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THE DIRECT FINANCIAL AND HUMAN RESOURCE COSTS OF PROVIDING TUBERCULOSIS TREATMENT SERVICES IN NIGERIA, 2008-2012



Federal Ministry of Health
Federal Republic of Nigeria

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Mission

The **Health Systems 20/20** cooperative agreement, funded by the U.S. Agency for International Development (USAID) for the period 2006-2011, helps USAID-supported countries address health system barriers to the use of life-saving priority health services. Health Systems 20/20 works to strengthen health systems through **integrated approaches to improving financing, governance, and operations, and building sustainable capacity** of local institutions.

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THE DIRECT FINANCIAL AND HUMAN RESOURCE COSTS OF PROVIDING TUBERCULOSIS TREATMENT SERVICES IN NIGERIA, 2008-2012

DISCLAIMER

The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development (USAID) or the United States Government

ABSTRACT

The Health Systems 20/20 project developed a customizable costing model using MS-Excel software to look at the direct cost implications of the Nigerian tuberculosis control program over the period 2008-12, based on the resources required to support future caseloads. The model simulates treatment cohorts for each of Nigeria's 37 states and accounts for cured, relapse, default, etc. treatment outcomes and retreatment issues. The methodology incorporates actual treatment outcome data for each state in Nigeria. The unit costs are built "bottom-up" using an ingredients approach, accounting for intensive vs. continuation phase treatment, for treatment of naïve cases vs. retreatment, and for adult vs. pediatric treatment. In addition, direct costs of inpatient care and multi-drug resistant (MDR)-TB treatment, as well as TB-HIV program coordination, are included. Full-time equivalent health workers required to diagnose, prescribe, and monitor drug intake are also estimated for each year from 2008 to 2012. The user can modify the unit cost ingredients and set treatment regimens and all prices.

With a baseline scenario for increase in TB-Directly Observed Therapy, Short Course (DOTS) caseload, this model projected Nigeria's total direct costs of the DOTS, MDR-TB, and TB-HIV program to be US\$17 million in 2012. Of this, US\$15.5 million was spent on DOTS cases (from all sources, including referrals from the HIV program) and TB inpatient care, US\$0.7 million on MDR-TB services, and \$0.8 million on co-trimoxazole preventive therapy/antiretroviral therapy for TB-HIV co-infections. Additional scenarios were costed, which varied the rate of DOTS case registrations and treatment outcomes, or enhanced registration and detection for TB-HIV cases and MDR-TB. Based on the estimated costs and the budget projected from the 2008 figures, the Nigerian TB treatment program looks sustainable if current TB case complication and drug resistance rates remain stable. A related scenario shows how additional costs of MDR-TB treatment could become significant. Hence attention should be paid to MDR-TB prevention. Nigeria needs to further improve DOTS treatment outcomes. Strengthening DOTS by an increase in labor input per active TB case by clinical workers is one option for deepening treatment quality, which was costed with the tool. The method was found to be affordable and also saved lives.

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ACRONYMS

ACSM	Advocacy, Counseling, and Social Mobilization
AFB	Acid-fast Bacillus
AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Therapy
ARV	Antiretroviral (drug)
CHW	Community Health Worker
CPT	Co-trimoxazole Preventive Therapy
CTBC	Community-based Tuberculosis Control
DOTS	Directly Observed Therapy, Short-course
DST	Drug Susceptibility Testing
EPTB	Extra-pulmonary Tuberculosis
FMOH	Federal Ministry of Health
FTE	Full-time Equivalent
GDF	Global Drug Facility
GF	Global Fund to Fight AIDS, Tuberculosis and Malaria
HIV	Human Immunodeficiency Virus
HRH	Human Resources for Health
IPT	Isoniazid Preventive Therapy
LGA	Local Government Area
MDR-TB	Multi-drug Resistant Tuberculosis
NNRTI	Non-nucleoside Reverse Transcriptase Inhibitor
NTBLCP	National Tuberculosis and Leprosy Control Programme
PCR	Polymerase Chain Reaction
PLWHA	People Living With HIV/AIDS
PTB	Pulmonary Tuberculosis
SCC	Short Course Chemotherapy
ss+	Sputum Smear Positive
ss-	Sputum Smear Negative
TB	Tuberculosis
USAID	United States Agency for International Development
WHO	World Health Organization

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EXECUTIVE SUMMARY

Nigeria's tuberculosis (TB) burden is the fifth highest in the world based on 2006 data, and the highest in Africa. National incidence of new registered TB cases per year – both pulmonary TB and extra-pulmonary TB (EPTB) cases – was estimated at 58 per 100,000 population as of 2007. However, this rate, which drives utilization of TB services in the country, varies widely across states. For example, the Federal Capital Territory and the Northern state of Kwara had a new case registration rate per year of less than 20 per 100,000, while the rate is more than 100 per 100,000 in the southern states of Lagos and Anambra (National TB and Leprosy Control Programme [NTBLCP] 2007a).

There is a considerable burden of TB-HIV co-infection, which complicates disease management and is worsening outcomes by increasing mortality among HIV-positive patients with untreated TB, and by increasing active TB rates and hence mortality in TB patients immuno-compromised due to HIV.

By 2008, Nigeria is likely to complete the expansion of standard Directly Observed Therapy Short-course (DOTS) for TB to almost 100% of the local government areas or LGAs. Currently, 100% coverage in LGAs has mainly been achieved in USAID-supported states. In other states, by 2007, the status of the expansion in DOTS coverage was such that nine out of ten LGAs were providing DOTS, though the implementation of correct DOTS guidelines requires more monitoring. These DOTS activities are supported by 794 TB microscopy laboratories.

For this study, the researchers estimated the comprehensive cost of the future of the TB control program. The results are framed using several scenarios, described below, that simulate the potential effects of ongoing TB policy developments on the incidence of new registered TB cases per year from 2008 to 2012. The recurring *direct* costs of providing TB services are calculated. The analysis is backed by actual program data, tabulated by state where possible. Unit costs of drugs and diagnostics, and imputed value of labor inputs per case are estimated and assumed common to all states. These were sourced from prior studies in Nigeria (Chankova et al. 2006) and a document review conducted in July and August 2008.

Three scenarios are applied to the years 2008-12, based on Nigeria's NTBLCP strategy as well as the global policy trends for TB. The first is a *Baseline* scenario that assumes moderate growth in the registered caseload and no change from the 2007 rates of sputum smear positive (ss+), sputum smear negative (ss-), and *EPTB* case types within new registrations, or in the cure and completion rates in the cohorts placed on DOTS. The next scenario, *Enhanced DOTS*, assumes 5 percent growth per year in the caseload over 2008-12, and a 5 percent increase in the cure and completion rates for Category I and II DOTS cases. The final scenario, *DOTS-Plus and TB-HIV*, uses the *Enhanced DOTS* settings as base and adds expanded coverage of multi-drug resistant (MDR)-TB and TB-HIV. These scenarios are described more fully below.

An *MS-Excel software tool* was created for this study; it generates the cohorts based on parameters modified by the user from some preset values and applies to them unit cost values to generate the overall costs. The parameters control future registrations of new cases, distribution of ss+ and ss- within new cases, rates of pediatric and MDR-TB, as well as cure and failure rates, etc., for standard DOTS treatment. Considering the variation in TB incidence and in the service delivery by state and zone, the results from the tool can be viewed at a disaggregated level. It is possible to focus only on states that the

United States Agency for International Development (USAID) supports. This customizable, user-friendly tool is delivered with this document.

For this costing analysis, unit costs were calculated separately for DOTS (complete course of treatment for Category I and II patients), MDR-TB, and TB-HIV. Except for TB-HIV, the total unit cost includes the imputed cost of the labor per case, based on labor input per patient encounter from a previous report and salary data for health workers at the LGA and state levels.

The unit cost of drugs were calculated using latest Global Drug Facility (GDF) price lists, and the per patient course cost reflects the dosage currently in the NTBLCP treatment guidelines and also the expected length of treatment (Table ES-1). The costs of drugs were adjusted for shipping and handling costs faced in Nigeria. For diagnostic tests, unit cost estimates used were based on data collection in Nigeria from various laboratory sources as well as budgeted numbers in the Nigerian Round 8 proposal for the Global Fund to Fight AIDS, Tuberculosis and Malaria (GF). The unit costs are expected to increase over time with inflation (5 percent per year as in the Round 8 GF proposal).

TABLE ES-1. SUMMARY OF UNIT COSTS PER PATIENT YEAR FOR CERTAIN TB-RELATED SERVICES, 2008

Case Type	Cost* per Case	Case Type	Cost* per Case
Category I DOTS	\$79	TB-HIV: CPT	\$8
Category II DOTS	\$93	TB-HIV: ART	\$353
MDR-TB **	\$2,368	HIV/TB: IPT	\$1.6

Source: Author calculations

Note: CPT—co-trimoxazole preventive therapy; ART—antiretroviral therapy; IPT—isoniazid preventive therapy

* Includes 25% shipping, handling, and management costs.

** MDR-TB treatment involves inpatient stay of 56 days on average.

For aggregate costs, the *Baseline* scenario assumes that the current rate of new case registrations per 100,000 population will increase moderately (1.1 percent per year) with the availability of DOTS in almost 100 percent of the LGAs, in the absence of any enhanced social mobilization, information campaigns, etc. to increase case notification and testing. Rates for cure, completion, etc., in Category I and II DOTS remain at the values that were achieved in 2007 for each state. Other assumptions inherent in the calculations are discussed in the main text.

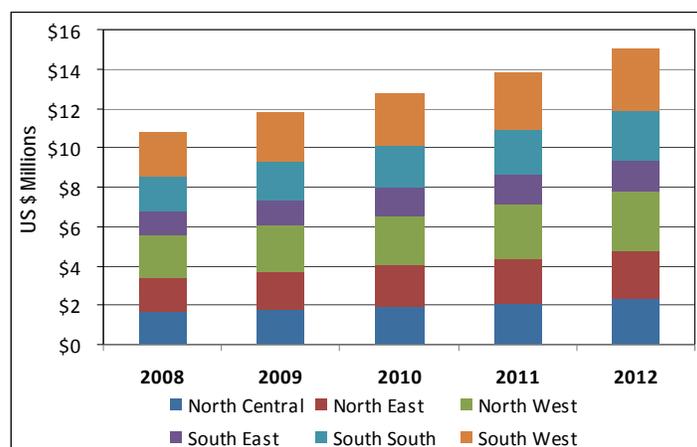
In the *Baseline* scenario, all Category II treatment failures are considered MDR-TB cases. In other words, there is only passive MDR-TB detection. Also, HIV-positive prevalence in TB cases are set using values for as many states as is known in 2008. Zonal averages of TB-HIV prevalence rates are computed, which are used for the states with unknown HIV-positive prevalence. It is assumed that the number of people living with HIV/AIDS (PLWHA) tested for TB co-infection increases moderately over time.

Figure ES-1 shows the distribution of total costs by zone under the *Baseline* scenario. The highest needs are in the northwest and southwest zones.

Two alternative policy scenarios are highlighted in the study. Both concern potential changes to TB-related policies under discussion in Nigeria, based on general policy directions set by the World Health Organization under its Stop TB Initiative. Of these scenarios, the second, *Enhanced DOTS*, assumes that advocacy, communication and social mobilization (ACSM) and community-based TB control (CTBC) activities lead to enhanced notification and registration, causing the new registered case rate per 100,000 individuals to increase year on year from 2008 to 2012 at 5 percent per year. The deepening of the quality of DOTS treatment is assumed to lead to a 5 percent increase in cure and completion rates

for both Category I and II DOTS cases, with the increase applied uniformly to the distinct 2007 rates in each state, and then applied per cohort year 2008-12.

FIGURE ES-1. BASELINE SCENARIO COSTS BY ZONE: DOTS (INCL. INPATIENT CARE), ALL TB-HIV, MDR-TB (US\$ MILLION)



The third policy scenario, *DOTS-Plus and TB-HIV*, is the same as *Enhanced DOTS*, except that it ramps up services for MDR-TB and HIV-TB. This scenario assumes that active detection for first-line drug-resistant *M. Tuberculosis* occurs at the point of registration of new (never-treated) TB cases, and a percentage of these are separated for MDR-TB detection (culture/drug susceptibility testing) and treatment with second-line drugs. For the detection of TB among PLWHA, the *DOTS-Plus and TB-HIV* scenario assumes that the number tested per year increases at a rate of 5 percent per year from the number tested in 2007.

Table ES-2 shows the results across the three scenarios costed using the tool. These scenarios are set at the national level. The software costing tool also allows the user to set disaggregated scenarios, by varying the growth in new registered cases over time across different zones.

TABLE ES-2. OUTCOMES, CASELOADS, AND COSTS UNDER THE THREE SCENARIOS

	Baseline	Enhanced DOTS	DOTS-Plus and TB-HIV
Deaths from TB			
2008	3,544	2,999	N/C
2012	4,027	3,960	N/C
DOTS caseload			
2008	56,187	57,712	N/C
2012	63,820	76,192	N/C
MDR-TB caseload			
2008	217	162	1,121
2012	256	199	1,467
TB-HIV caseload			
2008	3,789	3,908	N/C

	Baseline	Enhanced DOTS	DOTS-Plus and TB-HIV
2012	4,303	5,160	N/C
HIV/TB caseload			
2008	15,695	15,695	16,268
2012	16,527	16,527	19,774
TB inpatients (not including MDR-TB)			
2008	4,157	3,739	N/C
2012	4,723	4,936	N/C
Total costs (US \$ millions)			
2008	\$12.17	\$11.61	\$14.42
2009	\$13.20	\$12.95	\$16.16
2010	\$14.28	\$14.49	\$18.14
2011	\$15.44	\$16.21	\$20.37
2012	\$16.71	\$18.15	\$22.87

Note: N/C – no change from previous column

This study also estimated the human resource costs of the TB program over time. An earlier study by the Partners for Health Reform *plus* project (Chankova et al. 2006) had made available estimates of the time spent by various types of health worker on a DOTS patient encounter. The current study assumes that a certain proportion of DOTS cases are seen at the primary health care level by the community health care worker (CHEW) vs. those seen in the secondary/tertiary levels of the health care system (56 percent and 44 percent respectively). Using assumed values for the number of encounters for each type of health care worker per case over the course of treatment, we estimate the number of full-time equivalent (FTE) workers needed to service the cohorts of registered TB and TB-HIV cases (see Table ES-3, and Chapter 3, Figure 3). This analysis of FTE workers needed is for the *Enhanced DOTS* scenario.

TABLE ES-3. SUMMARY OF FTE HUMAN RESOURCES FOR HEALTH REQUIRED FOR DOTS ONLY, IN THE ENHANCED DOTS SCENARIO

	2008	2009	2010	2011	2012
Doctors	8	9	9	10	11
Interns	7	7	8	8	9
Staff nurses	127	134	142	151	160
Midwives	89	94	100	106	112
Nurse assistant	170	180	191	202	214
CHEW (all types)	279	295	313	332	352
Lab technician	206	218	231	245	260
Pharmacy technician	72	76	81	86	91

Note: Does not include tertiary staff involved in inpatient care for DOTS and MDR-TB patients.

The information obtained from this study provides stakeholders, including the Government of Nigeria, with key costing data as well as information on other aspects of providing services for TB and TB-HIV cases. In the future, USAID/Nigeria and the Federal Ministry of Health, in collaboration with the Health Systems 20/20 project, plan to use the costing data to provide estimates of the cost of scaling up services under different scenarios. Researchers also hope that some of the non-cost issues that came to light during this study will provide avenues for further discussion and research in Nigeria.

The following recommendations can be made to TB policymakers in Nigeria at the state and federal levels, especially staff at the NTBLCP, and the TB-related staff in the donor community:

- Consider using the costing tool for new cost estimations of running the state-level TB-DOTS programs in each Nigerian state.
- Consider using the costing tool to identify financial gaps by region or state, or by particular donor regional focus. For example, it can be used to focus on the total direct costs in USAID-supported states.
- Support the training for and institutionalized use of a costing tool such as this by NTBLCP planning staff, and interested stakeholders.
- Review the planning for expanded MDR-TB services from a cost perspective. The costs of treating MDR-TB remain very high even if the associated drug costs are reduced in the future. Therefore, spending more on further deepening the quality of initial DOTS - in terms of higher provider involvement in close supervision of DOTS patients and better drug-management - will be prudent. Such spending reduces the overall costs of the TB treatment program at the margin by decreasing drug resistance, as manifested by reduced rates of treatment failures in Category I & II patients, and ultimately is beneficial by preventing higher rates of MDR-TB in previously treated cases.

