USAID
FROM THE AMERICAN PEOPLE

TB CARE I

TB CARE I - Cambodia
Final Report

October 1, 2010 –December 31, 2014

Submitted: December 5, 2014

Cover photo: A physician tests a child for latent tuberculosis infection in Bantey Meanchey Province, Cambodia (Team Bakkhim, JATA Senior Program Officer).

This report was made possible through the support for TB CARE I provided by the United States Agency for International Development (USAID), under the terms of cooperative agreement number AID-OAA-A-10-00020.

Disclaimer
The authors' views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

Table of Contents

EXECUTIVE SUMMARY	**5**
INTRODUCTION	**7**
CORE INDICATORS	**8**
UNIVERSAL ACCESS	**9**
LABORATORIES	**14**
INFECTION CONTROL	**18**
PROGRAMMATIC MANAGEMENT OF DRUG RESISTANT TB (PMDT)	**20**
TB/HIV	**22**
HEALTH SYSTEM STRENGTHENING (HSS)	**23**
MONITORING & EVALUATION, SURVEILLANCE AND OR	**25**
TB CARE I'S SUPPORT TO GLOBAL FUND IMPLEMENTATION	**27**
THE WAY FORWARD	**28**
ANNEX I: KNOWLEDGE EXCHANGE	**30**

List of Abbreviations

ACF	Active case finding
CDC	Centers for Disease Control
CHC	Cambodia Health Committee
C-DOTS	Community based directly observed treatment, short course
CENAT	National Center for Tuberculosis and Leprosy Control
DOTS	Direct Observation TB Treatment, Short course
DST	Drug Susceptibility Testing
DW	DOT Watcher (community volunteer)
EQA	External Quality Assurance
FHI 360	FHI 360 (previously Family Health International or FHI)
GDP	General Department of Prisons
HC	Health Center
HCW	Health Care Workers
HIV	Human Immunodeficiency Virus
HSS	Health System Strengthening
IPT	Isoniazid Preventive Therapy
JATA	Japan Anti-TB Association
KNCV	KNCV Tuberculosis Foundation
MDR-TB	Multi-drug resistant TB
MSH	Management Sciences for Health
NCHADS	National Centre for HIV, AIDS and Dermatology Services
NGO	Non-Governmental Organization
NTP	National TB Program
OD	Operational District
OR	Operational Research
MoH	Ministry of Health
PMDT	Programmatic Management of drug-resistant TB
PPM	Public Private Mix
QI	Quality Improvement
SMS	Short Messaging Services
SRL	Supra-national Reference Laboratory
TB	Tuberculosis
TB-IC	Tuberculosis- Infection Control
TWG	Technical Working Group
USG	United States Government
USAID	United States Agency for International Development
WHO	World Health Organization

Executive Summary

Cambodia is one of the biggest success stories for tuberculosis (TB) control in Asia and the world. Previously with one of the highest TB incidence and prevalence rates among the World Health Organization's (WHO) 22 high-burden countries, the Cambodia National Tuberculosis Program (CENAT) took swift action beginning in 1993, instituting health reforms and shifting from hospital-based to health center- and community-based care, while advocating successfully for strong political commitment. Directly observed therapy-short course (DOTS) was introduced in 1994 and scaled up at the national level, which was followed by a dramatic decline in TB prevalence by 38% in smear positive and 45% in bacteriologically confirmed cases over a period of nine years.

Since October 2010, the United States Agency for International Development (USAID) has funded the TB CARE I project in Cambodia, a 4-year project globally led by the KNCV Tuberculosis Foundation (KNCV) overseeing a consortium of organizations in Cambodia including: Family Health International (FHI 360), Japan Anti Tuberculosis Association (JATA), Management Sciences for Health (MSH), and WHO. The project has achieved its objectives by focusing on seven key technical areas: universal and early access; laboratories and improved diagnosis; infection control; programmatic management of drug-resistant tuberculosis (PMDT); TB/HIV; health systems strengthening; and monitoring and evaluation, operational research, and surveillance.

Highlights of TB CARE I achievements in Cambodia over the life of project are summarized below.

1. **Increased case detection for risk groups:**
    a. **Prisons:** In 2009, the prevalence rate in prisons was 18 times that of the general population (approximately 5000 per 100,000) and in 2011, the rate had decreased to approximately 3000 per 100,000. Under TB CARE I, case notification rates (CNR) doubled in 2011 from active case finding across the nine prisons covered in the project's catchment area. In 2011 and 2012, the number of TB screenings were 4,804 and 4,901 respectively, and among those, 95 TB cases in 2011 and 140 TB cases in 2012 were diagnosed and put on treatment. In 2014, however, trends in CNR decreased as active case finding in prisons was not conducted due to CENAT's workload.
    b. **Hospital Engagement**: Screening for TB in the hospital setting was done in the outpatient department and diabetes (DM) clinics of five large hospitals. Cambodia has a 10% diabetes and 15% pre-diabetes prevalence, thus highlighting the importance of screening for TB among this risk group, as well as screening and managing diabetes among TB patients (bidirectional framework for TB and DM). Screening for TB in the hospital clinics was implemented in July 2013 in three provincial hospitals, and expanded to five hospitals in April of 2014. From January to September 2014, 4,715 clients visited an OPD and diabetes clinic and were then referred and screened for TB at TB units within the hospitals. 745 of the screened patients were diagnosed with TB and put on treatment.
    c. **Childhood TB:** Childhood TB care has become routine work in referral hospitals where TB physicians have been trained in diagnosis and treatment. During the life of the project, TB CARE I successfully expanded the diagnosis and treatment sites to 27 operational districts (OD) within 13 provinces. During this project period, a total of 79,441 children suspected of having TB were referred from communities and health centers for further diagnosis at referral hospitals. Of these presumptive TB patients, 14,180 children (18%) were diagnosed with TB and put on treatment. The national guideline for Childhood TB was introduced in 2008, offering isoniazid preventive therapy (IPT) at health facilities; however, IPT implementation was limited. Through the project's support, IPT was introduced and expanded to health centers in 27 ODs. A total of 5,825 children were successfully registered for IPT over the life of the project. Moreover, 95.7% (1965/2050) of the children who were registered for IPT in 2013 completed the six month course of treatment. Among those, 11 IPT children developed TB and were put on TB treatment; in addition, 74 children defaulted.
    d. **Public-Private Mix:** In the 2011 prevalence survey, approximately 45% of presumptive TB patients visited the private sector first prior to presenting to the

public sector. This represents a significant number of individuals who may be missed by CENAT. TB CARE I supported public-private mix (PPM) engagement in 26 ODs in 7 provinces, engaging with over 1,323 private providers. A total of 1,626 patients have been diagnosed through PPM activities throughout the life of the project, exceeding the life of project (LOP) target of 1,243. Private providers most often comprise pharmacists in the urban and peri-urban areas, and the rate of referrals received within CENAT system rose from 50% to 71% over the life of the project.

