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The economic costs of home-based directly observed treatment under patient centred tuberculosis treatment in Tanzania

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Abstract

Introduction: *understanding the economic costs after the patient-centred tuberculosis treatment (PCT) implementation is crucial. Since the majority of the TB patients opted for home-based directly observed treatment (HB-DOT), there are budget implications for the NTLP and consequences for personal costs for TB patient and treatment supporter. The aim of the study was to estimate the economic costs per HB-DOT patient treated under the PCT strategy in Tanzania from a societal perspective.* ***Methods:*** *we measured costs for tuberculosis (TB) service delivery for both direct and indirect patient and supporter costs using the World Health Organization (WHO) guidelines.* ***Results:*** *the economic costs per patient on the HB-DOT under the PCT strategy in Tanzania from a societal perspective were US$900. The high personal costs were subsidized by the indirect costs for a patient and his/her supporter. On average, more than two-thirds of the average six-month income of an HB-DOT patient has spent on TB related costs.* ***Conclusion:*** *the present study results reveal that the introduction of the HB-DOT resulted in the reduction of service delivery costs incurred by the National Tuberculosis and Leprosy Programme (NTLP) after the PCT implementation. The findings bring comparative advantages in the health system in provision TB services in the country.*

Introduction

Tuberculosis (TB) remains as one of the major universal health problems. Globally, tuberculosis (TB) is the tenth leading cause of mortality, ranking above HIV/AID [1]. Globally, an estimated 10 million people fell ill with TB in 2019. Most people who developed TB were in the WHO regions of South-East Asia (44%) and Africa (25%) [2]. In year 2018, Tanzania had a total of 75,845 cases of all forms were notified [3]. In 2019, Tanzania was ranked 14thamong the 30 high TB burden countries. The TB situation has been worsened with the advent of HIV epidemic [4]. In 2018, Tanzania had a total of 73,669 of new and relapse cases notified, of which 20,714, (28%) cases were found to be co-infected with HIV [3]. In Tanzania, TB is one of the major causes of morbidity and mortality [5]. Globally, the TB incidence rate is slowly falling to catch up the first milestone of the end TB strategy of a 20% reduction between 2015 and 2020. Tanzania is among of the country reached the 2020 milestone. The internationally recommended strategy is Directly Observed Treatment-short course (DOTS). Since 1996, Tanzania has implemented DOTS nationwide in all public and private health facilities for free of charge. Since 2006, the DOTS strategy has been implemented under the approach known as patient-centred TB treatment (PCT) [6]. Under this approach, newly diagnosed patients are given the opportunity to choose either home-based directly observed treatment (HB-DOT) supervised by a non-medical person of their preference (denoted treatment supporter), or health facility-based DOT observed by a health worker. According to the national tuberculosis and leprosy programme (NTLP) report in 2018, about 82% of all notified TB patients were supervised at home by treatment supporters who were mostly family members and community health workers including former TB patients.

Understanding the economic costs after the PCT implementation is crucial. Since the majority of the TB patients opted HB-DOT, there are consequences for personal costs for TB patient and treatment supporter. Before the PCT implementation, the economic costs of the community-based TB care were evaluated in Dar-es-salaam city, Tanzania. The main result from the evaluation was a substantial reduction (compared to health-facility based DOT) in both health system-related and patient cost [7] and for a few sites in other sub-Saharan African countries had shown the same [8,9]. This reduction tends to result from the reduced time which health care providers spent on TB care, reduced patient expenditure for transport, food, and drinks and decreased patient opportunity costs related to

time away from work or other daily duties [10]. The economic cost consists of service delivery and personal expenses. Currently, it is not known whether service delivery costs are increased or decreased after the introduction of the PCT approach. Likewise, it is not known whether personal costs for patient and treatment supporter are increased or decreased after the PCT implementation. However, some of these costs are instead incurred by supporters or guardians, for example when they visit the health facility for drug collection [11]. Thus, although the PCT approach has been scaled-up in Tanzania, little is known about the economic costs for the provider and patient/treatment supporter after the implementation of the PCT approach. We, therefore, measured the economic cost per patient on the HB-DOT under the PCT approach in Tanzania from a societal perspective, by considering the full costs incurred by all those involved in providing or using services: patients, supporters and the NTLP/health system.