I. BACKGROUND AND PURPOSE

I.1 BACKGROUND

Nigeria's tuberculosis (TB) burden is the fifth highest in the world based on 2006 data, and the highest in Africa. National incidence of new registered TB cases per year – both pulmonary TB (PTB) and extra-pulmonary TB (EPTB) cases – was estimated at 58 per 100,000 population as of 2007. However, this rate, which drives utilization of TB services in the country, varies widely across states. For example, the Federal Capital Territory and the Northern state of Kwara had a new case registration rate per year of less than 20 per 100,000, while the rate is more than 100 per 100,000 in the southern states of Lagos and Anambra (National TB and Leprosy Control Programme [NTBLCP] 2007a).

There is a considerable burden of TB-HIV co-infection, which complicates disease management and is worsening outcomes by increasing mortality among HIV-positive patients with untreated TB, and by increasing active TB rates and hence mortality in TB patients immuno-compromised due to HIV.

By 2008, Nigeria is likely to complete the expansion of standard Directly Observed Short-course Therapy (DOTS) for TB to almost 100% of the local government areas or LGAs. Currently, 100% coverage in LGAs has mainly been achieved in USAID-supported states. In other states, by 2007, the status of the expansion in DOTS coverage was such that nine out of ten LGAs were providing DOTS, though the implementation of correct DOTS guidelines requires more monitoring. These DOTS activities are supported by 794 TB microscopy laboratories.

The challenge now is to match the expanded coverage with deepened quality of the existing DOTS apparatus such that detection and treatment improve, and hence TB outcomes improve for the population. In addition, the NTBLCP, with the participation of donor partners, is expanding access to coordinated TB-HIV services, as well as applying the DOTS-Plus model to cater to the detection and cure of MDR-TB.

Given this expansion in scale as well as deepening of TB services, it is important to understand the requirements for *financial* as well as *human resources* for sustaining these programs in the future. This study provides the results of a comprehensive costing of the future of the TB control program. The results are framed using several scenarios, described below, that simulate the potential effects of ongoing TB policy developments on the incidence of new registered TB cases per year from 2008 to 2012. Given the emphasis on sustainability in an era of scale-up, this study focuses on the recurring, *direct* costs of providing TB services. Fixed, one-time costs of infrastructure, such as capital investment to set up a reference laboratory, are not a focus. Lack of data on the overhead and administrative costs of facilities meant that indirect costs of service provision are not calculated here. The analysis is backed by actual program data, tabulated by state where possible. Unit costs of drugs and diagnostics, and imputed value of labor inputs per case are estimated and assumed common to all states. These were sourced from an earlier study in Nigeria by the Partners for Health Reform *plus* project (Chankova et al. 2006) as well as document review conducted in July and August 2008.

Three policy scenarios are applied to the years 2008-12, based on the NTBLCP strategy in Nigeria as well as the global policy trends for TB. The first is a *Baseline* scenario that assumes moderate growth in the registered caseload and no change from the 2007 rates of sputum smear positive (ss+), sputum

smear negative (ss-), and *EPTB* case types within new registrations, or in the cure and completion rates in the cohorts placed on DOTS. The next scenario, *Enhanced DOTS*, assumes 2 percent growth per year in the caseload over 2008-12, and a 5 percent increase in the cure and completion rates for Category I and II DOTS cases. The final scenario, *DOTS-Plus and TB-HIV*, uses the *Enhanced DOTS* settings as base and adds expanded coverage of MDR-TB and TB-HIV. These scenarios are described more fully below.

An *MS-Excel software tool* was created for this study. It generates the cohorts based on parameters modified by the user from some preset values, and applies to them unit cost values to generate the overall costs. The parameters control future registrations of new cases, distribution of ss+ and ss- within new cases, rates of pediatric and MDR-TB, as well as cure and failure rates, etc., for standard DOTS treatment. Considering the variation in TB incidence and in the service delivery by state and zone, the results from the tool can be viewed at a disaggregated level. It is possible to focus only on states supported by USAID. This customizable, user-friendly tool is delivered with this document.

This study is organized as follows: this first chapter presents the background for the TB control program, including epidemiology, and case detection and treatment, and discusses the budget for the NTBLCP. The second chapter discusses the cohort model and economic cost estimation as implemented in MS-Excel software. It also discusses the necessary assumptions behind the scenarios. The third chapter presents the results by scenario, beginning with the estimated unit costs per patient for each of the major TB services; total costs of TB services under various scenarios of service expansion and quality deepening; and finally, the human resources for health (HRH) requirements under the scenarios. The fourth chapter concludes with a discussion of the findings and next steps.

I.2 BURDEN OF TB IN NIGERIA

The incidence of TB – of all new case types – has been near constant as a proportion of the Nigerian population (between 0.05-0.06 percent), potentially as a result of better case detection and stronger preventive efforts. The expansion of DOTS (see Table 2, in next section) has also meant that a larger proportion of the TB caseload has access to treatment, as well as counseling for better lung health, with its benefits for reducing the risk of transmission.

Table I describes the evolution of the disease in Nigeria over the past six years. The estimated level of ss+ cases has been based on a rate established from prevalence studies in the early 1990s, and as such is a less reliable indicator of the trend in the prevalence of active TB in the population. The registered and detected rate of ss+ cases – 44,016 cases in 2007 – has grown 10 percent from its 2006 level, while the total number of new cases increased 17 percent. Encouragingly, the growth in relapse, default, and failure cases, associated with poor treatment adherence or treatment complications, has slowed in recent years. However, this has to be balanced against the rise in the number of MDR-TB cases seen in Nigeria.

The incidence of MDR-TB has been a phenomenon in the countries of the former Soviet Union and in recent years also in sub-Saharan Africa, especially South Africa. These cases do not respond to conventional first-line drugs that are part of the conventional DOTS intensive and continuation phases. The incidence of MDR-TB in never-treated patients registering for DOTS among countries in Nigeria's region averages about 1.9 percent, according to the World Health Organization (WHO). Actual data on MDR-TB case detection in Nigeria is still hard to get. However this may change with more extensive and active detection via culture laboratories and drug-resistance testing that will occur in the future with the scale-up of MDR-TB activities in the country. There is as yet little information on extensively drug-resistant TB (XDR-TB) in Nigeria.

TABLE I. PREVALENCE AND INCIDENCE OF TB BY TYPE IN NIGERIA, 2002-2007

	2002	2003	2004	2005	2006	2007
Population	120,580,284	123,956,532	127,427,315	130,995,280	134,663,148	139,305,802
Estimated ss+ cases	120,580	123,957	129,976	133,615	137,356	142,092
New ss+ cases detected	19,699	28,173	33,755	35,048	39,903	44,016
New ss- cases	8,021	13,276	20,134	22,705	25,782	32,088
Total new PTB (ss+, ss-)	27,720	41,449	53,889	57,753	65,685	76,104
New EPTB	1,049	1,525	1,876	2,836	2,975	4,044
Total new cases	28,769	42,974	55,765	60,589	68,660	80,148
Relapse	1,012	1,210	1,481	2,009	2,074	2,269
Failure	419	888	662	1,056	787	835
Returned after default	798	1,263	1,278	1,802	1,336	1,303
Others	166	138	1,104	1,392	1,368	1,686
Total retreatment	2,395	3,499	4,525	6,259	5,565	6,093

Source: NTBLCP (2007a)

1.3 TRENDS IN TB CASE DETECTION AND TREATMENT

As Nigeria has increased access to DOTS – measured on a geographical coverage basis by the number of states and LGAs with DOTS available – the case notification and detection rates have also increased (Table 2). The case notification rate is expressed per 100,000 persons, as the sum of the rates of total new and relapse cases. The case detection rate is a ratio of the new detected ss+ cases per year and the estimated total ss+ cases in the population, and is expressed as a percentage. It is expected that 100 percent coverage of LGAs will be reached by late 2008. It remains for the quality of DOTS to be brought up to national standards in all these areas.

TABLE 2. SERVICE ACHIEVEMENTS IN TB DETECTION AND TREATMENT

	Dec. 2001		Dec. 2002		Dec. 2003		Dec. 2004		Dec. 2005		Dec. 2006		Dec. 2007	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
States with DOTS	21	57%	27	73%	36	97%	37	100%	37	100%	37	100%	37	100%
LGAs with DOTS	350	45%	380	49%	440	57%	505	65%	548	71%	650	84%	701	91%
TB microscopy centers	417		437		493		547		592		694		796	
TB treatment centers	1,605		1,665		1,725		1,929		2,015		2,219		2,321	
Case notification rate per 100,000	N/A		25		36		45		48		53		59	
Case detection rate (%)		16%		16%		23%		27%		28%		30%		35%
Treatment success rate (%)		79%		79%		79%		73%		75%		76%		79%
Treatment default rate (%)		11%		11%		6%		12%				12%		11%
Death rate (%)		6%		8%		3%		6%		N/A		11%		6%

Source: NTBLCP (2007a); other

The treatment success rate suffered some years of slippage (2004-06) before regaining previous levels. This improvement is potentially a result of a recommitment to the quality of DOTS provision in a period of scale-up, and increased adherence counseling for patients on medication. However, the case detection and treatment success rate are still a ways from the targets set by the NTBLCP for 2010: 70 percent and 85 percent respectively. Tables A-2 and A-3 in Annex A provide the treatment outcomes for the cohort registered for DOTS in the public sector over 2007-08. Rising rates of TB-HIV co-infection may be another reason why treatment outcomes have stagnated. HIV co-infection raises the risks of recurrent TB, which may be due to endogenous reactivation or exogenous re-infection (Federal Ministry of Health [FMOH] 2007). However, integrated TB-HIV detection and management has improved in Nigeria given greater policy focus on the issue. Table 3 provides details on achievements as well as targets.

TABLE 3. TB-HIV COLLABORATIVE ACTIVITIES: ACHIEVEMENTS AND TARGETS

Indicator	2007	2008	2009*	2010*
Proportion of TB patients tested for HIV and counseled	59.5%	68.0%	76.5%	85.0%
Proportion of HIV+ TB patients completing 6 months of CPT (only)	30.4%	38.8%	48.8%	61.2%
Proportion of PLWHA screened for TB	47.6%	54.6%	61.6%	68.7%
Proportion of newly diagnosed PLWHA, no TB, completing IPT	19.0%	19.0%	19.0%	19.0%
Proportion of HIV+ TB patients receiving care and support	70.0%	80.0%	90.0%	100.0%

Source: NTBLCP (2007b)

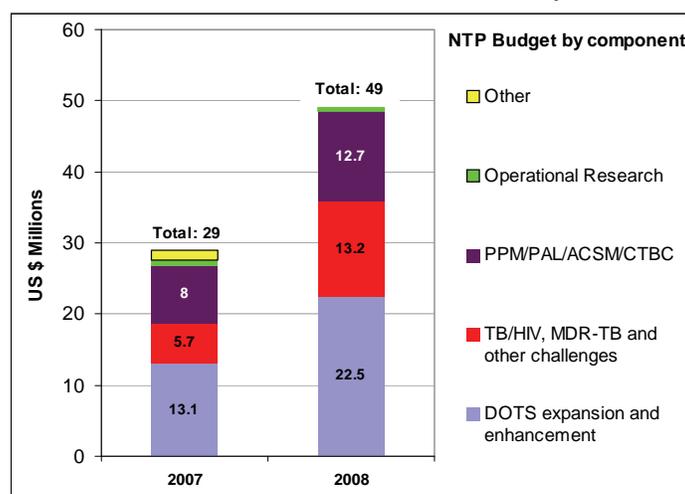
Note: CPT—co-trimoxazole preventive therapy; PLWHA—people living with HIV/AIDS; IPT—isoniazid preventive therapy

* Targets

I.4 BUDGET FOR THE TB CONTROL PROGRAM

The budget requirement for the NTBLVP has grown substantially since 2006 (actual expenditure: \$25 million), with the approval of Nigeria’s proposal for Round 5 of the Global Fund to Fight AIDS, Tuberculosis and Malaria (GF). The budget for 2008 is \$49 million. Both DOTS and TB-HIV/MDR-TB activities were expanded in recent years (Figure I). Funding has been available since 2003 for new approaches such as advocacy, communication and social mobilization (ACSM) and community-based TB control (CTBC). The NTBLCP reported a financing gap of \$30 million for 2008 (\$8.7 million for 2007), with more than \$20 million of this gap ascribed to DOTS, MDR-TB, and TB-HIV service provision needs (WHO 2008a).

FIGURE I. NTBLCP BUDGET BY LINE ITEM (US\$ MILLION)



Source: WHO (2008a)

In addition to the NTBLCP budget, the WHO has estimated the total costs of clinic visits and hospitalizations for PTB and EPTB patients at \$13 million in 2007, and \$31 million for 2008 (WHO 2008a). The large rise in 2008 is driven in their model by an increase in the expected number of patients to be treated.

The costs under the DOTS line item (\$22.5 million in 2008) are split as shown in Table 4. The budget for first-line drugs used to treat Category I and II TB patients has risen substantially, as has the funding for consumables and preliminary capital investment for TB laboratory services. However, it is reported that much of the financing gap under DOTS is due to a remaining need to fund laboratory services. This indicates it is imperative to estimate what future laboratory costs may be from an “ingredients of unit cost” perspective.

TABLE 4. DISTRIBUTION OF NTP BUDGET FOR DOTS EXPANSION AND ENHANCEMENT (US \$ MILLIONS)

DOTS Cost Heading	2007	2008
First-line drugs	1.22 (9%)	5.4 (24%)
NTBLCP staff	2.9 (22%)	5.4 (24%)
Program management and supervision	6.38 (49%)	2.94 (13%)
Lab supplies and equipment	2.61 (20%)	8.82 (39%)
TOTAL (DOTS)	\$13.1 mil. (100%)	\$22.5 mil. (100%)

Source: WHO (2008a)

I.5 SECTION CONCLUSIONS

Nigeria’s NTBLCP has made good progress in increasing coverage of DOTS services to most geographical areas. However, the deepening of the quality of clinical services is still an unfinished task. Field responses gathered by Health Systems 20/20 staff indicate that “full DOTS,” i.e., actually observed first-line therapy using the prescribed drugs at recommended intervals, may not be occurring in all the LGAs that are supposedly offering DOTS.

The case registration rate has steadily grown, bringing more TB-infected individuals under the purview of a managed treatment program. This will have beneficial effects on incidence, supported by existing programs for better lung health and other public information campaigns. Since true current TB prevalence and incidence are largely unknown in the absence of a population-based study, we cannot hypothesize whether the DOTS program is treating an increasing proportion of the estimated ss+ population per year.

While the NTBLCP treatment budget is large (and we will analyze the sustainability of treating projected DOTS cohorts in this regard), the ever-increasing need for TB treatment implies that prevention should be key. Since MDR-TB may be a challenge for the future, prevention of TB infection, and, for those infected, improving DOTS clinical care and adherence, should be priorities.

In this context, the achievement in treatment outcomes varies across states. While some states (Sokoto, Oyo) achieved cure rates in excess of 85 percent in 2007, others had rates below 40 percent (see the

states' treatment outcome rates for Category I DOTS in Table A-2, Annex A). Several states (Nasarawa, Borno, and Taraba) had a double digit death rate, and others were close to it, which implies a need for deepening the quality of DOTS clinical services, better training for DOTS staff, and the implementation of clinical guidelines as already established at the federal level.

In the analysis to follow, we explore the resource implications of policy actions that can be taken to deepen the quality of DOTS offered in Nigerian states. It is hoped that the costing tool developed for this report can be used by NTBLCP staff for exploring further policy options in this regard.

2. METHODOLOGY

2.1 OVERALL APPROACH

The primary goal of this analysis was to estimate the direct marginal costs of providing TB and TB-HIV services through public sector facilities in Nigeria in 2008, and project the aggregate financial resources associated with direct costs of these services as required over 2008-12 for different scenarios of the increase in caseload. The general methodology applied for this part of the study was to determine unit costs for the provision of TB DOTS for Category I patients, TB DOTS for Category II patients (retreatment cases), TB inpatient care excluding MDR-TB care, TB-HIV services including testing, and the detection and treatment of MDR-TB. Estimates were based on the required inputs of drugs, tests, labor, and equipment, on a per-patient or per-service basis. In addition, this study estimated the likely HRH requirements to meet TB DOTS and TB inpatient care service load, as per the scenarios. The reference year for all estimates was 2008, and the exchange rate used was US\$1=115 Nigerian naira.