2. **Innovative technology to strengthen TB diagnosis and management**
    a. Introduction of the GeneXpert MTB/RIF (GeneXpert) technology, complementing contributions from other donors, has helped to decrease the diagnosis gap for MDR-TB, although significant work still remains in this area. In the coming years, additional GeneXpert machines will be delivered to more rural settings, with the goal to improve access to diagnosis in the rural setting. This is particularly important in light of the last prevalence survey, which showed a higher prevalence of TB in the rural compared to urban areas, particularly in those with higher poverty indices. JATA-led activities have been instrumental in advising CENAT and collaborating with other organizations to develop national algorithms to integrate GeneXpert testing into the current diagnostic algorithm, which has been based upon sputum smear. GeneXpert testing was integrated into the national algorithm for TB testing for high risk populations across Cambodia.
    b. A very promising mobile health initiative was developed by FHI 360 to expedite sputum smear results to health center (HC) staff. This mobile and online short message service (SMS) system has been piloted in 43 HC and six labs. The system also uses a live database allowing supervisors to monitor and follow-up with TB labs if results are delayed (http://tblab.cenat.gov.kh). The turnaround time for delivery of test results decreased dramatically over the life of the project - from 15 days in the first three months of pilot implementation to 4 days in the final year of the project.

3. **Community mobilization to strengthen TB and MDR-TB control**
    a. TB CARE I supported CENAT to develop the country's standard operating procedures for MDR-TB and to transition from an NGO-led pilot to mainstreaming PMDT under CENAT. Closing the diagnosis gap has been one of the key priorities for CENAT and for the TB CARE I team, led by the WHO and its local partner, the Cambodia Health Committee (CHC).
    b. Throughout the life of the project, the number of presumptive MDR-TB patients tested using all forms of testing (including GeneXpert, culture and drug sensitive testing) increased sharply from 535 patients in the 2010 cohort to 1,593 patients in the 2013 cohort. The number of rifampicin-resistant (RR)/MDR TB enrolled on second line drug treatment also increased steadily, from 31 cases in the 2010 CENAT cohort to 121 cases in the 2013 CENAT cohort. 92% (n=121) of RR/MDR TB diagnosed (n=131), were initiated on treatment in 2013. Treatment success rates are high by international standards, and these have been maintained through close engagement and mobilization of community directly observed therapy (C-DOT). There are currently 11 MDR-TB treatment sites located in 10 provinces. With strong technical and financial support from TB CARE I, CENAT strengthened their routine presumptive MDR-TB referral system. Additionally, TB CARE I conducted robust supervision to all ODs and hospitals engaged with MDR-TB treatment. Even accounting for this progress, there is still a significant diagnosis gap in Cambodia for MDR-TB, with an estimated 500 MDR-TB cases arising every year among the TB cases notified; of these, approximately 30% are diagnosed and notified to CENAT. In contrast, >90% of those diagnosed are initiated on treatment, thus the country has done an impressive job of closing the treatment gap.

Introduction

USAID has funded the TB CARE I project in Cambodia from October 2010, with activities conducted over four years since that time. TB prevalence among SS+ cases for those over 15 years of age decreased 38% from a rate of 362/100,000 to 271/100,000 between 2002 and 2011. However, Cambodia still has one of the highest incidence and prevalence rates in the world. TB CARE I is one of the main global mechanisms for implementing USAID's TB strategy as well as contributing to TB/HIV activities under the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) to implement TB activities within this context. This project was initially a 5-year program aimed at building and expanding upon previous programs, particularly the Tuberculosis Control Assistance Program (TB CAP 2005-2010). The over-arching elements of TB CARE I are:

1. **C**ollaboration and Coordination
2. **A**ccess to TB Services for All People
3. **R**esponsible and Responsive Management Practices
4. **E**vidence-based project M&E

The overall aim of TB CARE I in Cambodia is to contribute to CENAT goal of halving TB prevalence and death rates in Cambodia by 2015 (relative to the 1990 baseline), consistent with the Global Plan to Stop TB. This goal builds on achievements of the previous TB CAP project. With an obligated amount of $1.7 million USD from USAID for 2011, the TB CARE I activities in Cambodia were launched in January 2011. Overall guiding principles for implementing TB CARE in Cambodia are:

- To align with the National Strategic Plan for TB Control 2011-2015 and USAID TB strategy
- Focus on technical assistance (TA) at the national level, and through collaboration with other USAID funded TB partners wherever possible
- Introduce innovations and implement pilots or demonstration projects introducing the new diagnostic technologies and concepts
- Scale up initiatives piloted or introduced through the previous TB CAP project

Five members of the Tuberculosis Coalition for Technical Assistance (TBCTA) consortium namely FHI 360, JATA, KNCV), MSH, and the WHO are involved in the TB CARE I Cambodia project. JATA was originally the lead partner for TB CARE I in Cambodia, followed by FHI 360 in the lead role in country. Three of the five partners – FHI 360, JATA and WHO- have local offices in Cambodia, and the main TB CARE I office is based at the National Center for TB and Leprosy Control (CENAT). Overall management of the TB CARE I Cambodia project is conducted by the core team from FHI 360, MSH, JATA and WHO based in Cambodia, with back stop support from the Project Management Unit (PMU)/KNCV and respective headquarter offices as required. The team, led by the Chief of Party (COP)/Project Director from FHI 360, is responsible for overall leadership, management and successful implementation of the project in Cambodia. This final report for TB CARE I outlines the project's key accomplishments within seven technical areas: universal and early access, laboratories and improved diagnosis, infection control, programmatic management of drug-resistant tuberculosis (PMDT), TB/HIV, health systems strengthening, and monitoring and evaluation, operational research, and surveillance.

Core Indicators

TB CARE I has seven core indicators that the program is working to improve across all countries. Table 1 summarizes the core indicator results across the life of the project for TB CARE I-Cambodia as well as the Tuberculosis Control Assistance Program (TB CAP), the precursor to TB CARE I, which our coalition also led.