Methods

Study area and population: this cross-sectional study was conducted in one urban municipality (Arusha city) and two rural districts (Mufindi and Kilosa). The three districts were selected to be broadly representative of NTLP activities, given their varying socio-economic levels and degrees of urbanization. Arusha is a major tourist hub with a population of 1.3 million in 2012 [12]. Mufindi district is located in Iringa Region in the Southern Highlands, with a population of around 265,000 in 2012, and a population density of 50 people per square kilometre [12]. The district is characterized by cash crop agriculture, forestry, and livestock rearing. Kilosa district is one of the six districts that constitute Morogoro region. Based on the 2012 census, the district population was 440,000, with 29 people per square kilometre [12]. The predominant economic activities are food crop agriculture mainly to cover people´s subsistence and livestock rearing.

Description of the PCT strategy: a short summary of the PCT strategy is given below; full details are described elsewhere [6]. In Tanzania, TB treatment and follow-up diagnosis are free for all patients diagnosed with TB infection. When the health worker registers a new TB patient, he or she underlines the importance of DOT and gives the patient the opportunity to choose either home-based DOT (HB-DOT) observed by a non-medical person (not paid, majority are family members) of their preference, or health facility-based DOT (HF-DOT) observed by a health worker. If HF-DOT treatment is chosen, patients are advised to come to the health facility every day (except during the weekend and public holiday) for the full treatment duration of six months to take their daily dose of treatment under the observation of the health worker. Medication is provided in full on the weekends and public holidays. If HB-DOT is chosen, the patient is asked to select - within the initial two weeks of treatment - a supporter to provide DOT and support at home during the entire treatment duration. The supporter is responsible for (i) collecting drugs from the health facility once every 7 days during the intensive phase (2 months), and once every 14 days during the continuation phase (4 months); (ii) reminding the patient to swallow the drugs daily; (iii) observing the drug intake on a daily basis; (iv) recording the drug intake by the patient on the patient identity card, and (v) reporting to the health worker in case of any side-effects of the treatment experienced by the patient. When visiting the health facility, the supporter is required to show the patient identity card on which the drug intake is recorded, to bring the empty blister packs, to collect new drugs, and to discuss any problems encountered by the patient, including treatment side-effects and treatment adherence. The patient preferably accompanies the supporter to the health facility at least once every two weeks for clinical assessment by a health worker. Smear-positive patients are required to visit the health facility for follow-up sputum smear examination (end of the 2nd month and 5th month), and whenever he or she feels it is

necessary to discuss problems. We assumed these extra visits to coincide with the regular two-weekly visits. For the entire treatment period, this translates to a total of 21 visits for a patient on HB-DOT and to 14 visits for a treatment supporter.

Sample size and sampling procedure: we aimed for a sample size of 90 patients to allow for an adequate variety of patient/supporter costs to be estimated, in line with sample sizes from similar previous study in our setting [13]. The sampling frame for the study included all three district hospitals and all 69 other health facilities (health centers and dispensaries) in the three districts. We randomly selected 15 health centers and dispensaries using a proportional-to-population size strategy, whereby the population size refers to the number of new TB cases identified in each facility in 2010. In the selected health facilities, we listed new patients on treatment consecutively as they appeared in the TB unit register. If a selected health facility had fewer than 5 patients, we intended to replace it with the health facility geographically closest to the one originally chosen.

Data collection procedure: the inclusion criteria for recruitment of patients were being newly diagnosed and 18 years or older, being currently on treatment and having started TB treatment at least one month before the interview. Between July and August 2012, research assistants traced patients at home or at the health facility with the help of community leaders and District Tuberculosis and Leprosy Coordinators (DTLCs). Data collectors had the patient name and his or her registered mobile phone number. If the patient could not be reached after several attempts on the same day, he or she was replaced with the subsequent patient on the list. With a structured questionnaire, we collected information from patients and supporters on demographics and cost-related items such as travel expenses, communication costs (phone call expenses), time lost due to TB illness (patients) and support (supporters), medical and treatment expenses (patients), and various other costs such as purchasing food and drinks during health facility visits. We also collected information on service delivery-related costs for TB patient management through health care providers and DTLCs as well as Regional TB and Leprosy Coordinators (RTLCs). These concerned health workers´ salaries and allowances, DTLCs/RTLCs salaries, TB drug costs, and costs of transport for DTLCs/RTLCs supervision visits. Data sources were districts´ payrolls, vehicle and motorcycle log-books, reports from DTLCs and RTLCs, and interviews with hospital administrators and health workers using structured questionnaires. All data were double entered in EpiData version 3.1 and analyzed using Stata 12.0 (StataCorp LP, College Station, Texas, USA).