2.2 DATA SOURCES

A variety of sources were consulted to get background cost and service information. Health Systems 20/20 staff as well as a local consultant visited with NTBLCP officers as well as certain facilities around Abuja to acquire programmatic documents and drug/equipment price lists. Most of these former sources were official government documents from the NTBLCP as well as the FMOH. A list of the data items and the sources are provided in Table 5.

TABLE 5. DATA REQUIREMENTS AND SOURCES

Data Type	Source
Distribution of new registered DOTS cases across categories (ss+, ss-, EPTB)	Province DOTS records, NTBLCP
MDR-TB rates in never-treated cases	MDR-TB coordinator
Treatment outcomes (success, failure, deaths, retreatment) by category	Province DOTS records, NTBLCP
Prevalence of HIV+ in new TB cases; % co-infection with TB in PLWHA	National TB-HIV coordination committee, NTBLCP
Unit costs of drugs, consumables, labor, test kits, other recurring costs.	Facility visits, GF proposals, expert consultation, documents
Labor input into DOTS encounters and inpatient care, by type of worker	Facility survey (Nigeria), or time-motion surveys, provider logbooks

2.3 STEPS IN THE ANALYSIS

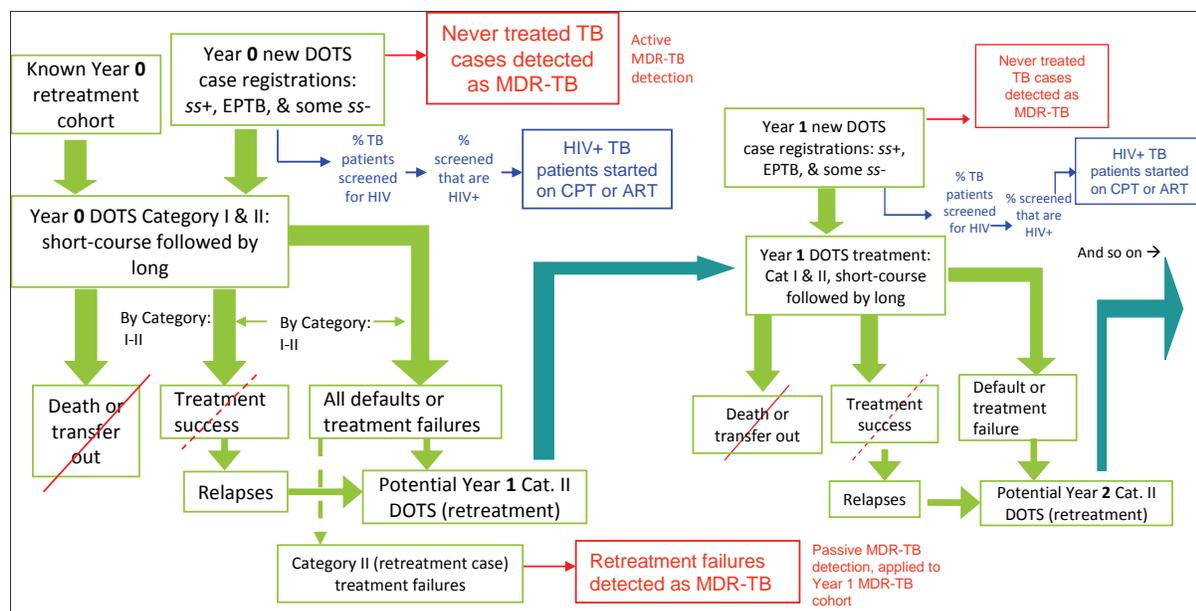
The study followed a structured approach to set up the data collection and the following analysis:

1. *Define the services to be costed:* first-line TB treatment involving outpatient DOTS, both adult and pediatric (under 14 years), and inpatient care for severely ill cases; TB-HIV services for PLWHA with TB co-infection and for HIV-positive individuals detected in the DOTS program; and MDR-TB cases that require inpatient care.
2. *Gather data on case distribution and treatment outcomes, by province* for Category I cases (short course chemotherapy [SCC], mostly for new cases of PTB ss+ and EPTB), Category II (SSC for retreatment of ss+ relapses and failure cases after SCC, and ss+ patients who have received anti-TB treatment for more than one month in the past), and pediatric cases of both categories.
3. *Gather data on recurring costs:* drugs, kits, test materials, equipment running costs, and public sector health worker salaries (sources listed in Table 5 above).
4. *Gather data on labor input per type of TB service:* e.g., DOTS encounters, inpatient care for TB and MDR-TB, based on a prior study (Chankova et al. 2006).
5. *Define scenarios* for change in the service load over time. These scenarios are listed in more detail below. Scenarios were defined based on changes to the service rates for:
 - New registered cases for DOTS: PTB ss+, ss-, EPTB
 - HIV-positive rate in new TB cases; TB co-infection in PLWHA
 - MDR-TB detection among never-treated active TB
6. *Calculate the treatment cohorts for DOTS* for each year 2008-12 (both categories) using the cohort model programmed in the MX-Excel tool, as discussed in section 2.3 below. These cohorts vary based on changes to the case registrations under certain scenarios. Also, the treatment cohorts for TB inpatients, TB-HIV, and MDR-TB are calculated and varied by scenario using the tool.
7. *Conduct cost analysis* in the MS-Excel costing tool which uses a 'bottom-up' or ingredients-based approach to first calculate the unit cost per unit of service (per DOTS patient year) and then multiply such unit costs by the service load (cohorts of registered DOTS patients per year, 2008-12). Similar unit costs were calculated for TB-HIV services and MDR-TB.
8. *Conduct HRH requirement analysis* in the MS-Excel costing tool, using the labor input per unit of service, and then projecting the numbers of health workers required to meet the treatment needs of the projected cohorts per year.
9. *Compare scenario results and evaluate cost implications of potential policy actions* using the MS-Excel costing tool. These results have been used to write this final report.

2.4 TB COHORT MODEL

The model used to estimate successive cohorts for each year 2008-12 is shown in a simplified form in Figure 2. This figure does not show the methods used to estimate the Category I cases in each year from the total new case registration. It also doesn't show the TB inpatient group for each year that derives from the severely ill cases within the cohort placed on DOTS every year. Those excluded processes are described in the text further below (see *Cohorts for TB-DOTS*).

FIGURE 2. COHORTS FOR TB-DOTS AND TB-HIV*, PLUS MDR-TB DETECTION**



* Shows HIV+ individuals detected in the DOTS program and placed on CPT or ART, but not HIV+ with TB put on DOTS.

** Year 1 passive MDR-TB detection (applied to Year 2 MDR-TB cohort) is not shown in the figure, but is the same as year 0.

In general, the cohorts in Figure 2 can be divided into three conceptual groups: the cohorts for TB-DOTS (further subdivided into Categories I and II); the cohort of new TB case registrations that are HIV positive and are placed on CPT or antiretroviral therapy (ART), and the HIV-positive co-infected with TB that are placed on DOTS; and finally the cohort for MDR-TB, based on the mode of case detection – active or passive. The method to calculate each of these cohort groups is discussed in the text further below. In Figure 2, the schematic for year 0 (2007, on the left side) is specific to the beginning of the cohort sequence. The schematic for year 1 (2008) repeats for the subsequent years (2009-12).

Cohorts for TB-DOTS: With the actual cohorts per state across Categories I and II for year 2007 (year 0) as the base, the Category II cohorts for year 1 are calculated by applying the treatment outcome rates for Categories I and II, by state, to this base. Category I cases for year 1 and every year thereafter are based on total new TB-DOTS case registrations, adult and pediatric. Category II (retreatment) cases are discussed further below. The total new case registration for DOTS in each state, per year, is subdivided into PTB ss+, ss-, and EPTB using the percentages from 2007 (based on actual data). It is assumed that these Nigerian state-specific percentages related to activation or complication of TB infection in new DOTS patients do not change across the study period 2008-12. As the definition on the previous page implies, Category I cases are the active TB cases, i.e., PTB ss+ and EPTB. The ss- cases among the new registrations are excluded from the DOTS program and disregarded. A modifiable proportion of the

Category I cases are considered to be pediatric Category I cases (the same proportion is applied to adult Category II cases).

The total new case registration is calculated for year 1 onward as per a rate per 100,000 persons applied to the state population. These rates for year 1 are a fixed percentage increment on the rate in year 0, which was calculated from the actual new case registration per state in 2007, and the state population of that year. Rates for year 2 are a similar increment on year 1, and so on. State populations are increased in each year using the Nigerian population growth rate per year, assumed as applicable to each state. The rate at which new case registration increases per year changes across the scenarios described below, but can also be directly modified in the costing tool, to fit different policy perceptions.

Retreatment cases (Category II) are constructed for each year from the population of relapses, treatment defaults, and treatment failures of the previous year. A modifiable percentage of those treated with DOTS in a year are assumed to relapse over the course of the year, and all are retreated in the following year (as part of Category II). This relapse percentage is set in the model based on 2007 data from Nigeria. A modifiable percentage of those who default in a year also return for retreatment in the following year and become another part of Category II. Finally, a certain modifiable percentage of Category I treatment failures of the year are considered for retreatment in the next year, as the final part of Category II. In each Category, the deaths and 'transfer outs' are removed from consideration for the cohorts in the next year. All these modifiable parameters (rates) are indicated in Table 6 below (section 2.4). Category I and II pediatric treatment failure and death rates are 110 percent of such adult rates. This is modifiable in the costing tool, with separate parameters for pediatric Category I and II cases.

While most TB-DOTS clinical services are outpatient, a certain proportion of active TB patients (PTB ss+ and EPTB) develop serious complications, which require inpatient care. Since the model estimates a sub-cohort of TB patients that die in each year, it can be safely assumed that the rate of hospitalization is highest in these fatal cases (Category I and II), with a smaller percentage of other active TB patients hospitalized (higher for Category II than I). The rates of hospitalization from fatal active TB cases as well as other active TB cases are set in the model at the national level, common across all states. They are modifiable by the user. The values used in the model are shown in Table 6 (see Section 2.5, below).

Cohorts for TB-HIV: Of the new registered TB cases per year, a certain proportion is screened for HIV co-infection. Of those found HIV positive, based on their clinical profile, a proportion are started on CPT or ART as required, instead of first-line TB drugs. This proportion tested differs by state, as does the HIV prevalence rate in those screened. Actual rates for TB patients screened for HIV, and the HIV prevalence rate in those screened are available for certain Nigerian states for 2007. From the available data, zonal averages were calculated and used to impute the rates for the states with missing rates. These rates were applied successively to the new TB case registrations per year to yield the TB→HIV+ population. To obtain the proportion put on CPT or ART from those found HIV positive, a modifiable percentage was used for the CPT caseload, and another for the ART caseload. Both of these latter percentages were fixed across states, and were derived from actual national-level data for the first quarter of 2008 (NTBLCP 2008b).

In 2007, 86,897 PLWHA were tested for TB co-infection at the national level in Nigeria. The number of PLWHA tested for 2008 was not available for this study. For the purposes of this analysis, it was assumed that the 2007 tested value grew by 1.3 percent every year thereafter in a "baseline" scenario. Other scenarios for the growth of this value are discussed further below. No actual data are available from Nigeria on the proportion of these tested that had active TB. Instead, the percentage of the PLWHA tested for TB who were placed on IPT, and the percentage of the same started on DOTS, were estimated, based on the service achievements in 2007 at the national level.

Cohorts for MDR-TB: Figure 2 above shows two modalities for the detection of MDR-TB cases. With passive detection, the NTBLCP recognizes MDR-TB cases by default as the treatment failures among Category II or retreatment cases. Because many of these cases were on first-line TB drugs, the failure of retreatment indicates that they were either initially infected with a resistant strain or re-infected at a later point after the cessation or default of the DOTS course. In addition, there could be active MDR-TB detection, using culture techniques, applied at the entry point of patients into the TB treatment program. The rate of MDR-TB case detection in these never-treated TB patients is set in the costing model as 1.9 percent, based on WHO estimates using multivariate regression.¹ In this costing study, all MDR-TB patients, when detected in the model, are placed on second-line drug regimens and given inpatient care in a tertiary institution.

2.5 ASSUMPTIONS AND FIXED PARAMETERS FOR THE COST ESTIMATION

For the purposes of this costing, DOTS was defined as the provision of directly observed treatment, via short-course (intensive phase) as well as long-course (continuation phase) regimens of first-line TB drugs in outpatient care. The split of regimens and the duration of intensive and continuation phases were derived from Nigerian TB clinical guidelines as well as the literature for practice in sub-Saharan Africa. The treatment regimens can be modified in detail within the costing tool in MS-Excel, from the mix of drugs, duration, and the pricing (Table 6). The regimens are defined and are editable separately for Category I and II, and for adult vs. pediatric in both Categories. The regimens as used for the costing conducted for this report are listed in detail in Annex A.

**TABLE 6. INITIALIZING PARAMETERS COMMON TO ALL SCENARIOS
(EDITABLE IN SOFTWARE TOOL)**

National new TB case registration rate per 100,000 (PTB ss+, ss-, EPTB), 2007	58
New pediatric case proportion as % of all adult TB cases, all states	2%
% of Cat. I treatment failures per year considered for treatment as Cat. II	80%
% of total treatment success cases, returning as “Relapsed” next year	7%
Percentage of cases Returning After Default in previous year	32%
Population growth rate per year, 2008-12	2.1%
Pediatric (age<14 yrs) treatment failure rate as % of adult failure rate	110% *
Pediatric (age<14 yrs) death rate as % of adult failure rate	110% *
Hospitalization: % of eventually fatal cases hospitalized in same year as death	80%
Hospitalization: % of Cat. I cases registered that are admitted in same year	2%
Hospitalization: % of Cat. II cases registered that are admitted in same year	5%

Applied uniformly to individual state's treatment outcome rates

In the tool, the point of outpatient service for DOTS can be split between primary and secondary institutions, with the former further split between community-level basic facilities with community health workers (CHWs), and more established primary health clinics. Both the latter and secondary institutions normally have staff of doctors, interns, and nurses/midwives who provide some of the DOTS

¹ The estimates of MDR-TB prevalence in Nigeria are from WHO's *Anti-tuberculosis drug resistance in the world, fourth global report* (2008b). In addition, this report states that the rate of MDR-TB in previously treated cases is about 9.3 percent. The true MDR-TB prevalence rate in the TB-infected population in Nigeria currently is unknown, but may be better estimated after the conclusion of planned population or sub-sample TB prevalence surveys with standard drug susceptibility testing.

outpatient care, from diagnosis to monitoring of the patient during the intensive phase. The split of labor for the provision of DOTS-related outpatient care can be set in the tool, i.e., percentage of encounters handled between doctors vs. interns; and further between doctors and interns vs. nurses and midwives. The labor (minutes) expended per encounter by various types of staff persons is set in the tool at the baseline based on values from a time motion observation study in the public health sector of Nigeria (Chankova et al. 2006). These values are listed in Annex A, Tables A-4 and A-5.

Laboratory work for DOTS outpatient care is taken to only involve Acid-fast Bacillus (AFB) tests with sputum smears, using standard microscopes. Confirmatory tests using culture/ drug susceptibility testing (DST) are assumed not be performed for standard TB (not MDR-TB). The reagents used for the staining were costed using the prices for Global Drug Facility (GDF) consumable kits as reported for Nigeria's Round 8 GF proposal. Additionally, the cost of replacing microscopes was added per year, with the number of microscopes to be replaced and the price also sourced from the Round 8 proposal.

For TB→HIV+ cases started on CPT only, the length of daily cotrimoxazole 480mg therapy was set at 48 weeks based on clinical guidelines. For those TB→HIV+ cases started on ART, the drug regimens offered were the standard length of Non-nucleoside Reverse Transcriptase Inhibitor (NNRTI)-based fixed-dose combinations (details provided in Annex A), as per the Nigerian HIV/AIDS clinical guidelines, and the prices, separate for each drug combination, were sourced from the Round 8 GF proposal. For HIV+→TB cases with latent TB, a proportion is offered IPT. The regimen for the calculation was set from clinical guidelines (details in Annex A), and the cost of the drugs were based on international published prices for loose Isoniazid 300 mg pills.