Table 1: TB CARE I core indicator results for Cambodia

		C1. Number of cases notified (all forms)	C2. Number of cases notified (new confirmed)	C3. Case Detection Rate (all forms)	C4. Number (and percent) of TB cases among healthcare workers	C5. Treatment Success Rate of confirmed cases	C6. Number of MDR cases diagnosed	C7. Number of MDR patients started on second line drugs
TB CAP	2008	36,495	35,601	N/A	N/A	93%	14	21
	2009	39,820	38,927	N/A	N/A	94%	47	55
	2010	40,199	39,202	N/A	N/A	95%	46	49
TB CARE I	2011	41,628	40,460	65%	N/A	95%	31	45
	2012	39,670	38,555	62%	N/A	94%	56	83
	2013	40,258	39,083	66%	N/A	93%	110	134
	2014	39,055	37,743	64%	N/A	N/A	121	143

Universal Access

Technical Outcomes

Outcome	Indicator	Indicator Definition	Baseline	Target LoP	Result LoP
1.1 Increased demand for and use of high quality TB services and improve the satisfaction with TB services provided (Population/Patient Centered Approach	1.1.1 Number of facilities where quality of services is measured	**Description:** NTP should measure the patient perception of the quality of services available/accessible and the appropriate health seeking behavior related to TB. Available tools for this purpose are TB CAP's QUOTE TB and QUOTE TB Light tools. However, any other tools could be used to measure it. Count the number of facilities where quality of services from a patient's perspective was measured using QUOTE or any other tool in the last 12 months. **Indicator Value**: Number **Level**: National **Source**: NTP and TB CARE project office **Means of Verification**: Report on quality of services from a patient's perspective	43 Y:2013	42	40
	1.1.2 X-ray films judged to have been read correctly by an expert cross reader (agreement rate)	**Description:** X-ray films judged to have been read correctly by an expert cross reader (agreement rate) **Indicator value:** Percent **Level:** National and TB CARE geographic areas **Source:** NTP and TB CARE project **Numerator:** Smear Negative TB cases after X-ray cross checked **Denominator**: Smear Negative TB cases were cross checked	83% (1611/1930) Y:2013	>85%	81% (1864/2289)
1.2 Increased quality of TB services delivered among all care providers (Supply)	1.2.2 TB cases diagnosed by private providers	**Description:** Number of new cases of TB diagnosed according to NTP guidelines by private providers **Indicator value:** Number **Level:** National **Source:** WHO **Means of verification:** Reporting forms from private facilities	NA Y:2010	1243	1626
	1.2.4 Number of TB cases (all forms) diagnosed in children (0-14 years)	**Description:** This indicator measures the number of TB cases (all forms) diagnosed in children 0-14 years of age. When childhood TB is a priority, being able to report on and measure changes in case notification by age group is important. **Indicator Value:** Number **Level:** National and TB CARE geographic areas **Source:** NTP, TB CARE project, WHO	NA Y: 2010	7025	14180

		Means of Verification: Recording & reporting system reports; TB registers			
	1.2.5 Prisons with TB services (number)	**Description:** This indicator measures the coverage of prisons providing DOTS services. Prisons should regularly diagnose and refer suspects and should put patients on treatment in order to be qualified as providing DOTS. Indicator Value: Percent **Level:** National and TB CARE geographic areas **Source:** NTP and TB CARE project Means of Verification: NTP records on number of suspects referred, number of patients put on treatment from the prisons. **Numerator:** Number of prisons providing DOTS **Denominator:** Total number of prisons in the country	NA Y:2010	10	10
1.3 Reduced patient and service delivery delays (Timing)	1.3.3 Provider Delay: Number of days from the time sputum smears are sent by HCs to receipt of lab results	**Description**: Number of days or weeks from sputum collection to initiation of treatment. Note that this measurement requires operations research using a valid tool. **Indicator Value**: Number (of days or weeks) **Level**: National or TB CARE geographic areas **Source**: TB CARE project **Means of Verification**: Data set and report on the operations research.	NA Y:2010	< 5 days	4 days

Key Results

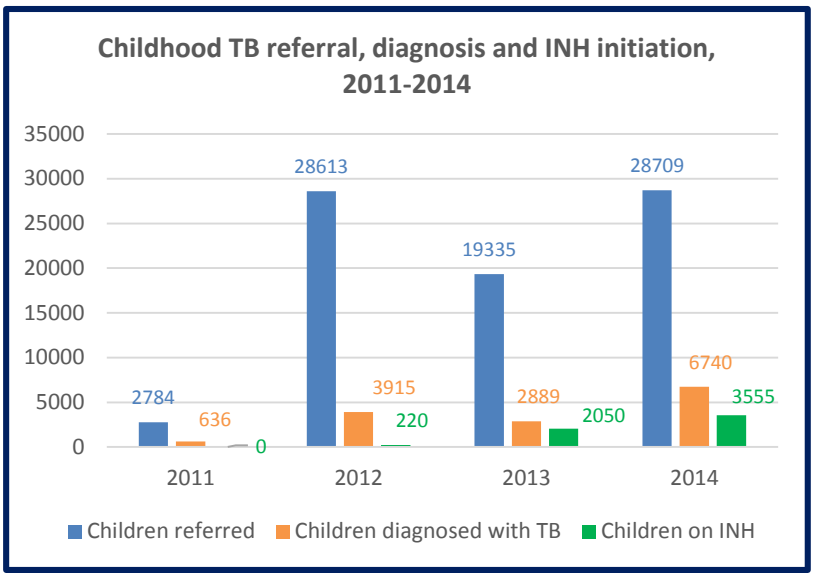
Universal access to increase early diagnosis and treatment for TB was one of the key technical areas for TB CARE I. Activities for this technical area were led by FHI 360 (prison, TB/diabetes screening, PPM); and by JATA to improve diagnostic capacity for chest X-ray and for childhood TB management. The primary goal for this technical area was to provide universal access to TB diagnosis and treatment through the following:

1. Effective, early identification of presumptive TB patients among risk groups: children, prisoners, diabetics.
2. Efficient referral and arrival of presumptive cases into CENAT system for diagnostic testing.
3. Prompt diagnosis expedited by improved chest X-ray capacity and SMS delivery of sputum results.
4. Prompt initiation of treatment following diagnosis.

Each of the risk groups targeted throughout the TB CARE I life of project demonstrated successful results, as described below.