Cost analysis: costs were assessed from a societal perspective using the WHO guidelines for cost and cost-effectiveness analysis of tuberculosis control [14]. The costs were divided into "personal costs" and "service delivery costs". Personal costs were those incurred by patients and supporters and included direct and indirect costs. Direct costs were out-of-pocket expenditures such as transport costs, buying food and drinks when visiting a TB clinic, and communication costs (mobile phone call expenses). Indirect costs referred to the value of time lost per month by the patient and supporter due to the TB illness episode. These were calculated by subtracting average earnings per month during TB treatment from average earnings before the illness episode for TB patients and supporters. It was assumed that the reported daily earning was constant for the whole month. Service delivery costs were recurrent costs incurred by the general health system and the NTLP. Capital costs for buildings and vehicles were not included but would be unlikely to vary substantially for the volume of patients considered. The service delivery costs were divided into three levels; at health facility level this concerned health worker salaries and allowances, at the district level the cost comprised the DTLC´s salary and allowance, drugs, transport and fuel allowance, and maintenance cost for a motorcycle. At the regional level, the costs included the RTLC´s salary and allowance, transport and fuel allowance, and

maintenance cost for vehicles. The average annual exchange rate of 1,579.5 Tanzanian shillings to the US $1 for 2011 was applied [15].

We also estimated average (mean) of recurrent total costs incurred by the NTLP for supervision management of new TB patients at a health facility, district, and regional level. We divided the average annual cost by annual TB cases at district/regional level. Lastly, in order to estimate the average (mean) cost per HB-DOT patient treated for six months in each of the three districts, we calculated the average service delivery costs and personal direct costs per visit at the health facility. These costs were multiplied by the projected total number of visits throughout the entire treatment period of six months. Monthly indirect costs were multiplied by six to calculate the total indirect costs for the treatment duration. These were then summed to estimate the average total economic cost per HB-DOT patient treated in each district. This methodology was used by Ngalesoni *et al.*to estimate the provider costs of the World Health Organization´s medical primary prevention guidelines for cardiovascular disease to be implemented in Tanzania [16].

Ethics consideration: the study protocol was approved by the Ifakara Health Institute (IHI) review board and the National Ethics Committee at the National Institute for Medical Research (NIMR), Dar-es-Salaam. Written informed consent was obtained from all study participants.

Results

Background characteristics of study participants: in total, 88 new TB patients and 71 supporters were enrolled in the study. The majority of the patients (n=53; 60.2%) were males, and the mean age was 38.5 (Standard Deviation (SD) 11.3) years. Three-quarters of the interviewed patients had completed primary or higher education. Farming was the most common occupation among the study participants in the two rural districts, while in Arusha small business was most frequent. Half of the participants were married or living in partnership. Most of the enrolled patients were in the continuation phase of TB treatment 55 (62.5%), and smear-positive pulmonary TB patients, 50 (56.8%) accounted for all diagnosed cases. Overall, the mean monthly income before TB diagnosis based on patients´ self-report ranged from US$62 in Kilosa to US$129.3 in Arusha (Table 1).

Personal costs for patients and supporters: average personal direct costs amounted to US$4.8 per visit for HB-DOT patients (ranging from US$3.1 in Kilosa to US$5.3 in Arusha), and US$5.2 per visit for supporters (ranging from US$4.1 in Arusha to US$5.1 in Mufindi) (Table 2). Overall, average costs for patients for buying food were US$1.6 per visit, with a higher amount in Arusha (US$2.1) compared with Mufindi and Kilosa. The overall average cost of traveling to the health facility was US$1.5 per visit for the patients, with the highest amounts in Mufindi (US$2.4). Supporters incurred average travel costs of US$2.3 in Arusha, US$3.2 in Mufindi, and US$ 1.9 in Kilosa. In Arusha, the indirect monthly patient costs due to inability to work were higher (US$80.9) than in Mufindi and Kilosa. In Mufindi, the supporter costs per month (US$79.7) due to an inability to work and helping a TB patient was higher than in Arusha and Kilosa (Table 2). Total personal costs for HB-DOT patients for the entire treatment duration of six months varied between US$304.5 in Kilosa and US$596.7 in Arusha. The HB-DOT patients spent 77.9% (in Arusha), 90.4% (in Mufindi), and 81.9% (in Kilosa) of their respective income for the six-month treatment period (Table 3). Total personal costs for supporters for the entire treatment duration of six months varied between US$132.6 in Kilosa and US$549.6 in Mufindi. The supporters spent 52.3% (in Arusha), 75.9% (in Mufindi), and 33.1% (in Kilosa) of their respective income for the six-month treatment period (Table 3).

