant strain or. Because, most of the steps involved in treating MDR-TB such as diagnosis, treatment set-up, follow-up test schedules, reporting and recording activities, are longer, extensive and complicated than in routine TB treatment. MDR-TB treatment takes 18 -24 months and involves a daily injection and drugs intake of 10–13 different drugs and more expensive [61].

In order to effectively treat and reduce transmission it requires early diagnosis and immediate initiation into treatment. Despite the worrying rise in MDR-TB cases, the much higher cost of using second-line drugs is prompting some policy-makers to question the merits of introducing them in poor countries like Ethiopia with limited resources. However, with MDR-TB accounting for nearly one third of TB cases, first-line therapies seem unlikely to be sufficient in the long term.

Second-line strategies, or “DOTS-Plus” strategies, are either standardized for a particular region or chosen for individual patients on the basis of drug susceptibility tests. Thus, the health policy makers and patients are the first beneficiaries of the output of this study, because the results of the study are easier to reach larger number of the patient population with lesser cost and effectiveness results [58].

After careful searches and reviewing what is known and what is not known in the area as illustrated in Annex 1 and Annex 2, from published international journal articles on the issue, the investigator confirmed that cost and Cost-effectiveness analysis for MDR-TB is very few. Based on the previous studies, MDR-TB is identified as a major public health problem and mainly affects economically productive age group of the population and male [16, 20, 34]. The costs of TB diagnosis incurred by patients represent a significant portion of monthly income. Costs arising from time lost in seeking care comprised a major portion of the total cost of diagnosis, and may worsen the economic position of patients and their families [28, 66].

Evidence on the cost and cost-effectiveness MDR-TB treatment is limited, and no published data are available in Ethiopia where as the rates of MDR-TB disease burden is highest. Studies further commented that MDR-TB treatment cost data are limited [28, 64, and 66]. Thus, this study is expected to add value to the literature on the issues and fill the treatment cost data gap by and effectiveness of MDR-TB treatment in St. Peter Specialized and ALERT (TICs) and the health centers (TFCs) follow up centers in Addis Ababa.

Therefore, Cost-effectiveness analyses (or CEAs) studies will help to identify and describe the optimum method of interventions in terms of cost per DAYLs and reach the maximum possible MDR-TB patients and it are measured from the societal perspective. Cost-effectiveness analysis is broadly understood to observe that health systems have two objectives: To improve the level and distribution of health outcomes in the population and to protect individuals from financial risks that are often very substantial and frequent causes of poverty [52].

Chapter II: Literature review

2.1 General overview of MDR tuberculosis

Tuberculosis (TB) is an airborne infectious disease caused by Mycobacterium tuberculosis (MTB) that primarily infects the lungs (pulmonary TB), but can also infect other parts of the body (extra-pulmonary TB) [54].TB accounts for an estimated one-third of the world's population, with nearly 9.6 million new TB cases and 1.2 million deaths occurring each year [57]. Subsequently, someone in the world is newly infected with MTB every second and more than 2 billion people are infected with MTB in total. Although effective drugs exist, a major reason for the failure to stem the spread of TB lies in the rise of drug-resistant strains of the bacterium. Some strains are resistant to several drugs; patients with this sort of infection are said to have multidrug-resistant (MDR- TB).

2.2 Global burden of MDR-TB

According to WHO, 2017 report it is believed that there were 600,000 new cases with resistance to rifampicin - the most effective first-line drug, of which 490,000 had MDR-TB. Almost half of these cases are from India, China and Russian Federation. A total of 129,689 patients (22% of those newly eligible for treatment) were enrolled and started on MDR-TB treatment. The average cure rate for these MDR-TB patients are of only 54% for treated MDR-TB patients. In 2016, 57% of MDR-TB patients globally had a documented HIV test result. In the African region, that has the highest TB/HIV burden, 82% of MDR-TB patients knew their HIV status. Globally, 85% of reported HIV-positive TB patients in 2016 were started on antiretroviral therapy. Nevertheless, only 39% of the total number of people living with HIV estimated to have developed TB in 2016 had been placed on antiretroviral therapy [12, 46, 47].

2.3 Tuberculosis in Ethiopia

Despite recent achievements seen in the fight against tuberculosis (TB), it still remains a significant cause of morbidity and mortality in Ethiopia [60].The recent TB drug resistance survey, conducted in Ethiopia from 2011 to 2013, revealed an increase in MDR-TB with a prevalence of 2.3% and 17.8% among new and previously treated cases, respectively [28]. The data indicate that MDR-TB has been becoming a significant public health threat in the country.

The World Health Organization recommends an approach to TB control called "DOTS," which has been adopted by many countries. The antibiotics that are used in DOTS are described as "first-line" treatment drugs. They are highly effective against non-resistant TB but much less so against MDR-TB. There are other, more expensive, "second-line" antibiotics that perform better against MDR-TB [36].

2.4 MDR-TB treatment in Ethiopia

The treatment of MDR-TB requires a longer duration, is considerably more complicated, expensive and toxic [62]. The longer treatment course of MDR-TB results in poor treatment outcome, leading to the emergence of XDR-TB. XDR-TB treatment on the other hand is much more difficult and costly and stress national health budgets even more than MDR-TB treatment [57]. In Ethiopia, a total of 1144 MDR-TB cases were reported between 2007 and 2012 [37, 59]. The first patients were admitted for MDR-TB treatment in Ethiopia in 2009 in a rehabilitated isolation ward in St. Peter's Hospital in Addis Ababa [55].

In the same year, 45 MDR-TB patients were enrolled initially in the second phase at St. Peter's Hospital. However, there has been a rapid scale-up of drug-resistant TB care in the last five years; in 2014, at the national and regional level, there were 42 care sites for MDR-TB therapy initiated on 811 patients in 2012, of these nine of them were XDR-TB. Progress is being made; however, the response is too slow given the prevalence MDR-TB in Ethiopia. This is because the expanding access to care for MDR-TB cases is limited to the main and regional large cities.

As a result of this, MDR-TB patients in rural and remote areas may not have access to health care services, may prefer consultation with traditional healers that are more readily available and come late to health care centers.

Delayed case detection and treatment of MDR-TB cases might also contribute to the disease spread in the community [10]. The treatment policy for MDR-TB in Ethiopia combines standardized and individualized treatment based on second-line drug susceptibility testing [16]. According to the data obtained from [58], report on the prevalence of MDR-TB in Ethiopia was estimated to be 170 MDR-TB cases, among the new and 550 from the previously treated Tuberculosis (TB) respectively, in 2011 [27].

However, Drug Susceptibility Testing (DST) coverage among the new and previously treated cases in the country in 2012 was 1% and 4%, respectively [22]. Furthermore, recent TB drug resistance survey, conducted in Ethiopia from 2011 to 2013, revealed an increase in MDR-TB with a prevalence of 2.3% and 17.8% among new and previously treated cases, respectively [18].

2.4.1 MDR-TB treatment strategies in Ethiopia

The cost associated with MDR-TB treatment imposes a significant challenge to the government health care system and especially to vulnerable low income families [4]. According to programmatic Management of MDR-TB, national training for health workers in 2013, the strategies recommended for Ethiopia and functional in the MDR-TB treatment centers are:

1. A Standardized treatment regimen, where, all newly diagnosed MDR-TB patients receive in the absence of Drug Sensitivity Test (DST). Only confirmation of the diagnosis of MDR-TB is enough.

   Intensive Phase: 8Z-Cm_6-Lfx-Pto (Eto)-Cs

   Continuation Phase: 12Z-Lfx - Pto (Eto)-Cs
2. Empiric Treatment: This is used for empiric initiation of MDR-TB treatment for high risk group or when the patient's condition does not allow waiting for DST confirmatory test.
3. Standardized regimen treatment followed by individualized treatment, which are used after full DST results while on treatment.

2.5 MDR-TB and demographic characteristics

According to WHO, 2010 report from the data collected from 13 countries of Central and Eastern Europe, the frequency of MDR-TB was much higher in all age groups compared in these countries with higher frequency on the young adulthood age. The significant contributor of for the development of MDR-TB is found to be the younger age. The report further explained that, there is no association between MDR-TB and sex of the patient. However, in a study conducted in Peru among 673 patients, more than half of diagnosed and confirmed (60.8%) MDR-TB was male which shows that gender is a risk factor for the development of MDR-TB [58].

On the other hand, various researches depicted that majority MDR-TB cases suffered from pulmonary TB (PTB). For example, in China, Hong Kong it was found to be (98%) [10].

Table 1 Socioeconomic and demographic indicator of Ethiopia

Indicators	**Estimated Values**	**Reff.**
Total population in million (2017)	105	[70]
Real GDP growth rate (2016)	8 %	[70]
GDP per capita in current USD (2018)	909.99	[72]
Consumer Prices (2016)	7.3%	[70]
Nominal exchange rate Birr/USD end of (2015)	21.29	[72]
TB mortality rate(2015)	26	[59]
TB incidence rate (2015)	192	[59]
MDR-TB estimated from new(2015)	2.7%	[59]
MDR-TB estimated from perversely treated TB cases(2015)	14%	[59]
Life expectancy at birth, years total (2015)	65	[73]

N.B.: TB estimation well be per100, 000 population

2.6 MDR-TB treatment centers

MDR-TB treatment is typically delivered using the WHO DOTS-Plus model and traditionally involves prolonged inpatient treatment that enables enhanced monitoring of adverse drug reactions, ensures adherence, and may prevent spread within the community. Unfortunately, resource limitations often force patients to wait months for inpatient therapy, during which time they can spread to other people in their community. According to FMOH, 2013 the MDR-TB treatment health facilities are grouped into two treatment initiating centers (TIC) or treatment follow up centers (TFC) [17]. These two levels of treatment centers have complementary roles in order for the program to function efficiently and deliver comprehensive MDR-TB care, treatment and support. The treatment for MDR-TB is provided to patients in two major strategies because of the limited resources and infrastructure, these are begin the treatment at Treatment Initiation Centers (TIC) for the purpose of this study these are hospitals St. Peter specialized and ALERT Hospitals and Treatment Follow-up Centers (TFC) health centers where MDR-TB patients follow their treatments.

2.6.1 MDR-TB treatment initiation centers (TIC)

Patients arrived at the Treatment Initiation Centers (TIC) are diagnosed and screened for types of MDR-TB treatment and will be sensitized and informed about TB including: different phases of TB treatment (i.e. the intensive versus continuation phases), and associated costs with TB care. According to [17], the responsibilities (TIC) include:

- Designate space for inpatient and outpatient MDRTB treatment service
- Involve in case finding process of MDR-TB
- Handle Patient preparation and initiation of treatment with Second Line Drugs
- Admit difficult cases and those with serious complications

2.6.2 MDR-TB treatment follow-up centers (TFC)

MDR-TB-treatment is typically delivered using the WHO DOTS-Plus model and traditionally involves prolonged inpatient treatment. Therefore, these high costs of the treatment of multidrug-resistant tuberculosis (MDR-TB) are a major obstacle to implementation in developing countries like Ethiopia. To address these challenges, treatment programs that incorporate Treatment Follow up Center (TFC) are inevitable.

TFC based directly observed therapy (DOTS) programs are relatively low-cost treatment programs that utilize health centers, family members, neighbors, coworkers, local health care workers (HCWs) or former patients to DOTs rather than requiring hospitalizations or frequent visits to health care facility [38]. According [17], the responsibilities of treatment follow up center (TFC).

- Manage all patients referred/transferred from treatment initiation center (patients are initiation of treatment.)
- Involve in case finding process of MDR-TB
- Routine screening of adverse events, supervise DOT and administer injection

2.7 Cost- Effectiveness of MDR-TB treatment

The cost of treating MDR-TB is expensive and requires a long treatment duration of greater than 20 months compared to drug susceptible TB which requires at least 6-8 months of treatment [58]. According to the study treating DS TB with first line drugs cost approximately US$20 for 6-8 months compared to about US$5,000 for treating an MDR-TB case for 20-24 months.

The Global Plan to Stop TB estimated that financing the MDR-TB control program globally in 2015 would cost US$16 billion, about 16 times higher than what it was in 2010. In addition to the high treatment costs for MDR-TB, treatment outcomes (its effectiveness) are also poor, as shown by the low cure rates and high mortality. The average cost per patient treated based on WHO guidelines (in prices for 2003) was USD 8,974 in Estonia and USD 14, 657 USD, in Tomsk Oblast. The WHO guidelines used were 4,729 USD in Estonia and 2,282 USD for Tomsk Oblast. The Drugs and in-patient care accounted for 69–90% of total costs [25]. The best estimates of the cost per DALY averted were 598 USD (960 IUSD), and 745 USD (1059 IUSD) respectively [25]. Besides that the cost associated with MDR-TB treatment in health care and patient perspective (direct cost for food and transport) and indirect cost (productivity loss) and health service providers cost per patient as shown in Table 2.

Table 2 MDR-TB treatment Costs, 2014

	South Africa	Brazil	Bangladesh	Tanzania	Reff.
Guidelines					
Healthcare provider costs	10,215	5,223	4,262	2,507	[49], [50],
MDR treatment all	(8,619–24,580)	(4,800–5,348)	(3,836–4,688)	(2,454–2,561)	[51]
Patient costs	3,319	280	213	454	[25], [49],
MDR treatment all	(2,987–3,650)	(102–1142)	(192–234)	(409–499)	[19]
DALY averted, mean (SD)	9.97 (0.23)	16.50 (0.51)	16.19 (0.53)	13.66 (0.36)	
ICER, calculated mean	CS	CS	1,472	CS	
Current					
Healthcare provider costs	10,215	5,223	4,262	2,507	[49], [50],
MDR treatment all	(8,619–24,580)	(4,800–5,348)	(3,836–4,688)	(2,454-2,561)	[51]
Patient costs MDR treatment	3,319	280	213	454	[25], [49],
all	(2,987–3,650)	(102–1,142)	(192–234)	(409–499)	[19]
DALY averted, mean (SD)	8.26 (0.18)	14.68 (0.51)	16.17 (0.51)	12.97 (0.36)	
ICER, calculated mean	13.6	CS	1,220	161	

2.8 Effectiveness measurements

Cost Effectiveness Acceptability Curves a number of analytical techniques can be used, including the commonly implemented bootstrap percentile method [25]. Using this approach, promoted by the choosing interventions that are Cost-Effective (WHO-CHOICE) project, an intervention that costs less than three times the national annual GDP per capita per DALY avoided is considered cost-effective, whereas one that costs less than once the national annual GDP per capita is considered highly cost-effective [15].

Therefore, it needs to be noted that the cost-effectiveness threshold recommendations by WHO-CHOICE are based on cost per DALY averted .So the treatment outcomes are used to measure the effectiveness of MDR-TB treatment in respective service providing centers. Treatment outcomes are assessed using standard definitions [17]. According to the standard there are seven possible outcomes including transferred out where the treatment outcomes are unknown and adverse effects.

2.8.1 Treatment outcomes

The treatment outcomes for this study have five categories these are: cured, completed treatment, died, defaulted, and failed treatment. The cost information for these five groups of patients (defaulted, Died, cured, treatment completed and failed) are collected from hospital records as shown in the Table 2.

Table 3 General variables related to effectiveness from literature

Variables	**Findings**	**Sources**
1. Prevalence of MDR among patients who do not respond to first-line treatment regimen (%)	58%, 68% (uniform)	
2. Treatment outcomes for patients who are treated with the standardized second-line drug regimen and being found to have MDR		
• Cure rate (%) (uniform)	55%, 65%	Assumptions
• Death rate (%)	5%	
• Default rate (%)	7%	
• Non-response rate (%)	88% - cure rate	
3. Discount rate for valuing health gains arising in the future (%)	3%	[42]
4. Average health gain associated with one averted death (DALYs)**	27·9	[30], [35]
5. Long-term relapse rate among those initially cured with regimens that include second-line drugs (%)	14%, 4% (normal)	[24]

2.8.2 Disability Adjusted Life Years (DALYs)

The disability-adjusted life year (DALY) is a public health measure used to quantify burden of disease [54]. DALY is a measure of diseases burden which is calculated by adding year of life lost due to premature mortality (YLL) and year of life with disability (YLD). The concept behind is every person is born with a determined life years with an optimal health. However, people lose their life years due to living with illness and/or dying before life expectancy. These losses in life years are exactly what are measured by the DALY metric. A utility score is obtained through preference-measurement techniques, reflect the "value" people place on a health state on a scale from zero (equal to death) to one (equal to perfect health), values for the Disability-Adjusted Life-Year Calculations from the literature as shown in Table 3.

Table 4 Disability-Adjusted Life-Year Calculations from the literature

Condition	**Mortality (Range)**	**Disability Weight (Range)**
HIV, TB negative	0.05 (0–0.3) [47]	0.053(0.034–0.079) [43]
HIV, untreated TB	1.00 (0.5–1) [47, 51]	0.399 (0.267–0.547) [43]
HIV, treated drug susceptible TB	0.105 (0.04–0.3) [51, 65]	0.1 (0.085–0.115) [47]
HIV, treated MDR-TB	0.2 (0.04–0.37) [51, 46]	0.2 [47]

Effectiveness in terms of utility allows comparison across different health programs and policies by using DALYs in cost–effectiveness analysis as (Treatment cost/DALY averted).

Chapter III: Objective

3.1 General objective

To estimate and compare the cost-effectiveness of MDR-TB treatment at the Treatment Initiation Centers (TIC), and Treatment Follow-up Centers (TFC) in Addis Ababa, Ethiopia.

3.2 Specific objectives

The specific objectives of the study were:

1. To estimate the societal cost of delivering MDR-TB treatment at the Treatment Initiation Centers (TIC)per TSR
2. To estimate the societal cost of delivering MDR-TB treatment at Treatment Follow-up Centers (TFC) per TSR
3. To estimate and compare the cost-effective provision of MDR-TB treatment based at TIC and TFC.

Chapter IV: Methods

4.1 Study area

Ethiopia is a highly populated country in Africa, with a population of 107 million. The country is administratively divided in to nine regions and two federal chartered cities. This study is conducted in Addis Ababa, Ethiopia. Addis Ababa is the capital city of Ethiopia, and has an area of 540 square kilometers, with a predicted population of 4.6 million in 2016 [7]. Addis Ababa has 10 *Sub-cities* and 117 *Woreda*, with 95 health centers and 38 hospitals including private hospitals in 2016. Addis Ababa has two hospitals (ALERT and St. Peter's) as treatment initiation centers (TIC) and 47 health centers or treatment follow up centers (TFC) for MDR-TB detection and treatment.

4.2 Study design:

The study design used in this study was a full economic evaluation using markov model. To provide relevant cost and effectiveness information, for the economic evaluation a MDR-TB costing study design was applied.

The Markov model was selected since in this particularly case MDR-TB is a chronic diseases and recurrent over time. Besides that, Markov model analyze uncertain processes over time, because, the model can be used for long-term outcomes, where costs and effects are spread over a long period of time [54]. The model is characterized with the following categories.

1. **Comparators groups**

   The study compares cost-effectiveness MDR-TB treatment in the treatment Initiation centers (hospital) and treatment follow up centers (health center) (TIC and TFC).

2. **Cycle length**

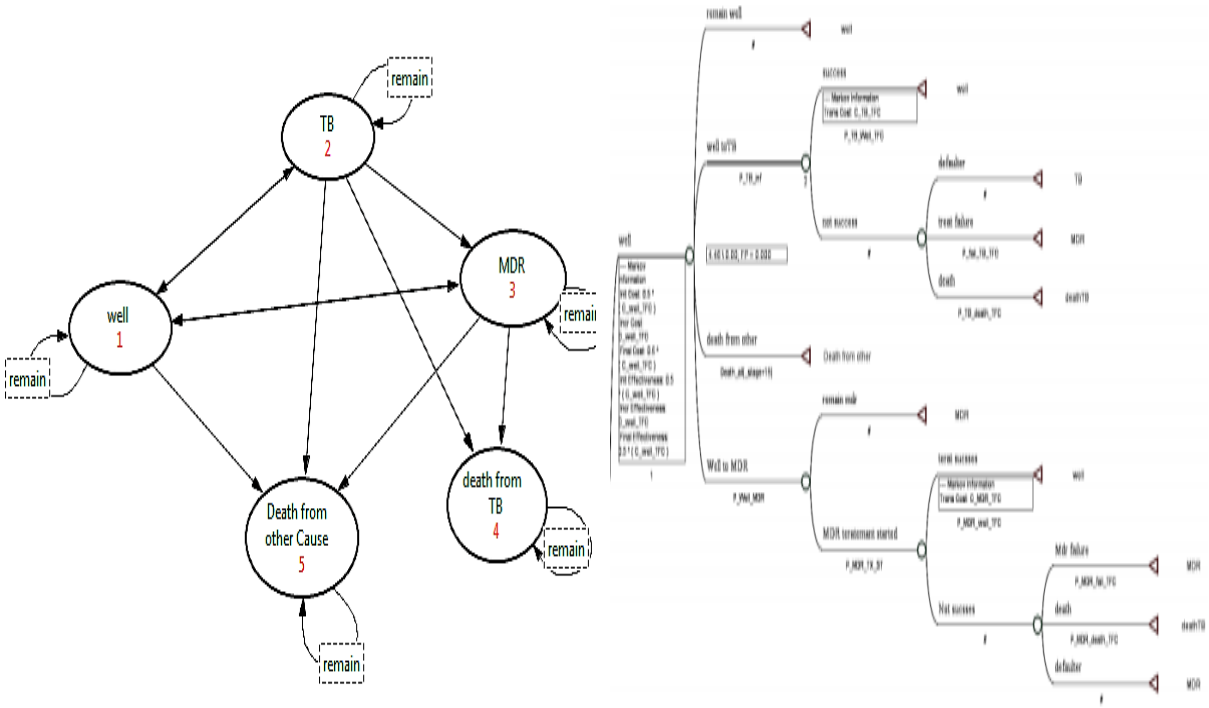
   The cycle length in this model was annual. The probability and costs in the study have one year cycle length. Therefore, half-cycle correction was done in order to assume that events occur halfway through a cycle.