Childhood TB (JATA): The national guideline on childhood TB management was introduced in 2008. Its implementation was initially limited, however, with the exception of active case finding for TB in selected areas. Routine childhood TB services at the health facility level were not available. With the TB CARE I project in collaboration with the Cambodia CENAT, pilot activity was started in 3 ODs and services were expanded to 27 ODs over the life of the project. The activities supported by TB CARE I included trainings on clinical management of childhood TB, Tuberculin Skin Test administration (TST), chest x-ray reading skills and Isoniazid Preventive Therapy (IPT). The project also continues to

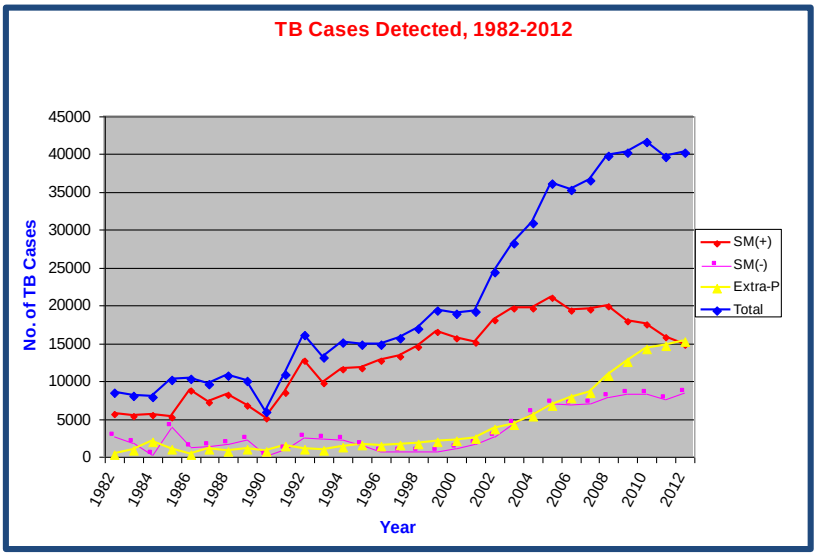
monitor, supervise and provide on-the-job training for CENAT staff. Over the life of the project (Figure, right), 79,441 children were identified as presumptive TB cases, many of whom were household contacts of known TB patients; these children were referred to and arrived to the referral hospitals for clinical evaluation including TST, physical and history examination and chest x-ray. 14,180 (18%) of those referred were diagnosed with TB and initiated on treatment. Among those, 5,825 (7%) children were ruled out for active TB disease and initiated on isoniazid preventive therapy (IPT). These results demonstrate a marked improvement on childhood TB diagnosis and treatment. To address the over-diagnosis of extrapulmonary TB, which has been documented to be as high as 96% of all childhood TB cases, the TB CARE I and CENAT team developed diagnostic algorithms to assist field TB physicians. After introduction of the algorithm and on-the-job training in the fields, TB physicians improved their skill of chest x-ray reading, resulting in an increased proportion of pulmonary TB to 21.7% among all childhood cases.



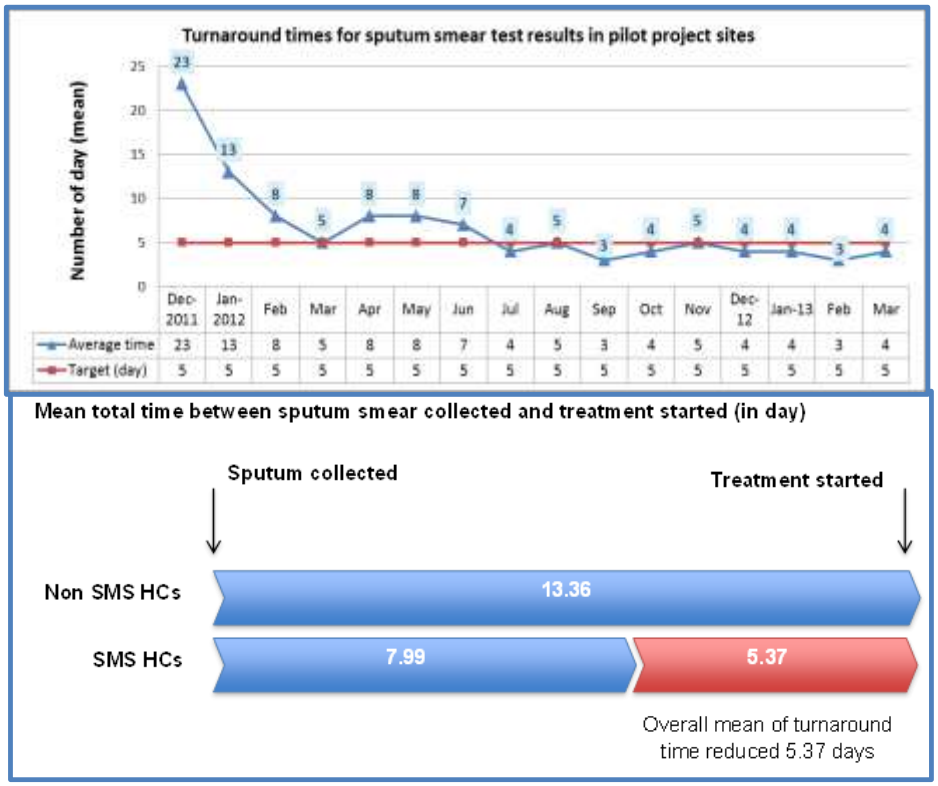
Prison TB/HIV Services (FHI 360): In 2009, the TB prevalence rate in the prison setting was estimated through active case finding as 18 times higher than the general population: approximately 5,000 per 100,000. In 2012, active case finding among ten prisons supported by TB CARE I doubled the case notification rates. In 2011 and 2012, the number of people screened for TB were 4,805 and 4,901 respectively, and among those, 95 TB cases in 2011 and 140 TB cases in 2012 were identified and put on treatment. The TB case notifications were high in 2011 and 2012 due to active case findings (ACF) in prisons using multiple testing methods, including GeneXpert. In 2014, trends in CNR decreased as ACF in prisons was not conducted due to a budget shortage, likely accounting for the lower case notification rate. Over the life of the project, 20,277 prisoners were identified as presumptive TB cases and referred for screening. Among these, 397 (2%) were diagnosed with active TB disease and initiated on treatment. Treatment success rates in the 10 prisons supported by the project have been maintained at >85% throughout the life of the project. In FY14, 40 TB cases were diagnosed among 5,616 prison inmates (712/100,000) through routine passive TB screening activities. Operationalizing a clear strategy for identification of presumptive TB cases in the prison setting is critical in the coming years, which should include policy guidelines enabling TB staff to access patients in need of health care as well as clear mechanisms for diagnostic testing (sputum transport, chest X-rays, etc.).

Hospital Engagement (FHI 360): TB CARE I supported five provincial hospitals working in outpatient and diabetes clinics to implement a bi-directional screening and referral mechanism. During FY14, 5,005 patients presenting to diabetes clinics and outpatient departments were referred to the TB unit for diagnosis. Among those referred, 732 (14.6%) were diagnosed and treated with TB. Activities for TB/DM bidirectional screening were started in FY13 Quarter 4, and the results over this brief implementation period suggest that this framework should be scaled up in additional provinces. Mapping the scale-up for expanded implementation should be guided by diabetes prevalence throughout the country, if data are available.