Service delivery costs for the health system and NTLP: the average recurrent cost for the management of a new TB patient at the health

facility level was US$1.4 per visit, with the lowest costs in Arusha and the highest cost in Kilosa. The average recurrent cost for supervision per patient for the NTLP program amounted to US$7.0 at the district level and US$6.9 at the regional level. The management costs at the district and regional-level were higher in the Mufindi district than in the Arusha city and Kilosa district (Table 4). The total average economic costs (for the patient and the health system/NTLP) of providing a patient with HB-DOT were US$901.7 for six months (Table 5). The average service delivery costs were US$37.6 in Arusha, US$56.4 in Mufindi, and US$72.3 in Kilosa. More than 50% of the average service delivery cost was contributed by the cost of a visit to the TB clinic. In Arusha, the average personal patient costs were higher (US$596.7) than in Mufindi (US$462.0) and Kilosa (US$304.5). In Mufindi, the average personal supporter costs were higher (US$549.6) than in Arusha (US$493.6) and Kilosa (US$132.6). Indirect costs for patients made up more than 75% of the personal costs. Total costs incurred by patients and supporters were higher than service delivery costs (Table 5).

Discussion

Our study main result shows that the economic costs per patient on HB-DOT under the PCT approach in Tanzania from a societal perspective were about US$900. These costs consist of service delivery and personal expenses for a patient and a treatment supporter. Of which, only about US$50 were service delivery expenses. This implies that the introduction of the HB-DOT under the PCT approach resulted in the reduction of service delivery costs incurred by the NTLP which brings comparative advantages in the health system in provision TB services. Inversely, before the introduction of the PCT approach, the personal costs for a patient (US$43) were ten times lower than after the PCT approach (US$454.4) implementation. In another study conducted in Tanzania 2012, to estimate the costs incurred by patients during the intensive and continuation phases, revealed that overall patient costs were US$74 and US$150 in the 2 months of the continuation phase and during the 2 months of the intensive phase of treatment respectively [**17**]. Still the patient costs were low compared with the economic costs per patient on HB-DOT under the PCT approach. The high personal costs were contributed by the indirect costs. The direct costs for the patient are remains the same before and after the PCT implementation (about US$20.0). Thus, the high costs shifted from provider to the patient and treatment supporter after the introduction of the HB-DOT under the PCT approach. Our findings are inconsistent with other community-based TB DOT interventions that the personal costs for a patient were lower than service delivery [9,18].

Surprisingly, the recurrent costs (US$7) for supervision before the PCT approach at district level were four times higher than after the PCT approach. The recurrent costs for supervision before the PCT approach at the regional level were seven times higher than after the PCT approach. It is expecting the recurrent costs to be maintained after the PCT approach. However, the high cost could be happened due to frequently supervision visits of RTLC/DTLC at their respective tasks after the PCT approach. Possibly, the number of DOT centers for supervision visits are increased and more daily tasks (TB/HIV roles) after the PCT approach. A study conducted in Uganda with community-based care included programme supervision spent US$18 [9], which is high compared to this study. Some of these tasks of the DTLC during supervision at the district level is to ensure that all TB patients receive treatment as prescribed, a unit and district registers are kept up-to-date, to refer TB patients who may benefit from expert management, and to support health facilities to trace irregular patients and defaulters. Some of the tasks of the RTLC is to regularly visit (at least once every 3 months) all the districts in the region in order to supervise and support the DTLCs and health workers in the region and to ensure a three-months supply of tuberculosis.