MDR-TB was assumed to be confirmed with a rapid molecular Polymerase Chain Reaction (PCR) assay using culture isolates, as is becoming more common in developing country settings than standard DST. The equipment used in a Nigerian culture laboratory setting, and the unit prices as well as price per test of processing and PCR reagents and PCR equipment were sourced from a field visit to a public sector laboratory near Abuja in August 2008. The total cost of a PCR-type molecular assay for MDR-TB as used in this study thus reflects the direct cost of reagents as well as the straight-line depreciation of the equipment.

For the treatment of MDR-TB, it was assumed that all patients with confirmed drug-resistant TB were transferred to inpatient care. The still-manageable number of MDR-TB patients in Nigeria currently makes this possible; however as an assumption it can be questioned if the MDR-TB caseload increases dramatically with the addition of active detection in never-treated cases – as happens under the *DOTS-Plus and TB-HIV* scenario discussed below. The length of hospitalization is discussed in the next paragraph. Second-line TB drug regimens used in this costing were as per WHO guidelines, with prices sourced from the Round 8 GF proposal as well as internationally published GDF price lists for developing countries. All prices were inflated by a set percentage to reflect insurance, freight/shipping, and storage and handling costs (details in Annex A).

As mentioned previously, a certain proportion of severely ill DOTS outpatient cases need to be hospitalized every year. The length of hospitalization for such DOTS cases was set at 21 days for each Category I DOTS case hospitalized, and 28 days for Category II and fatal cases. It was assumed that an MDR-TB case required earlier hospitalization to isolate the case from the public and manage the treatment. The length of hospitalization for such cases was set at 56 days. The values are assumed, but reflect consultation with global TB experts and the literature. The WHO report on global TB control (2008a) (Nigeria country annex) uses 56 days of hospitalization for any TB inpatient. This was considered to be excessive for the Nigerian context, and was instead set as the likely length of hospitalization for an MDR-TB case only. While hospitalized, patients incur feeding and bed supplementation costs of \$10 per day (as per Round 8 GF proposal), assumed to be the same regardless of the clinical complications.

2.6 COST SCENARIOS

Three scenarios were costed. The *Baseline* scenario assumes that the current rate of new case registrations per 100,000 population will increase moderately (1.1 percent per year) with the availability of DOTS in almost 100 percent of the LGAs, in the absence of any enhanced social mobilization, information campaigns, etc. to increase case notification and testing. Rates for cure, completion, et al., in Category I and II DOTS remain at the values that were achieved in 2007 for each state. Scenarios are detailed in Table 7.

TABLE 7. SCENARIOS USED IN THIS COSTING STUDY

	Baseline	Enhanced DOTS	DOTS-Plus/TB-HIV
Growth in new TB case registration, per year, 2008-12	1.1%	5%	5%
Category I treatment outcome rates per state: cured / completed / failed / death / defaulted / transfer out	Set as per actual data from 2007 (last complete year) for each state	5% (not percentage points) increase in cure and completion rates from baseline scenario, applied to individual rates for all states	5% (not percentage points) increase in cure and completion rates from baseline scenario, applied to individual rates for all states
Category II treatment outcome rates per state: cured / completed / failed / death / defaulted / transfer out	Set as per actual data from 2007 (last complete year) for each state		
MDR-TB case detection	<i>Passive only</i>	<i>Passive only</i>	<i>Passive and active (at 1.9% of new active cases: PTB ss+ and EPTB)</i>
% of HIV+ TB patients started on CPT, all states	18% (2008 Q1 rate)	18% (2008 Q1 rate)	18% (2008 Q1 rate)
% of HIV+ TB patients started on ART, all states	7% (2008 Q1 rate)	7% (2008 Q1 rate)	7% (2008 Q1 rate)
Growth in HIV+ caseload tested for TB, per year, 2008-12	1.3%	1.3%	5%
% of those HIV+ and tested for TB that are placed on DOTS, all states (<i>note this is not from those ss+</i>)	17.74% (2008 data)	17.74% (2008 data)	25%
% of those HIV+ and tested for TB placed on IPT, per year, 2008-12 (<i>note this is not from those ss+</i>)	0.09% (2008 data)	0.09% (2008 data)	1.2%

Note: Q1-quarter 1

Two other scenarios are highlighted in the study. Both concern potential changes to TB-related policies under discussion in Nigeria based on general policy directions set by the WHO under its Stop TB Initiative. Of these, the first alternative policy scenario, *Enhanced DOTS*, assumes that ACSM and CTBC activities lead to enhanced notification and registration, causing the new registered case rate per 100,000 individuals to increase year on year from 2008 to 2012 at 5 percent per year. The deepening of the quality of DOTS treatment is assumed to lead to a 5 percent increase in cure and completion rates for both Category I and II DOTS cases, with the increase applied uniformly to the distinct 2007 rates in each state, and then applied per cohort year 2008-12. The second policy scenario, *DOTS-Plus and TB-HIV*, is the same as the *Enhanced DOTS* scenario, except it ramps up services for MDR-TB and HIV/TB. This scenario assumes that active detection for first-line drug-resistant *M. Tuberculosis* occurs at the point of registration of new (never-treated) TB cases, and a percentage of these are separated for MDR-TB detection (culture/DST) and treatment with second-line drugs. For the detection of TB among PLWHA,

the *DOTS-Plus and TB-HIV* scenario assumes that the number of HIV positive tested per year for TB co-infection increases at a rate of 5 percent per year from the number tested in 2007.

2.7 METHODOLOGY TO ESTIMATE HRH REQUIREMENT FOR TB TREATMENT

Labor costs associated with TB services included time for patient consultations, collecting and analyzing sputum specimens for diagnosis and follow-up, performing and analyzing x-rays for diagnosis, and observing patient treatment (where relevant). It was assumed that standard DOTS is being followed in the facilities. A full-time equivalent (FTE) staff member for a given service (e.g., DOTS) is a health professional who is spending all his/her working time allocated for patient visits to provide that service. For example, a doctor in the public sector in Nigeria has 221 working days per year and spends about 6.5 hours each working day attending to patients.² For each of the TB treatment services included in the costing, the FTE-HRH calculations use the average time for one patient encounter/test reported by each staff type providing the service (in the facility survey). These average times as detailed in Annex A, Table A-4, are from a previous study (Chankova et al. 2006). The number of encounters per year required for each treatment service – DOTS outpatient and TB inpatient – are based on the DOTS and inpatient TB (including MDR-TB) cohorts per year, multiplied by the expected number of clinical diagnosis, treatment monitoring, and DOTS “observed drug intake” encounters per patient year. The formula used is provided below:

$$\text{FTE number of staff of type X required for year T} = \frac{(\text{Total number of DOTS cases for year T} \times \text{No. of encounters per year per DOTS case} \times \% \text{ of all DOTS cases seen at this level} \times \% \text{ of encounters dealt with by staff type X})}{(\text{Total time worked per year for staff type X} \div \text{Average time spent per patient encounter by staff type X})}$$

Example: Nurse assistants spend an average of 15 minutes per DOTS encounter base, and belong to the primary (clinic) or secondary level of the public health system. It is assumed that the nursing staff in these levels see 44 percent of DOTS encounters (monitoring drug intake, taking clinical samples) while CHWs see 56 percent of the same at a primary (community) level. During the year, given two months of intensive and six months of continuation regimens, there are about 60 encounters with nursing staff. Of these, we assume that across the primary (clinic) and secondary level, nurse assistants conduct about 50 percent of encounters, with the rest conducted by staff nurses and/or trained clinic midwives. Total minutes worked per year equal 86,190. With 59,897 standard DOTS cases in 2010, 139 FTE nurse assistants would be needed.

A similar methodology and formula was used to estimate the FTE of staff required to perform inpatient TB services.

² Public health sector employees in Nigeria have 221 working days per year net of holidays, vacation days, etc. Each staff member works for eight hours a day and spends 1.5 hours for lunch, tea breaks, and administrative tasks and staff meetings.

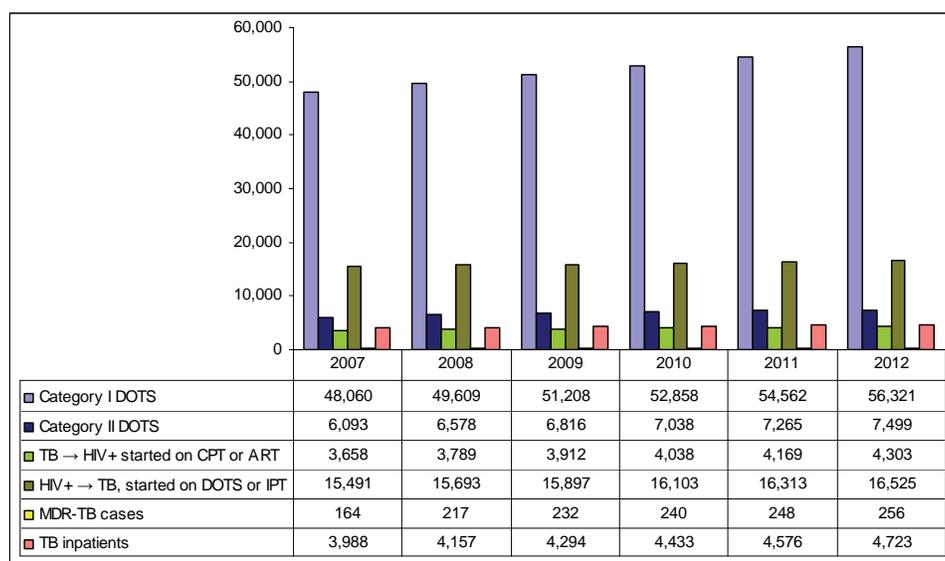
3. FINDINGS AND DISCUSSION

This section presents the results of costing the treatment services and scenarios discussed above.

3.1 TB TREATMENT COHORTS

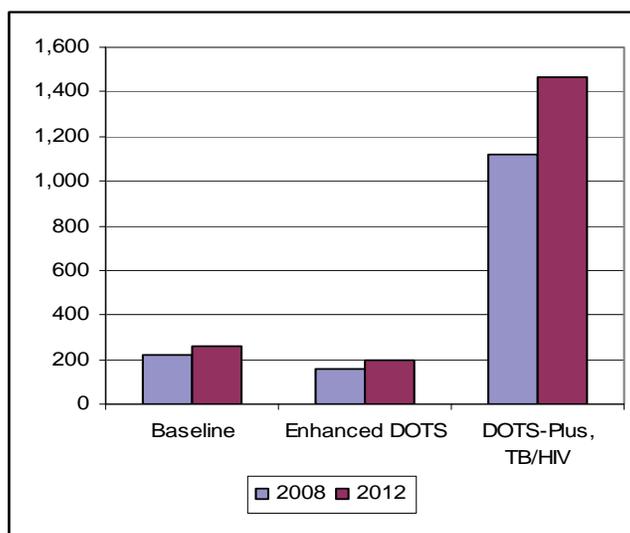
The results of the cohort model described with Figure 2 above and in section 2.3 are presented below for the *Baseline* scenario (Figure 3). The data for 2007 are based on actual achievements. Similar figures and data tables for the two other scenarios are in Annex B. The largest category of regular DOTS patients is Category I, which increases slowly over time under the scenario for 2008-12. The cohorts of HIV program referrals started on DOTS or IPT (separated for the cost analysis) and TB inpatients are also shown.

FIGURE 3. PROJECTED COHORTS OF REGISTERED TB AND TB-HIV CASES, BASELINE SCENARIO



Because the MDR-TB treatment cohorts were too small to be visible in Figure 3, they are shown separately in Figure 4 for all the three scenarios. The difference in the values for the *DOTS-Plus and TB-HIV* scenario vs. the other two is clearly visible, given additional, active detection of never-treated cases with MDR-TB.

FIGURE 4. MDR-TB TREATMENT COHORTS UNDER THE THREE SCENARIOS

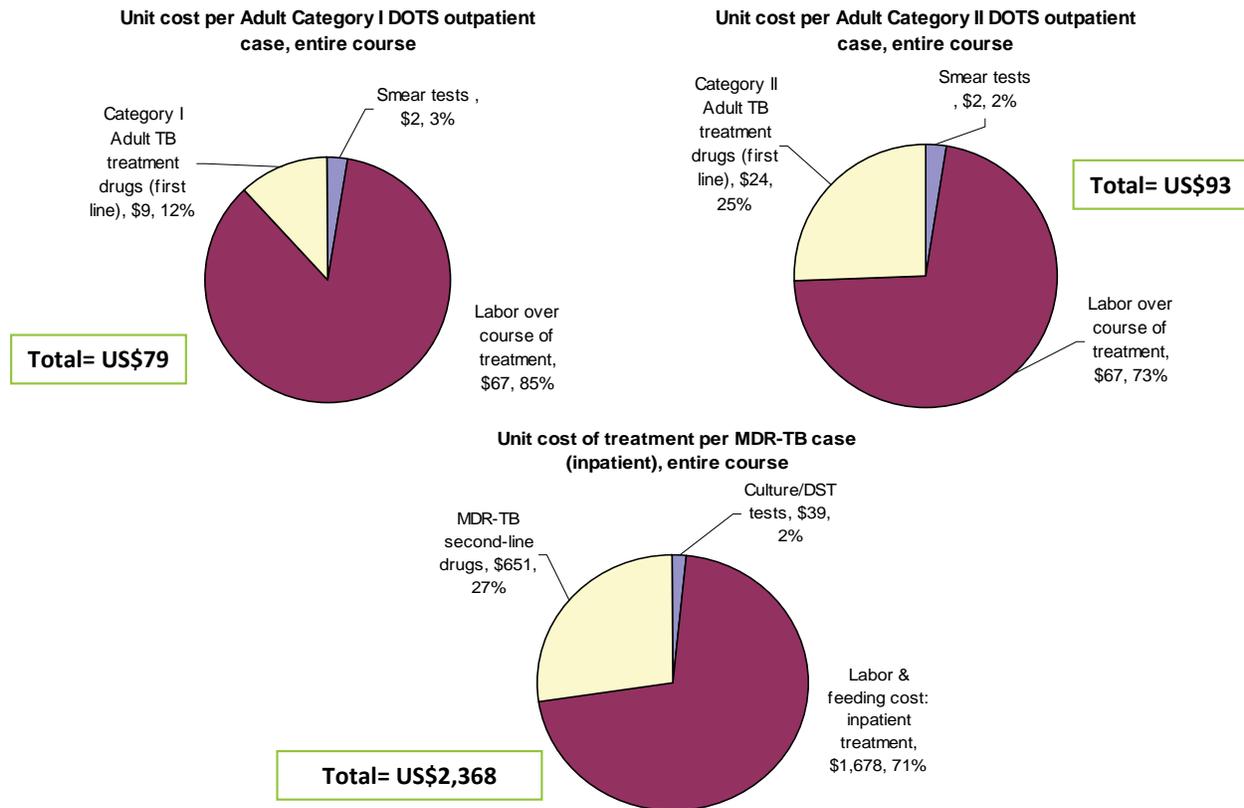


3.2 BASELINE SCENARIO: UNIT COSTS OF TB TREATMENT

The unit costs of standard DOTS treatment per unit of service were calculated from the bottom up, using the ingredients approach. The unit of service was one patient year, which involved treatment diagnosis, initiation, a complete course of intensive phase first-line TB drug regimen and monitoring, and then a complete continuation phase with an appropriate drug regimen and occasional sputum conversion visits. All standard tests involving sputum smear AFB tests were included at a number per case per year appropriate to the established clinical guidelines in Nigeria. These unit costs for standard DOTS were differentiated across Category I (new active TB) and II (retreatment) patients, with the difference in the values stemming from the difference in treatment regimens and hence drug costs only. Adult and pediatric unit costs were estimated separately for each category, and the difference again stemmed from the difference in treatment regimens. Figure 5 shows the unit costs of standard DOTS for Category I and II patients for adults only. Labor is the major driver of costs in standard DOTS outpatient treatment. Salaries used to cost the labor input were based on Nigerian FMOH salary scales, adjusted by the grades of the various staff types and the distribution of such grades. These are shown in Annex A, Tables A-6 and A-7. Regimens used and prices of drugs are also detailed in Annex A, Tables A8-11.