CXR diagnostic capacity development (JATA): The TB CARE I and CENAT teams collaborated closely throughout the life of the project to build technical capacity for chest x-ray interpretation by provincial physicians. Given that chest x-rays are the main diagnostic method for AFB smear negative TB, it is important to maintain technical skill for chest x-ray interpretation. Quarterly supervision visits by CENAT and the TB CARE I team were done in 46 OD in 11 provinces. During this year, the agreement rate between hospital physicians and cross-readers was 81%, decreased compared to the agreement rate at 83% (1,611/1,930) in the previous year. There has been a slow but steady decline since the first year of the project (89%, 86%, 83%, 81%) as the target was set at 85%. An assessment of the consistency for cross-checking may be warranted given these data, to ensure that an unbiased group of cross-checkers from CENAT and TB CARE I team have contributed to the assessments throughout the life of the project. In addition, the country's data for smear-negative case notification (Figure, above) has plateaued since 2008, suggesting that current efforts to improve smear-negative TB diagnoses are not effective. This should be addressed as a priority in coming years.

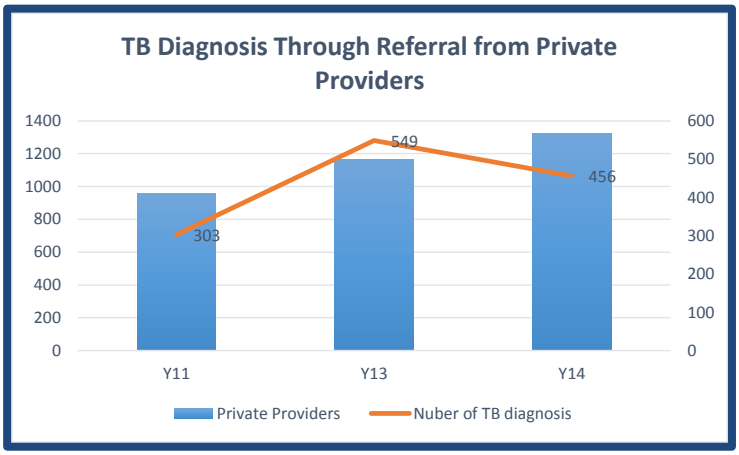


SMS Alert System (FHI 360): Starting in FY12 Quarter 1, FHI 360 developed an internet-based SMS alert system to deliver sputum smear test results to health center (HC) staff and community TB volunteers, piloted in 15 HC and four labs. The turnaround time for delivery of test results decreased dramatically within 3 months after initiation of the system: from 15 days pre-SMS alert down to an average of 4-5 days. In FY 13 and FY14, TB CARE I continued implementing this SMS alert system, expanding to cover 43 HC and six TB laboratories in three ODs. The system maintains good performance characteristics, with an average turnaround time of approximately 4 days (range: 0-19 days) (Figure). In 2013, the SMS alert system decreased the time between sputum collection to treatment initiation



by 5 days compared to non-SMS implementing HCs, a statistically significant result (Figure). Going forward, the national program has considered using this approach for national scale up following a cost analysis.

Public-Private Mix (FHI 360): In 2011, approximately 45% of presumptive TB patients visited the private sector first prior to presenting to the public sector. TB CARE I supports public-private mix (PPM) engagement in 26 OD in 7 provinces, engaging with over 1,323 private providers. A total of 1,626 patients have been diagnosed through PPM activities throughout the life of the project, exceeding the 4-year target of 1243 patients diagnosed. Private providers most often comprise pharmacists in the urban and peri-urban areas, and the rate of referrals of presumptive TB patients from private providers who reached the CENAT system rose from 50% to 71% over the life of the project. Questions remain, however, on the overall efficacy of PPM to improve case detection, and these questions should be addressed through a formal evaluation of the country's PPM initiatives, including TB CARE I's implementation.



Quality Improvement (FHI 360): Two primary quality improvement (QI) objectives were identified in FY11: to increase 1) identification and 2) referral of presumptive TB patients by private providers and community volunteers to the public sector. Following site selection, root cause analysis, and definition of the "change intervention package", the QI measurement tools were introduced and utilized throughout the life of the project to measure impact. In FY 2012 quarter 1, five health centers in Kampong Cham province applied the quality improvement (QI) model to improve successful referrals of TB suspects through community DOTS volunteers and private providers. Monthly and bimonthly learning sessions were used as a forum to discuss the challenges and proposed solutions for the improvement. In FY14, TBCARE I scaled up QI model to cover 40 HCs in Kampong Cham, Chamkar Leu and Stueng Trang ODs. Based on data available from 34 HCs for the period May 2012 – April 2014, the number of TB suspects referred by PP and C-DOTS volunteers increased from 8,997 in period of May 2012-April 2013 to 9,098 in period of May 2013 – April 2014. However, the numbers of TB cases diagnosed among referred suspects decreased from 1,133 to 944 TB cases.

Laboratories

Technical Outcomes

Outcome	Indicator	Indicator Definition	Baseline	Target LoP	Result LoP
2.1 Ensured capacity, availability and quality of laboratory testing to support the diagnosis and monitoring of TB patients	2.1.1 A national strategic plan developed and implemente d for providing the TB laboratory services needed for patient diagnosis and monitoring, and to support the NTP	**Description**: A national laboratory plan has been developed that addresses strategic objectives on how the country will meet the national requirements for quality TB diagnostic services. Strategic objectives can be, but are not limited to: Establishment of reference laboratory, laboratory network, EQA program, increase laboratory capacity, improvement of HR situation, data management etc. According to strategic objectives, annual workplans and budgets with targets and indicators should be developed and implemented to implement the national laboratory strategic plan. **Indicator Value:** Score based on below: 0 = Laboratory strategic plan is not available 1 = Laboratory strategic plan is ready but no annual implementation plan and budget available for the current year 2 = Laboratory annual implementation plan and budget is available for the current year 3 = NTP annual report for the current year includes a section demonstrating progress with the implementation of the laboratory strategic plan. **Level**: National **Source**: NTP **Means of Verification**: National Strategic Plan Document	NA (2010)	3	3
	2.1.2 Laboratories with working internal and external quality assurance programs for smear microscopy and culture/DST	**Description**: Laboratories have successfully established a mechanism for performing internal quality control for smear microscopy and culture/DST (e.g. performing control samples etc) and are enrolled in an EQA program, which is supervised by a higher-level laboratory (i.e. by proficiency testing, blinded re-checking and supervision visits). Participating laboratories should have met WHO standards for QC/EQA results. Both laboratories, supervising and participating, have to keep data on results for verification. **Indicator Value:** Percent **Level**: National and TB CARE geographic areas **Source**: National Reference Laboratory and TB CARE Project	U (2010)	40% (87/ 215)	40% (87/ 215)