3. **Time horizon**

   The time horizon in this study was life-time horizon. The Ethiopian life expectancy year according to the world life expectancy was 65years and run the model in 65 cycles.

4. States, transitions and disease progression

Initially, all individuals would be in 'well' or susceptible to Tuberculoses (TB). A person from a 'well' state would be infected with certain probability of TB. About 69% (51%-98%) of individual with Tuberculoses infection believed to be investigated, treated and cured or treatment complete(TSR) [53]; while some might not be diagnosed and remain with the disease . Death from Tuberculoses when properly treated would be very rare; therefore, we assume zero mortality while the improper treatment of cases could progress to MDR-TB. Therefore we assume a mortality of 26 per 100,000 untreated cases [53].



A B

Figure 1 Markov tree state-transitions diagram (A), Markov model (B)

(N.B:- The full scale for Figure 1B is attached at the annex.)

Based on this fact, the model was structured in five health states: Well, TB, MDR-TB, death from TB, and death from other cause. The health states and transition states in any given time interval, considers the individual in only one health state with mutually exclusive states as (Figure 1A). The transition probabilities are the probabilities in which a subject is moving from one state to another state within a given cycle-length. The starting age fort the study in the model was assumed to be fifteen year.

Patients were modeled to start from the well state and from a 'well' state patients might be infected with MDR-TB in certain probability (Figure 1B). The transition data probabilities are based on Table 5 and, the following formula was applied [70, 71] in order to change the rate into the probability values.

$$P = 1 - \exp(-rt)$$

Where: P = Probability
exp = the base of natural logarithm
rt = rate,

Table 5 Markov model transition probability matrix

	Well	**Sources**	**TB**	**Reference**	**MDR TB**	**Sources**	**TB/ MDRTB death**	**Death from other cause**
Well to	#	-	0.00182	[56]	0.000027	[56]	-	[73]
TB to	0.84	[56]	#	-	0.00014	[56]	0.09	[73]
MDR – TB to	0.70[56]		_	-	#		0.13	[73]

5. State rewards

Each state was associated with annual state rewards, related to spending a year in the particular health state. These include the annual societal cost of MDR-TB treatment TIC (USD 4637.35) and TFC (USD3073.23) as shown in Table 6 and annual effectiveness value: effectiveness value (DALY averted).

6. Discounting

Both the cost and effect were discounted with 3% discount rate [70, 71].

7. Perspective

This model considers the healthcare system and patient side cost (societal perspective) to estimate cost-effectiveness of MDR-TB treatment at treatment Initiation and follow up centers (TIC and TFC).

8. Measurement of Effectiveness

In this study the incremental cost-effectiveness ratios (ICER) of MDR-TB treatment at TIC and TFC are measured. Uncertainty in ICER result is characterized using Willingness-To-Pay (WTP) thresholds and Cost-effectiveness Acceptability Curves (CEACs) [14]. This approach uses a pre-defined definition of value, the WTP threshold to guide decision making [39].

Table 6 Input Probability for model

Probability Data	Base value	Range	Distrib.	Data Source
1. Well person to MDR TB	0.000027	0.000015__0.00004	Beta	[56]
2. Perversely tired TB to MDR-TB	0.00014	0.000036_00025	Beta	[56]
3. TB treatment coverage in Ethiopia	0.69	0.51_0.98	Beta	[56]
4. DS TB Treatment success at TFC	0.76	0.78_92	Beta	[28] , [29]
5. DS TB failure at TFC	0.007	0.004_0.012	Beta	[28] ,[29]
6. DS TB death at TFC	0.05	0.017_0.058	Beta	[7],[29]
7. DS TB Treatment success at TIC	0.84	0.78__0.93	Beta	[29]
8. DS TB failure at TIC	0.01	0.004_0.03	Beta	[28],[29]
9. DS TB death at TIC	0.07	0.04_0.3	Beta	[29],[28]
10. Well person Tb infection	0.00182	0.00199_0.00353	Beta	[56]
11. MDR-TB failure at TIC	0.02	0.0122_0.048	Beta	Own data
12. MDR-TB death at TIC	0.013	0.093_0.30	Beta	Own data
13. MDR-TB treatment success at TIC	0.598	0.54_0.80	Beta	Own data
14. MDR-TB defaulter at TIC	0.26	0.10_0.34	Beta	Own data
15. MDR-TB death at TFC	0.09	0.049_0.19	Beta	Own data
16. MDR-TB treatment success at TFC	0.796	0.74_0.93	Beta	Own data
17. MDR-TB defaulter at TFC	#	0.10_0.22	Beta	Own data
18. Cost of DS TB at TIC	$260	$160-500	Gama	[53],[10],[63]
19. Cost of DS TB at TFC	$162	$160_260	Gama	[53],[10]
20. Cost of MDR-TB HIV negative pts at TIC	$ 4637.35	$3710_$5563.34	Gama	Own data
21. Cost of MDR-TB HIV negative pts at TFC	$3328.17	$2458.45_$3668.35	Gama	Own data
22. Disability weight of TB/MDR-TB	0.333	0.267_0.547	Beta	[53],[10],[70]
23. MDR-TB treatment started	0.24	0.22_0.28	Beta	[56]
24. Discounting for assessing costs and effectiveness	0.03	0.01-0.06	Beta	[71]

*Gamma= Cost Data ** Beta= Probability Values

Using this approach, promoted by choosing interventions that are Cost-Effective (WHO-CHOICE) intervention that costs less than three times the national annual GDP per capita per DALY avoided is considered to be cost-effective, whereas one that costs less than one national annual GDP per capita is considered very cost-effective above three times the national annual GDP per capital is considered to be not cost-effective [23].Effectiveness of treatment, on the other hand, is evaluated in terms of DALYs averted.

The Disability adjusted life years (DALY), and years of life lost due to premature mortality that are sourced from two sources: global burden of disease study that reported disability weights for active TB and the WHO life tables [26, 27]. The Disability weight for patients who completed their treatment assumed to be zero (since there is no disability). We assume a Tb mortality of 26 per 100000 untreated cases [56] and inputs DALYs as shown in Table 7. The Disability Adjusted Life Years (DALYs) was calculated by adding YLL and YLD — to estimate the effectiveness of MDR-TB treatment [70, 71].

DALY = YLL + YLD

Table 7 Inputs for Disability-Adjusted Life-Year for MDR- TB treatment TIC vs. TFC

Probability	Base	Range	Source
1. The disability weight for TB(MDR TB)	0.333	0.255 - 0.575	[1],[11],[12]
2. Age started	>15 year		
3. Ethiopian life expectancy year total	65		[73]
4. Discounting for cost and effect	0.03	0.01 - 0.06	[6]

4.3 Target Population

The sample source of this study is a cohort of patients enrolled to receive MDR-TB treatment (St.Peter TB Specialized, All Africa Leprosy, Tuberculosis and Rehabilitation Training Centre (ALERT) and selected TFC in Addis Ababa (Annex 7).

4.4 Study population

The study is conducted in St. Peter specialized and ALERT Hospitals as Treatment Initiation Centers (TIC) and 13- selected health centers as Treatment Follow-up Centers (TIC) by taking a sample of two hundred seventy nine (279)MDR-TB patients with age greater than 15, The patients are from TIC centers are randomly selected by using simple random sampling, whereas the 13-TFC centers are selected out of 42 health centers providing the follow-up services, based on more MDR-TB patients and gene expert machine is available which is mandatory for MDR-TB diagnosis. The two hospitals on the other hand are selected because; all MDR-TB patients of Addis Ababa are referred to (St. Peter TB Specialized, All Africa Leprosy, Tuberculosis and Rehabilitation Training Centre (ALERT).

4.4.1 Inclusion and exclusion criteria

In this study patients with the following criteria are included. Available MDR-TB patients' outcome records from March 2014 to March 2016 are included. MDR-TB patients aged ≥15 years and consented to participate in the study. MDR-TB patients who declined to participate and transfer-in and transfer-out, no-indicated clear outcomes, inconsistent (incomplete info-rmtion) recording and pre-XDR patient were the criteria for exclusion.

4.4.2 Sample size estimation

According to multiple studies conducted on different parts of Ethiopia, the rate of MDR-TB cases range from 0.5% to 2.3% among new cases and from 3.5% to 17% among previously treated cases [2, 5, 9]. The average value of the standard deviation of patient's direct cost reported in various cost- effective studies is used to make better sample size required for the analysis. The study participants sample size is calculated with 95% Confidence Interval of width ± 5%, $\alpha = 0.05$, with a critical value of $z\alpha/_2 = 1.96$. The Mean direct costs incurred by MDR-TB patients across five studies according to [42], were 14,112.00 ETB (SD 13,041.00) across 4899 screened eligible population for five studies, where Ethiopia was included in least developed countries in the study. Margin of error (e) is the amount of error that can be tolerated and it is:

$$\mathbf{n = z^2\delta^2/e^2} \qquad \mathbf{n =} (1.96)^2 (13{,}041)^2 / (1640)^2 = 243$$

Where: n = Desired sample size
δ = Mean standard deviation of direct cost of MDR-TB treatment
z = The standard normal deviation (1.96)
e = Degree of precision (Marginal Error) desired

The result found is adjusted with rate of 15% factor to take of the care of missing data or inconsistencies in recording of information on TB cards the sample size is 279 (including 15% for patients excluded from the study due to incomplete information)which are collected with simple random sampling from the general population.

4.4.3 Sampling procedures

The representative sample is taken as a portion of the population based on their proportions to represent the population of MDR-TB patients treated in the two hospitals. Thus, the required sample size from respective population is calculated and the results found are listed as follows.

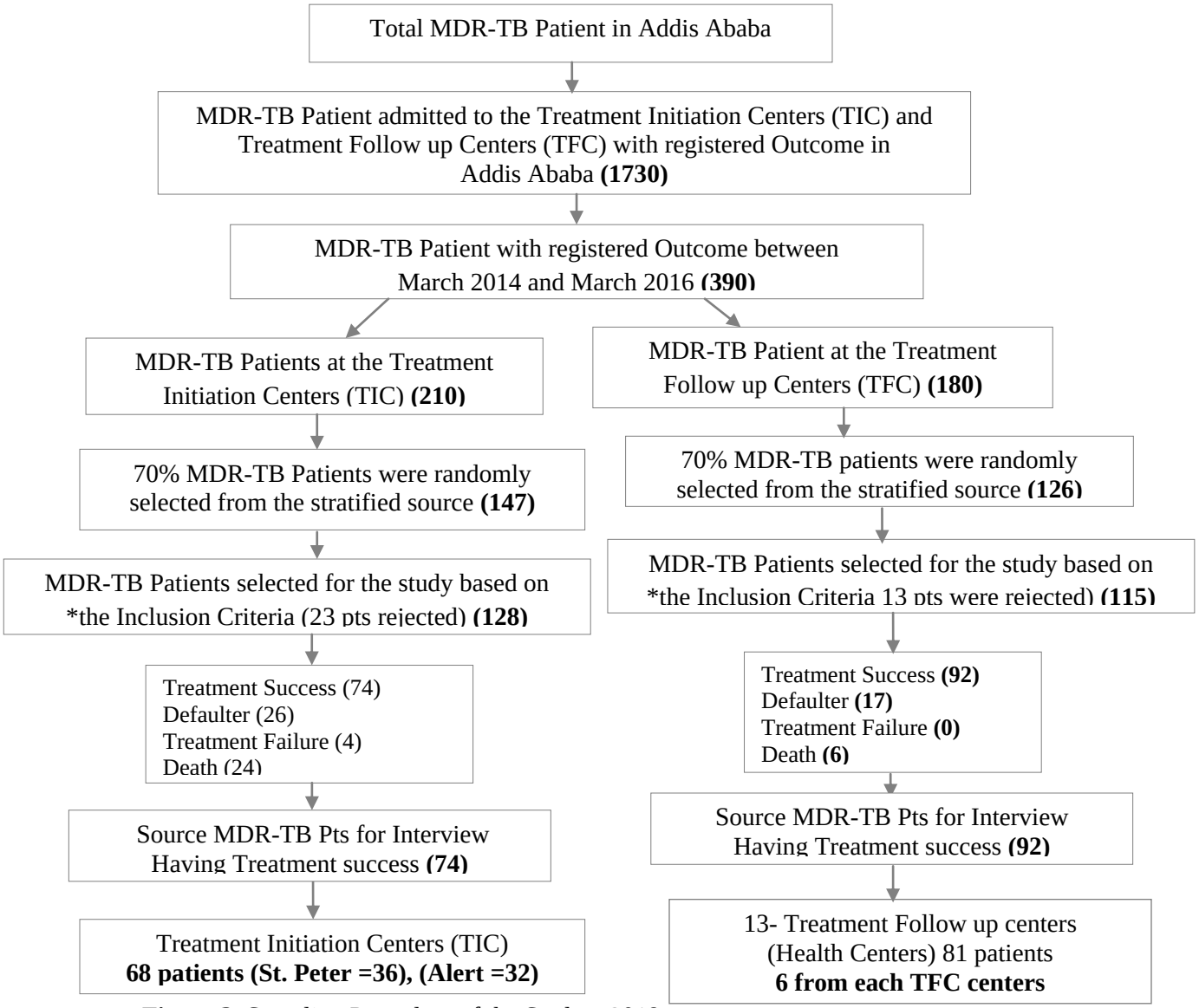


Figure 2 Sampling Procedure of the Study – 2018

N.B. 6 patients from TIC and 11 from TFC are not interviewed since patients are inaccessible

4.5 Data collection instruments

The intervention time frame for this Cost-effectiveness study is determined to be from March 2014 – March 2016. The data collection instruments mainly a questionnaire adapted from a well structured comprehensive MDR diagnosis and treatment, WHO, 2017 methodology, utilized in CEA researches [74].

The questionnaire is then supplemented with structured interview check list adapted from the World Health Organization, Global TB Programme (2015), Protocol for survey Field testing version, to collect information associated with the indirect patients' costs. The questionnaire is comprised of the following sections:

Part I: Patient information to be obtained from MDR-TB treatment card

A. Socio-Demographic Data
B. Clinical record and histories given by the study participants
C. Direct Cost (Medical, From Patients Card)
    1. Patients' Investigation Costs (From Patients Card)
    2. Drug Costs (From Patients Card)

Part II: Information collected from Patient Interview

A. Direct Medical Cost(This part is covered by the service provider and considered as provider's cost)
B. Indirect Costs

Part III. Health care Providers Cost

A. Interview for (get information case team coordinator and finance) the health professional or directly to the service giver
    1. Building (get information from team coordinator and by observation
    2. Provider's cost
B. Medical supplies and equipment used for provision MDR-TB treatment (these questions are to pharmacist and laboratory technician case them)

Part IV: Summary of patients Direct costs during Intensive and Continuation phase.

4.6 Operational definitions for MDR-TB

1. **Cured**: A patient who initially culture positive and treatment completed according to national recommendation without evidence of failure and three or more consecutive cultures taken at least 30 days apart are negative after intensive phase.
2. **Treatment Completion:** A patient who tested smear negative at the onset of treatment, completed treatment by taking all the prescribed doses and remained smear negative at the end of treatment.
3. **Default:** A patient who interrupted treatment for two consecutive months or more after initiation of treatment.
4. **Treatment failure:** Treatment terminated or need for permanent regimen change of at least two anti-TB drugs because lack of conversion by the end of the intensive phase, or bacteriological reversion in the continuation phase conversion to negative after intensive phase or evidence of additional acquired resistance to fluoroquinolones or second line inject able drug or Adverse drug reactions.
5. **Death:** Death occurring in a patient from any cause during treatment of tuberculosis
6. **Treatment Success:** If patients were declared "cured" and "completed" treatment with no evidence of remaining disease.

4.7 Study variables

The variables considered in this study, i.e. dependent and independent variables. The dependent variable cost of MDR-TB treatment and independent variables are: demographic characteristics i.e. Age, Sex, occupational status, Income level, Type of TB, Education Status, HIV status, and previous history of MDR-TB treatment, MDR-TB treatment out come and MDR-TB treatment costs. The costs are assessed from societal perspective and assumptions were made based on the average value from literature.

4.8 Cost data sources and collection procedures

The source population for the research is a cohort of patients enrolled to receive MDR-TB treatment (St. Peter TB Specialized, All Africa Leprosy, Tuberculosis and Rehabilitation Training Centre (ALERT) in Addis Ababa at the health centers and hospitals from appropriate personnel.

The cohort of patients enrolled for the MDR-TB treatment at the two hospitals and 13 health centers from March 2014 to March 2016. In this study cost of pregnancy test for women age >15-49 years and for all HIV patient related cost are included.

Table 8 Sources of data relevant to costing analysis

Data Type	Source
1. Building costs (Laboratory, TB waiting, OPD, admission room, etc..)	Local rental values for similar building , consulting local architects and quantity surveyors for estimates per square km
2. MDR-TB and other drug costs (Z, E, Cm, Lfx, Cs, Pto, etc...)	Interview Pharmacy case team, Central, Medical Stores, from record review and the purchase price list of Central, Medical Stores
3. Direct Patient (food and transport) cost	Face to face patient interview
4. Personal cost(Basic salary, Incentives paid and Uniforms)	Interview with Health center and Hospital head, payrolls; list of salary scales, personnel and administration officers
5. X-ray and laboratory equipment	Interview with personnel in pharmacy stores, from record review health centers& hospital purchase order of TFC and TIC
6. Personal cost (time used for MDR-TB treatment)	Interview of all appropriate staff participated in MDR-TB treatment and from log book and turn around references(log in and log out)
7. Laboratory reagents and supplies cost (hematology, chemistry, sputum, etc.)and supplies;(stationery,N95,glove,syringe,gowen etc..)	Interview with laboratory case team and expert opinion form health center and hospital purchase price order
8. Investigation cost (x-ray, sputum, hematology, chemistry, etc...)	Price lists investigation cost and patient card recorded review
9. Furniture's and capital cost	Health center and hospital Purchase price order
10. Culture investigation & regent cost	From literate [9]
11. DS TB treatment cost	From literate [13],[10],[20]

The data are collected from the hospitals record and interview after having an informed consent with the patients and appropriate personnel are laboratory technologist, pharmacists, nurses, health officers and other administration staff at TFC and additional internist, radiologist and physician at TIC from January 01 to April 30, 2018.

The data that used for the study are obtained from medical records on patients treated in the specified time frame. The treatment cards of the patients who registered and received treatment are kept in the records section of the unit.

4.9 Cost valuation

Cost items were divided into variable and capital costs. Variable costs were defined as costs which are used recurrently and with duration of less than a year, whereas capital costs are expected to last longer than one year [71]. Capital costs were annuitized based on the useful life-years, initial unit price, and consumer price index was used in order to account for annual inflation. The direct costs are related to patient costs for TB services and costs incurred to access these services. These are costs related to transportation, nutritional foods, health care visits and lodgings costs which are quantified from patient face to face interview for round trips and the number of visits.

The patients indirect (productivity loss) cost are several alternative approaches, including the human capital and friction cost techniques [71]. In the friction cost approach, it is assumed that society incurs only productivity-losses during the period it takes to replace the worker (the so-called 'friction period') due to illness. Estimates from a friction cost approach better reflect the economic impact of the illness since it accounts for short-term absences and reduced productivity while at work, and provides considerably lower estimate compared with the human capital approach. However, from practical perspective, the friction cost approach requires detail data on the friction period, which is unstable and often not known in informal sector [71].