For MDR-TB, the unit costs per patient year were estimated, with patient year understood similarly to be the unit of service, involving all diagnosis, treatment, and hospitalization costs. Inpatient treatment averaging 56 days of hospitalization for each MDR-TB case till discharge or death was the major driver of this unit cost, but second-line drugs remain expensive even with GDF price lists as used for this study.

FIGURE 5. BASELINE SCENARIO: AVERAGE COST OF VARIOUS TB TREATMENT LINES PER UNIT OF SERVICE



3.3 BASELINE SCENARIO: UNIT COSTS OF TB-HIV TREATMENT

Addressing the costs of TB-HIV collaborative treatment is complex as the points of service delivery differ depending on the particular clinical profile of the co-infected patient and the referral direction. In general, for this costing, the philosophy was that if the treatment has a positive impact on the health of a TB-HIV co-infected individual (or PTB ss+ or EPTB individual, but HIV negative, detected in the HIV program), then the costs are eligible to be considered as costs of TB treatment. For such costs, another complexity emerges in deciding which are the appropriate *direct* costs for the purposes of this study. For those active TB-infected patients detected in the HIV program, i.e., HIV→TB, who are placed in the DOTS treatment cohort, or the latent TB cases and/or close contacts placed on IPT, it is clear that all the direct costs (labor, tests, and drugs) should be included. It was assumed that HIV→TB co-infections were adult cases for the purposes of DOTS regimens and costs. Pharmaceutical cost here is the average of Categories I and II, as it is unknown how many co-infected are put on Category I vs. Category II regimens. Labor costs are included (\$67), and the same as shown in Figure 5.

However, for the HIV-positive patients detected in the TB program and placed on CPT or ART depending on their clinical profile, it is not clear that the labor costs are “direct” for the purposes of the TB treatment program. Pharmaceutical costs are direct, given the fact that being administered cotrimoxazole or a fixed-dose ARV combination has an immediate, beneficial effect for TB treatment, via reducing the risk of developing active TB as an opportunistic infection. It was decided to *exclude* the

labor costs for such TB→HIV+ cases, considering them as *indirect* costs for the purposes of this costing, but include the CPT or antiretroviral drug (ARV) regimen costs per patient year. While seemingly arbitrary, this distinction was necessary to not artificially inflate the cost of the TB treatment “sub-sector” of the public health system – especially given that HIV/ART costs are borne from different sources and budgeted separately, and labor costs for ART can be a significant part of the unit cost. This argument is also supported by the fact that, while CPT can be administered by DOTS service providers at the primary level (except CHWs) and as such the labor is minimal, ARVs are offered presently in Nigeria only at secondary and tertiary facilities (FMOH 2007) via specific ART clinics that are budgeted for separately.

As per the joint TB-HIV strategic plan, in the future HIV/AIDS services will be incorporated into the already existing DOTS centers, while DOTS services will be incorporated into all the HIV counseling and testing (HCT) centers. This will however follow a phased approach. At that point, a similar costing study can be undertaken with the existing software tool to present a comprehensive cost for the national TB-HIV integrated program.

TABLE 8. UNIT COSTS FOR TB-HIV COLLABORATIVE SERVICES (US\$)

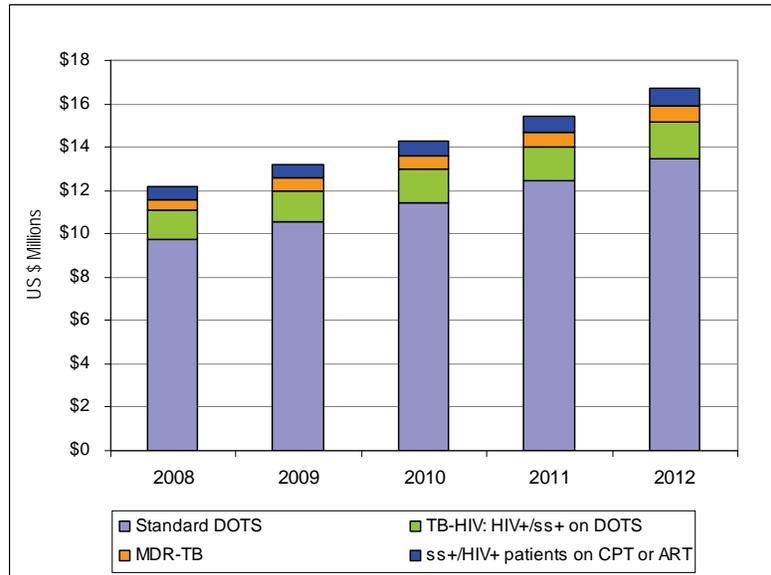
TB → HIV: testing cost	per patient	\$2.3
TB → HIV: CPT	per patient year	\$6.7
TB → HIV: ART 1st line*	per patient year	\$282
HIV → TB: DOTS (adult)	per patient year	\$82.9
HIV → TB: IPT	per patient course	\$1.3

* Weighted average of cost of AZT+3TC+EFV, AZT+3TC+NVP, and d4T+3TC+NVP, with an assumed division of 33% of TB→HIV ART patients for each fixed-dose combination regimen.

3.4 AGGREGATE DIRECT FINANCIAL COSTS OF TB TREATMENT COHORTS

Figure 6 shows how the total direct cost across the four major cohort categories varies over time once the unit costs above were applied as per the *Baseline* scenario. Such costs of treatment for TB across the major service lines reach approximately US\$17 million by 2012. About 80 percent of the costs are accounted for by standard DOTS treatment for Category I and II patients, both adult and pediatric. In contrast, MDR-TB treatment accounts for only 4 percent of the costs, given the small cohorts in this scenario.

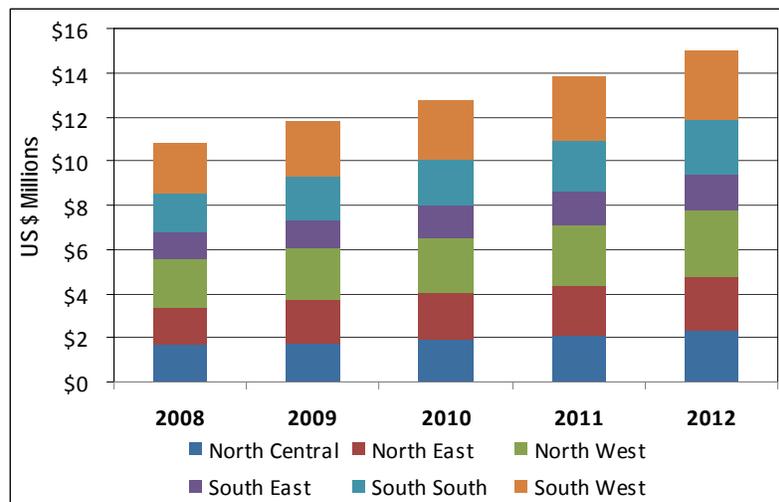
FIGURE 6. BASELINE SCENARIO: COSTS OF COHORTS FOR DOTS*, TB-HIV, AND MDR-TB



* Includes HIV→TB DOTS

Figure 7 shows the distribution of total costs by zone under the *Baseline* scenario. The highest needs are in the northwest and southwest zones (18 percent each).

FIGURE 7. BASELINE SCENARIO: DISTRIBUTION OF COSTS OF STANDARD DOTS* ACROSS GEOGRAPHICAL ZONES



* Excludes HIV→TB DOTS, as these costs were not split by zone

3.5 COMPARISON OF COHORT OUTCOMES UNDER THE SCENARIOS

Table 9 compares the treatment outcomes under the three scenarios used in this analysis. The first and most important outcome is that of lives saved in the standard DOTS program. Raising treatment cure and completion rates by 5 percent under the *Enhanced DOTS* scenario leads to a significant reduction in deaths per year, even though there is an *increase* in new case registrations over the *Baseline* scenario. The caseload in 2012 is 12,372 higher with the former scenario. These achievements in lives saved continue in the *DOTS-Plus and TB-HIV* scenario, which replicates the raised treatment success rates and the enhanced DOTS caseload.

TABLE 9. OUTCOMES AND CASELOAD UNDER THE THREE SCENARIOS

	Baseline	Enhanced DOTS	DOTS-Plus and TB-HIV
Deaths from TB in standard DOTS			
2008	3,544	2,999	N/C*
2012	4,027	3,960	N/C*
Standard DOTS caseload			
2008	56,187	57,712	N/C
2012	63,820	76,192	N/C
MDR-TB caseload			
2008	217	162	1,121
2012	256	199	1,467
TB→HIV caseload (CPT/ART)			
2008	3,789	3,908	N/C
2012	4,303	5,160	N/C
HIV→TB caseload (DOTS/IPT)			
2008	15,695	15,695	16,268
2012	16,527	16,527	19,774
TB inpatients (not including MDR-TB)			
2008	4,157	3,739	N/C
2012	4,723	4,936	N/C

Note: N/C – no change from previous column

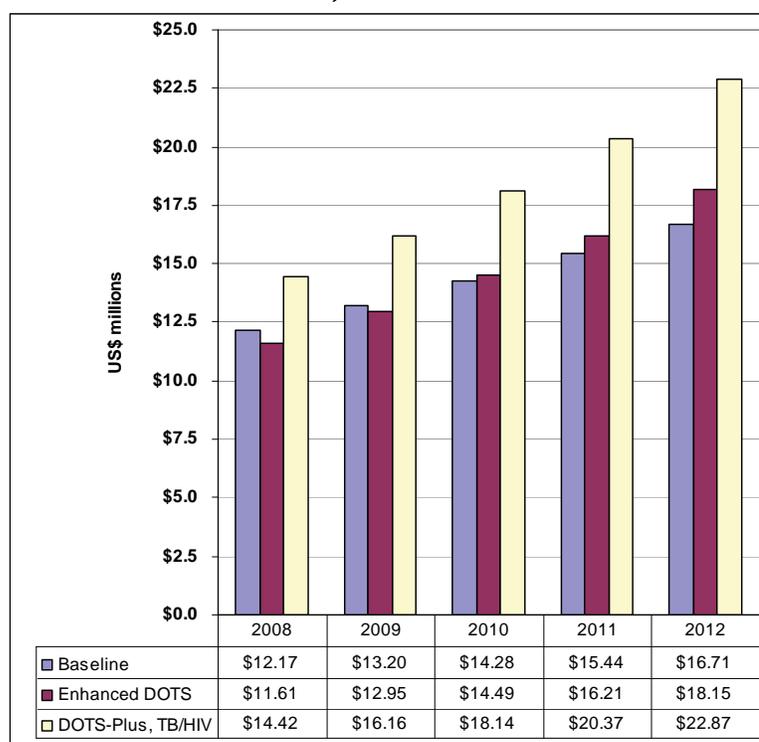
* Potentially, deaths were lower than Enhanced DOTS. See explanation below.

The HIV→TB and the MDR-TB caseloads are higher with the *DOTS-Plus and TB-HIV* scenario. The treatment outcomes on HIV→DOTS, ART, CPT or IPT are not projected in this costing, and therefore the additional lives saved under the *DOTS-Plus and TB-HIV* scenario compared with the *Enhanced DOTS* scenario will not be known. The reason why treatment outcomes for the HIV→DOTS group are not calculated is as follows: Though this group can be costed by assuming all individuals referred by the HIV/AIDS program to DOTS to be active PTB/EPTB, and thereafter an equal split of Category I and II patients, there is still no information on what treatment outcome rates should be applied to this group of potentially co-infected individuals. The rates in TB-only cohorts, PTB ss+ or EPTB, may not be applicable. Similarly, little information is available so far on the death rate in MDR-TB cohorts, and what is available is from very small samples. In the future, both HIV→DOTS and MDR-TB cohorts will be projected with specific treatment outcome rates, so as to give a better picture of what is bought by increased spending on TB-HIV and MDR-TB as per the *DOTS-Plus and TB-HIV* scenario.

3.6 COMPARISON OF AGGREGATE DIRECT COSTS UNDER THE SCENARIOS

Figure 8 shows a comparison of the total direct costs for TB-related treatment across the three scenarios described previously. The interesting differences seen are a validation of the scenario-based approach as well as of cohort models. For example, we know that the growth rate of new case registrations per year is 3.9 percentage points higher per year under the *Enhanced DOTS* scenario (see Table 7 above), leading to a net gain on the *Baseline* scenario of 12,372 standard DOTS cases by 2012. However, the total direct costs actually *fall* in years 2008 and 2009. This is an effect of programming treatment outcome rates into a costing framework via a cohort model. The higher treatment success (cure and completion) rates under the *Enhanced DOTS* scenario lead to cost savings due to the following effects, in order of decreasing importance: fewer Category II regimens, which are more expensive than Category I; fewer TB inpatient treatments (by reducing both Category II cases as well as deaths, which also incur inpatient care during the period of severe illness); and finally, fewer retreatment failures that could eventually lead to MDR-TB treatment. Though the *Enhanced DOTS* scenario costs finally overtake the *Baseline* on the force of the increased new case registration, it must be remembered that the former scenario is also saving lives over the period of analysis compared with the latter.

FIGURE 8. TOTAL DIRECT COSTS OF COHORTS FOR DOTS*, TB-HIV, AND MDR-TB, BY SCENARIO



* Includes HIV→TB DOTS

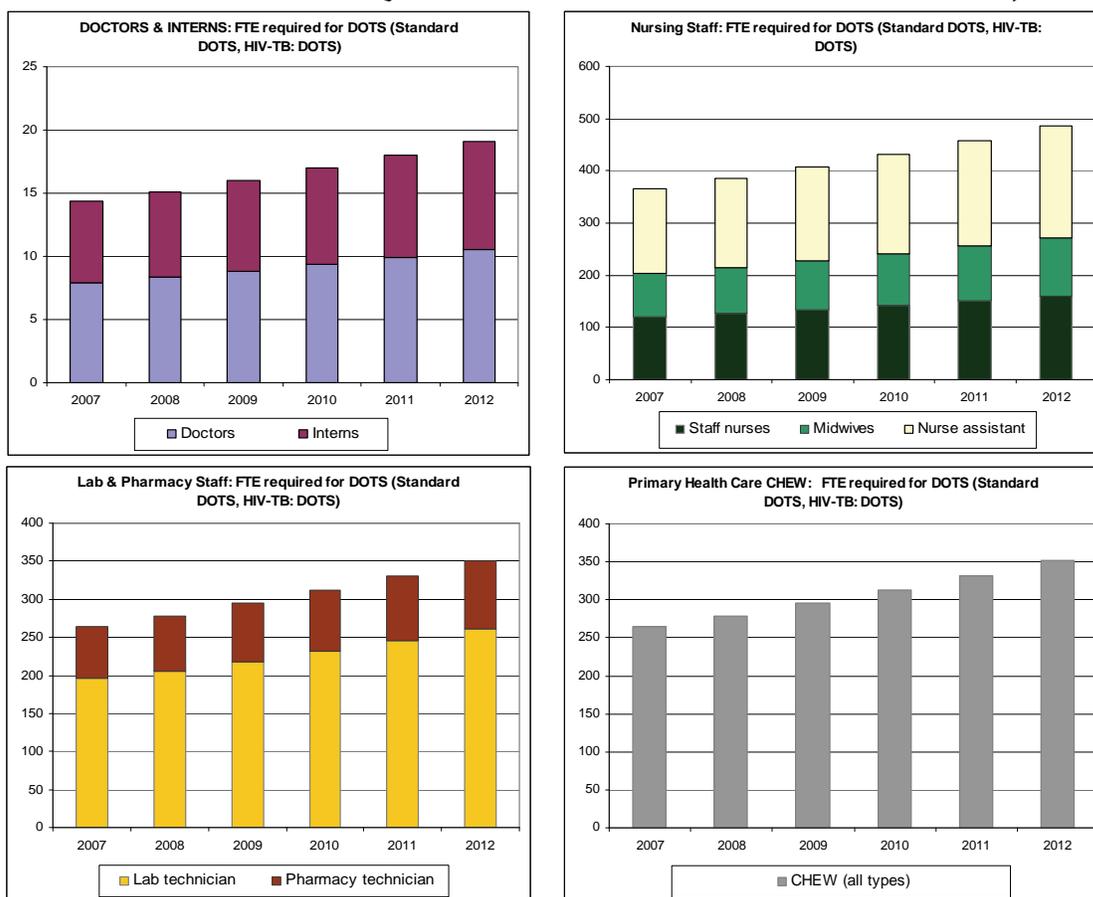
The total direct costs of the *DOTS Plus and TB-HIV* scenario are substantially higher than the *Enhanced DOTS* scenario, and the difference is completely accounted for by the increased costs of HIV→TB and MDR-TB. Over 2008-12, the *DOTS Plus and TB-HIV* scenario costs US\$18.55 million more than the *Enhanced DOTS* scenario, of which increase 79 percent is accounted for by increased detection and

treatment of MDR-TB (see Figure 4), and the rest by increased HIV→TB treatment (DOTS and IPT). If the combined active and passive detection of MDR-TB as used in the *DOTS Plus/TB-HIV* is realistic for the current situation in Nigeria,³ then such cost increases should be anticipated and budgeted for.