		Means of Verification: Lab register, EQA result reports/statistics, separate supervision visit reports. **Numerator**: Number of laboratories enrolled in EQA program for smear microscopy and/or culture/DST both nationwide and TB CARE areas. **Denominator**: All laboratories (national and TB CARE areas separately) that perform smear microscopy and/or culture/DST.			
	2.1.3 TB laboratories participating in smear microscopy EQA program performing with over 95% correct results	**Description:** Performance of EQA is just as important as having EQA established. This WHO indicator measures the percent of laboratories enrolled in EQA for smear microscopy and/or culture/DST that successfully passed EQA in the last reporting period. **Indicator Value**: Percent **Level:** National and TB CARE geographic areas **Source:** NRL, TB CARE Project, WHO **Means of Verification**: EQA reports/statistics; supervision reports **Numerator:** Number of laboratories enrolled in EQA for smear microscopy and/or culture/DST that passed the EQA assessment from the last reporting period. **Denominator:** Number of laboratories enrolled in EQA for smear microscopy and/or culture/DST	NA Y: 2010	>80%	89% (77/ 87)
2.2 Ensured the availability and quality of technical assistance and services	2.2.1 Technical assistance visits from a SRL through a formal link of memorandum of agreement (Yes/No)	**Description**: A selected SRL conducts TA visits to national reference laboratories. TA visit reports should be provided by the SRL. Suggestions for improvement made by SRL should be successfully implemented. **Indicator Value:** Yes/No **Level**: National **Source**: National Reference Laboratory **Means of Verification**: Memorandum of agreement, SRL visit reports	Yes Y:2010	Yes	Yes
2.3 Ensured optimal use of new approaches for laboratory confirmation of TB and incorporation of these approaches in national strategic laboratory plans	2.3.1 Diagnostic sites offering advanced technologies for TB or drug-resistant TB	**Description**: Number of diagnostic sites, in which GeneXpert MTB/RIF, HAIN MTBDRplus or liquid culture/DST are implemented and routinely used for diagnosis, stratified by testing type. **Indicator Value:** Number **Level**: National and TB CARE areas **Source**: NTP and TB CARE **Means of Verification**: Laboratory register, treatment register, EQA reports from supervising laboratories, implementer report, National Strategic Plan **Numerator**: Number of diagnostic sites using GeneXpert MTB/RIF, HAIN	NA Y:2010	3 GX and 22 LED FM	3 GX and 22 LED FM

		MTBDRplus or liquid culture/DST disaggregated by type of technology			
	2.3.3 Patients diagnosed with GeneXpert out of total tests conducted	**Description:** This indicator measures the number and percent of patients diagnosed using GeneXpert (disaggregated by RIF-resistance) **Indicator Value:** Percent **Level:** TB CARE areas **Source:** NTP and TB CARE **Means of verification:** lab register, TB treatment register **Numerator:** Number of TB patients diagnosed using GeneXpert disaggregated by RIF-resistance **Denominator:** Number or TB suspects tested with GeneXpert	NA Y:2010	NA	22% 273/1242

Key Results

The TB CARE I laboratory portfolio was led by JATA throughout the life of the project. TB CARE I procured three GeneXpert machines to support CENAT –two instruments were procured in 2011 and another one in 2012. One instrument was placed in the Battambang referral hospital, and two instruments in CENAT. Between 2012 and the end of the project, 7,256 patients had sputum samples analyzed by the three TB CARE I GeneXpert machines, and among those, 1,566 TB cases were diagnosed, of which 181 were MDR-TB, as demonstrated in the GeneXpert chart depicted below. The TB CARE I laboratory network also included 87 microscopy centers, where laboratory technicians were trained and assessed using standard external quality assurance (EQA) criteria. Slide selection, cross checking of smear slides, and on-site evaluation for EQA were conducted on quarterly basis. Throughout the project, EQA performance improved, from 76% in FY11 to 89% in FY14, with an average life of project achievement of 89%. The most frequent problem identified during the quarterly site evaluations was false negative readings, due to insufficient time to examine the required number of fields under the microscope, among other variables.

The project also procured 22 LED fluorescent microscopes for all high volume labs in 24 provinces throughout the country. LED fluorescent microscopy was shown to be comparable to conventional microscopy while reducing the time for examination. The high cost for the ready-made reagent for LED microscopy may challenge rapid expansion, which is an issue requiring follow-up. The country still relies on smear microscopy for TB diagnosis, thus highlighting the need to maximize quality and minimize work burden while maintaining a cost-effective laboratory strategy. Complementing the current laboratory strategy will be the further expansion of molecular diagnostics, in the form of an additional 10 GeneXpert machines that have been procured by UNITAID. Currently, 11 GeneXpert machines from TB REACH, TB CARE I, CDC, CHC, and Medicins Sans Frontieres are in use for active case finding among risk groups, people living with HIV, and presumptive MDR-TB cases.

Test Results from GeneXpert Machines at TB CARE I Supported Sites

GeneXpert tests conducted in TB CARE I supported sites	**Y11**	**Y12**	**Y13**	**Y14**
Number Rapid tests conducted	NA	2302	2230	2724
Patients diagnosed with GeneXpert in TB CARE I supported sites				
Presumptive **new TB**				
Total successful **tests****	NA	2302	1375	1242
Number of **MTB+** cases diagnosed using GeneXpert	NA	541	201	273
Number of **Rif+** (and MTB+) diagnosed	NA	70	20	5
TB positivity rate	NA	24%	16%	22%
Rif resistance rate	NA	13%	9%	2%
Presumptive MDR-TB				
Total successful **tests****	NA	NA	781	872
Number of **MTB+** cases diagnosed using GeneXpert	NA	NA	280	271
Number of **Rif+** (and MTB+) diagnosed	NA	NA	43	43
TB positivity rate	NA	NA	41%	36%
Rif resistance rate	NA	NA	13%	14%

*In FY12, GeneXpert testing was not disaggregated by presumptive TB or MDR-TB cases, which largely explains the decline in successful tests for presumptive new TB cases, from a peak of 2302 in 2012 to 2156 (1375 + 781) in 2013 to 2114 (1242 + 872) in 2014.

**A successful test is defined as GeneXpert analyses that produce results. Tests are unsuccessful when a GeneXpert analysis produces no results.