In this study, patients indirect (productivity loss) cost are estimated based on the human capital approach (HCA). Because the approach is widely used to estimate productivity cost in cost effectiveness analysis [17]. The gross wage is the unit of value before MDR TB illness, income lost to patients who had no permanent job are estimated using local daily wage rate for unskilled labor in their respective localities and 26 working days per month (excluding four Sundays). On the other hand, local daily wage rate for unskilled labor was obtained about thirty five Ethiopian Birr in 2013[70]. After the identification of all forms cost based on the health care perspective, these individual items costs are measured and valued.

The valuation involves two steps of costing: measuring the quantities of resource utilized with their unit prices followed by valuing the resources using Ethiopian Birr and converting it to USD end 2015 year based on existing USD dollar rate. The analysis is performed using individual patient data. Thus the following table shows how individual cost items are valued and used in the study. Reagent and supply cost are estimated by the average unit cost per patient multiplied by the number of test per TSR (Annex 8).

Table 9 Valuation of costing analysis for MDR-TB treatment TIC vs. TFC

Data Type	Source
1. Building costs	Based on expert opinion 160 Birr to 200Birr *per sq km per month
2. Ambulance and hospital car fuel	Based on number and length of trips could be recorded serves given for MDR-TB change to how much fuel use per km*total visit
3. Personal cost(time used for MDR-TB treatment)	Each visit per minutes *total minutes per TSR =change to Birr based on Personal salary
4. Laboratory reagents and all supplies cost	Unit cost per patient *total reagent(supply) use per TSR
5. Laboratory investigation cost	(Unit cost * number of tests) *per TSR
6. Furniture's and other capital cost	Annuitized based on the useful life-year
7. Culture investigation & regent cost	[63]
8. DS TB treatment cost	[29],[30],[10]
9.Indirect patient (productivity loss) cost	Human capital approach (HCA)
10.Direct patient costs(food and transports)	Average rounds cost * number of visit per TSR

Evaluation materials and equipment includes laboratory and computing equipment, automotives, operating equipment, and furniture/furnishings/fixtures, using useful life of the item. The estimated useful life (or the period over which an asset might reasonably be expected to be useful in earning income in Ethiopia) is estimated using Consumer price Index (CPI) further estimating the furniture and equipment usage for other health facility hospital purpose.

Then the depreciation is calculated for two years (20- months) considering the total treatment time. This effort is measured by interview appropriate personnel and from log in and log out book. However, the providers do not spend their full time in direct contact with MDR-TB patients. Activities that the provider engaged in other patient care activities are excluded from the study.

4.10 Data quality management

The validity and reliability of instrument is concerned with the quality of the data and appropriateness of methods used in the research. Thus, the English version questionnaire adapted from WHO-2017 used in this study is translated into Amharic by experts to be used for the study. The five data collectors who are MDR-TB focal person (to minimize data collection bias) especially during the patient interview and then the field supervisors were briefed with refresher training for a day to ensure administration reliability. One day training on the purpose of the study and data collection procedures was given. Completeness of the questionnaire was assessed daily by the field supervisor and the researcher. Data are double-entered using with excel spreadsheet and inconsistencies of the entered data are be reconciled by checking the questionnaire.

4.11 Validation of research instrument

The eligibility and exclusion criteria of the study are stated to meet the objectives of the study. Opinions from medical officers and nurses providing medical service for MDR-TB patients were requested on the questionnaire and their opinions are incorporated to make the instrument measure and construct the study domain and ensure instruments validity. Then, the questionnaire is checked for its validity with a pilot study by taking 10% of the sampled population (279* 10% = 28), and these 28 patients are excluded from the final study which makes a total of 243 patients for the analysis, where 8 –patients were excluded due to incomplete information.

4.12 Data analysis

The data entry and analysis were conducted with excel and the various costs collected in Birr are converted into United States Dollars (USD) at official exchange rate of the National Bank of Ethiopia at the time of patient consumed, end of year 2015(1USD = 21.29 ETB). Demographic data are analyzed using SPSS-20 and for the Markov model TreeAge software is used to compare the treatment Cost-effectiveness of a cohort of Multi-drug resistant tuberculosis (MDR-TB) patients diagnosed. The treatment initiation and follow-up centers (TIC and TFC) are evaluated in terms of incremental costs per (DALY) averted. The cohort-based Markov model is developed in a previously published from peer reviewed international journal article and WHO guidelines to be used for the Cost-effectiveness analysis as shown in Table 5.

The demographic, clinical and financial status characteristics outputs of patients/ respondents/ from the SPSS-20 are tabulated and analyzed in the respective subject matter. The outputs are further investigated to see the interrelationships among the variables sought.

4.12.1 Sensitivity Analysis

The outputs from TreeAge Software Sensitivity Analysis were conducted to test suitability of results. Based on this fact both of sensitivity analyses are performed: one-way and Probabilistic Sensitivity Analysis (PSA). Variables are studied using possible range specified in Table 6 for deterministic sensitivity analysis. After having completed these, sensitivity analyses are employed to verify the effectiveness of the MDR-TB treatment at TIC and TFC based on the upper and lower limits of the expected cost-effectiveness from the literature and this study. The sensitivity analysis employed assumption model, since there is no published research on Cost-effectiveness of MDR-TB treatment to compare the results with. Therefore, low cost and high cost of TB treatment both at TIC and TFC are assumed to be equal.

4.12.2 Monte Carlo simulation

Monte Carlo simulation is a form of statistical analysis in which the probability of different outcomes is calculated repeatedly, using different scenarios for each calculation. To perform these tasks TreeAge software is used to perform the calculations as a single operation, and provide information about full range of possible outcomes, and the likelihood of each [32].

4.12.3 Cost-Effectiveness Ratio (CER)

The cost-effectiveness ratio (CER) is an important summary statistic to compare costs and effectiveness of competing interventions (Treatment Initiation Centers (TIC), Hospitals and Treatment Follow-up Centers (TFC), Health Center). Though, outcomes can be assessed in the study incremental costs are evaluated against Disability-Adjusted Life Years (DALY) averted, which is computed as the incremental cost-effectiveness ratio (ICER). The cost-effectiveness is expressed as cost-effectiveness ratio, which is cost per unit of outcome of the (MDR-TB) treatment with the perspective of a societal system. The treatment effectiveness is expressed in terms of Disability Adjusted Life Years DALYs). The demographic data are further analyzed with the multivariate analysis using SPSS-21 statistical software.

4.12.4 Incremental Cost-Effectiveness Ratios (ICERs)

The use of incremental cost-effectiveness ratios (ICERs) answers questions like what are the additional benefits to be gained from a new intervention, and at how much additional cost? These are calculated by dividing the difference in costs (between interventions) by the difference in health effects (between interventions). In order to determine whether an intervention represents good value for a national health care system based on the per capita gross domestic product (GDP), [60]. Furthermore, the incremental cost-effectiveness ratios (ICER) are measured. Uncertainty in ICER results is characterized using Willingness-To-Pay (WTP) thresholds and Cost-effectiveness Acceptability Curves (CEACs) [14]. This approach uses a pre-defined definition of value, the WTP threshold to guide decision making [39].

Using this approach, promoted by the choosing interventions that are Cost-Effective (WHO-CHOICE) project, an intervention that costs less than three times the national annual GDP per capita per DALY avoided is considered cost-effective, whereas one that costs less than once the national annual GDP per capita is considered decidedly cost-effective [23]. ICER is calculated to express the cost of MDR-TB treatment per DALYs averted [33]. Therefore, it is noted that the cost-effectiveness threshold recommendations by WHO-CHOICE are based on cost per DALY averted. In similar manner, the outputs from the TreeAge software, namely incremental cost-effectiveness ratios (calculated as the difference in TIC and TFC costs divided by the increase in DALYs averted).

4.13 Ethical Consideration

This study has been done in conformity with the ethical guidelines approved by the Research Ethical Committee of school of public health, Addis Ababa University preceded by permission request letter written to the hospital's MDR-TB treatment centers explaining the study objectives and its significance. At the hospital level (both at St. Peter and ALERT), the hospital research committee approved the university request and forward the request to all concerned departments and their catchment treatment follow up centers (TFC) and gave permission for the relevant data collections. A room is solicited from the hospital authority to conduct the study to ensure privacy and confidentiality.

The treatment cards from which the data retrieved are kept under lock and used with limited access. At individual level verbal consent are obtained after the necessary explanation about the purpose, benefits and risks of the study and their right on decision to participate in the study. The consent states that the data collected solely be used for the research purpose and all interviews with respondents are made under strict privacy. No identifying information such as names are captured from the records.

4.14 Dissemination of Results

After completion of the study, the findings of the study is expected to be shared with the two hospitals, health centers where data collected, the School of Public Health, College of Health Sciences of Addis Ababa University through hard and soft copies.

Chapter V: Results

5.1 Demographic characteristics of study participants

Among those included in the study 126 (51.9%) are males and 117 (48.1%) females. The level of education also shows that 190 (78.2%) are below secondary education among which 28 (11.5%) are illiterate.

Table 10 Study participants demographic Characteristics N (%) 2014-2016 years (TIC vs. TFC)

Demographic Variables	Drug providers Category Description	Drug providers Category		Total
		TIC	TFC	
Sex	Male	77 (60.16)	49 (42.61)	126(51.9)
	Female	51 (39.84)	66 ‘(57.39)	117(48.1)
Age	15 - 24	38 (29.69)	35 (30.43)	73 (30)
	25 -34	54 (42.19)	48 (41.74)	102(42)
	35 - 44	19 (14.84)	17 (14.78)	36(14.8)
	45 - 54	14 (10.94)	11(9.57)	25(10.3)
	55 - 64	2 (1.56)	1 (0.87)	3(1.2)
	> 65	1 (0.78)	3 (2.61)	4(1.6)
Marital status	Married	48 (37.50)	66 (57.39)	114(46.9)
	Single	76 (59.38)	47 (40.87)	123(50.6)
	Divorced	4 (3.13)	2 (1.74)	6(2.5)
Education	Illiterate	13 (10.16)	15 (13.04)	28(11.5)
	Can read and write	51 (39.84)	18 (15.65)	69(28.4)
	Primary Education	51 (39.84)	42 (36.52)	93(38.3)
	Secondary Education	10 (7.81)	31 (26.96)	41(16.9)
	College and Above	3 (2.34)	9 (7.83)	12(4.9)
Occupation	Farmer	2 (1.56)	0 (0.00)	2(0.8)
	Government Employee	15 (11.72)	22 (19.13)	37(15.2)
	Self Employed	78 (60.94)	51 (44.35)	129(53.1)
	School Student	8 (6.25)	14 (12.17)	22(9.1)
	Daily Laborer	9 (7.03)	8 (6.96)	17(7)
	Unemployed	15 (11.72)	20 (17.39)	35(14.4)
	Retired	1 (0.78)	0 (0.00)	1(0.4)
Family Size	< 3	33(25.8)	30(26.1)	63(25.9)
	3 - 6	89(69.5)	76(66.1)	165(67.9)
	> 6	6(4.7)	9(7.8)	15(6.2)
	Total	**128**	**115**	**243**

On the other hand 74 (30%) of the study participants are students, daily laborers or unemployed, with an implication that there seems to be a relationship between MDR-TB and these section of the population. It is also noted that 175(72%) of the participants were aged between 15- 34 which shows the diseases is highly affecting the youth, the working group of the population. The marital status of study groups shows that 123(50.6%) of study participants are single and 6(2.5%) are divorced. Furthermore, family 74.1% of study participants lives in a family size of 3 or above, out of which 6.2% lives in a family having more than 6 people. Table 11 shows that, out of the total of 243 patients enrolled in the study 130 (53.5%) are MDR-TB from new cases while the rest 113(46.5%) are MDR-TB from the previously treated cases.

5.2 Clinical characteristics of study participants

Table 11 Study participants clinical characteristics N (%)

Clinical Variables	Description	Drug providers Category		Total
		TIC	TFC	
MDR TB site	Extra pulmonary	39 (30.5)	29 (25.2)	68(28)
	Pulmonary	89(69.5)	86 (74.8)	175(72)
Regimen	Standardized	125(97.7)	115(100.0)	240(98.8)
	Individualized	3(2.3)	0(0.0)	3(1.2)
Category	MDR New	61(47.7)	69(60.0)	130(53.5)
	MDR- Relapse	29(22.7)	17(14.8)	46(18.9)
	MDR- After Lost follow up	6(4.7)	3(2.6)	9(3.7)
	MDR - After Failure	32(25.0)	26(22.6)	58(23.9)
Intensive duration	< 3	17(13.3)	8(7.0)	25(10.3)
	3 – 6	12(9.4)	8(7.0)	20(8.2)
	6 – 8	88(68.8)	91(79.1)	179(73.7)
	> 8	11(8.6)	8(7.0)	19(7.8)
Continuation Duration	< 5	34(26.6)	16(13.9)	50(20.6)
	5 -10	2(1.6)	0(0.0)	2(0.8)
	10 -15	66(51.6)	92(80.0)	158(65)
	> 15	26(20.3)	7(6.1)	33(13.6)
HIV status	Positive	38(29.7)	18(15.7)	56(23)
	Negative	90(70.3)	90(78.3)	180(74.4)
	Unknown	0(0.0)	7(6.1)	7(2.9)
Outcome	Cured	34(26.6)	44(38.3)	78(32.1)
	Treatment Complete	40(31.3)	48(41.7)	88(36.2)
	Defaulter	26(20.3)	17(14.8)	43(17.7)
	Treatment Failure	4(3.1)	0(0.0)	4(1.6)
	Death	24(18.8)	6(5.2)	30(12.3)
	Total	**128**	**115**	**243**

On the other hand, almost all patients are treated under standard regimen and among these, 175 (72%) the MDR-TB site is pulmonary and the rest 68(28%) are extra pulmonary. The treatment success at TIC is 61% and 53% for males and females respectively, whereas at TFC the treatment success for both males and females is 80%. This implies that, better probability of treatment success rate at the follow up centers than initiation centers (Figure 3).

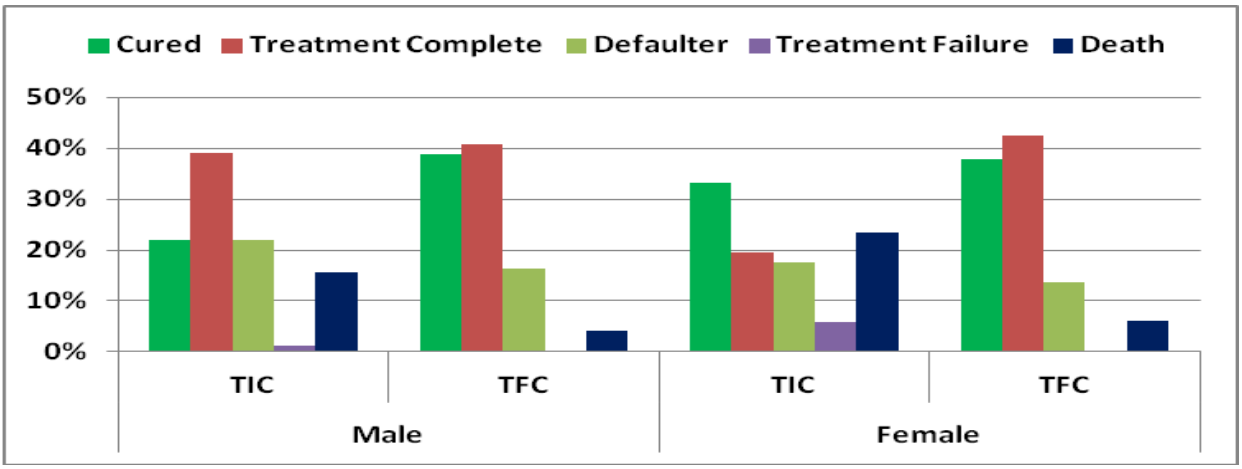


Figure 3 Health facility, Treatment outcome and sex relationship

On the other hand shows that 16% of the male and 24% of the female, treated at TIC were dead, while 4% of males & 6% of females treated at TFC were dead, implying that the incidence of death at TIC is far greater than TFC. The HIV infection in the study participants identified as 56 (23%) are positive, 180 (74.4%) negative. Patients with unknown status are 7(2.9%) and all these study participants are from TFC (Figure 3). Among the patents treated 166 (68.3%) shown treatment success where, 92 (80%) are from TFC and 74(57.9%) are from the TIC, this implies a better success rate at TIC than TFC treated patients.

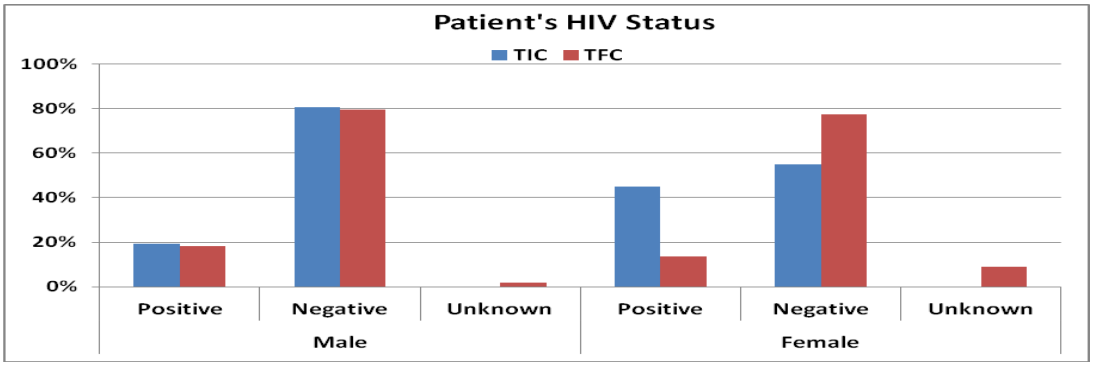


Figure 4 Health facility, HIV Status and sex relationship

Out of the total of 30 (12.3%) death records 24 (18.8%) are from the TIC and only 6 (5.2%) are from the TFC. However, the results may be related to the patient's category treated at treatment initiation centers. Because, among 113 (46.5%) patients who came to the treatment centers as relapse 46 (18.9%), after lost follow up 9 (3.7 %) and treatment failure 58 (23.9 %), 67 (52.4%) are treated at TIC and the rest 46 (60%) are treated at TFC in their respective populations. The results obtained further depicted that, the percentage of patients who are unknown and screened for HIV are higher at TFC (2% male and 9% female), where this is not true at TIC (Figure 4).

5.3 Patient financial status of study participants

Patents with a monthly disposable income of less than 1000 ETB (USD 45) are 59(24.3%). Out of the total of randomly selected patients 243(100%), 180 (74.1%) have three or more people in the family. 41(16.9%) of the patients participated in the study has no one employed in the family to support them while they were on their treatment (Table 12).

Table 12 Study participants financial characteristics N (%)

Financial Variables	Description	Drug providers Category		Total
		TIC	TFC	
Disposable	< 1000	33(25.8)	26(22.6)	59(24.3)
Income	1001 - 3000	76(59.4)	65(56.5)	141(58)
	3001 - 5000	18(14.1)	22(19.1)	40(16.5)
	5001 - 7000	1(0.8)	1(0.9)	2(0.8)
	7001 -9000	0(0.0)	1(0.9)	1(0.4)
Family	< 3	33(25.8)	30(26.1)	63(25.9)
Size	3 - 6	89(69.5)	76(66.1)	165(67.9)
	> 6	6(4.7)	9(7.8)	15(6.2)
Number of	0	27(21.1)	14(12.2)	41(16.9)
employed	1	40(31.3)	51(44.3)	91(37.4)
families	2	57(44.5)	38(33.0)	95(39.1)
	3	4(3.1)	9(7.8)	13(5.3)
	4	0(0.0)	3(2.6)	3(1.2)
Average	< 1000	39(30.5)	27(23.5)	66(27.2)
Family	1001 - 3000	43(33.6)	38(33.0)	81(33.3)
Income	3001 - 5000	33(25.8)	30(26.1)	63(25.9)
	5001 - 7000	5(3.9)	12(10.4)	17(7)
	7001 -9000	6(4.7)	5(4.3)	11(4.5)
	> 9000	2 (1.6)	3(2.6)	5(2.1)
	Total	**128**	**115**	**243**

On the other hand the average family income of greater than 5000 ETB constitutes a total of 33%, which is 13(10.2%) and 20 (17.3%) for the TIC and TFC respectively (Table 12). The (figure5) shows the number of death incidence increases as the family size increases, this incidence will be opposite as the number of people in the family is less than three, the treatment success goes up to 185 (76%) and the percentage of defaulters, treatment failure, and death within the family size of 3 or more found to be 44(18%).