Despite the fact that in Tanzania TB diagnosis and care is free for all patients, direct and indirect costs for patients and supporters are still substantial. On average, more than 75% of the average six-month income of an HB-DOT patient has spent on TB related costs while more than 30% of the average six-month income of a supporter has spent also on assisting TB patient. High costs for patients were also seen in a study conducted in Nigeria [11]. The high cost for patients spent on TB related costs can jeopardize timely health-seeking behavior and adherence to treatment and may lead to the impoverishment of whole families. The personal direct and indirect costs for patients and supporters varied widely across study sites and depend - among other factors - on local prices for food and transport as well as on geographical characteristics. Such determinants were also observed in a systematic review which looked at demand-side barriers to health care utilization [19].

The WHO TB control strategy for the post-2015 era stipulates a target of zero catastrophic health expenditure for TB affected families by 2020 [20]. These hidden costs from this study incurred by patients and their households may worsen poverty and health are called "catastrophic costs" [21]. While patient-centered treatment strategies like in Tanzania can contribute to these efforts, our study results suggest that still much needs to be done to reach the set target. Whereas patients´ income loss due to illness may be hard to avert, some of the personal costs (such as transport and beverage costs) borne by supporters could be reduced by decreasing the number of health facility visits through longer intervals between drug collection visits, e.g. by introducing mobile technology interventions. Mobile technology enables supporters to discuss with health care providers any problems encountered by the patients over the phone, including treatment side-effects instead of going physically to the health facility. In addition, mobile technology interventions would help to support patients´ adherence. A pilot study conducted in Kenya showed that mobile technology-based DOT used by supporters was technically feasible [22]. In this study, supporters could produce a video and sent it by mobile phone to the health facility showing the patient during his or her medicine intake. The technology alleviates the travel burden for both patients and supporters.

The present study has strengths and limitations. The key strength of our study is that it included both typical urban and rural Tanzanian locations, making it possible to generalize the results to other parts of the country. The inclusion of both the providers´, patients´ and supporters´ costs allowed the transfer of costs related to TB care between these actors to be identified. Another strength of the study is that we were able to analyze directly measured information on primary data for unit volumes and costs, and did not use aggregated modeled data costs to extrapolate costs as done in other studies. In fact, this might be the reason why some costs are higher than what has been calculated in other studies using modeled data. There are some limitations to the study. First, in real life, HB-DOT patients and their supporters might visit the facility less often than they are supposed to as instructed in the PCT guideline. If this is the case, we have may have overestimated the indirect costs for HB-DOT patients and supporters, thus have provided a conservative estimate of cost savings associated with HB-DOT choice. However, a similar study conducted in 2001, recorded high indirect costs of a TB patient of more than US$1000 [23]. Second, with regards to our costs estimates, we were not able to include costs related to buildings and equipment. Estimating indirect costs for patients and their supporters was done by estimating income loss due to visits to a health facility or other actions related to TB care of the patient, based on the reported average earnings. The disadvantage of this method is that it might not fully capture the actual costs, especially when there is volatility in income [14]. Participants without a regular income from employment in the formal sector, like farmers, might not have lost

money but might have lost agricultural yield because they could not work in the fields, which is not captured in our calculations. This results in the average income loss to be a conservative estimate. Incurred costs may differ during the six-month treatment period, but we assumed linear additive costs over the treatment period. Third, the study was conducted since 2012, eight years ago, however our finding seems to be valid. So far, no publish texts addressed the HB-DOT costs under the PCT in Tanzania.

Conclusion

The present study results reveal that the introduction of the HB-DOT resulted in the reduction of service delivery costs incurred by the NTLP after the PCT implementation. The findings bring comparative advantages in the health system by providing TB services in the country. However, the HB-DOT still places the bulk of the personal costs on TB patients and their supporters. Future research should focus on strategies to further reduce the costs to patients and supporters.

What is known about this topic

- *The economic costs of the health-facility based DOT in Tanzania;*
- *The economic costs of the community-based TB care in Tanzania.*

What this study adds

- *The economic costs of the HB-DOT under the PCT approach in Tanzania;*
- *The catastrophic costs under the PCT approach in Tanzania.*

Competing interests

The authors declare no competing interests.

Authors' contributions

All the authors have read and agreed to the final manuscript.