Infection Control

Technical Outcomes

Outcome	Indicator	Indicator Definition	Baseline	Target	Result
				LoP	LoP
3.2 Scaled-up implementation of TB-IC strategies	3.2.1 "FAST" strategy has been adapted and adopted	**Description:** NTP must have adopted a FAST strategy that prioritizes the following four core interventions to implement TB IC a) active identification of coughing patients, b) rapid diagnosis, c) separation of TB suspects and infectious TB patients, and d) early onset of effective treatment of TB patients. (FAST - "Find cases Actively, Separate safely, and Treat effectively") **Indicator Value:** Score based on below: 0 = Country has not adopted the four core interventions for TB IC "FAST strategy" and there are no plans for implementation 1 = Country has adopted the four core interventions for TB IC ("FAST strategy") and there are plans for implementation but the implementation has not started 2 = "FAST strategy" has been piloted 3 = "FAST strategy" has been fully implemented at the national level Level: National **Source:** TB CARE project Means of Verification: Any evidence of prioritizing the above four core interventions for implementation of TB IC, initiated and propagated by the MOH.	1 Y:2010	3	2
	3.2.2 Facilities implementing TB IC measures with TB CARE support	**Description**: Facilities that received support for implementation of TB IC measures through TB CARE out of the number of facilities planned to receive support for TB IC implementation. **Indicator Value**: Percent **Level**: TB CARE geographic areas **Source**: TB CARE project **Means of Verification**: Country-wide monitoring reports or reports on the implementation of TB-IC, from districts where TB CARE is involved. **Numerator**: The number of facilities where TB CARE I supported the implementation of TB IC measures. **Denominator**: Total number of facilities where TB CARE I planned to support the implementation of TB IC	NA Y:2010	44	46

Key Results

This technical area is implemented by FHI 360 in two operational districts of Kampong Cham (Chamkar Leu and Kampong Cham), and in ten of the 27 prisons in the country.

During the first year of the project, a communications strategy for TB infection control (TBIC) was developed with a branded logo: "SAKSIT", which means effectiveness/blessing in Khmer. Pretesting of the brand and of SAKSIT's key messages were defined prior to launching. A baseline survey was also conducted during FY12 so that the impact of this communication strategy could be measured after a period of implementation. In FY12, SAKSIT communication tools (flipcharts, posters, X stand, masks, logo and hand washing stickers) were developed and distributed to project sites (see photo to the right). Health Center staff and community-directly observed therapy (C-DOTS) volunteers were trained to use these tools. In addition, a checklist was used to assess the effectiveness of SAKSIT for changing knowledge, attitudes and practices related to TB infection control.

Based on the final evaluation conducted in 2013, there was a significant increase of Health Center staff's knowledge of administrative and environmental TBIC measures. More than 80% of surveyed Health Center staff in intervention areas understood how to identify presumptive TB patients and appropriately separated them into isolated areas compared with 35.1% at baseline. Knowledge on environmental control was also significantly increased, with respondents recognizing how to keep rooms clean and well ventilated, with open windows: knowledge on this component was at 83.3% at the final evaluation compared with 56.7% baseline.

The "FAST" strategy for TBIC advocates key messages for TB prevention: **F**ind cases **A**ctively, **S**eparate safely, and **T**reat effectively. CENAT and its partners, including TB CARE I, implemented activities related to intensified and active case finding among high risk groups (prisons, contacts, migrants etc.). Some health facilities also implemented triage of patients and maintained separate wards for infectious patients; MDR-TB sites instituted isolation rooms, and initiatives such as the SMS alert system and use of rapid diagnostic testing (GeneXpert) were also encouraged to improve early diagnosis and early initiation of treatment. In FY14, CENAT and TB CARE I were able to conduct TB screening among health care workers (HCW), for the first time during the life of the project. The screening was performed among 381 HCW from three ODs using a symptom check-list, chest x-rays, and GeneXpert tests. 95% (363/381) HCW participated in the TB screening, with 89% (322) of them undergoing chest x-ray plus GeneXpert test and 11% (41) HCW tested with GeneXpert only. No HCW were diagnosed with TB via GeneXpert, however, 3% (11) had abnormal chest x-rays suggestive TB, after CENAT confirmation.

Following the implementation of FAST and use of the SAKSIT campaign, it will be helpful to monitor TB case notification rates in the TB CARE I catchment areas to determine if the intensified TBIC activities have impacted disease transmission. Effective prevention should decrease primary transmission of TB and MDR-TB.

Programmatic Management of Drug Resistant TB (PMDT)

Technical Outcomes

Outcome	Indicator	Indicator Definition	Baseline	Target LoP	Result LoP
4.1 Improved treatment success of MDR TB	4.1.2 MDR TB patients who are still on treatment and have a sputum culture conversion 6 months after starting MDR-TB treatment	**Description**: MDR TB patients who are still on treatment and have a sputum culture conversion 6 months after starting MDR-TB treatment. The cohort is patients put on treatment in a calendar year. **Indicator Value**: Percent Level: National and TB CARE geographic areas **Source**: MDR treatment register **Numerator**: Number of MDR TB patients in a calendar year cohort who are still on treatment and had culture conversion latest at month 6 (having had 2 negative sputum cultures taken one month apart and remained culture negative since) **Denominator**: Total number of MDR patients who started treatment in the calendar year	U	Y1:NA Y2:>70% Y3:>70% Y4:>70%	Y1: N/A Y2: 81% (42/52) Y3: U Y4: 71% (78/110)
	4.1.3 MDR TB patients who have completed the full course of MDR TB treatment regimen and have a negative sputum culture	**Description**: MDR TB patients who have completed the full course of MDR TB treatment regimen and have a negative sputum culture. **Indicator Value**: Percent **Level**: National and TB CARE geographic areas **Source**: MDR treatment register/WHO **Numerator**: Number of MDR TB patients in a cohort who completed a course of MDR treatment and who fit the WHO criteria for cure or completed treatment **Denominator**: Total number of MDR patients who started treatment in the cohort	68% (21/31) Y:2010	>70%	86% (48/56)
	4.1.4 A functioning National PMDT coordinating body	**Description:** National PMDT coordinating body has been established, is recognized by the MOH and is functioning. **Indicator Value:** Yes/No **Level:** National **Source:** NTP	Yes Y:2010	Yes	Yes

Key Results

PMDT activities were implemented through WHO and its sub-recipient, Cambodia Health Committee (CHC), a local non-governmental organization (NGO), in close collaboration with CENAT.

The most important challenge for PMDT is the diagnosis gap, with only a fraction of estimated MDR-TB cases (~500) being diagnosed annually. Cambodia is not a high-burden MDR-TB country, as shown by the most recent drug resistance survey conducted in 2006-2007: the rate of MDR-TB among new

TB cases was 1.4% and 10% among retreatment cases. Although these rates are relatively low, they are projected to increase given that the 6-month rifampicin regimen was only introduced in 2004, and the generation of rifampicin resistance will take 5-10 years to develop in the community. Nonetheless, the country has maintained impressive treatment success rates for drug-susceptible TB >90%, as well as commendable treatment success rates of MDR-TB (86%, most recent data from 2014, with a range from 70% to 86% from FY11 through FY14).