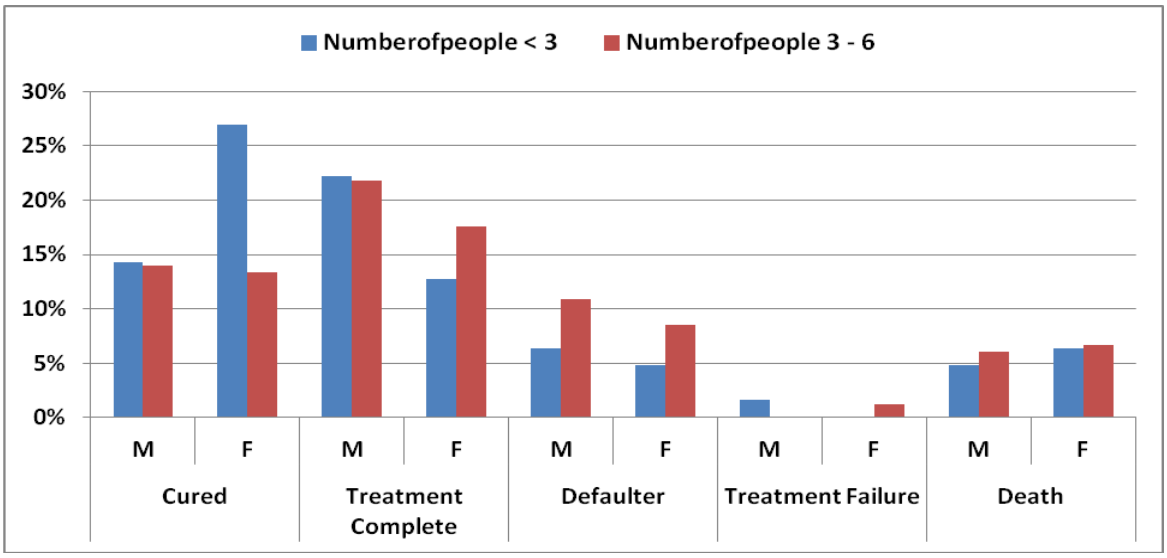


Figure 5 Treatment outcome, family size and sex

Out of the total study group 200 (82.3%) participants have a monthly average net income of less than 3001(USD 136), where as the average family income of less than 3001(USD 136) is found out to be 147(60.5%) (Table 12). Figure 6 shows the number of death incidence increases as the family size increases, this incidence seems to be opposite as the number of people in the family is less than three, the treatment success goes up to 185 (76%) and the percentage of defaulters, treatment failure, and death within the family size of 3 or mere found to be 44(18%).

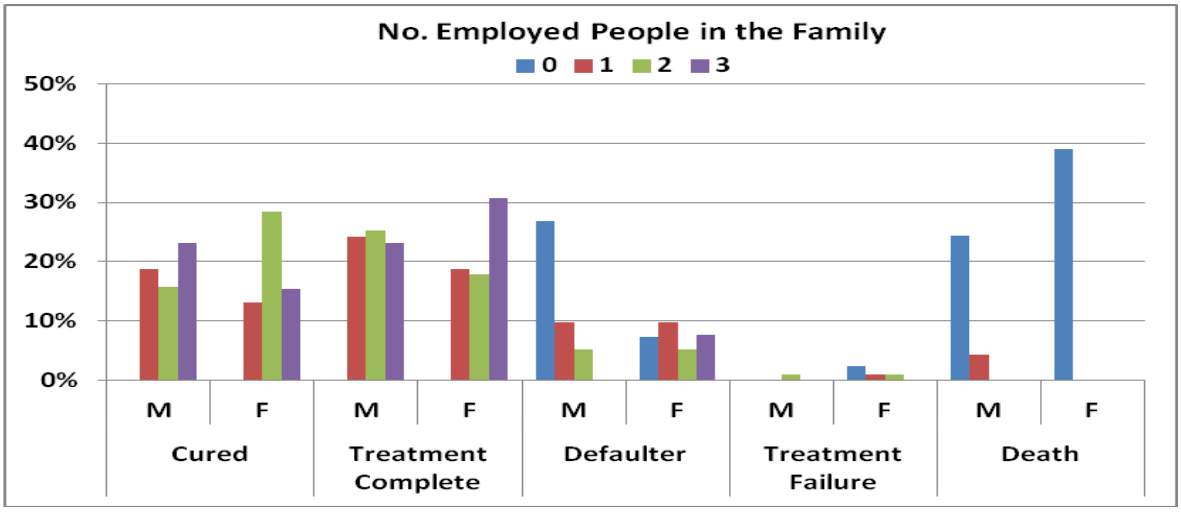


Figure 6 Treatment outcome, no. of employed people in the family and sex

This can be further clarified by the percentage of death in the family with no employee is found out to be 39% female and 24% male which sum up to be 63% of the MDR-TB treatment is unsuccessful in the family with no employee (Figure 7).

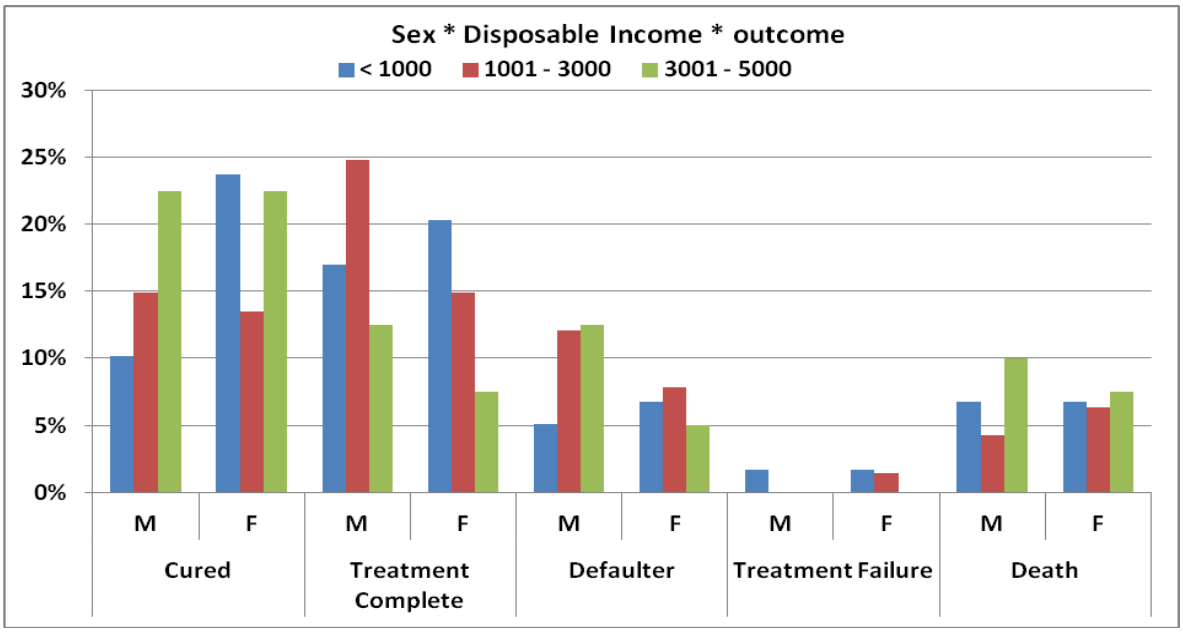


Figure 7 Treatment outcome, patient disposable income and sex

5.4 MDR-TB Treatment Costs

5.4.1 Patients productivity time loss

The average month loss during MDR-TB treatment at both TIC and TFC was 7 month, with an average of 80 days of admission. The mean treatment duration for the intensive and continuation phase is found to be 8 and 10 months with mean average number of DOTS, visits of 7days/week and two visits per month respectively.

5.4.2 Patients Costs of study population

As can be seen from the, patient cost is Seven times higher intensive care phase than the continuation phase, which shows the cost of MDR-TB treatment can immensely be minimized if there is a disease awareness trainings in all health facilities of the country to encourage patients to see heath facilities in earlier stage especially those of HIV positive patients, which will avoid admission cost of the treatment (Table 13).

On the other hand, the patients' total non medical costs at TIC is higher than the amount expended at TFC, this might be related to the longer distance they should travel to reach the TIC. However, this costs are relatively minimum since most TFC, are located near the locality of the patients, where, they pay less to get there.

Table 13 Intensive and continuation phase of Patient non medical costs in USD

Cost Centers	TIC		Total TIC	TFC		Total TFC
	Intensive	Continuation		Intensive	Continuation	
HIV Positive Patient Cost						
1. Total Transport Dot	389.34	-	389.34	253.37	-	253.37
2. Total food Dot	320.32	-	320.32	209.3	-	209.3
3. Total accommodation	-	52.17	52.17	-	-	0
4. Total Transport for follow up	-	41.01	41.01	-	64.87	64.87
5. Total food for follow up	-	123	123	-	98	98
6. Productivity loss	996.29	-	996.29	818.2	-	818.2
Total Cost (USD)	1,705.95	216.18	1,922.13	1,280.87	162.87	1,443.74
HIV Negative Patient Cost						
1. Total Transport Dot cost	335.41	-	335.41	233.92	-	233.92
2. Total Food Dot cost	270.55	-	270.55	196.1	-	196.1
Total Accommodation cost	-	52.17	52.17	-	-	-
4.Total Transport for follow up	-	41.01	41.01	-	64.87	64.87
5. Total Food for follow up	-	123	123	-	98	98
6. Productivity loss cost	976.29	-	976.29	798.2	-	798.2
Total Cost (USD)	1,582.25	216.18	1,798.43	1,228.22	162.87	1,391.09

5.4.1 Health System MDR-TB treatment costs of study population

The health care system cost of DSTB and MDR-TB in Addis Ababa supported by global fund and challenged.

Table 14 MDR Treatment cost for admitted HIV Positive Pts per TSR

Cost Centers	TIC		Total TIC	TFC		Total TFC
	Intensive	Continuation		Intensive	Continuation	
A. Fixed Cost						
1. Building	235.98	337.11	573.09	143.38	286.75	430.13
2. Equipment and Furniture	157.48	224.98	382.46	48.91	97.81	146.72
Sub- Total 1	**393.46**	**562.09**	**955.55**	**192.28**	**384.56**	**576.84**
B. Variable Cost						
1. Personnel's	1,278.57	544.00	1,822.57	648.60	340.00	988.60
2. Supplies cost	304.94	124.00	428.94	180.00	92.00	272.00
3. Investigation	351.27	143.00	494.27	313.30	134.27	447.57
4. Reagent cost	179.00	45.00	224.00	159.00	38.00	197.00
5. MDR and Other Drug	3,032.86	1,424.00	4,456.86	2,564.63	1,369.00	3,933.63
6. Food cost	168.67	-	-	-	-	-
Sub- Total 2	**5,315.31**	**2,280.00**	**7,595.31**	**3,865.53**	**1,973.27**	**5,838.80**
Grand Total (USD)	**5,540.10**	**2,842.09**	**8,550.86**	**4,057.81**	**2,357.83**	**6,415.64**

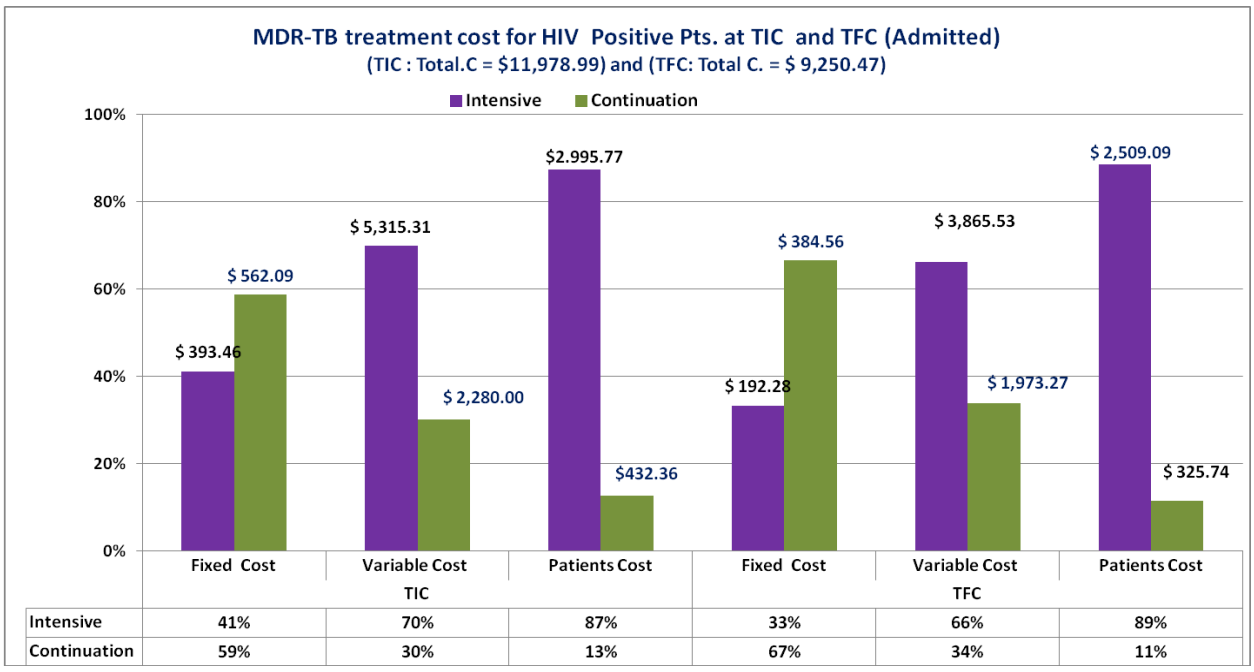


Figure 8 Cost breakdown of MDR-TB treatment for admitted HIV positive patients on Intensive and Continuation phase at TIC and TFC

Table 15 MDR Treatment cost for non Admitted/HIV Positive Pts per TSR

Cost Centers	TIC		Total TIC	TFC		Total TFC
	Intensive	Continuat.		Intensive	Continuat.	
A. Fixed Cost						
1. Building	168.56	337.11	505.67	143.38	286.75	430.13
2. Equipment and Furniture	112.49	224.98	337.46	48.91	97.81	146.72
Sub- Total 1	**281.04**	**562.09**	**843.13**	**192.28**	**384.56**	**576.84**
B. Variable Cost						
1. Personnel's	1,134.12	544.00	1,678.12	648.60	340.00	988.60
2. Supplies	293.00	124.00	417.00	180.00	92.00	272.00
3. Investigation	335.31	143.00	478.31	313.30	134.27	447.57
4. Reagent cost	179.00	45.00	224.00	159.00	38.00	197.00
5. MDR and Other Drug	2,627.53	1,424.00	4,051.53	2,564.63	1,369.00	3,933.63
Sub- Total 2	**4,568.96**	**2,280.00**	**6,848.96**	**3,865.53**	**1,973.27**	**5,838.80**
Grand Total (USD)	**4,850.00**	**2,842.09**	**7,692.09**	**4,057.81**	**2,357.83**	**6,415.64**

The total fixed cost utilized for the MDR treatment of non Admitted/HIV positive patients is found to be USD 843.13 and USD 576.84 at TIC and TFC respectively. The variable costs on the other hand are USD 6,848.96 for the TIC and USD 5,838.80 for the TFC(Figure 9).

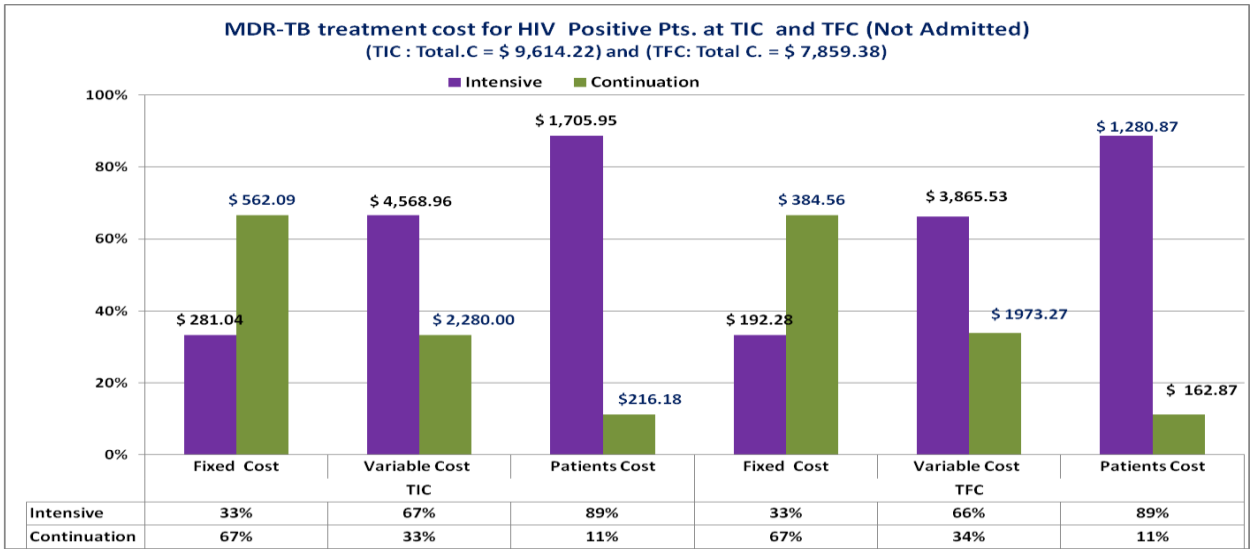


Figure 9 Cost breakdown of MDR-TB treatment for not admitted HIV positive patients on Intensive and Continuation phase at TIC and TFC

The other one is then the variable costs. The MDR-TB treatment Drug and Other related supplies with respective costs are calculated to be 5,471.93 USD and 5,400.49 USD at TIC and TFC respectively.

The total cost of hospitalized HIV positive MDR-TB patient's treatment at TIC is 11,978.99 USD, but for non-hospitalized for MDR-TB treatment at TIC is 9,614.38 USD (Figure 8 and 9)

Table 16 MDR Treatment cost for admitted HIV Negative pts per TSR

Cost Centers	TIC		Total TIC	TFC		Total TFC
	Intensive	Continuat.		Intensive	Continuat	
A. Fixed Cost						
1. Building	235.98	337.11	573.09	143.38	286.75	430.13
2. Equipment and Furniture	157.48	224.98	382.46	48.91	97.81	146.72
Sub- Total 1	**393.46**	**562.09**	**955.55**	**192.28**	**384.56**	**576.84**
B. Variable Cost						
1. Personnel	1,178.57	443.19	1,621.76	548.60	280.60	829.20
2. Supplies	254.05	103.92	357.97	126.01	80.70	206.71
3. Investigation	253.96	59.60	313.56	116.86	50.80	167.66
4. Reagent cost	124.97	34.06	159.03	75.95	20.70	96.64
5. MDR and Other Drug	2,575.35	1,324.82	3,900.17	2,099.00	1,290.00	3,389.00
6. Food cost	168.67	-	-	-	-	-
Sub- Total 2	**4,555.58**	**1,965.59**	**6,521.16**	**2,966.42**	**1,722.80**	**4,689.21**
Grand Total (USD)	**4,949.04**	**2,527.68**	**7,476.71**	**3,158.70**	**2,107.36**	**5,266.06**

The total fixed cost utilized for the MDR treatment of Admitted/HIV negative patients is found to be USD 843.13 and USD 576.84 at TIC and TFC respectively. The variable costs on the other hand are USD 5771.81for the TIC and USD 4,689.21 for the MDR-TB patients at the TFC.