3.7 ENHANCED DOTS SCENARIO: HRH REQUIREMENTS FOR TB TREATMENT SERVICES

Figure 9 shows the results of applying the formula from section 2.6 to the *Enhanced DOTS* scenario. This scenario was chosen as it reflects a ramping up of DOTS services – a situation that would require more public health staff time.

FIGURE 9. FTE HRH REQUIRED FOR DOTS TREATMENT SERVICES, 2008-12



Though FTE HRH is a conceptual variable, the values in Figure 9 depict strength of need for public health staff to provide DOTS that can be compared to current staff levels in primary (clinic and community) as well as secondary facilities that provide TB services. The need for 350 full-time CHWs providing only DOTS is based on such workers providing 56 percent of supervised DOTS drug-intake

³ Applying the parameters for MDR-TB prevalence from the WHO report (see footnote 1), the total caseload for MDR-TB over 2008-12 is 36 percent higher than that estimated using a comparable version of the *DOTS Plus and TB-HIV* scenario. It is unclear if the WHO regression model is over-estimating the MDR-TB caseload compared to the active plus passive MDR-TB detection method within this costing study. The true picture will emerge only with a comprehensive TB prevalence study in Nigeria employing rapid culture/DST to confirm MDR-TB.

services. With greater task-shifting from clinical to community health workers, this need will further increase.

Table 10 shows the results of applying the formula from section 2.6 to the inpatient TB and MDR-TB caseloads. The staff list here is expanded based on more detailed staff qualification and competencies. These estimates can be compared with actual staff availability for inpatient TB care – from clinical management and laboratory tests to drug prescription – in tertiary institutions in Nigeria.

TABLE 10. ENHANCED DOTS SCENARIO: FTE HRH NEEDED FOR INPATIENT TB CARE

	2007	2008	2009	2010	2011	2012
Doctors	35	36	39	42	45	48
Interns	68	71	76	82	88	94
Regular nurses	45	48	51	54	58	62
Enrolled nurses	107	113	120	129	138	148
Pharmacists	4	4	4	4	5	5
Pharmacy technician	9	10	11	11	12	13
Lab technologist	45	47	51	54	58	62
Lab technician	68	72	77	82	88	94
Radiographer	48	51	54	58	62	67

4. POLICY OPTIONS AND RECOMMENDATIONS

This section discusses the policy implications of the results of the costing study and examines some potential actions that the FMOH may take to improve DOTS treatment outcomes. The section concludes with recommendations on how this study and the associated costing tool may be used in the future.

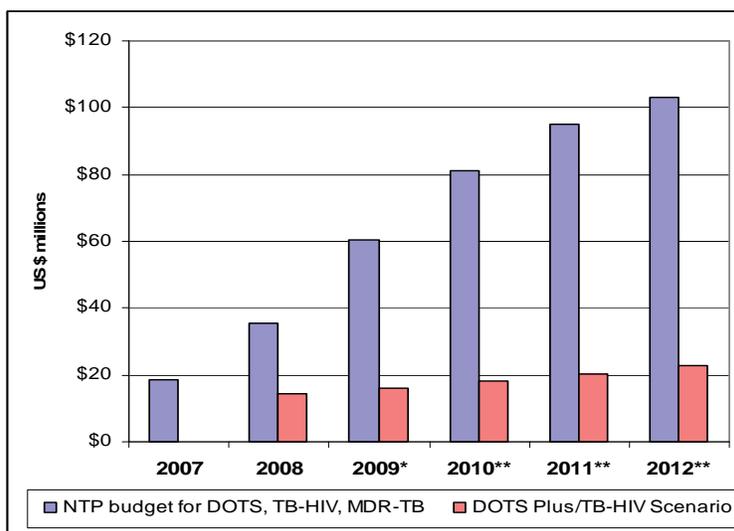
4.1 NIGERIA'S TB TREATMENT BUDGET AND THE DOTS-PLUS/TB-HIV SCENARIO

The NTBLCP budgets for 2007-08 (not actual expenditure) were discussed above in section 1.1, Background. The actual expenditure for the NTBLCP in 2008 will be known at a point during 2009. It would be useful to compare the projected direct costs for TB treatment with the amounts that would be available in 2009-12 as per the budgets and the treatment proportion of those budgets in the past. For this analysis, it would be necessary to make certain calculations, as follows.

The total NTBLCP budget for 2009 was projected by applying the year-to-year growth between 2007 and 2008 in the budget, to the known 2008 value. It is assumed that this rate of growth cannot be sustained. Thereafter, the NTBLCP budget was forecast for years 2010-12 using a rate of growth equal to half of the year-to-year growth across the previous two years. Therefore, the rate of growth of the total NTBLCP budget across 2009-2010 is half that of 2008-2009, and so on. This is meant to indicate a gradual slowing in the increase of the budget. Using the proportions of the 2008 NTBLCP budget allocated to DOTS expansion and enhancement, TB-HIV, and MDR-TB services, we can estimate the amounts likely to be available for these purposes for the years 2009-12. These estimated values for each year are shown in Figure 10 (blue bars), and compared with the direct costs of treatment as projected under the *DOTS Plus and TB-HIV* scenario – the most expensive scenario under this costing study (pink bars).

If the rate of growth of the overall budget and the proportional allocation within the budget for DOTS expansion and enhancement, TB-HIV, and MDR-TB can be sustained as shown in Figure 10, then the total direct costs of the *DOTS Plus and TB-HIV* scenario look sustainable. This conclusion is supported even further by the fact that the unit costs used in this cost analysis include a 25 percent surcharge on the actual direct costs that are meant to cover certain management and logistics costs, as per the approach in Nigeria's Round 8 GF proposal. Also, all scenarios costed in this study include the direct costs of hospitalization and the costs of labor inputs for direct patient care during clinical visits. These two headings of cost are not included in the NTBLCP budget quoted or estimated in Figure 10. The WHO global TB control report for 2008 (Nigeria country annex) estimated these separately as an additional amount over and above the NTBLCP budget.

FIGURE 10. COMPARISON OF THE TOTAL DIRECT COSTS UNDER DOTS PLUS/TB-HIV SCENARIO AND NTBLCP BUDGETS FOR DOTS EXPANSION AND ENHANCEMENT, TB-HIV, AND MDR-TB



Source: For 2007, 2008 budgets: WHO (2008a), Nigeria country annex; others: author calculations

* Projected based on rate of growth of budget 2007-2008

** Projected based on 1/2 of the previous year-to-year rate of growth of budget

The discrepancy between budgeted values and the costed scenario inherent in Figure 10 is interesting because the FMOH has recently reported a funding gap for 2008 of US\$30 million (WHO 2008a, Nigeria country annex), of which about US\$20 million is via unmet DOTS expansion and enhancement, TB-HIV, and MDR-TB needs. We cannot say that Figure 10 shows conclusively that such a gap should not exist. In the favor of a gap existing despite the large discrepancy between the scenario “total direct costs” and the projected NTBLCP budget for these service lines, consider that:

- The total direct costs as estimated in this costing study do not include TB clinical staff training costs or the costs of managing the NTBLCP secretariat and non-clinical support staff.
- The *indirect costs* of facility overhead and supportive services/staff in facilities are not costed.
- Fringe benefits and paid vacations are not costed.

Given that DOTS is technically available in almost all LGAs by 2008, the “expansion” part of the DOTS-related NTBLCP budget allocation in Figure 10 should be stable, releasing more funds for “enhancement” from the larger annual resource envelope. The next section looks more carefully at a policy action leading to DOTS enhancement, i.e., deepening the quality of DOTS treatment.

If we accept that a NTBLCP budget gap related to unmet DOTS enhancement, TB-HIV, and MDR-TB needs could exist in the future, consider that large amount of funds will be available if Nigeria’s Round 8 GF proposal is signed. Table 11 provides the summary of the requested funding by service area.

TABLE 11. NIGERIA GF ROUND 8 PROPOSAL BUDGET BY SERVICE DELIVERY AREA (US\$ MILLIONS)

Service Delivery Area	Year 1	Year 2	Year 3	Year 4	Year 5	Total
High-quality DOTS	\$2.3	\$2.4	\$2.6	\$28.7	\$30.7	\$66.7
TB-HIV	\$3.2	\$3.2	\$3.4	\$3.6	\$3.8	\$17.1
MDR-TB	\$1.6	\$0.8	\$0.9	\$3.1	\$3.3	\$9.8
Improving diagnosis	\$2.5	\$2	\$2.1	\$2.2	\$2.3	\$11.1
CTBC	\$2.6	\$3.9	\$6.5	\$7.8	\$9.2	\$30
Program management and administration cost	\$7.3	\$6	\$6.2	\$8.1	\$8.6	\$36.3
Insurance for laboratory equipment	\$0.01	\$0.01	\$0.01	\$0.01	\$0.01	\$0.04
Monitoring & Evaluation	\$2.80	\$1.41	\$1.23	\$1.52	\$3.37	\$10.3
Grand Total	\$22.29	\$19.77	\$22.91	\$55.03	\$61.29	\$181.3

Source: Country Coordinating Mechanism for Global Fund Grants, Nigeria (2008)

4.2 IMPROVING DOTS TREATMENT OUTCOMES WITH ENHANCED CLINICAL LABOR

The quality of DOTS clinical treatment could ostensibly be improved with greater clinical time investment by the relevant staff per DOTS case. This would necessarily have to be supported with improved training and sufficient staff resources. This policy action was costed in the software tool developed for this study, and the cost and HRH implications of implementing this action were compared with those under the *Enhanced DOTS* scenario. It was assumed that to increase treatment cure and completion rates by 10 percent (not percentage points) over the values for each state under the *Baseline* scenario, i.e., the current rates, it would require the clinical staff in primary (clinic and community) and secondary facilities providing outpatient DOTS services to increase their labor input per encounter by 50 percent. In other words, the length of each clinical encounter – which excludes pharmacist and laboratory technician time – in minutes would rise from the values estimated by time-motion observation in a prior study (Chankova et al. 2006) by 50 percent.

The hypothetical policy action leading to deepening of DOTS treatment quality achieves it with only US \$4.2 million in additional direct costs, which amounts to about US\$ 1,034 for each of the 4,088 additional lives it saves under DOTS treatment. This is close to the true incremental cost per life saved as it is assumed that the cost per DOTS case of the additional training required to be given to clinical staff in outpatient clinics will not be long or very expensive. There is an increase in the number of staff required to carry out the deepened DOTS services, stemming from longer encounters in outpatient care. In contrast, because the caseload decreases for TB inpatient care (reduced complications and deaths), there is a reduction in FTE staff required in tertiary facilities for this purpose.

TABLE 12. COMPARISON OF COHORT OUTCOMES WITH DEEPEINED DOTS TREATMENT QUALITY AND THE ENHANCED DOTS SCENARIO

	Deepened DOTS treatment quality	Enhanced DOTS scenario
Deaths from TB in standard DOTS cohorts		
2008	2,292	2,455
2012	3,024	3,960
Total averted deaths 2008-12 compared to <i>Enhanced DOTS</i>	4,088	
Total direct costs (US \$ millions)		
2008	\$12.3	\$11.6
2009	\$13.7	\$12.9
2010	\$15.3	\$14.5
2011	\$17.1	\$16.2
2012	\$19.2	\$18.2
Total additional direct cost 2008-12 compared to <i>Enhanced DOTS</i>	US \$ 4.2 million	
Incremental direct costs per additional life saved	US \$1,034	
Total additional FTE HRH required (DOTS outpatient, TB inpatient)		
2008	261	
2009	247	
2010	266	
2011	282	
2012	297	

4.3 OTHER CONCLUSIONS

The analysis here has led to unit cost estimates that are at divergence with those recently used in other studies and therefore merit further scrutiny. First, they indicate that the unit costs of treatment with first-line drugs for DOTS, per case, is in the range of \$80-\$93, depending on DOTS category, and this is inclusive of 25 percent shipping and handling cost, *as well as* labor costs of approximately \$67 per case over the course of treatment. This can be compared with the estimated cost in Nigeria's Round 8 GF proposal of just first-line drugs for DOTS, per case year, of \$62.2 *not including* shipping and handling.

Second, unit costs for drugs and diagnostics for MDR-TB, with the latest second-line drug prices and dosage, inclusive of 25 percent shipping and handling, sum to approximately \$650 per case over the course of treatment. If we add \$1,680 in costs for inpatient admission for an average stay of 56 days for an MDR-TB case, this results in a total of approximately \$2,370 per case. This can be compared with the \$2,906 per case year cost for procuring just second-line drugs for MDR-TB, *not including* shipping and handling, labor, or costs of the inpatient stay, as used in the Round 8 GF proposal.

Overall, this preliminary analysis of the recurring direct financial and HRH costs incurred to provide TB services to future cohorts indicates that the Nigerian TB control program is on a sustainable footing. However, donors should pay attention to the financing of MDR-TB, as well as that for routine consumables and drugs for the entire TB treatment program. The 2008 NTBLCP budget in Figure 1

indicates \$14.2 million in funding for first-line drugs, plus laboratory *equipment* and consumables. Since capital investment for AFB microscopy, national and zonal reference laboratories, as well as various culture/DST laboratories is a substantial part of this outlay, it should be ensured that there will be sufficient allocation for the recurring, direct costs of laboratories.

4.4 RECOMMENDATIONS

The following recommendations can be made to TB policymakers in Nigeria at the state and federal levels, especially staff at the NTBLCP, and the TB-related staff in the donor community:

- Consider using the costing tool for new cost estimations, at each Nigerian state level, of running the state TB-DOTS program.
- Consider using the costing tool to identify financial gaps by region or state, or by particular donor regional focus. For example, it can be used to focus on the total direct costs in USAID-supported states:

Total direct costs, DOTS*, TB→HIV, and MDR-TB (US\$ Mil.)				
2008	2009	2010	2011	2012
\$4.2	\$4.5	\$4.9	\$5.3	\$5.8

* Standard DOTS only. Excludes costs of HIV→TB DOTS

- Support the training for and institutionalized use of a costing tool such as this by NTBLCP planning staff, and interested stakeholders.
- Review the planning for expanded MDR-TB services from a cost perspective. The costs of treating MDR-TB remain very high even if the associated drug costs are reduced in the future. Therefore, spending more on further deepening the quality of initial DOTS - in terms of higher provider involvement in close supervision of DOTS patients and better drug-management - will be prudent. Such spending reduces the overall costs of the TB treatment program at the margin by decreasing drug resistance, as manifested by reduced rates of treatment failures in Category I & II patients, and ultimately is beneficial by preventing higher rates of MDR-TB in previously treated cases.