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Tables

Table 1: characteristics of analysed patients (N=88)

Table 2: average (mean) costs incurred by HB-DOT patients and supporters by district (US$)

Table 3: estimated total direct and indirect costs for HB-DOT patients and supporters for 6-month´s TB treatment (US$)

Table 4: estimated average (mean) recurrent cost for supervision (at district and regional level) and health facility patient management (US$)

Table 5: estimated average (mean) service delivery and personal costs per HB-DOT patient treated for six months (US$)

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Table 1: characteristics of analysed patients (N=88)				
Variable	**Arusha n = 29**	**Mufindi n = 29**	**Kilosa n = 30**	**Overall N = 88**
Male (n, %)	21 (72.4)	17 (58.6)	15 (50.0)	53 (60.2)
Age (yrs)				
Mean (SD)	34.5 (10.4)	39.4 (11)	41.5 (11.8)	38.5 (11.3)
Education status (n, %)				
No education	4 (13.8)	8 (27.6)	9 (30.0)	21 (23.9)
Primary education	17 (58.6)	20 (69)	17 (56.7)	54 (61.6)
Secondary school and above	8 (27.6)	1 (3.5)	4 (13.3)	13 (14.8)
Occupation*(n, %)				
Farmer	1 (3.5)	20 (69)	17 (56.7)	38 (43.2)
Small scale business	14 (48.3)	6 (20.7)	5 (16.7)	25 (28.4)
Employed work	2 (6.9)	2 (6.9)	1 (3.3)	5 (5.7)
Temporary work	6 (20.7)	3 (10.3)	2 (6.7)	11 (12.5)
Marital status (n, %)				
Married/living together	17 (56.6)	15 (51.7)	16 (53.3)	48 (54.6)
Not married	7 (24.1)	7 (24.1)	7 (23.3)	21 (23.9)
Divorced	4 (13.8)	2 (6.9)	3 (10.0)	9 (10.2)
Widow/widower	1 (3.5)	4 (13.8)	4 (13.3)	9 (10.2)
Missing	0	1 (3.3)	0	1 (1.1)
Treatment phase (n, %)				
Intensive	12 (41.4)	11 (37.9)	10 (33.30)	33 (37.5)
Continuation	17 (58.6)	18 (62.07)	20 (66.7)	55 (62.5)
Type of TB (n, %)				
Smear-positive pulmonary TB	21 (72.4)	15 (51.7)	14 (46.7)	50 (56.8)
Smear-negative pulmonary TB and Extra pulmonary TB	8 (27.6)	14 (48.3)	16 (53.3)	38 (43.2)
Average monthly income (US$) Mean (SD)	129.3 (90.3)	85.2 (52.7)	62.0 (47.9)	92.1 (71.4)
*Multiple responses applied				

Table 2: average (mean) costs incurred by HB-DOT patients and supporters by district (US$)				
Cost per patient	**Arusha**	**Mufindi**	**Kilosa**	**Overall**
Direct				
Total foods costs per visit	2.1	1.0	1.6	1.6
Total beverages costs per visit	0.8	0.5	0.4	0.6
Total call expenses per visit	1.3	0.3	0	1.1
Travel costs per visit	1.1	2.4	1.1	1.5
Total direct costs per visit	5.3	4.2	3.1	4.8
Indirect				
Costs due to inability to work per month	80.9	62.3	39.9	61.0
Cost per supporter				
Direct				
Total foods costs per visit	0	1.1	1.9	1.2
Total beverages costs per visit	2.1	0.8	0.4	0.9
Total call expenses per visit	0.8	0	0	0.8
Travel costs	1.2	3.2	1.9	2.3
Total direct costs per visit	4.1	5.1	4.2	5.2
Indirect				
Costs due to inability to work per month	72.7	79.7	12.3	57.5

Table 3: estimated total direct and indirect costs for HB-DOT patients and supporters for 6-month's TB treatment (US$)					
Patients					
	Total direct cost for 6 months (a)	Total indirect cost for 6 months (b)	Total personal cost for 6 months (a + b)	Total income for 6 months	% of income spent for treatment for 6 months
Arusha	111.3	485.4	596.7	775.8	77.9
Mufindi	88.2	373.8	462.0	511.2	90.4
Kilosa	65.1	239.4	304.5	372.0	81.9
Supporters					
	Total direct cost for 6 months (a)	Total indirect cost for 6 months (b)	Total personal cost for 6 months (a + b)	Total income for 6 months	% of income spent for treatment for 6 months
Arusha	57.4	436.2	493.6	944.4	52.3
Mufindi	71.4	478.2	549.6	724.2	75.9
Kilosa	58.8	73.8	132.6	400.2	33.1