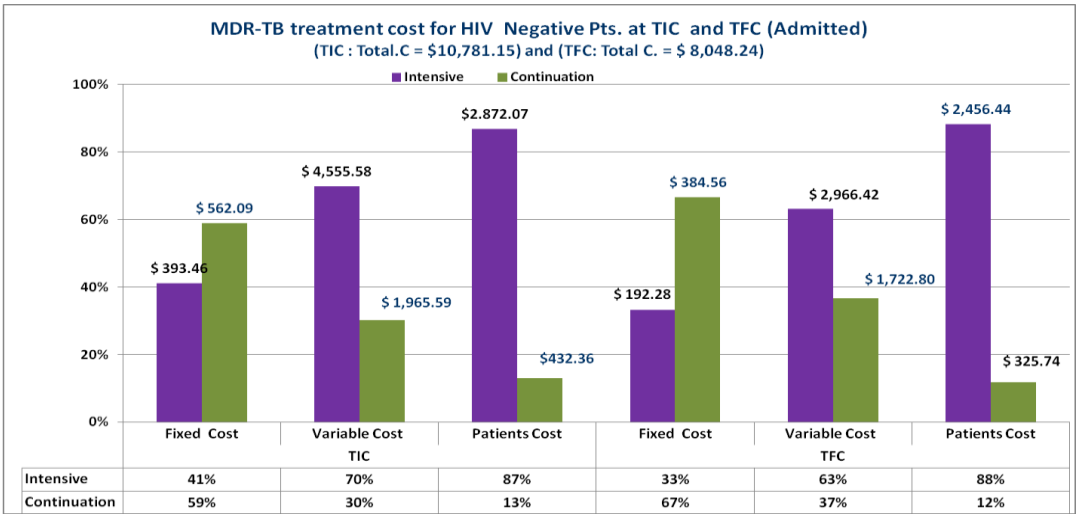


Figure 10 Cost breakdown of MDR-TB treatment for admitted HIV negative patients on Intensive and Continuation phase at TIC and TFC

The fixed, variable and patient costs are all the same except for the admission cost which is 945.84 USD, which is 9.14% of the total cost for the HIV positive cost at TIC.

Table 17 MDR Treatment cost for non Admitted/HIV Negative Pts per TSR

Cost Centers	TIC		Total TIC	TFC		Total TFC
	Intensive	Continuat.		Intensive	Continuat.	
A. Fixed Cost						
1. Building	168.56	337.11	505.67	143.38	286.75	430.13
2. Equipment and Furniture	112.49	224.98	337.46	48.91	97.81	146.72
Sub- Total 1	**281.04**	**562.09**	**843.13**	**192.28**	**384.56**	**576.84**
B. Variable Cost						
1. Personnel's	1,034.12	443.19	1,477.31	548.60	280.60	829.20
2. Supplies cost	242.11	103.92	346.03	126.01	80.70	206.71
3. Investigation	238.00	59.60	297.60	116.86	50.80	167.66
4. Reagent cost	124.97	34.06	159.03	75.95	20.70	96.64
5. MDR & Other Drug Costs	2,170.02	1,324.82	3,494.84	2,099.00	1,290.00	3,389.00
Sub- Total 2	**3,809.22**	**1,965.59**	**5,774.81**	**2,966.42**	**1,722.80**	**4,689.21**
Grand Total (USD)	**4,090.27**	**2,527.68**	**6,617.94**	**3,158.70**	**2,107.36**	**5,266.06**

As the figure 11 shows that the total cost for MDR-TB treatment for the HIV negative patients) is USD 8,413.37 and USD 6,657.15 at TIC and TFC respectively and the majority of the costs is associated with variable cost of intensive care which is found to be 70 % and 63 % for the TIC and TFC respectively.

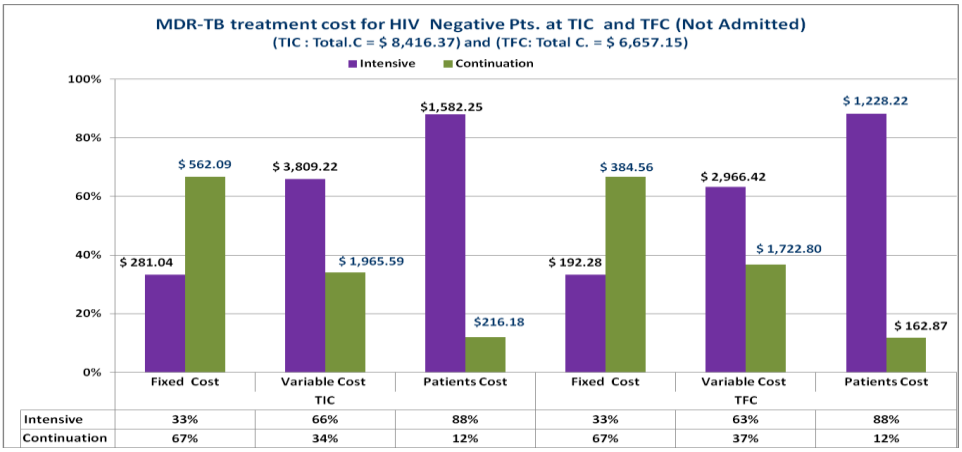


Figure 11 Cost breakdown of MDR-TB treatment for not admitted HIV negative patients on Intensive and Continuation phase at TIC and TFC

Table 1 TIC vs. TFC MDR-TB treatment average costs per TSR in USD

Treatment Categories	Treatment Facility Centers							
	TIC				TFC			
	Fixed	Variable	Patients	Total	Fixed	Variable	Patients	Total
Admitted (HIV Positive)	**955.55 (**764.44-1,146.66**) SD =** (270.27)	**7,595.31** (6,076.25 - 9,114.37) **SD =** (969.62)	**3,428.13** (2,742.50 - 4,113.76) **SD =** (2,148.28)	**11,978.99** (9,583.19 - 14,374.79) **SD =** (3,388.17)	**576.84** (461.48 - 692.21) **SD =** (163.16)	**5,838.80** (4,671.04 - 7,006.56) **SD=** (801.81)	**2,834.83** (2,267.86 - 3,401.80) **SD=** (1651.46)	**9,250.47** (7,400.38 - 11,100.57) **SD=** (2616.43)
Not Admitted (HIV Positive)	**843.13 (**674.50 - 1,011.75**) SD=** (238.47)	**6,848.96 (**5,479.17 - 8,218.75**) SD=** (543.66)	**1,922.13** (1,537.70 - 2,306.56) **SD=** (1,937.18)	**9,614.22** (7,691.37 - 11,537.06) **SD=** (2,719.31)	**576.84** (461.48 - 692.21) **SD =** (163.16)	**5,838.80** (4,671.04 - 7,006.56) **SD=** (408.35)	**1,443.74** (1,154.99 - 1,732.49) **SD=** (1,651.46)	**7,859.38** (6,287.51 - 9,431.26) **SD=** (2,222.97)
Admitted (HIV Negative)	**955.55 (**764.44 - 1,146.66**) SD=** (270.27)	**6,521.17** (5,216.94 - 7,825.40) **SD=** (934.63)	**3,304.43 (**2,643.54 - 3,965.32) **SD=** (1,844.47)	**10,781.15** (8,624.92 - 12,937.38) **SD=** (3049.37)	**576.84** (461.48 - 692.21) **SD =** (163.16)	**4,689.21** (3,343.39 - 5,015.09) **SD=** (786.92)	**2,782.18** (2,225.74 - 3,338.62) **SD=** (1,182.07)	**8,048.23 (**6,030.61 - 9,045.92) **SD=** (2,132.14)
Not Admitted (HIV Negative)	**843.13 (**674.50 - 1,011.75**) SD=** (238.47	**5,771.81** (5,216.94 - 7,825.40) **SD=** (508.67)	**1,798.43** (1,438.74 - 2,158.12) **SD=** (1844.47)	**8,416.17** (7,420.12 - 11,130.18) **SD=** (2,623.41)	**576.84** (461.48 - 692.21) **SD =** (163.16)	**4,689.21** (3,343.39 - 5,015.09) **SD=** (393.46)	**1,391.09** (1,112.87 - 1,669.31) **SD=** (1,182.07)	**6,657.15 (**4,917.74 - 7,376.61) **SD=** (1,738.68)

5.5 Sensitivity Analysis

The cost-effectiveness analysis is challenged with uncertainty associated with input like DALYs estimates for the calculation of ICER and time horizon of estimated values. In order to formalize the sensitivity analysis both one-way (tornado analysis) and probabilistic sensitivity analysis (PSA), were employed to measure and evaluate sensitivity analysis. A sensitivity analysis employed in this study help to determine how different values of an independent variable impact cost-effectiveness analysis under a given set of assumptions. In put probability for tornado and PSA was based on Table 6 for distribution of stranded deviation we assume ±20% based on the mean value [11]. All DSTB cost and probability was literature review for MDR-TB based on this research.

5.5.1 One way sensitivity Analysis (Tornado Diagram)

The tornado diagram, in the study is one-way sensitivity analyses performed by because, it would show the effects of changes of many variables at once, with its conical structure sorted from the high to low impact in a way that shapes the chart like a tornado cone. The selected lists of variables are very important to show the effect in the sensitivity analysis in the tornado diagrams shows that model parameters that were found to be most effective on the ICER at base-case for TIC and TFC, compared to the standard of care. The ICER represents how much it would cost patients to one unit DALY averted from MDR- TB treatment at TIC, over the effect obtained at TFC.

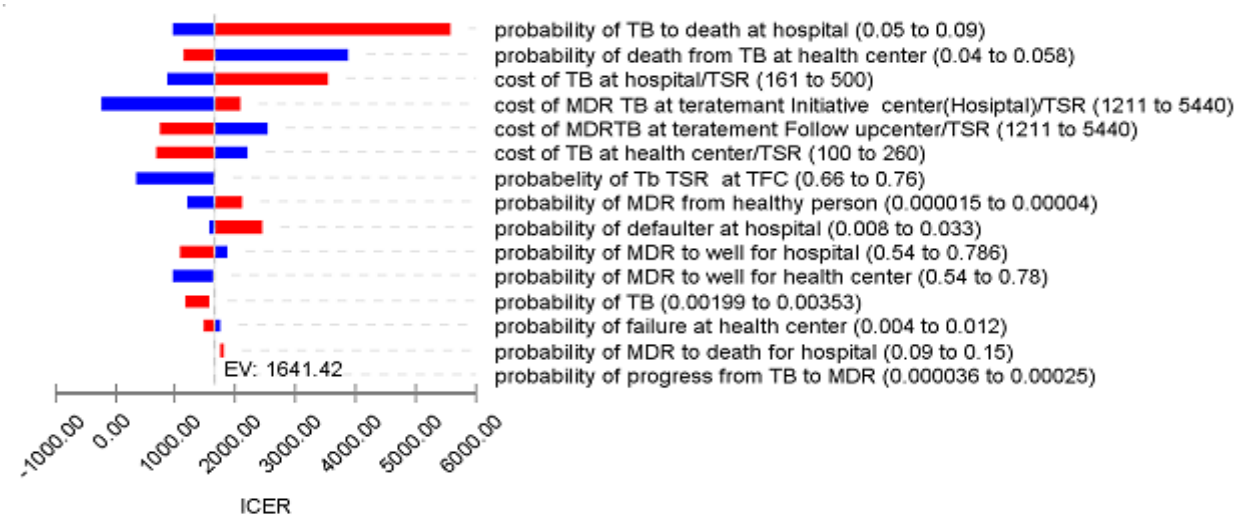


Figure 12 Tornado Diagram-ICER (TIC vs. TFC) per DALYs averted

It also compares how much patients are Willing To Pay (WTP) for an additional unit of DALY averted to determine whether TIC or TFC is cost-effective. The lower the value of ICER, the more cost-effective is the intervention [6]. From the sensitivity analysis (tornado) two variables, namely, the probability of TB treatment success at TFC and the probability of TB death at TIC are found to be sensitive (Figure 13 and 14).

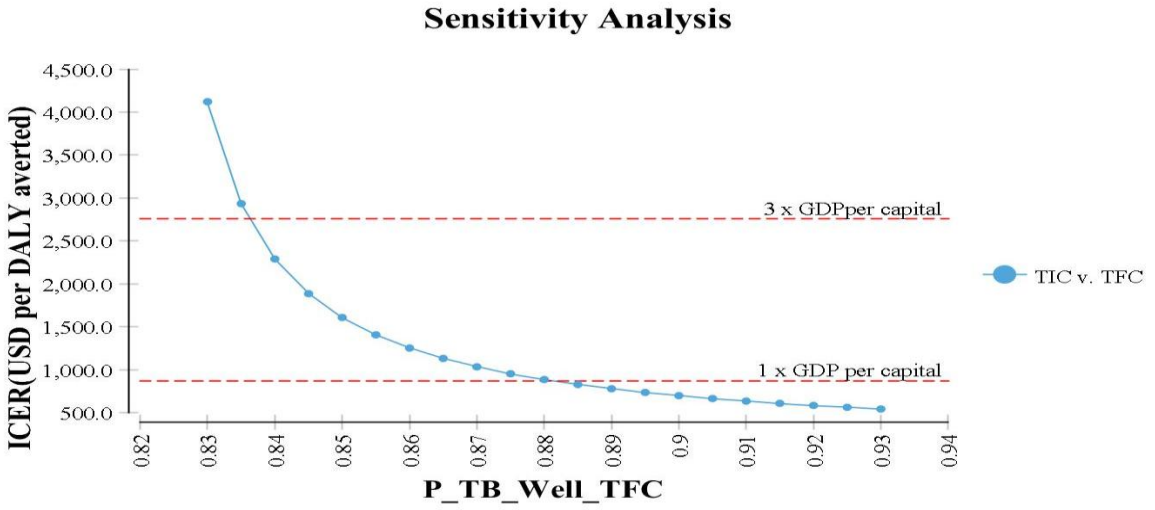


Figure 13 Probability of TB well (TSR)at TFC (health center)

The one way sensitivity result in figure 13 show that TFC (health center) had very cost effective for the treatment TB at the TSR of 88%to 94% if WTP threshold is define one times GDP per capital per DALY averted. With 3 times GDP per capital WTP threshold cost effective for treatment TB at TFC it had 84% treatment success rate.

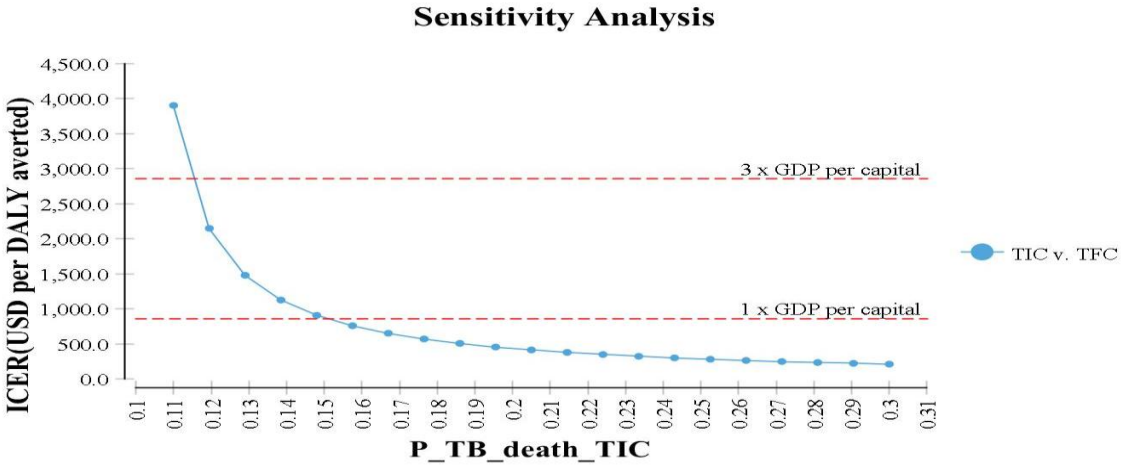


Figure 14 Probability of TB death at TIC (hospital)

The one way sensitivity analysis (Figure 14) shows that the probability of TB death averted at TIC (hospital) 15% to 30% if WTP threshold is define one times GDP per capital. With 3 times GDP per capital WTP we averted 12% TB death at TIC (hospital).

5.5.2 Probabilistic Sensitivity Analysis (PSA)

As the Figure 15 shows both facilities are cost effective to treatment MDR-TB, But at TFC is relatively cost effective than treatment at TIC. The treatment at TFC is chosen by the model TFC with $15 lower cost. The model revealed that at WTP of one GDP per capital for the MDR-TB treatment as cost effective. However, the MDR-TB treatment at TIC is effective at higher cost, and the values are not still dominated by the TFC. With regards to these findings TFC is considered to be cost effective. Because, according to the recommendation by WHO-CHOICE in choosing cost effective interventions, states that, the cost per DALY averted at less than 3 times the national annual Gross Domestic Product (GDP) per capita is considered effective, and the costs less than one national annual GDP per capita is considered to be highly effective[58].

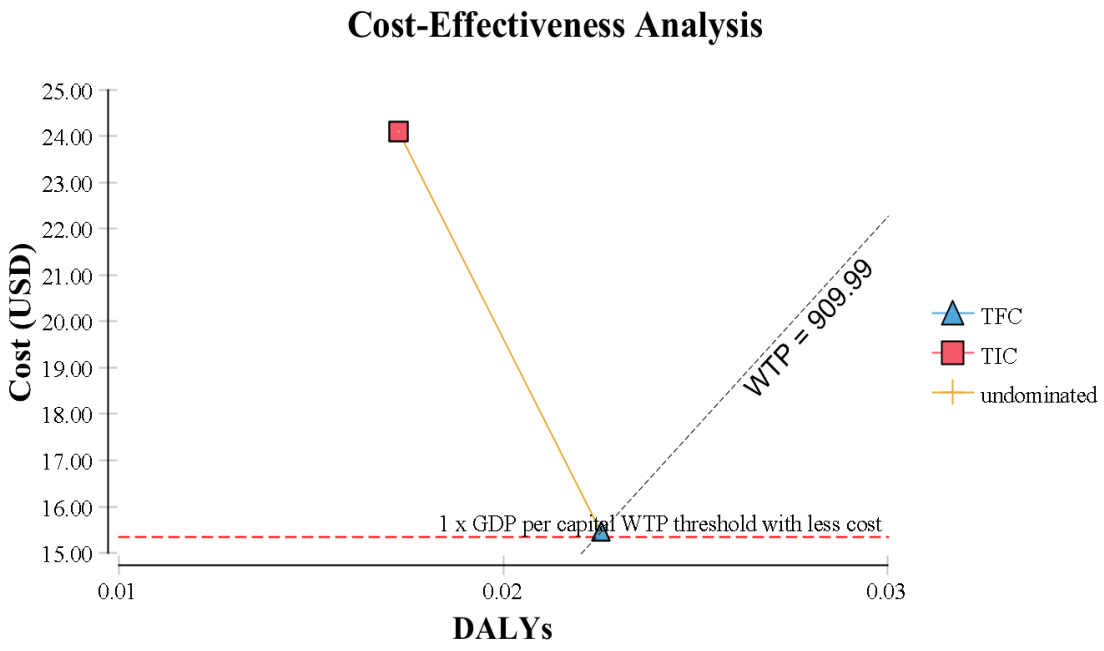


Figure 15 Cost-effectiveness analysis(Change)

The incremental cost-effectiveness ratio (ICER) USD 1641 per DALYs averted implying both TIC and TFC can be used in the treatment of MDR-TB, though as show in Table 19 TFC is more cost effective in less cost but not great differences in DALYs.

Table 2 Cost-effectiveness Ratio per DALYs averted all referencing common baseline

Strategy	Cost (USD)	Incremental Cost	Eff. (DALYs)	Incremental Eff	Incremental C/E
TFC	15.448	-	0.023	-	-
TIC	24.096	8.648	0.017	0.005	1641

5.5.3 Cost-effectiveness scattered plot

The scatter plots in Figure 16 present for comparisons between MDR-TB treatment options (TIC and TFC) and shows that TFC has lower cost than TIC not great variation in DALYs.

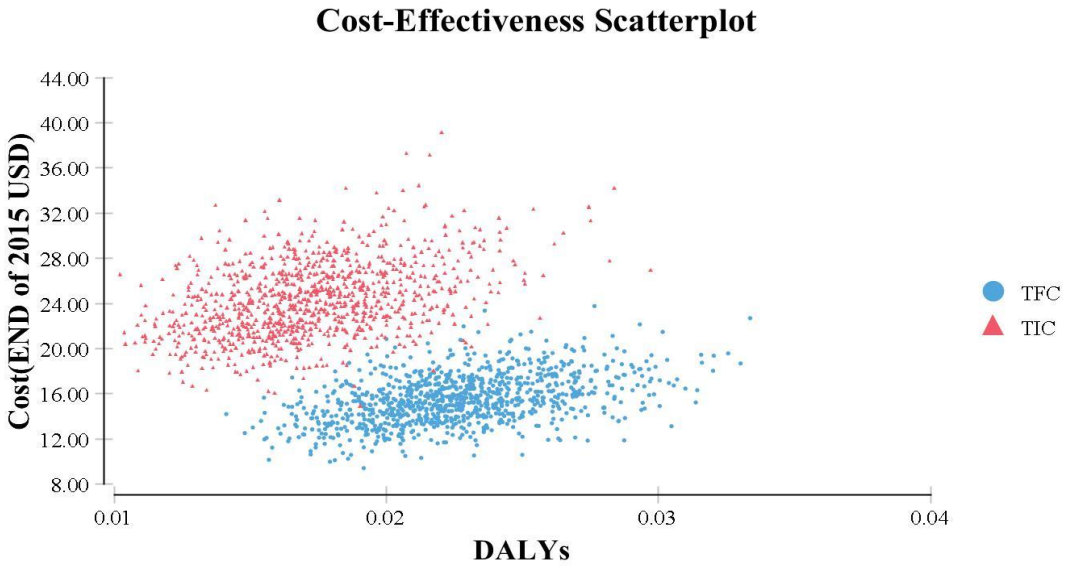


Figure 16 Cost-effectiveness scatter plot per DALYs for MDR-TB treatment (1000) Monte Carlo Simulations

5.5.4 Cost-effectiveness acceptability curve

The graph plots a range of cost-effectiveness thresholds (Willingness to Pay per DALY averted) the acceptability curve in the Figure 17 shows for MDR-TB treatment TIC being cost-effective option was less than 20% at a willingness to pay threshold of one GDP per DALY averted while at willingness to pay threshold of three GDP per DALY averted the probability of MDR-TB treatment at TIC being cost-effective is nearly at 65%.