ANNEX A. ADDITIONAL TABLES

TABLE A-I. NIGERIA: DISTRIBUTION OF NEW TB CASE REGISTRATIONS BY COMPLICATION, 2007

		PTB ss+	ss-	EPTB
Benue	NC	35%	64%	0%
FCT	NC	49%	44%	8%
Kogi	NC	59%	41%	0%
Kwara	NC	78%	17%	5%
Nasarawa	NC	35%	64%	1%
Niger	NC	84%	14%	3%
Adamawa	NE	54%	41%	6%
Borno	NE	48%	46%	6%
Gombe	NE	39%	57%	4%
Yobe	NE	49%	47%	4%
Jigawa	NW	72%	26%	2%
Kano	NW	47%	50%	4%
Katsina	NW	39%	57%	4%
Kebbi	NW	82%	15%	3%
Sokoto	NW	82%	13%	5%
Zamfara	NW	75%	22%	3%
Plateau	NC	27%	67%	5%
Bauchi	NE	25%	70%	4%
Taraba	NE	79%	17%	4%
Kaduna	NW	40%	57%	3%
Abia	SE	81%	11%	8%
Anambra	SE	67%	24%	9%
Ebonyi	SE	54%	31%	15%
Enugu	SE	61%	19%	20%
Imo	SE	65%	25%	10%
Akwa Ibom	SS	68%	23%	9%
Bayelsa	SS	64%	26%	10%
Cross River	SS	49%	31%	19%
Delta	SS	64%	25%	11%
Edo	SS	64%	34%	2%
Rivers	SS	66%	26%	8%
Ekiti	SW	41%	54%	5%
Lagos	SW	53%	45%	2%
Ogun	SW	68%	28%	3%
Ondo	SW	67%	30%	3%
Osun	SW	76%	21%	3%
Oyo	SW	70%	25%	6%

TABLE A-2. CATEGORY I TB TREATMENT OUTCOME RATES BY STATE, 2007

State and Zone		Cure Rate	Completion rate	Failure Rate	Death Rate	Default Rate	Transfer out
Benue	NC	53.0%	20.8%	2.5%	7.9%	13.0%	2.8%
FCT	NC	43.3%	22.8%	0.4%	5.5%	15.1%	12.9%
Kogi	NC	80.3%	10.7%	2.0%	3.5%	3.2%	0.3%
Kwara	NC	38.6%	37.0%	1.5%	4.8%	17.5%	0.6%
Nasarawa	NC	60.5%	8.8%	1.6%	14.1%	11.9%	3.2%
Niger	NC	66.0%	19.3%	0.0%	4.4%	4.8%	5.4%
Adamawa	NE	83.7%	4.4%	1.3%	7.6%	1.8%	1.2%
Borno	NE	45.5%	25.0%	1.8%	11.5%	13.5%	2.7%
Gombe	NE	78.8%	0.9%	0.5%	9.5%	4.7%	5.6%
Yobe	NE	55.7%	23.1%	1.4%	9.0%	7.6%	3.3%
Jigawa	NW	65.1%	14.8%	1.5%	6.1%	8.1%	4.4%
Kano	NW	71.7%	9.2%	4.1%	5.7%	8.9%	0.4%
Katsina	NW	76.8%	6.9%	0.4%	7.5%	7.8%	0.6%
Kebbi	NW	76.4%	4.0%	1.5%	7.2%	10.6%	0.4%
Sokoto	NW	91.9%	3.1%	1.7%	1.6%	1.6%	0.1%
Zamfara	NW	49.3%	21.0%	3.2%	6.5%	18.9%	1.1%
Plateau	NC	63.1%	14.9%	2.1%	9.2%	8.5%	2.1%
Bauchi	NE	62.5%	18.8%	0.6%	7.7%	4.4%	6.0%
Taraba	NE	73.5%	3.1%	0.4%	10.2%	9.2%	3.6%
Kaduna	NW	63.8%	21.1%	0.4%	6.4%	4.4%	4.0%
Abia	SE	56.8%	11.6%	1.9%	7.3%	20.7%	1.7%
Anambra	SE	79.8%	10.2%	1.6%	2.9%	5.2%	0.4%
Ebonyi	SE	79.2%	2.0%	1.1%	5.7%	11.7%	0.3%
Enugu	SE	65.2%	13.4%	1.0%	7.1%	10.1%	3.2%
Imo	SE	73.5%	7.3%	1.7%	7.4%	8.8%	1.3%
Akwa Ibom	SS	78.7%	3.8%	2.3%	7.0%	7.7%	0.4%
Bayelsa	SS	79.4%	7.2%	2.1%	2.3%	8.1%	0.9%
Cross River	SS	68.0%	9.7%	3.2%	9.4%	7.9%	1.9%
Delta	SS	52.6%	20.8%	1.5%	4.5%	18.8%	1.8%
Edo	SS	66.5%	11.2%	2.2%	7.4%	10.4%	2.3%
Rivers	SS	65.1%	12.8%	2.4%	3.5%	15.3%	1.0%
Ekiti	SW	75.4%	9.6%	2.0%	5.8%	5.8%	1.2%
Lagos	SW	61.0%	12.1%	2.4%	2.9%	18.4%	3.1%
Ogun	SW	62.3%	17.2%	2.3%	6.3%	10.3%	1.6%
Ondo	SW	80.8%	0.9%	1.5%	6.7%	8.9%	1.1%
Osun	SW	79.1%	4.9%	4.5%	2.7%	5.9%	2.9%
Oyo	SW	85.9%	0.9%	2.8%	2.7%	4.8%	3.0%

**TABLE A-3. NIGERIA: CATEGORY II TB TREATMENT OUTCOME RATES
BY STATE, 2007**

State and Zone		Cure Rate	Completion rate	Failure Rate	Death Rate	Default Rate	Transfer out
Benue	NC	48.03%	40.16%	1.57%	7.09%	3.15%	0.00%
FCT	NC	16.67%	38.89%	3.70%	4.63%	20.37%	15.74%
Kogi	NC	76.00%	16.00%	4.00%	4.00%	0.00%	0.00%
Kwara	NC	21.74%	39.13%	8.70%	8.70%	21.74%	0.00%
Nasarawa	NC	81.03%	13.79%	0.00%	3.45%	1.72%	0.00%
Niger	NC	62.34%	19.48%	1.30%	3.90%	9.09%	3.90%
Adamawa	NE	81.88%	5.07%	1.45%	9.42%	0.72%	1.45%
Borno	NE	55.00%	16.67%	8.33%	10.00%	3.33%	6.67%
Gombe	NE	78.85%	0.00%	1.92%	19.23%	0.00%	0.00%
Yobe	NE	61.90%	14.29%	4.76%	9.52%	9.52%	0.00%
Jigawa	NW	55.56%	19.44%	2.78%	8.33%	13.89%	0.00%
Kano	NW	62.37%	13.98%	2.15%	16.13%	5.38%	0.00%
Katsina	NW	75.00%	2.94%	0.00%	16.18%	4.41%	1.47%
Kebbi	NW	83.33%	2.38%	0.00%	7.14%	4.76%	2.38%
Sokoto	NW	68.70%	11.41%	1.06%	10.88%	6.10%	1.86%
Zamfara	NW	47.62%	28.57%	0.00%	9.52%	9.52%	4.76%
Plateau	NC	63.64%	7.58%	1.52%	12.12%	9.09%	6.06%
Bauchi	NE	77.33%	4.00%	1.33%	6.67%	6.67%	4.00%
Taraba	NE	73.58%	1.89%	3.77%	8.49%	6.60%	5.66%
Kaduna	NW	72.65%	11.97%	0.85%	5.98%	5.13%	3.42%
Abia	SE	50.60%	14.46%	4.82%	4.82%	25.30%	0.00%
Anambra	SE	70.86%	13.91%	0.00%	4.64%	9.93%	0.66%
Ebonyi	SE	68.75%	0.89%	6.25%	8.93%	12.50%	2.68%
Enugu	SE	62.03%	13.92%	5.06%	7.59%	8.86%	2.53%
Imo	SE	57.89%	7.37%	9.47%	11.58%	13.68%	0.00%
Akwa Ibom	SS	65.41%	13.53%	1.50%	9.02%	10.53%	0.00%
Bayelsa	SS	58.54%	14.63%	12.20%	2.44%	4.88%	7.32%
Cross River	SS	23.56%	47.13%	1.72%	13.22%	10.34%	4.02%
Delta	SS	51.85%	27.51%	3.70%	1.59%	13.76%	1.59%
Edo	SS	59.20%	12.94%	1.49%	8.96%	16.42%	1.00%
Rivers	SS	51.40%	25.23%	3.74%	6.54%	12.15%	0.93%
Ekiti	SW	67.44%	13.95%	6.98%	9.30%	2.33%	0.00%
Lagos	SW	53.50%	13.22%	4.86%	8.05%	17.02%	3.34%
Ogun	SW	70.42%	8.33%	6.25%	2.08%	10.00%	2.92%
Ondo	SW	71.65%	0.79%	3.15%	7.87%	14.96%	1.57%
Osun	SW	68.51%	6.49%	6.82%	6.82%	7.47%	3.90%
Oyo	SW	82.07%	1.99%	4.78%	6.37%	1.99%	2.79%

Note: Values for Sokoto are imputed from NW zone values for the purposes of the cohort model (2008-12) as there were no Category II cases in the state in 2007.

TABLE A-4. DOTS OUTPATIENT CARE: LABOR INPUT PER CASE AND SERVICE DISTRIBUTION ACROSS LEVELS OF THE PRIMARY/SECONDARY SYSTEM

Type of health worker	Time spent per patient encounter (minutes) *	Location (level of health system)	Percentage of all DOTS cases seen at this level	Type of activities per DOTS case	Of cases seen at this level, percentage dealt with by this type	Number of encounters/tests per DOTS case, per year
Doctors	18.5	Clinic/Sec.	44%	Consult/diagnose and prescribe	40%	3
Interns	10.1	Clinic/Sec.			60%	3
Staff nurses	16.1	Clinic/Sec.			35%	60
Midwives	26.3	Clinic/Sec.			15%	60
Nurse assistant	15.1	Clinic/Sec.			50%	60
CHEW (all types)	12.4	Primary (community)	56%	Diagnose, observe and manage intens. phase	100%	60
Lab technician	24.2	N/A	N/A	Conduct tests	N/A	10
Pharmacy technician	14.1	N/A	N/A	Dispense drugs, keep stock	N/A	N/A

TABLE A-5. DOTS INPATIENT CARE: LABOR INPUT PER CASE

Type of health worker	Admitted TB Inpatients (IP)			
	Time spent per patient encounter (minutes) *	Location (level of health sys.)	Number of encounters per day per admitted IP	Number of tests done or prescriptions filled for entire IP stay
Doctors	14.76	Tertiary	2	N/A
Interns	19.28	Tertiary	3	N/A
Regular Nurses	19.23	Tertiary	2	N/A
Enrolled Nurses	18.28	Tertiary	5	N/A
Pharmacists	3	Tertiary	N/A	1
Pharmacy Technician	4	Tertiary	N/A	2
Lab Technologist	19.17	Tertiary	N/A	2
Lab Technician	19.37	Tertiary	N/A	3
Radiographer	13.7	Tertiary	N/A	3

* Source: Chankova et al. (2006)

TABLE A-6. GRADE AND SALARY FOR DOTS OUTPATIENT CARE WORKERS (LGA SCALE)

Type of health worker	Entry-level workers			Mid-level workers			Senior-level workers			Weighted average salary
	Pub. Sec. Grade	% of workers at this grade	Salary (US\$, 2008)	Pub. Sec. Grade	% of workers at this grade	Salary (US\$, 2008)	Pub. Sec. Grade	% of workers at this grade	Salary (US\$, 2008)	
Doctors	GL 9	30%	\$4,968	GL 14	50%	\$8,456	GL 17	20%	\$17,466	\$9,211
Interns	GL 7	45%	\$3,301	GL 10	45%	\$4,830	GL 14	10%	\$8,456	\$4,504
Staff nurses	GL 8	33%	\$3,301	GL 10	33%	\$4,830	GL 14	33%	\$8,456	\$5,529
Midwives	GL 9	33%	\$3,301	GL 10	33%	\$4,830	GL 14	33%	\$8,456	\$5,529
Nurse assistant	GL 4	50%	\$1,379	GL 8	25%	\$3,787	GL 14	25%	\$8,456	\$3,750
CHEW (all types)	GL 4	50%	\$1,379	GL 8	25%	\$3,787	GL 14	25%	\$8,456	\$3,750
Lab technician	GL 8	33%	\$3,787	GL 12	33%	\$6,938	GL 14_7	33%	\$9,040	\$6,588
Pharmacy technician	GL 4	33%	\$1,379	GL 8	33%	\$3,787	GL 14	33%	\$8,456	\$4,541

Nigeria Naira were converted to US\$ at the rate 115 Naira/\$1

TABLE A-7. GRADE AND SALARY FOR TB INPATIENT CARE WORKERS (TERTIARY/FEDERAL SCALE)

Type of health worker	Entry-level workers			Mid-level workers			Senior-level workers			Weighted average salary
	Pub. Sec. Grade	% of workers at this grade	Salary (US\$, 2008)	Pub. Sec. Grade	% of workers at this grade	Salary (US\$, 2008)	Pub. Sec. Grade	% of workers at this grade	Salary (US\$, 2008)	
Doctors	GL 10	30%	\$8,904	GL 12	50%	\$10,857	GL 15	20%	\$22,209	\$12,541
Interns	GL 7	45%	\$5,729	GL 10	45%	\$8,904	GL 14	10%	\$18,273	\$8,412
Regular Nurses	GL 7	40%	\$5,729	GL 10	40%	\$8,904	GL 14	20%	\$18,273	\$9,507
Enrolled Nurses	GL 4	40%	\$1,855	GL 8	50%	\$6,652	GL 12	10%	\$10,857	\$5,153
Pharmacists	GL 9	50%	\$7,644	GL 12	30%	\$10,857	GL 14	20%	\$18,273	\$10,733
Pharmacy Technician	GL 4	35%	\$1,855	GL 8	50%	\$6,652	GL 12	15%	\$10,857	\$5,604
Lab Technologist	GL 9	60%	\$7,644	GL 14	30%	\$18,273	GL 15	10%	\$22,209	\$12,289
Lab Technician	GL 8	50%	\$6,652	GL 10	40%	\$10,857	GL 14	10%	\$19,492	\$9,618
Radiographer	GL 9	30%	\$7,644	GL 10	50%	\$10,857	GL 14	10%	\$19,492	\$10,745

Note: Nigeria Naira were converted to US\$ at the rate 115 Naira/\$1

TABLE A-8. DRUG REGIMENS USED IN THIS COSTING STUDY FOR DOTS CATEGORY I TB TREATMENT: INGREDIENTS-BASED APPROACH

ADULTS: Intensive Phase: Standard Regimen		Dosing and Distribution				% of Cat. I adult patients on this dosing		Cost: Blister Boxes			
Average* weekly doses (tablets)	Duration of course (weeks)	Equiv. months	# of doses			Packaging: tablets/box	Price per box	Cost per tablet	Cost per patient course		
Rifampicin 150 mg / Isoniazid 75 mg / Pyrazinamide 400 mg / Ethambutol 275 mg (RHZE)	7	8	2	56	100%	672	\$39.6	\$0.06	\$3.30		
ADULTS: Continuation Phase: Options											
Ethambutol 400 mg / Isoniazid 150 mg (EH)	7	24	6	168	50%	672	\$20.7	\$0.031	\$5.18		
Rifampicin 150 mg / Isoniazid 75 mg (RH)	7	16	4	112	50%	672	\$19.7	\$0.029	\$3.29		
Rifampicin 150 mg / Isoniazid 75 mg (RH): Intermittent	3	16	4	48	0%	672	\$19.7	\$0.029	\$1.41		\$4.24
Rifampicin 150 mg / Isoniazid 75 mg (RH): Special ^{†**}	7	28	7	196	0%	672	\$19.7	\$0.029	\$5.76		
Rifampicin 150 mg / Isoniazid 75 mg (RH): Special/Intermittent	3	28	7	84	0%	672	\$19.7	\$0.029	\$2.47		
* Average over pretreatment patient weight categories. These should usually be adjusted downwards.											
Default is 7 (or 3 for intermittent)											
** Special: Cavitation on initial CXR and sputum at end of intensive phase is culture positive											
PEDIATRIC: Intensive Phase											
Average weekly doses (tablets)	Duration of course (weeks)	Equiv. months	# of doses		% of Cat. I pediatric patients on this dosing	Packaging: tablets/box	Price per box	Cost per tablet	Cost per patient course		
Rifampicin 60mg/Isoniazid 30mg/Pyrazinamide 150mg (RHZ)	7	8	2	56	100%	672	\$39.6	\$0.06	\$3.30		
PEDIATRIC: Continuation Phase											
Rifampicin 60mg/Isoniazid 30mg (RH)	7	16	4	112	100%	672	\$20.7	\$0.031	\$3.45		
										TOTAL per patient year	\$6.75