Table 4: estimated average (mean) recurrent cost for supervision (at district and regional level) and health facility patient management (US$)				
	Average annual cost (a)	Annual TB cases at district/region in 2011 (b)	Number of OPD visits (c)	Average cost for management of a new TB case (a/b) DTLC & RTLC (a/c) patient management
Arusha				
District level supervision				
DTLC salary and allowance	4,953.1			
Transport and fuel allowance	139.3			
Maintenance	19.9			
Sub-total	5,112.3	888		5.8
Regional level supervision				
RTLC salary and allowance	14871.8			
Transport and fuel allowance	1321.4			
Maintenance allowance	90.4			
Sub-total	16283.6	2,689		6.1
Health facility patient management	192,842.5		209,831	0.9
Mufindi				
District level supervision				
DTLC salary and allowance	4465.6			
Transport and fuel allowance	195.2			
Maintenance allowance	19.9			
Sub-total	4,680.7	530		8.8
Regional level supervision				
RTLC salary and allowance	24546.2			
Transport and fuel allowance	1465.6			
Maintenance allowance	397.7			
Sub-total	26409.5	2,838		9.3
Health facility patient management	147,265.1		97,642	1.5
Kilosa				
District level supervision				
DTLC salary and allowance	5125.3			
Transport and fuel allowance	290.6			
Maintenance allowance	19.9			
Sub-total	5,435.8	747		7.3
Regional level supervision				
RTLC salary and allowance	17205.4			
Transport and fuel allowance	1364.9			
Maintenance allowance	189.9			
Sub-total	18760.2	3,318		5.7
Health facility patient management	240,257.0		96,031	2.5
Average supervision at district level	**15,228.8**	**2,165**		**7.0**
Average supervision at regional level	**61453.3**	**8,845**		**6.9**
Average health facility patient management	**580,364.6**	**403,504**		**1.4**
OPD=outpatient department; DTLC=district tuberculosis and leprosy coordinator; RTLC=regional tuberculosis and leprosy coordinator				

Table 5: estimated average (mean) service delivery and personal costs per HB-DOT patient treated for six months (US$)		
ARUSHA	**Total**	**%**
Service delivery cost		
Visit TB clinic	18.9	50.3
Drugs	6.8	18.1
NTLP management and supervision district level	5.8	15.4
NTLP management and supervision regional level	6.1	16.2
Total Service delivery cost	37.6	100.0
Personal cost: Patient's cost		
Direct	111.3	18.7
Indirect	485.4	81.3
Total patient's cost	596.7	100.0
Personal cost: supporter's cost		
Direct	57.4	11.6
Indirect	436.2	88.4
Total supporter's cost	493.6	100.0
Grand total - Arusha	1127.9	
MUFINDI		
Service delivery cost		
Visit TB clinic	31.5	55.9
Drugs	6.8	12.1
NTLP management and supervision district level	8.8	15.6
NTLP management and supervision regional level	9.3	16.5
Total service delivery cost	56.4	100.0
Personal cost: patient's cost		
Direct	88.2	19.1
Indirect	373.8	80.9
Total patient's cost	462.0	100.0
Personal cost: supporter's cost		
Direct	71.4	13.0
Indirect	478.2	87.0
Total supporter's cost	549.6	100.0
Grand total - Mufindi	1067.9	
KILOSA		
Service delivery cost		
Visit TB clinic	52.5	72.6
Drugs	6.8	9.4
NTLP management and supervision district level	7.3	10.1
NTLP management and supervision regional level	5.7	7.9
Total service delivery cost	72.3	100.0
Personal cost: patient's cost		
Direct	65.1	21.4
Indirect	239.4	78.6
Total patient's cost	304.5	100.0
Personal cost: supporter's cost		
Direct	58.8	44.3
Indirect	73.8	55.7
Total supporter's cost	132.6	100.0
Grand total - Kilosa	509.4	
Average service delivery costs - all	55.4	6.1
Average personal costs (patient) - all	454.4	50.4
Average personal costs (supporter) - all	391.9	43.5
Total average cost	901.7	100.0
HB-DOT= home-based directly observed treatment		