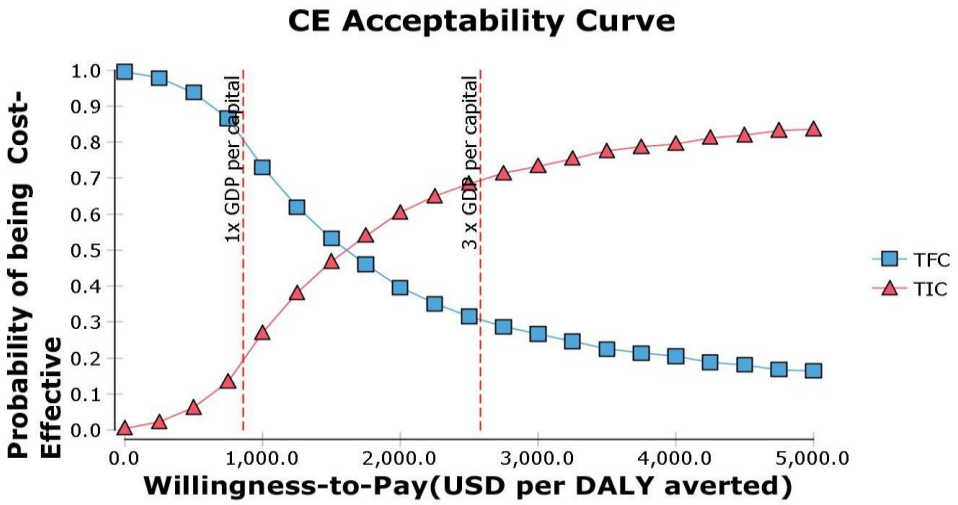


Figure 17 Cost-effectiveness Acceptability curve

Chapter VI: Discussion

The aim of this study was to compare the cost, and cost-effectiveness of MDR-TB treatment at TIC (Treatment Initiation Center) versus TFC (Treatment Follow-up Center) using full economic evaluation of markov model. To provide relevant cost and cost-effectiveness information for the economic evaluation a based on costing method were employed. The primary cost data from TIC and TFC using markov modelling. This study is the first of its kind in Ethiopia, since there is no published cost-effectiveness study.

The study found that treatment of MDR-TB at TIC level is costly than at TFC level , yet, MDR-TB treatment provision was cost-effectiveness both at TIC and TFC at ICER of USD1641per DALY averted which is less than 3 times GDP per capital for Ethiopia.

6.1 Demographic characteristics of study participants MDR-TB Patients

Study found that 175 (72%) of participants were aged between 15-34 which shows the diseases is highly affecting youth, working group of the population. The previous studies also depict that MDR-TB is a major public health problem and mainly affects economically productive age group of the population and male [10].

The HIV infection, on the other hand, of the study participants identified as 56 (23%) are HIV positive. According to (WHO) reports for MDR-TB with HIV was a big public health problem in low resource countries including Ethiopia because it is more difficult and costly to cure [56]. In addition to this most of the patents treated in the study area are from low economic status.

The family size also has a great effect on the burden of MDR- TB treatment, i.e., as the size of the family gets bigger there is a higher probability of being MDR-TB patient. This shows relationship between MDR–TB and family income or the net income of the patients implying that, most of the family income comes from the patient, which is expected to be stopped when patient got sick. There is an implication for a high disease burden in economically poor family than those living in economically well families. This was true in many researches that Tb burden higher in economically poor family [6, 8].

6.2 Patient side and health care provider cost of MDR-TB treatment at TIC

In this study patient cost for MDR-TB treatment was higher than TFC especially during intensive phase this might be related to the longer distance they should travel to reach the TIC centers; when they travel from far distance they may consume more food and additional charge for transportation and other unexpected expenses. Besides this still, sizable numbers of patients are treated at the TIC centres, though as per the guideline TIC centres are structured to admit only the difficult cases and those with serious complications, however patients with no complications and no serious illness are still treated at TIC.

MDR-TB treatment patient cost is varying depending on the country economic status and the implemented model of care. Compared to the previous studies patient costs of TIC is less than from South Africa and greater than Brazil, Bangladesh and Tanzania since these studies was done in different model not hospital vs. health center and the currency year of exchange rate is different at the time of the study[56]. On top of that, some countries did not include indirect cost of patient and South Africa study includes care giver cost.

The provider cost of TIC are costly compared to TFC based personnel cost, as most physicians at TIC are relatively high paid (medical practitioners in hospitals) and equipment like x-ray and chemistry machine are available and used in hospital or TIC. Because of this most MDR-TB patients refer to TIC for consultation of skilled personnel and for investigation when laboratory reagent was stock out at TFC. However, this values for this study are less than other studies in South Africa and Brazil but greater than Bangladesh and Tanzania [56].

However according to research findings the cost of MDR-TB treatment according to WHO guidelines were 61% (90 out of 149) in Estonia and 76% (76 out of 100) in Tomsk Oblast, with cost per patient treated registered to be USD 8,974 and USD 10,088 respectively, which are close to the costs calculated in this study[25]. This study prove that mean cost for MDR-TB treatment per patient at TIC was USD 8416.17 for HIV negative not admitted patient and more than12% higher if patient was admitted .In addition to that the cost will increase at10% if the patient was HIV positive because other investigation like CD4 and Viral load test and ART drug would be the main cause of cost escalating of HIV positive patient.

6.3 Patient side and health care provider cost of MDR-TB treatment at TFC

This study proved that the MDR-TB treatment cost of TFC was 21% lower than TIC. This result as discussed above TFC is located near the locality of the patients, where, they pay less to get there as compared to the TIC. It is also found that MDR-TB drug cost and investigation cost are almost similar to both for TIC and TFC, since this facility may be donated by similar donor. From patients perspective follow-up transport cost is higher at TFC than TIC because during MDR-TB treatment TFC patient are referred to TIC for sputum culture, other investigation and physician consultation. Other study showed that the health care provision cost is low in South Africa, Brazil, Bangladesh and more in Tanzania [30, 42].

However the MDR-TB treatment per patient cost at TIC and TFC is less than WHO estimation of MDR-TB cost per patient for Ethiopia in 2015 USD 10,000 [53]. This result might be related to omission of some costs like laboratory sample transport cost, culture media, personal and building cost from TIC and TFC, because the investigation is done at Ethiopian Public Health Institute (EPHI), which is far from the selected sample hospitals and not accessible for data collections. Beside that of direct and indirect cost of care giver, cost of patient before and after MDR-TB treatment and training cost are exclusion.

6.4 The cost-effectiveness of the provision of MDR-TB treatment at TIC and TFC

The study showed that MDR-TB treatment is cost-effective at TIC and TFC at ICER value of USD 1641 per DALY averted which is less than 3 times GDP per capital for Ethiopia. Whereas the ICER calculated in this study is nearest to USD 1,472 in Bangladesh and greater than Estonia and Tomsk Oblast 598 (960 IUSD), and USD 745 USD (1059 IUSD) respectively [25].

The reasons for higher ICER in this study may be related to the costs of laboratory reagent, and MDR drug cost. In addition the study was conducted in 2011 which makes the currency exchange rate may cause bigger difference for the study, that why funding budget is increasing as time progress. This can be explained by the amount financed by the Global Plan to Stop TB, which was estimated that financing the MDR-TB control program globally in 2015 would cost US$16 billion, about 16 times higher than what it was in 2010[58].

This ICER is less likely to be greater than other diseases like malaria prevention program in Ethiopia with an ICER of USD 1403[70]. The reasons for higher ICER in this study are that MDR-TB treatment success rate needs long duration with costly drugs. Besides, the loss of indirect (productivity cost) cost for an average time of 7-month which is a long duration and loss of indirect cost which is rising in all health care centers and the patient side cost may results in the higher incremental cost-effectiveness ratios.

This study also found that TFC (health center) is a very cost effective option for the treatment of MDR-TB at the treatment success rate of 88% to 94% if WTP threshold is defined as one GDP per capital per DALY averted. With 3 GDP per capital at WTP threshold TB treating at TFC was cost effective nearly at 84% treatment success rates. While TIC was being cost-effective option at less than 10% of WTP threshold of one GDP per DALY averted while at WTP threshold of 3GDP per DALY averted the probability of MDR-TB treatment at TIC being cost-effective is nearly 65%.The one way sensitivity analysis at (Figure 14) shows that probability of TB death averted at TIC (hospital) ranges from 15% to 30% if WTP threshold is defined as one GDP per capital. With 3 GDP per capital WTP it was possible to avert 12% TB death at TIC (hospital). This cost-effectiveness analysis can be taken as vital support to inform a policy choice in the scaling up or not MDR-TB treatment at TFC and TIC centers, while ICER value of USD 1641 per DALY averted which is less than 3 times GDP per capital for Ethiopia.

Chapter VII: Limitation and strength

7.1 Limitation

This study is based on a costing model to compare the cost, and the cost-effectiveness of MDR-TB treatment at TIC versus at TFC using a full economic evaluation of markov model. However, the study encounters a number of limitations. Some of the limitations are:

- No published study in cost-effectiveness analysis of MDR-TB treatment in Ethiopia to compare the results found, besides sample size determination uses unsuitable sampling process which could bring in selection bias. However, to pass this challenge adequate sample size was taken based on the available study population.
- Some of the cost items might be changed within a short period (e.g. reagent and drug) and few cost items estimated based on pharmaceuticals found and supply agency (PFSA).
- Some direct and indirect cost of the care givers, training cost did not evaluate and also the patient cost before and after the MDR-TB treatment exclude, this action might underestimate the actual unit cost of MDR-TB treatment but no considerable suggestion on cost-effectiveness estimations.

7.2 Strength

This study is the first of its kind in Ethiopia. The strength of the study goes with its limitation in that the un availability of cost data, and tried to alleviate this challenge using scientific references to make the study as springboard for future studies and fulfils data requirement/gap for costs arising from time lost in seeking care. Furthermore, the following can be considered as strength.

- Employ the societal perspective cost analysis.
- Use full economic evaluation of markov model.
- Provide relevant cost and effectiveness information for the economic evaluation using costing method
- Analyze the primary cost data for MDR-TB treatment from TIC and TFC using markov modeling.

Chapter VIII: Conclusion and recommendation

8.1 Conclusion

Diseases is highly affecting youth, working group of the population (72%) of participants were aged between15-34. From the study participants 56 (23%) are HIV positive. The family size also has a great effect on the burden of MDR- TB treatment, i.e., as the size of the family gets bigger there is a higher probability of being MDR-TB patient.

The MDR-TB treatment costs is potentially high both patient and provider side especially at TIC the cost was high if the patient was HIV infection and over if patient was admitted. High awareness need to prevent TB to minimize the amount cost, because failing TB burden could add to rising employment especially youth and beside poverty.

The study also presented an evidence on the MDR-TB treatment both (TIC and TFC) are Cost-effectiveness in terms of the incremental cost-effectiveness ratio (ICER) is USD1641 per DALYs averted which is less than 3times GDP per capital per DALYs averted in Ethiopia and compare the treatment at initiation and follow up centers (TIC and TFC) centers. Study defined that TFC (health center) had very cost effective for the treatment of Tuberculosis's at the TSR of 88% to 94% if WTP threshold is define one times GDP per capital per DALY averted.

8.2 Recommendations

Recommends broaden public lessons and awareness trainings about MDR-TB at all possible public places to help the fight in stopping TB, especially for the young Ethiopian generations. This is vital, to minimize the infection risk of TB as well as the number of patients coming to treatment centers as retreatment cases, as it has been told "prevention is better than cure" The establishment of social security for MDR-TB in the form of social income insurance or disability benefits is key to balance the productivity loss to lessen sizeable deterioration of household income and increase treatment rate, as most deaths from MDR-TB are recorded from the low income patient categories.

It is also wise to recommended that as per the recommendation of the guide line majority of the MDR-TB cases to be treated at TFC centers at relatively lesser cost than that of TIC centers. In addition the MDR-TB treatment can be more cost effective by reducing the number of highly paid medical practitioners and equipment like x-ray and chemistry machine are made available at TFC. Efforts should also be done to make the MDR-TB treatment scaling up at TFC and TIC centers available at the regional and district public health directorates to be able to achieve better economic benefit as most costs are associated with the health provider perspectives.

Though, Ethiopia is one of the 30 global high burden countries of MDR TB, there is no published MDR-TB cost effective analysis in Ethiopia. So it is wise to call more researchers to perform studies in this area and publish their findings to support the high demand for published research on MDR-TB cost-effectiveness analyses.

Finally, this cost-effectiveness analysis study can be suggested as appropriate informer not only by the FMoH of Ethiopia, but also for various donor organizations for the decisions-making processes in the effort to stop TB challenge.

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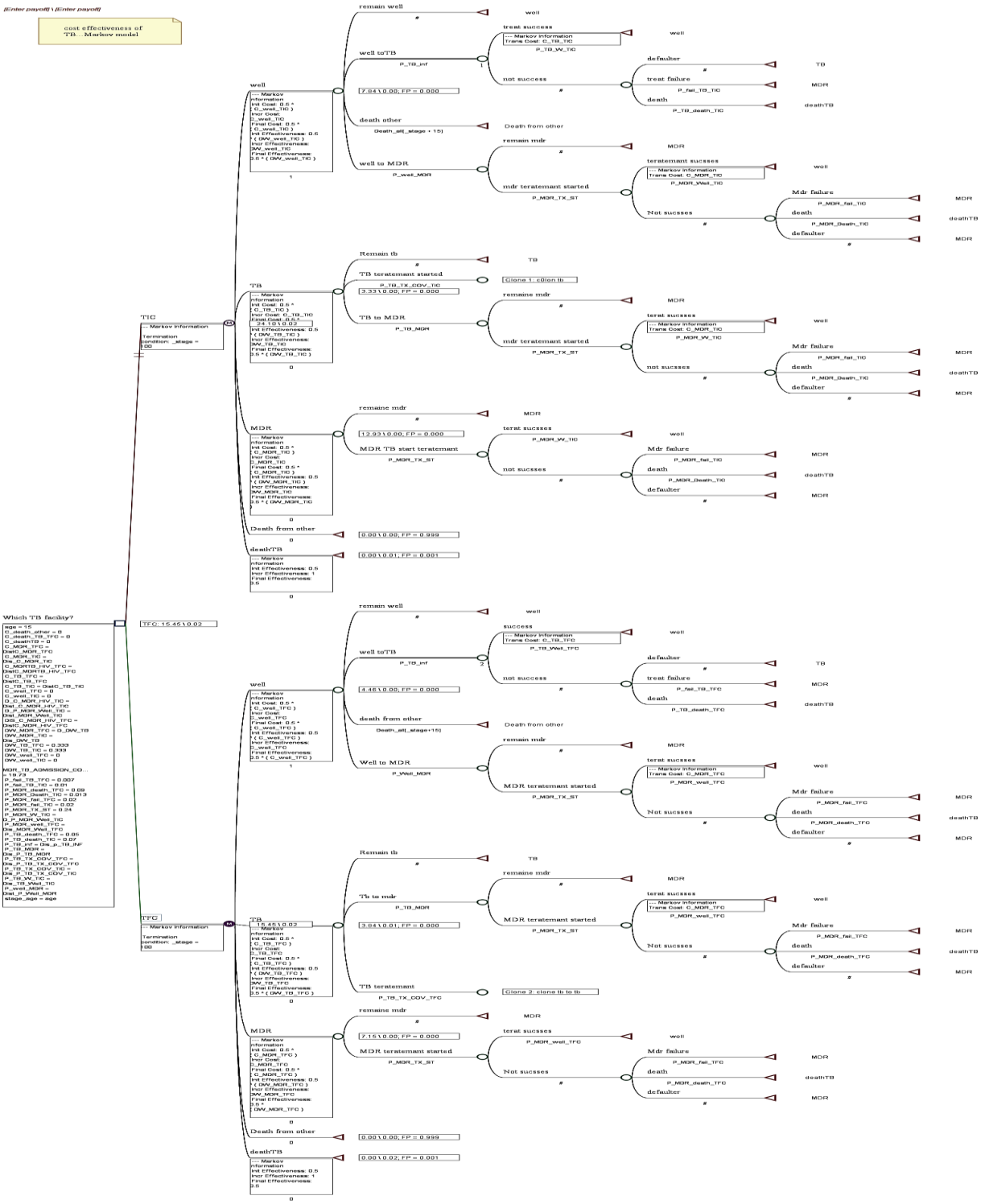
Annex 1 Researches on MDR-TB in Ethiopia

S. No.	Research Title	Year of Publication	Research Objectives	Methods	Study Findings	References
1	Prevalence of MDR-TB among Presumptive Multi Drug Resistant Tuberculosis Cases in Amhara National Regional State, Ethiopia	2014	Determination of the prevalence of MDR-TB	Cross-sectional study, Binary logistic regression analysis, P-value, odds ratio and CI Multivariate analysis for independent association of factors.	MDR-TB is a major public health problem and mainly affects economically productive age group of the population and female	[10]
2	Anti-tuberculosis drug resistance in Ethiopia: systematic review	2017	Prevalence rate of any anti-TB drug resistance, nonresistance and MDR-TB in Ethiopia	A systematic review of the literature on any resistance, mono resistance and MDR-TB was conducted.	TB remains a serious public health problem in Ethiopia. Rapid and advanced diagnostic tools should be introduced, along with strong treatment and follow-up strategies.	[48]
3	Molecular Detection of MDR-TB and associated Risk-Factors among Smear-Positive Pulmonary TB Patients in Jigjiga Town, Somali Region of Ethiopia	2015 Unpublished	Rapid identification of MDR-TB and determine Risk-factors related to DR-TB, among smear-positive PTB patients.	Cross sectional survey design was employed in this study.	Among the total 67 new cases observed, 3 (4.5%) showed MDR-TB. Of the total 31cases characterized previously treated, 7(22.6%) were MDR-TB cases	[34]
4	Multidrug-resistant tuberculosis in Ethiopia: efforts to expand diagnostic services, treatment and care	2014	Description of the current status of MDR-TB and factors that increase the risk of this infection.	Systematic review of the literature on MDR-TB in Ethiopia	Previous exposure of anti-TB treatment increased the risk of MDR-TB in Ethiopia. Strengthening early case detection and proper treatment of drug susceptible TB	[13]
5	Drug resistance and population structure of M.tuberculosis isolates from prisons and communities in Ethiopia	2016	Population structure and MDR-TB pattern in Ethiopian prisons and communities	A comparative cross sectional study on 126 MTBC strains isolated from prisons and communities in SW & SE Ethiopia.	The MDR-TB prevalence of the community was 2.27% whereas that of prisons was 9.52%. The highest mono resistance was seen against streptomycin (15.89%).	[3]
6	Multidrug-resistant Mycobacterium tuberculosis and associated risk factors in Oromia Region of Ethiopia	2015	Determination of risk factors for tuberculosis (TB) caused by MDR-TB	Case–control study from cases with suspected MDR-TB. Logistic regression analysis and outcome variables wit odds ratio (OR) together with 95% CI	MDR-TB Is high among the suspected cases. If TB is suspected, it is alerting to screen the patients for MDR-TB	[21]
7	Multidrug resistant tuberculosis in Ethiopian settings and its association with previous history of anti-tuberculosis treatment: a systematic review and meta-analysis	2017	Pooled prevalence of MDR-TB among newly diagnosed and previously treated TB cases, and measure the association between MDR-TB and previous anti-TB drugs treatment	Associations between previous TB treatment and MDR-MTB infection were examined through subgroup analyses stratified by new and previously treated patients.	The overall prevalence of MDR-TB among newly diagnosed and previously treated TB patients to be 2% (95% CI 1% - 2%) and 15% (95% CI 12% - 17%), respectively. The past 10 years (2006-2014) overall MDR-TB prevalence show stable time trend	[44]