TABLE A-9. DRUG REGIMENS USED IN THIS COSTING STUDY FOR DOTS CATEGORY II: INGREDIENTS-BASED APPROACH

ADULTS: Intensive Phase: Standard Regimen	Dosing and Distribution					% of Cat. II adult patients on this dosing	Cost: Per Packaging Unit			
	Average* weekly doses (tablets)	Duration of course (weeks)	Equiv. months	# of doses	Packaging: tablets/box		Price per box	Cost per tablet	Cost per patient course	
Rifampicin 150 mg / Isoniazid 75 mg / Pyrazinamide 400 mg / Ethambutol 275 mg (RHZE)	7	12	3	84	672	100%	\$39.6	\$0.06	\$4.95	
Streptomycin (1 gram, injectible)	Average* weekly doses (vials)	Duration of course (weeks)	Equiv. Months	Doses	Packaging : vials/box		Price per box	Cost per dose	Cost per patient course	
ADULTS: Continuation Phase	7	8	2	56	50	100%	\$5.2	\$0.10	\$5.81	
Rifampicin 150 mg / Isoniazid 75 mg / Pyrazinamide 400 mg / Ethambutol 275 mg (RHZE)	7	20	5	140	672	100%	\$39.6	\$0.06	\$8.25	
* Average over pretreatment patient weight categories. These should usually be adjusted downwards.										
	Default is 7								TOTAL per patient year	
									\$19.01	
PEDIATRIC: Intensive Phase, Loose drugs: Options	Dosing and Distribution					% of Cat. II pediatric patients on this dosing	Cost: Loose Drugs			
	Average weekly doses (tablets)	Duration of course (weeks)	Equiv. months	# of doses	Packaging: #/box		Price per box	Cost per tablet/vial	Cost per patient course	
Type I: (children 6-14 years)						90%			Average cost/course	
Ethambutol (E) 150 mg ***	7	12	3	84	1000		\$22.9	\$0.02	\$9.69	
Rifampicin 150mg/Isoniazid 100mg (RH) ****	7	12	3	84	1000		\$26.1	\$0.03	\$1.92	
Pyrazinamide 400mg (Z)	7	12	3	84	1000		\$14.5	\$0.01	\$2.19	
Streptomycin 500mg (1/2 vial): price will reflect dosage	7	12	3	42	50		\$5.2	\$0.10	\$1.22	
Type II: (children below 6 years)						10%			\$4.36	
									\$7.77	

ADULTS: Intensive Phase: Standard Regimen	Dosing and Distribution					% of Cat. II adult patients on this dosing	Cost: Per Packaging Unit		
	Average* weekly doses (tablets)	Duration of course (weeks)	Equivalent months	# of doses			Packaging: tablets/box	Price per box	Cost per tablet
Rifampicin 150mg/Isoniazid 100mg (RH)	7	12	3	84		1000	\$26.1	\$0.03	\$2.19
Pryazinamide 400mg (Z)	7	12	3	84		1000	\$14.5	\$0.01	\$1.22
Streptomycin 500mg (1/2 vial): price will reflect dosage	7	12	3	42		50	\$5.2	\$0.10	\$4.36
PEDIATRIC: Continuation Phase									
Rifampicin 150mg/Isoniazid 100mg (RH)	7	20	5	140	100%	1000	\$26.1	\$0.03	\$3.65
Pryazinamide 400mg (Z)	7	12	3	84		1000	\$14.5	\$0.01	\$1.22
									TOTAL
									per patient year
									\$14.37
	*** price based on GDF E/400mg, loose box								
	**** price based on GDF RH/150/150								

TABLE A-10. DRUG REGIMENS USED IN THIS COSTING STUDY FOR TB-HIV COLLABORATIVE TREATMENT: INGREDIENTS-BASED APPROACH

	Dosing and Distribution				% of HIV+ latent TB patients on this dosing	Cost: Loose Drugs		
	Average weekly doses (tablets)	Duration of course (weeks)	Equiv. months	# of doses		Packaging: # per box	Price per box	Cost per tablet/vial
Cotrimoxazole Preventive Therapy for TB patients found HIV+								
Cotrimoxazole 480mg (adults, CD4 count > 500 cells/mm3)	14	48	12	672	100%	\$10.00	\$0.01	\$6.72
Cost of HIV test for TB patients (per test)	\$2.3	Cost source: GOALS model						
First-line ARV Treatment Initiation for TB patients found HIV+								
Components of fixed triple-line regimens (strength)	Type	Cost per patient year	% of cases placed on regimen	Average cost per course				
AZT+3TC+EFV (300/150/600)	NNRTI-based	\$540	33%	\$282	TOTAL per patient year			
AZT+3TC+NVP (300/150/200)	NNRTI-based	\$174	33%					
d4T+3TC+NVP (30/150/200)	NNRTI-based	\$132	33%					
			Cost data source: CHAI 2007					
Isoniazid Preventive Therapy for HIV+ patients with latent TB								
Isoniazid 300mg (H)	7	24	6	168	100%	\$7.59	\$0.01	\$1.28
	Average weekly doses (tablets)	Duration of course (weeks)	Equiv. months	# of doses	% of HIV+ latent TB patients on this dosing	Packaging: # per box	Cost per tablet/vial	Cost per patient course

TABLE A-1.1. DRUG REGIMENS USED IN THIS COSTING STUDY FOR MDR-TB TREATMENT: INGREDIENTS-BASED APPROACH

ADULTS: Intensive Phase	Dosing and Distribution				% of MDR-TB patients on this dosing	Cost: Loose Drugs				Average cost of regimen
	Average weekly doses (tablets)	Duration of course (weeks)	Equivalent months	Number of doses		Packaging: # per box	Price per box	Cost per tablet/vial	Cost per patient year	
Kanamycin 1 gram powder for injection vial (750mg eff. dose)	7	16	4	112	50	\$33.18	\$0.66	\$74.32		\$177.34
Ethionamide 250mg (2 a day)	14	16	4	224	100	\$10.21	\$0.10	\$22.87		
Ofloxacin 200mg (4 a day)	28	16	4	448	100	\$3.49	\$0.03	\$15.64		
Pyrazinamide (Z) 500mg (3 a day)*****	21	16	4	336	1000	\$14.50	\$0.01	\$4.87		
And add: Option 1: Cycloserine 250mg (2 a day)	14	16	4	224	100	\$50.96	\$0.51	\$114.15	\$231.85	
And add: Option 2: Ethambutol (E) 400mg (2 a day)	14	16	4	224	1000	\$22.86	\$0.02	\$5.12	\$122.82	
ADULTS: Continuation Phase: Options			(Average mo.)							Average cost of regimen
Ethionamide 250mg (2 a day)	14	56	14	784	100	\$10.21	\$0.10	\$80.05		\$343.49
Ofloxacin 200mg (4 a day)	28	56	14	1568	100	\$3.49	\$0.03	\$54.72		
And add: Option 1: Cycloserine 250mg (2 a day)	14	56	14	784	100	\$50.96	\$0.51	\$399.53	\$534.30	
And add: Option 2: Ethambutol (E) 400mg (2 a day)	14	56	14	784	1000	\$22.86	\$0.02	\$17.92	\$152.69	
		***** prices for 400mg tablet available, and used							TOTAL per patient treated (lifetime)	\$520.83

ANNEX B. ADDITIONAL RESULTS

FIGURE B-1. PROJECTED COHORTS OF REGISTERED TB AND TB-HIV CASES, ENHANCED DOTS SCENARIO

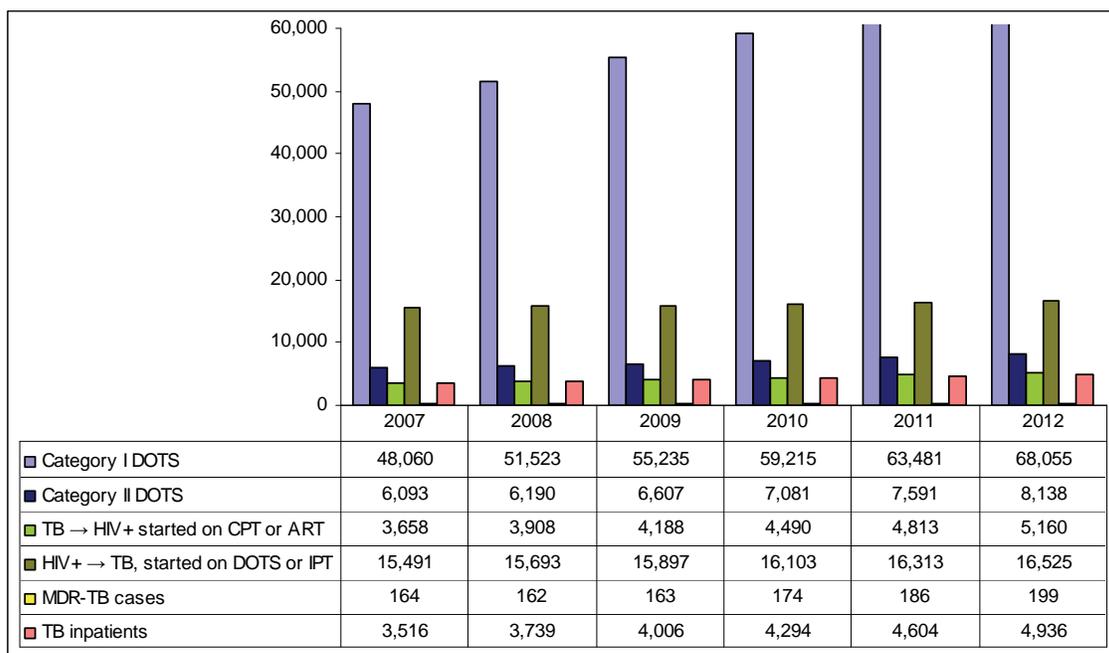


FIGURE B-2. PROJECTED COHORTS OF REGISTERED TB AND TB-HIV CASES, DOTS-PLUS AND TB-HIV SCENARIO

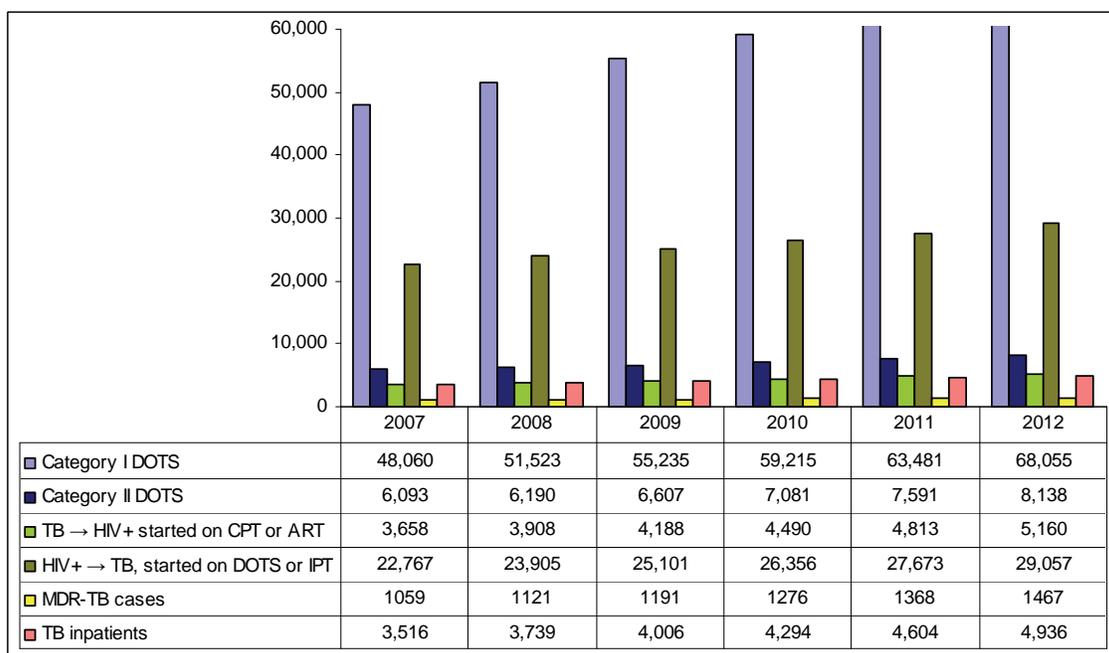
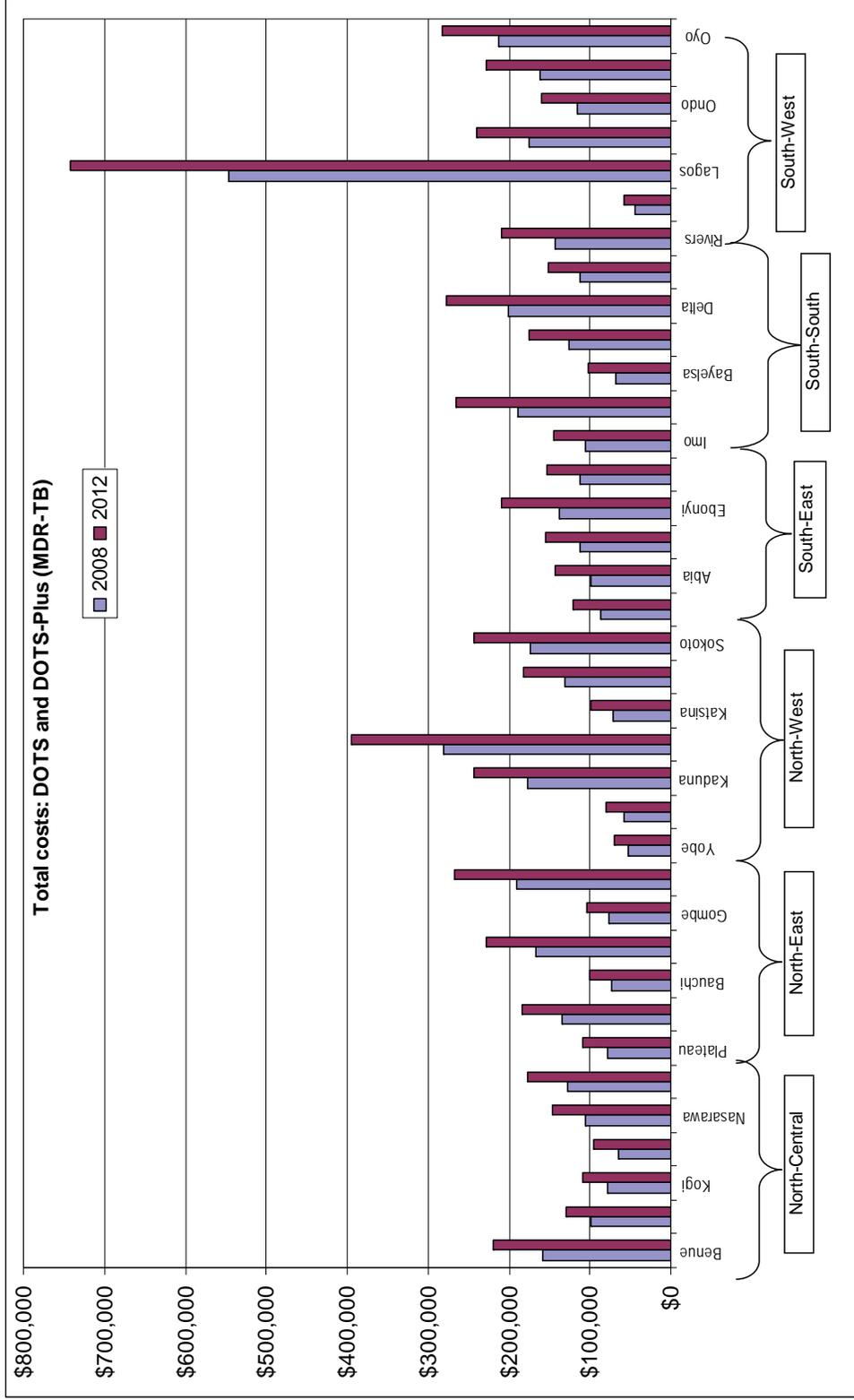


FIGURE B-3. TOTAL COSTS BY STATE, BASELINE SCENARIO: STANDARD DOTS AND MDR-TB



*** These costs do not include:**
 - costs of hospitalization for DOTS patients
 - costs of PLWHA with active TB placed on DOTS (HIV -> TB)
 - costs of HIV+ patients placed on ART/CPT (TB -> HIV)

ANNEX C. REFERENCES

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