Annex 2 Cost-effectiveness

S. No.	Research Title	Year of Publication	Research Objectives	Methods	Study Findings	References
1	Cost and Cost-Effectiveness of Smear-Positive Tuberculosis Treatment by Health Extension Workers in Southern Ethiopia	2010	Comparison of the cost and effectiveness of HEWs in health posts and general health workers at health facility along a community-randomized trial	Community Randomized Trial to measure of effectiveness based on sputum smear results at the end of the months of treatment	Community-based treatment by HEWs costs only 39% of general health workers for similar outcomes. Involving HEWs in TB treatment is a cost effective treatment alternative to health service, to patients and the family	[10]
2	Assessment of cost of tuberculosis to patients and their families: a cross-sectional study at Addet Health Center, Yilmana Densa District, Amhara National Regional State.	2010	Estimation of the cost of TB to and their families in a rural district health center	Cross-sectional study, cost of TB and their families before and after the diagnosis	The mean direct cost and indirect cost of tuberculosis to and their families were 1078.00 Birr and 2080.43 Birr, respectively, at the time of study. The mean total cost of tuberculosis to and their families was 3159.23 Birr.	[64]
3	Costs to Health Services and the Patient of Treating Tuberculosis: A Systematic Literature Review	2015	Review of papers assessing provider-incurred as well as patient-incurred costs of treating both drug susceptible (DS) and (MDR)-TB.	Five databases 1990- 2015 full-text papers with primary DS-TB & MDR-TB treatment Cost and Cost-Effectiveness Analysis searched for cost and economic evaluation	Cost data for MDR-TB treatment are limited, and costs of DS-TB treatment from all regions of the world	[66]
4	Cost-Effectiveness Analysis of Introduction of Rapid, Alternative Methods to Identify Multidrug-Resistant Tuberculosis in Middle-Income Countries	2008	Determination of the Cost-Effectiveness Analysis of Introduction of Rapid Drug susceptibility testing (DST)	Direct phage-replication assay, direct amplification & reverse hybrid. Indirect colorimetric and direct proportion method was compared with indirect proportion method.	Alternative DST methods were found to be cost-effective, compared with other health care interventions. DST methods also generate substantial cost savings in settings of high prevalence of MDR-TB.	[9]
5	Cost implications of delays to tuberculosis diagnosis among pulmonary tuberculosis patients in Ethiopia	2010	Investigation of costs of TB diagnosis incurred by patients, escorts and the public health system in 10 districts of Ethiopia.	Costs incurred by patients, escorts and the public health system were quantified through patient interview and review of medical records.	The costs of TB diagnosis incurred by patients and escorts represent a significant portion of their monthly income. The costs arising from time lost in seeking care comprised a major portion of the total cost of diagnosis, and may worsen the economic position of patients and their families.	[28]

Annex 3 Markov cohort decision tree for cost effective analysis's MDR-TB treatment



Annex 4 Questionnaire /English

ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH /HEALTH ECONOMICS

This questionnaire is developed as part of a study on the Cost-effectiveness analysis of multi drug resistance Tuberculosis treatment at initiative and follow up centers in Addis Ababa. Its aim is to collect and use the information in order look into the Cost-effectiveness of MDR-TB treatment in hospitals (TIC) and health centers (TFC) so as to avoid the financial risk results from illness-related expenditures and identify the most cost effective intervention. Therefore, your cooperation in answering each question as thoughtfully and frankly as possible is highly required. All your responses are summarized and processed in analytical form so that you are not identified by name.

Would you be willing to participate?"

Yes_____ (continue) No_____ (Thank and stop)

Questionnaire code_____ Name of the health facility: _____

Interviewer name _____ signature _____

Checked by: Name of supervisor/investigator _____ Signature_____

Date of interview _____

Senait Alemayehu

Thank you.

ALL RESPONSES WILL BE KEPT CONFIDENTIAL. DATA WILL BE USED

FOR THE RESEARCH PURPOSE

Part I: Patient information to be obtained from MDR-TB treatment card

A. Socio-Demographic Data

Question	Answer categories (circle appropriate number or fill answer on the answer line)	Action for interviewer The questions in part 1 are not part of the interview and should be pre-filled before the interview	Variable name (This column does not require translation nor adaptation)
1. Geographical Location of the Patient	Region___Sub City ------- Woreda--------		
2. Age group (years).	____years of age		
3. Sex	1. Male_____2. Female_____		
4. Marital states	1. Married ___ 2. single ___ 2. Widowed ___ 4. Divorces____		
5. Level of Education	1. Illiterate (can't read and write) 2. Only can read and write 3. Primary Education 4. Secondary 5. College/Above secondary		
6. Main occupation	1. Farmer 2. Government employee 3. Self Employed 4. School student 5. Daily laborer 6. Unemployed 7. Retiree 8. Other (specify)		
7. If you were in paid work, how much do you estimate your average net wage or average net revenue from labour related activities (labour income), per month was before you contracted MDR TB?	1. (Net Wage)_____Birr 2. (Net Labour Income)_ _____Birr		
8. Number of people living in your house hold	_____Numbers		
9. How many are employed	_____Numbers		
10. What is average monthly income of the household?	1_____ birr 2. I don't know 3. refuse to tell		

B. Clinical record and histories given by the study participants

Question	Answer categories ….	Action for interviewer….	Variable name….
11. Site of MDR-TB	1. Extra pulmonary 2. Pulmonary 3. No information		
12. Treatment regimen prescribed	6. Standardized Regimen 7. Individualized Regime		
13. Total duration of planned treatment from start	1. _____months intensive 2. _____months continuation		
14. Treatment category	1. MDR, new (initial MDR) 2. MDR, after relapse 3. MDR, after loss to follow-up 4. MDR after failure 5. Other, specify: ……		
15. who did provider/supporter MDR-TB drug	1. TIC 2. TFC 3.Other_____		
16. HIV status according to patient card	1. Positive 2. Negative 3. Not Tested 4. Unknown		
17. Treatment outcomes	1. Cured 3. Treatment Completed 2. Default 4. Treatment Failure 5. Death		

C. Direct Cost (Medical, From Patients Card)

I. Patients' Investigation Costs (From Patients Card)and card

S. No.	Description of Investigation Type	Units* Cost per patient	No. of times? Per stay	Type of Treatment Center				Total cost
				Treatment Initiation Center(TIC)		**Treatment Follow-up Center (TFC)**		
				Intensive	**Continuation**	**Intensive**	**Continuation**	
1	Sputum smear							
2	Gene Expert							
3	x-ray investigation							
4	Urine							
5	CBC							
6	Cretonne							
7	Electrolyte							
8	ECG							
9	Blood glucose							
10	TSH							
11	HbsAg							
12	HIV Test							
13	Pregnancy test							
14	Psychiatry consultation							
15	SGOT							
16	Cards							
17	Others							
18								
19								
20								

II. Drug Costs (From Patients Card)

S. No.	Description of Treatment Type	Units* Cost per dose per patient	Total number of dose Per stay	Type of Treatment Center				Total cost
				Treatment Initiation Center(TIC)		Treatment Follow-up Center (TFC)		
				Intensive	Continuation	Intensive	Continuation	
1	Pirazinamide 400 mg							
2	Capromacyne							
3	Kanamycin 1 g vial							
4	Levofloxacin 250 mg							
5	Protinamyde 250 mg							
6	Cycloserin 250 mg							
7	Pyridoxin 10 mg							
8	Moxyfloxacine							
9	PAS							
10	N95							
11	Syringe with Needle							
12	Glove							
13	Others							
14								
15								
16								
17								
18								

Part II: Information collected from Patient Interview

A. Direct non medical Cost

Question	Answer categories ….	Action for interviewer….	Variable name….
1. Patient Costs for food and transpiration during DOT and Follow up visit (Non medical- Direct)			
18. What Transport modality have you used to travel from home to the clinic (put it in code), during DOT visit?	Code;- 1=Walked 2=Cycled 3=Bus 4=Minibus 5=Taxi 6=Private car 7=Other		
19. How long is the distance from your home to the health faculty the last DOT?	_____Km/m		
20. What was the cost of transport (return) for the last DOT visit, including parking costs, in total?	_____Birr		
21. How much did you spend on food and drinks for the last DOT visit (on the road, while waiting, lunch etc.), in total for you	_____Birr		
22. What accommodation cost did you when you pick up drugs last picked	_____Birr		
23. Do you buy any nutritional supplements outside your regular diet because of the MDR-TB illness, for example vitamins, meat, energy drinks or fruits as recommended by health care staff?	1. Yes _____2. No_____		
24. If yes, how much did you spend on nutritional supplements in one month approximately?	_____Birr		
25. What Transport modality have you used to travel from home to the clinic (put it in code) for last follow –up visit?	Code;- 1=Walked 2=Cycled 3=Bus 4=Minibus 5=Taxi 6=Private car 7=Other		
26. How long is the distance from your home to the health faculty last follow up visit?	_____Km/m		
27. What was the cost of transport (return) for the last follow –up visit including parking costs	_____Birr		
28. How much did you spend on food and drinks for the last follow –up visit (on the road, while waiting, lunch etc.), in total for you	_____Birr		
29. What accommodation cost pay during your last follow-up medical outpatient visit?	Other fees ----Birr		
30. Do you buy any nutritional supplements outside your regular diet because of the MDR-TB illness, for example vitamins, meat, energy drinks or fruits as recommended by health care staff?	1. Yes _____ 2. No_____		
31. If yes, how much did you spend on nutritional supplements in one month approximately?	_____Birr		
32. What other cost did you spend during your treatment follow up?	Others _____Birr		

Question	Answer categories ….	Action for interviewer….	Variable name….
2. Hospitalization Cost			
33. Have you been previously hospitalized during your current MDR-TB treatment phase and because of MDR TB? If yes, how many times	1. Yes 2. No _____Times	If yes, the cost data collected applies row of the table question	
34. About how much money did you spend for each of these hospitalizations	See the card & fill Type of hospital: _____ Number of days hospitalized:_____ Includes outpatient visits as well as hospitalizations. Should be filled in chronological order Day charges: total fees ____.see list		

B. Indirect Costs

Question	Answer categories ….	Action for interviewer….	Variable name….
35. How many times a week picked up drugs during DOT visit?	_____Number	maximum will be 7 times a week	
36. How long did during DOT visit take, including travel time and waiting time (total turnaround time)?	_____Minutes		
37. How many MDR TB-related medical follow-up visits have you had so far during this treatment phase (to see the doctor or nurse, have follow-up tests, etc.)?	_____Times		
38. How long did the last follow-up visit to pick up drugs take, including travel time and waiting time (total turnaround time)	(Month)___ Hour _____ Minutes _____		
39. Approximately how many working days of have you lost due to your MDR-TB illness Overall	_____Days _____ Minutes		

Part III. Health care Providers Cost

A. Interview for (get information case team coordinator and finance) the health professional or directly to the service giver

Name of health facility _____ sub city _____

Respondent name_____ position_____

Unit/department_____ was respondent interviewed Y / N

I. Building (get information from team coordinator and by observation

S. No.	Service given	No of room at the clinic	No of room used for MDR-TB treatment	Was there joint service at the room, specify	Average MDR-TB pt coming to the room per day	Room space (in square meter/ estimations)	Average Rental value of the space	Remark
1								
2								
3								
4								

II. Provider's cost

S. No.	Type of Provider	Average MDR TB patient seen per Month	Registration	Average time spent for Provide per MDR-TB patient for the following activity (Days: Hours:)per Month									Other patient Average seen per Month	Average Monthly salary of health professionals
				Counseling	Drug Provides	Other lab investigation	Sputum test	Reporting and hx taking	Gene expert	X-ray investigation	Other procedures	Average time spent /Month		
1	Laboratory													
2	**Pharmacy**													
3	**General practitioner (MD)**													
4	**Internist**													
5	**Health officers**													
6	**Nurses**													
7	**Radiologist**													

8	**Other specify**													

B. Equipment used for provision MDR-TB treatment (these questions are to pharmacy case tem or laboratory case tem) or Administration staff.

S. No.	Types of Equipment	Numbers	Birr of purchase	Year of purchase	Month /year in operation	Depletion(cost) Birr	Days/month in operation	No of average MDR-TB pt served per month	No of average other pt served per month	Remark
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										

C. Supply and reagent used for the provision of MDR-TB treatment per month questions are to (pharmacy or laboratory case team) or representative person

S. No.	In put item /supply used	Unit of Measurement	Unit Cost per pt	Total Cost	Average MDR-TB pt /used per month	Other pt used/ per month	Total MDR-TB pt cost/year	Annual usage cost	Remark
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Part IV: Summary of patients and Health care provider costs during Intensive and Continuation phase

Indirect Cost patent (A)						Health care provider cost (Total per visit)(B)				Direct Non-medical , cost patient (Total per visit) (C)				Total patient (A+C) (Gross)	Total Indirect cost		Total Direct and Indirect cost (A+B+C) (Net)
Visit of month	Distance from your home to the clinic (total turnaround time	Travel time Days: Hours:	Time spent for treatment,	Time spent for investigation	Hospitalizations stay day	Monthly charges (for hospitalizations only)- A1	Capital cost A2	Investigation, supply and procedure A3	Treatment (for MDR and other complication…)	Transportation to health facility B1	Food and lodging	Other, including accommodation B3	Nonmedical payments (Total) ΣB1-3	Total cost Per Month	No of days lost in a Months	average net waged in	
1st																	
2nd																	
3rd																	
4th																	
5th																	
6th																	
7th																	
8th																	
9th																	
10th																	

Annex 5 Questionnaire /Amharic

በአዲስ አበባ ዩኒቨርሲቲ

የጤና ሳይንስ ኮሌጅ

የህብረተሰብ ጤና ህክምና ትምህርት ክፍል

ይህ መጠይቅ የተዘጋጀው መድሀኒት በተላመደ ቲቢ በሽታ ላይ “the Cost-effectiveness analysis of multi drug resistance Tuberculosis treatment at initiative and follow up centers in Addis Ababa” በሚል ርዕስ ለሚደረገው ጥናት መረጃ ለመሰብሰብ ነው። ጥናቱ የሚያተኩረው ህክምናውን በማስጀመሪያ (TIC) እና የክትትል ህክምና መስጫ (TFC) ቦታዎች ላይ ነው።

ስለሆነም ከእርስዎ የምንጠብቀው ነገር ቢኖር መረጃውን የምንጠቀመው ለጥናቱ ብቻ መሆኑንን ተረድተው ቃለመጠይቅ ለማድረግ ወደ እርስዎ ለሚመጣው ሰው ለተዘጋጀጁት መጠየቆች ግልጽ የሆነ መልስ እንዲሰጡንና የሚያውቁትን እንዲገልጹልን ፍቃደኛ መሆንዎን ነው። በዚህ ጥናት መሳተፍ በፈቃደኝነት ላይ የተመሰረት ነው። ስሞትን ቃለመጠየቅ በሚያደርጉበት ፎርም ወይም ወረቀት አይጻፍም ። ስለዚህ በዚህ ጥናት ለመሳተፍ ፍቃደኛ ነዎት?

አዎ_____ (ቀጥል) የለም_____ (አመስግነህ ተሰናበት)

የመጠይቁ ኮድ_____ የህክምና መስጫ ስም: _____

ቃለመጠየቅ አድራጊው _____ ፊርማ _____

የጥናቱ ሃላፊ _____ ፊርማ _____

ቃለ መጠይቁ የተደረገበት ቀን _____

ሰናይት አለማየሁ
አመሰግናለሁ

በጥናቱ ስለማንነትዎ የሚገልፅ መረጃ ከእርስዎ ፈቀድ ዉጭ ለማንም የማይሰጥ መሆኑን እንገልፃለን

ክፍል 1: የታካሚውን ማኅበራዊ ሁኔታ (ከታካሚው ካርድ ላይ)

ሀ. የታካሚውን ማኅበራዊ ሁኔታ

የታካሚውን ሁኔታ	እንደመልሱ አይነት በተሰጠው ቦታ ላይ መልስህን አስቀምጥ	ይህ ቦታ ቃለ መጠይቅ አቅራቢውን የሚረዱ	የምላሹ አይነ ት
40. የበሽተኛው አድራሻ	ክልል ___ ክ/ከ. ___ ወረዳ ___		
41. ዕድሜ	___ ዓመት		
42. ፆታ	1.ወንድ ___ 2.ሴት ___		
43. የጋብቻ ሁኔታ	3. ያገባ ___ 2. ያላገባ ___ 4. የሞተበት ___ 4. የፈታ____		
44. የትምህርት ደረጃ	8. ያልተማረ (ማንበብና መጻፍ የማይችል) ___ 9. ማንበብና መጻፍ ብቻ የሚይችል ___ 10. የመጀመሪያ ደረጃ የተማረ ___ 11. ሁለተኛ ደረጃ የተማረ ___ 12. ኮሌጅ እና ከዚያ በላይ ___		
45. የስራ ሁኔታ	8. ግብርና ___ 9. የመንግስት ሰራተኛ ___ 10. የግል ስራ ___ 11. ተማሪ ___ 12. የቀን ሰራተኛ ___ 13. ስራ አጥ ___ 14. ጡረተኛ ___ 15. ሌላ ከለ ይገለጽ ___		
46. ከደሞዝ ወይም ከሌላ ብር የሚከፈልህ ከሆነ በአማካይ በወር ስንት ብር ይከፈልሀል የተለማመደ ቲቢ በሽታ ሳይዝህ በፊት ?	1. _____ አጠቃላይ ደመወዝ በብር 2. _____ የተጣራ ክፍያ በብር		
47. ስንት ሰው በቤት ውስጥ ይኖራል ?	_____ በቁጥር		
48. ምን ያህሉ ስራ አላቸው ?	_____ በቁጥር		
49. በአማካይ የቤተሰቡ ገቢ በብር ምን ያህል ነው ?	4. _____ ብር 2. አላውቅም _____ 5. መንገር አልፈልግም _____		

ለ. ስለታካሚው የበሽታ ሁኔታና የክትትል ደረጃ (ከታካሚው ካርድ ላይ)

የታካሚውን ሁኔታ	እንደመልሱ አይነት በተሰጠው ቦታ ላይ መልስህን አስቀምጥ	ይህ ቦታ ቃለ መጠይቅ አቅራቢውን የሚረዱ	የምላሹ አይነ ት
50. በሽታው ያጠቃው ቦታ	4. ከሳንባ ውጪ__ 2.ሳንባ ውስጥ__3.ያልተገለፀ __		
51. የታዘዘለት የመድሀኒት ሁኔታ	1. ሰታንዳርድ Regimen 2. ግለሰባዊ Regime		
52. መድኃኒቱን ለመከታተል የተወሰነው ጊዜ ከመጀመሪያው ጀምሮ	3. _____ ጥብቅ ክትትል ጊዜ ላይ 4. _____ ቀጣይ ክትትል ጊዜ ላይ		
53. የበሽተኛው ሁኔታ	6. MDR, አዲስ (initial MDR) _____ 7. MDR, ያገረሸበት _____ 8. MDR, ካቋረጠ በኋላ የጀመረ _____ 9. MDR ከበሽታው ያልዳነ _____ 10. ሌላ ካለ ይገለጽ _____		
54. መድሀኒቱን ከየት ነው ዕየወሰደ ያለው	1. ማስጀመሪያ ቦታ ህክምና(TIC) _____ 2. ክትትል ቦታ ህክምና (TFC) _____ 3. ሌላ ካለ ይገለጽ_____		
55. የኤችአይቪ ሁኔታ ከበሽተኛው ካርድ ላይ	6. በሽታው የተገኘበት _____ 7. ከሽታው ነጻ _____ 8. ያልተመረመረ _____ 9. አይታወቅም _____		
56. የበሽተኛው የመጨረሻ ህክምና ውጤት	1 ከባክቴርያ ነፃ _____ 2 ህክምናውን የጨረሰ _____ 3 ህክምናውን ያቋረጠ _____ 4 ከበሽታው ያልዳነ _____ 10. የሞተ _____		

ሐ. የህክምና ወጪ

A. የላብራቶሪ ምርመራ ወጪ(ከበሽተኛው ካርድ ላይ)

ተራ ቁ.	የምርመራው አይነት	ነጠላ ዋጋ በበሽተኛ	የተመረመ ረበት ጊዜ (በቁጥር)	የህክምናው ቦታ				ጠቅላላ ዋጋ
				ህክምና ማስጀመሪያ ቦታ (TIC)		ህክምና ክትትል ቦታ (TFC)		
				ጥብቅ ክትትል ጊዜ	ቀጣይ ክትትል ገዜ	ጥብቅ ክትትል ጊዜ	ቀጣይ ክትትል ገዜ	
1	የአክታ ምርመራ							
2	የጅን ኤክሰፐርት							
3	የራጅ ምርመራ							
4	የሽንት ምርመራ							
5	አጠቃላይ የደም ምርመራ							
6	(የኩላሊት) Creatinine							
7	ኤልክትሮ ላይት ምርመራ							
8	ECG(የልብ ምርመራ)							
9	የስኳር ምርመራ							
10	የእንቅርት							
11	HbsAg(የጉበት)							
12	የኤች.አይ.ቪ							
13	የእርግዝና ምርመራ							
14	የአይምሮ ማማከር							
15	የጉበት መርመራ							
16	የካርድ ክፍያ							
17	ሌሎች							
18								
19								
20								

B. መድሐኒት የተላመደ የሳንባ በሽታ መድሀኒትና ሌሎች የመድሃኒት ወጪዎች(MDR DRUG COST) (ከበሽተኛው ካርድ ላይ)

ተራ ቁ.	የመድሀኒት አይነት	ነጠላ ዋጋ በበሽተኛ	የወሰደበት ጊዜ (በቁጥር)	የህክምናው ቦታ				ጠቅላላ ዋጋ
				ህክምና ማስጀመሪያ ቦታ (TIC)		ህክምና ክትትል ቦታ (TIC)		
				ጥብቅ ክትትል ጊዜ	ቀጣይ ክትትል ጊዜ	ጥብቅ ክትትል ጊዜ	ቀጣይ ክትትል ጊዜ	
1	ፓራዚነማየድ 400 ሚ/ግ							
2	ካፕሮማይሲን (Capromacyne)							
3	ካናማይሲን (Kanamycin) 1ግ/ብልቃጥ							
4	ሊቮፍክሲሌን (Levofloxacin) 250 ሚ/ግ							
5	ፕሮቶኖማይድ (Protinamyde) 250 ሚ/ግ							
6	ሳክሎስቶሪን (Cycloserin) 250 ሚ/ግ							
7	ፓይራዶክሴን (Pyridoxin) 10 ሚ/ግ							
8	ሜሶፍልክሳስሌን (Moxyfloxacine)							
9	ፐሰኤ(PAS)							
10	ነ95(N95)							
11	መርፊና ሲርንጅ							
12	ጓንት							
13	ሌሎች							
14								

ክፍል 2: ከበሽተኛው ጋር በሚደረግ ቃለ መጠይቅ የሚሰበሰብ መረጃ

ሀ. ቀጥተኛ የህክምና ወጪ

1. በጥብቅ ክትትል ጊዜ ለምግብና ለመድሀኒት የወጣ ወጪ (ለህክምና ያልሆነ- ቀጥተኛ ወጪ)			
57. በጥብቅ ክትትል ጊዜ ምን አይነት ትራንስፖርት ይጠቀማሉ? ከቤት ወደ ጤና ተቃም ሲመጡ	መለያ- 1=በእግር 2=በሳይክል 3=በባስ 4.ሚኒባስ 5=ታክሲ 6=የግል መኪና 7=.ሌላ ካለ ይገለጽ		
58. ርቀቱ ምን ያህል ይሆናል? ከቤቶ እስከ ጤና ተቃሙ ድረስ (ደርሶ መልስ አጠቃላይ)	_____ኪሜ / ሜ		
59. የትራንስፖርት ወጪ ምን ያክል አወጣህ(ሽ)? በጥብቅ ክትትል ጊዜ አጠቃላይ የመኪና ማቆሚያን ጨምሮ	_____ብር		
60. የምግብ እና የመጠጥ ወጪ ምን ያክል አወጣህ(ሽ)? በጥብቅ ክትትል ጊዜ ለመጨረሻ መድሀኒት ለመውሰድ ስትመጣ(ጪ)(መንገድ ላይ ስተጠብቅ(ቂ) ለምሳ ...ለመሳሰሉት)አጠቃላይ ወጪ ሰንት ነበር?	_____ብር		
61. በጥብቅ ክትትል ህክምና ግዜ ለመጨረሻ ግዜ ለማደሪያ ያወጣኸው(ሸው)ምን ያህል ነው?	_____ብር		
62. ለተመጣጠነ ምግብ ወጪ ታወጣለህ(ሽ)? ከበፊቱ ምግብ የተለየ ለምሳሌ - አትክልት ቫይታሚን ፍሩት ስጋ/ ወተት ሌሎችም በጤና ባለሙያ ሲታዘዝ	1.አዎን _____ 2.አይደለም_____		
63. አዎን ከሆነ ባለፈው ሳምነት በግምት ምን ያክል ለተመጣጠነ ምግብ ወጪ አወጣህ(ሽ) ?	_____ብር		
64. በተመላላሽ ህክምና ግዜ ምን አይነት ትራንስፖርት ይጠቀማሉ? ከቤት ወደ ጤና ተቃም ሲመጡ	መለያ- 1=በእግር 2=በሳይክል 3=በባስ 4.ሚኒባስ 5=ታክሲ 6=የግል መኪና 7=.ሌላ ካለ ይገለጽ		
65. ርቀቱ ምን ያህል ይሆናል ከቤቶ እስከ ጤና ተቃሙ? (ደርሶ መልስ አጠቃላይ)	_____ኪሜ / ሜ		
66. የትራንስፖርት ወጪ ምን ያክል አወጣህ(ሽ)? በቀጣይ በተበላሽ ህክምና ጊዜ አጠቃላይ የመኪና ማቆሚያን ጨምሮ	_____ብር		
67. የምግብ እና የመጠጥ ወጪ ምን ያክል አወጣህ(ሽ) በተመላላሽ ህክምና ጊዜ ለመጨረሻ መድሀኒት ለመውሰድ ስትመጣ(ጪ)(መንገድ ላይ ለምሳ ...ለመሳሰሉት)አጠቃላይ ወጪ ሰንት ነበር?	_____ብር		
68. በተመላላሽ ህክምና ግዜ ለመጨረሻው ግዜ ለማደሪያ ያወጣኸው(ሸው)ምን ያህል ነው?	_____ብር		
69. ለተመጣጠነ ምግብ ወጪ ታወጣለህ(ሽ)? ከበፊቱ ምግብ የተለየ ለምሳሌ - አትክልት ቫይታሚን ፍሩት ስጋ/ ወተት ሌሎችም በጤና ባለሙያ ሲታዘዝ	1. አዎን _____ 2. አይደለም_____		
70. አዎን ከሆነ ባለፈው ሳምነት በግምት ምን ያክል ለተመጣጠነ ምግብ ወጪ አወጣህ (ሽ) ?	_____ብር		
71. ከላይ ከተዘረዘሩት ወጪዎች ሌላ በተመላላላሽ ህክምና ጊዜ ምን ሌላ ወጪ አወጣህ (ሽ)?	ሌሎች _____ብር		

የታካሚውን ሁኔታ	እንደመልሱ አይነት በተሰጠው ቦታ ላይ መልስህን አስቀምጥ	ይህ ቦታ ቃለ መጠይቅ አቅራቢውን የሚረዱ	የምላሹ አይነ ት
2. በሆስፒታል ተኝቶ በመታከም የወጡ ወጪዎች			
72. መድሀኒት ለተላመደ ቲቢ በሽታ ምክንያት ሆስፒታል ተኝህ ታውቃለህ(ሽ)? አዎን ከሆነ ስንት ጊዜ	.1 አዎን----------ጊዜ 2.አይደለም	አዎን ከሆነ ወደ ሰንጠረዡ ይሂዱ	
73. ለእያንዳንዱ የሆስፒታል ህክምና ስንት ብር አወጣህ(ሽ)?	1. ከበሽተኛ ካርድ ላይ የሚሞላ 2. የሆስፒታሉ ስም: _____ 3. በሆስፒታሉ የተገለገሉበት ቀን:_____ የተኙበት ቀን____ በተመላላሽ የታከሙበት ቀን፡____ 4. የቀን ክፍያ_____ ጠቅላላ ወጪ ____		

ሐ. ቀጥተኛ ያልሆነ ወጪ

የታካሚውን ሁኔታ	እንደመልሱ አይነት በተሰጠው ቦታ ላይ መልስህን አስቀምጥ	ይህ ቦታ ቃለ መጠይቅ አቅራቢውን የሚረዱ	የምላሹ አይነት
74. በጥብቅ ክትትል ጊዜ መድሀኒት በሳምንት ስንት ጊዜ ትወስዳለህ(ሽ)?	_____በቁጥር	ከፍተኛው በሳምንት 7 ግዜ ነው፡፡	
75. በጥብቅ ክትትል ጊዜ የመጨረሻውን ጉዞ ሲያደርጉ ከቤቶ እስከ ጤና ተቋሙ ምን ያህል ሰዓት ወሰደብዎት፣ ለጉዞና ተራ ለመጠበቅ (ደርሶ መልስ አጠቃላይ)?	_____ደቂቃ		
76. ስንት ጊዜ መድሀኒት ለተላመደ ቲቢ በሽታ ለክትትል ወደ ጤና ተቋም ሄደሃል (ሻል)(በዶክተሮችወይም በነርሶች ለመታየት ለላብራቶሪ ምርመራ ለመሳሰሉት) ?	_____ጊዜ		
77. መድሀኒት ለመውሰድ ስንት ሰአት(ደቂቃ)ይፈጅብሃል(ሻል) የምትጋጋዝበት ጊዜ እና ተራ በምትጠብቅበት ጊዜ ጨምሮ(ደርሶ መልስ አጠቃላይ)	_____ሰአት_____ደቂቃ		
78. በዚህ በሽታ ህመም ምክንያት በማምት ሰንት የስራ ቀን አባክነሀል(አጥተሀላል)(ሻል) አጠቃላይ	_____ቀን (ወር) አመት		

ክፍል 3፡ የጤና ተቀሙ ወጪ ለመገመት የተዘጋጀ ቃለ መጠይቅ

ሀ. የጤና ተቃሙ (ከቲም ኮርዲኔተሩ/ በምልከታ የሚሞላ)

የጤና ተቃሙ ሰም _____ ክ/ከ _____

የተጠያቂው ስም_____ ሀላፊነት_____

የሚሰራበት ክፍል_____ ፈቃደኛ ነው 1.አዎን _____2.አይደለም_____

1. የህክምና ጣቢያው ክፍሎች ወጪ (ከቲም ኮርዲኔተሩ/ በምልከታ የሚሞላ)

ተራ ቁ.	ክፍሉ የሚሰጠው አገልግሎት	ስንት ክፍል አለው	የክፍሉ ስፈት በካሪ ሜትር	የኪራይ ዋጋው	መድሀኒት ለተለማመደ የሳንባ በሽተኛ በወር ሰንት ይታያል	ሊሎች አገልግ ሎት	መድሀኒት ለተለማመደ የሳንባ በሽታ ህክምናየወሰደው ክፍል	ምርመራ
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2. የባለሙያ ወጪ

ተራ ቁጥር	የባለሙያው አይነት	መድሀኒት የተለማመደ የሳንባ በሽታ በወር በአማካይ ስንት ይታያል	ለምዝገባ	መድሀኒት የተለማመደ የቲቢበሽታን ለማከም በአማካይ ለባለሙያ የሚወስደው ጊዜ ቀን (ሰአት)በወር									ሌሎች በሽተኞች በአማካይ ስንት ይታያሉ በወር	የባለሙያው ወራዊ ደሞዝ በአማካይ
				የምክር አገልግሎት	መድሀኒት መስጠት	የአክታ ምርመራ	ሪፈር ታሪክ መጻፍ	ጂን ኤክስፐርት	የራጅ ምርመራ	ሌሎች የላቦራቶሪ ምርመራዎች	ሌሎች ምርመራዎች	ጠቅላላ ሰአት በወርየፈጀው ጊዜ		
1	ላብራቶሪ													
2	ፋርማሲ													
3	ጠቅላላ ሀኪም (MD)													
4	የውስጥ ደዌ እስፔሻሊስት													
5	የጤና መኮንን													
6	ነርስ													
7	የራጅ ባለበያ													
8	ሌሎች ካለ ይገለጽ													

ለ. መድሀኒት የተለማመደ ቲቢ በሽታን ለማከም የሚያስፈልጉ የህክምና መገልያ እቃዎች እና ቁሳቁሶች (ለላብራቶሪ እና ለ ፋርማሲ የክፍል ሀላፊ የሚጠየቅ) ወይም አስተዳደር የሚጠየቁ

ተራ ቁ.	የእቃው ወይም የቁሳቁሱ አይነት	ብዛት	ስንት ብር ተገዛ	የተገዛበት አመት	የሰራበት ጊዜ ወር /አመት	የቅነሳ ጊዜ በር	መስረት የጀመረበት ወር እና አመት	በአማከይ በወርስንት ቲቢበሽተኞ ይገለግላሉ	በአማከይ በወርስንት ሌሎች በሽተኞች ይገለግላሉ	ምርመራ
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ሐ. መድሀኒት የተለማመደ ቲቢ በሽታን ለማከም የሚያስፈልጉ አላቂ እቃዎች ዕና የለላብራቶሪ መመርመሪያዎች (ለላብራቶሪ እና ለፋርማሲ የክፍል ሀላፊ የሚጠየቅ)

ተራ ቁ.	የተጠቀመው ግብአት አይነት	መለኪያ	ብዛት	ነጠላ ዋጋ በበሽተኛ	ጠቅላላ ዋጋ	በአማከይ በወር ስንት ስነት የቲቢ በሽተኛ ይጠቀማል	በአማከይ በወርስንት ሌሎች በሽተኞች ይጠቀማሉ	የዓመቱ ጠቅላላየቲቢ በሽተኛ ወጪ	ምርመራ
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ክፍል 4 : የበሽተኛው ቀጥተኛና/ቀጥተኛ ያልሆነ ወጪበጥብቅና ቀጣይ ክትትል ጊዜ ላይማጠቃለያ

ለበሽተኛው የፈጀው የጊዜ						ቀጥተኛ ህክምና የሆነ ወጪ (ጠቅላላ ምልልስ)(A)				ቀጥተኛ ህክምና ያልሆነ ወጪ (ጠቅላላ በእያንዳንዱ ምልልስ) (B)				ቀጥተኛ ወጪ (A+B) (ጠቅላላ)	ቀጥተኛ ያልሆነ ወጪ		ጠቅላላ ወጪ (A+B+C) (ጠቅላላ)
ምልልስ በወር	ርቀቱ ምን ያህል ይሆናል ከቤቶ እስከ ጤና ተቋሙ (ደርሶ መጻጻዣ ጊዜ ቀን ሲሉት	መድሀኒት ለመውሰድ የፈጀው ጊዜ	ለምርመራ የፈጀውጊዜ ሆስፒታል ተኝተው የቆዩበት ጊዜ	ለሆስፒታል የተከፈለ በወር	ለካርድ የተከፈለ	የላቦራቶሪእና የምርመራወጪ	መድሀኒት ለተላመደ የቲቢ በሽታ መድሀኒት እና ሌሎች ጠቅላላ ወጪ	የትራንስፓርት ወጪ	የምግብ ወጪ ለሆስፒታልቆይታ እና ለምልልስ	ሌሎች ወጪዎች	ለህክምና ላሆኑ ወጪዎች	ጠቅላላ ወጪ በወር	የጠፋው ጊዜ በወር	የተጣራ ክፍያ በብር በወር	
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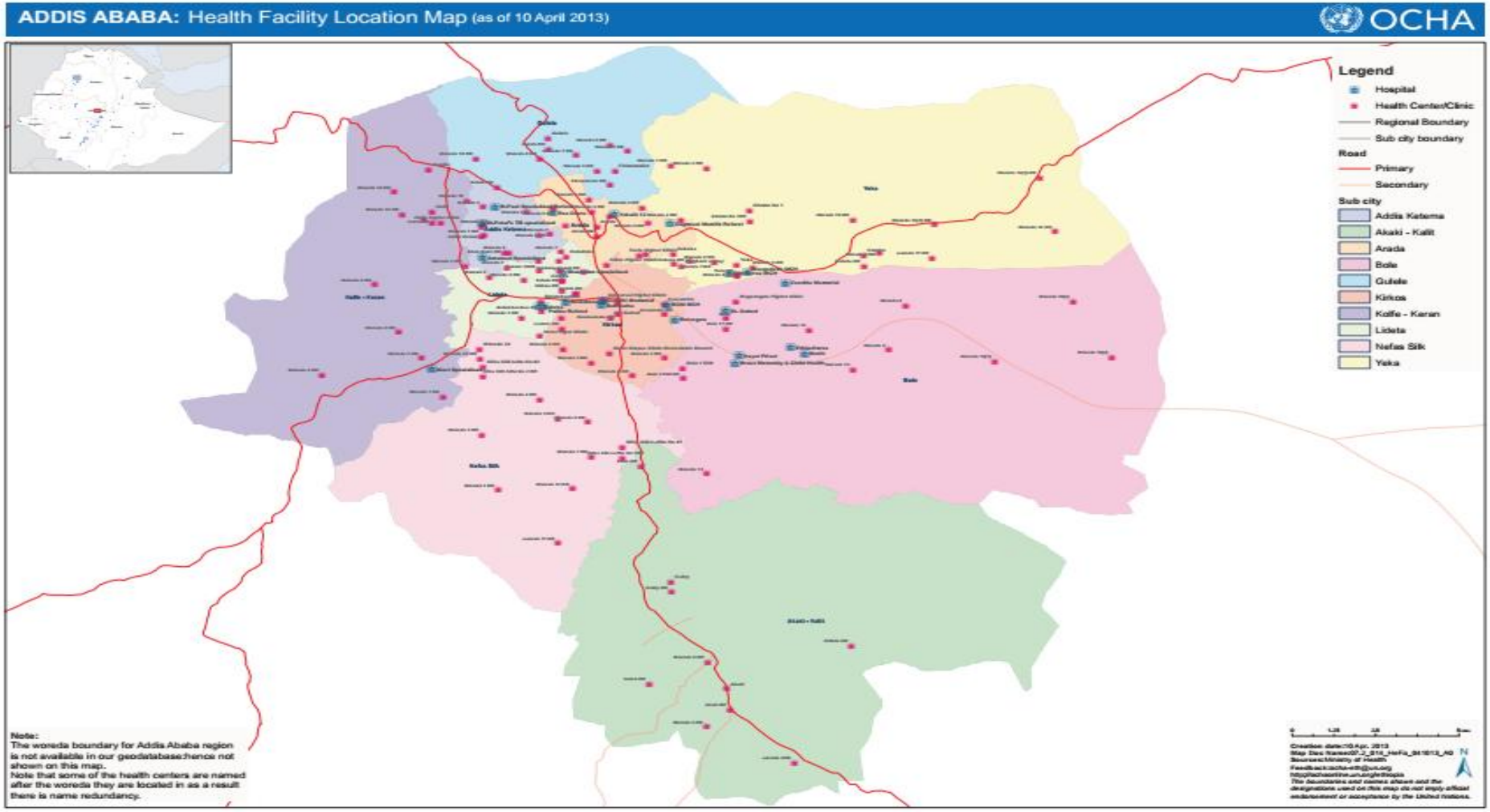
Annex 6 Location Map of the health facilities participated in the study



Accessed from
https://reliefweb.int/sites/reliefweb.int/files/resources/Ethiopia%20Addis%20Ababa%20Health%20Facility%20Location%20Map%20as%20of%2010%20April%202013.pdf

Annex 7 Health (TFC) centers participated in the study

1. Addis Ketema H/C
2. Amoraw Memorial H/C
3. Arada H/C
4. Gulele H/C
5. Kasanchis H/C
6. Kolfe Keranyo Woreda 13 H/C
7. Kolfe Keranyo H/C
8. Kotebe H/C
9. Nifas Silk Lafto Woreda 3 H/C
10. Nifas Silk Lafto Woreda 9 H/C
11. Sheromeda Woreda 5 H/C
12. Teklehaymanot H/C
13. Yeka H/C

Declaration

I, the undersigned, declare that this thesis is my original work, prepared under the guidance of Professor Damen Hailemariam and Alemayehu Desallegn (Thesis Advisors). All sources of materials used for the thesis have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other higher learning institution for the purpose of earning any degree.

Student name:

Senait Alemayehu Signature_____Date_____

Name of the advisor:

Professor Damen Haile Mariam Signature _____Date_____

Addis Ababa University College of Health Sciences, Addis Ababa, 2018