TB CARE I supported efforts to improve MDR-TB case findings, build capacity of staff through trainings and supportive supervision, as well as providing enablers for MDR-TB patients such as food, transportation, psychological support, and monthly medical follow ups. Approximately 180 MDR-TB patients on second line treatment received this comprehensive package of support between 2012 and 2014. Joint supervision from TB CARE I (WHO), CENAT and Cambodia Health Committee (CHC) was done from the national level to at least 8 MDR-TB treatment sites, 15 provinces and 20 drug resistant-TB patients' homes every quarter. Every month, the MDR-TB program manager and clinicians of CHC visited at least 3 treatment sites and 10 patients in both the hospital and community. In addition, field nurse-monitors of CHC visited at least 122 patients' homes every month.

While there has been progress in MDR-TB case detection to date, there is a need for further increase considering that among all notified TB cases per year there are an estimated 500 MDR-TB cases that may or may not be diagnosed. Activities in the future should continue to support active case finding; to refine the referral system for MDR-TB diagnosis; and to engage with NGOs implementing community DOTS to promote active identification and referrals of MDR-TB suspects. In 2013, there were 1,593 presumptive MDR TB cases screened by GeneXpert/culture/DST and among those, 131 RR/MDR-TB patients (8%) diagnosed. This was an increase of 12% from 2012, in which 117 MDR cases were diagnosed. In 2013, 92% (121/131) of those diagnosed were initiated on treatment. As of June 2014, 865 presumptive MDR TB cases have been screened. Among those, 53 RR/MDR TB cases were diagnosed as MDR TB and 98% (52/53) were initiated on treatment.

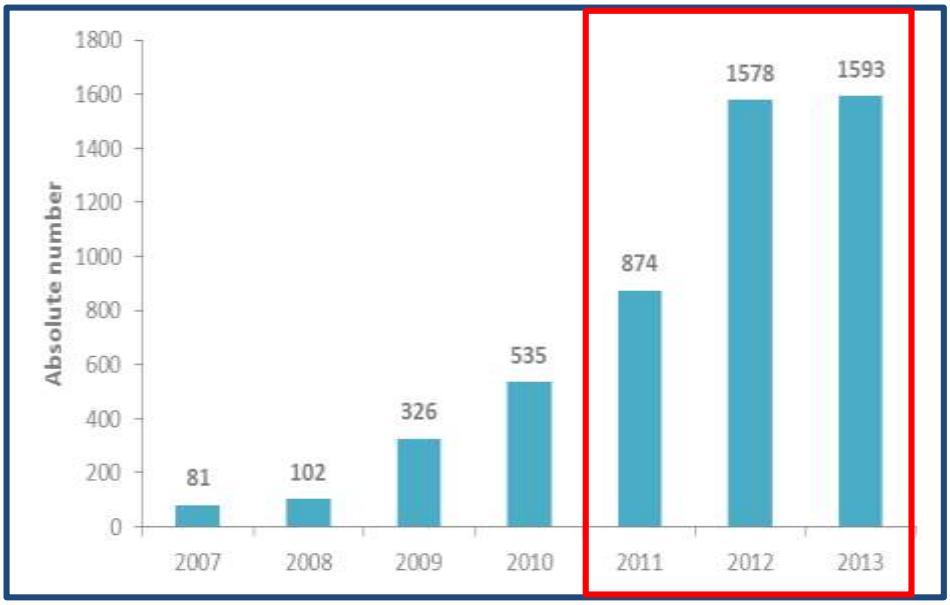


Figure 1: Number of presumptive MDR-TB patients tested by Drug Susceptibility Testing: 2007-2013. 2011 through 2013 are highlighted as years of TB CARE I implementation.

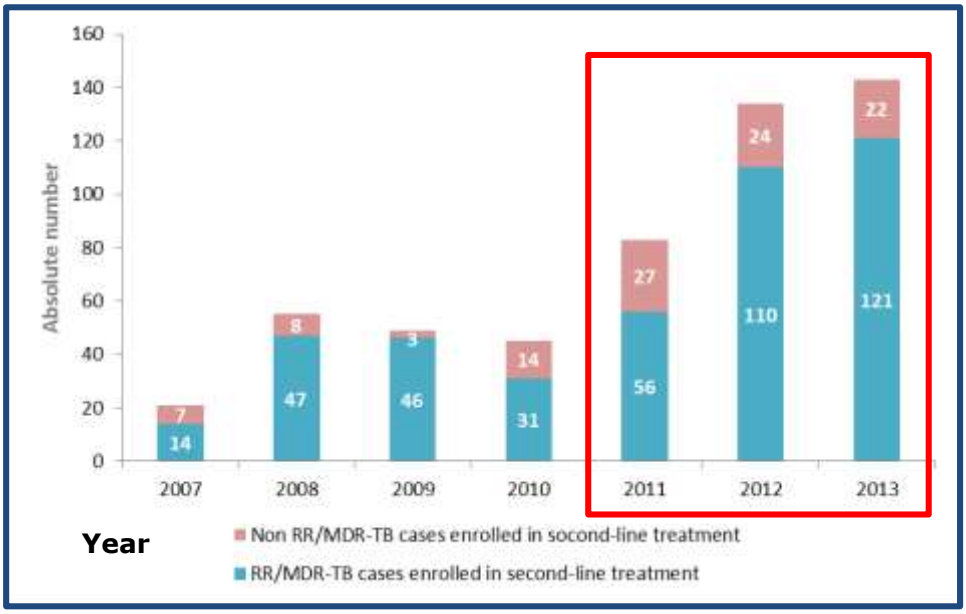


Figure 2: Number of MDR-TB patients enrolled on second-line TB treatment 2007-2013. 2011 through 2013 are highlighted as years of TB CARE I implementation.

TB/HIV

Technical Outcomes

Outcome	Indicator	Indicator Definition	Baseline 2013	Target LoP	Result LoP
5.2 Improved diagnosis of TB/HIV co-infection	5.2.2 TB patients (new and re-treatment) with an HIV test result recorded in the TB register	**Description**: The purpose is to assess how many TB patients know their HIV status, regardless of whether testing was done before or during TB treatment. In settings where HIV is driving the TB epidemic, all TB patients should be offered and encouraged to have an HIV test. **Indicator Value**: Percent **Level**: National and TB CARE geographic areas **Source**: NTP/NAP/WHO/TB CARE project **Numerator**: Total number of all TB patients registered over a given time period with an HIV test results recorded in the TB register. **Denominator***:* Total number of TB patients registered over the same time period.	80% (32359/ 40258)	>80%	82% (32176/ 39055)

Key Results

Led by WHO, TB CARE I supported HIV testing among TB patients in 22 of the total 77 operational districts where there was no funding from the Global Fund or C-DOTS implementing partners. Through CENAT, the project supported the cost of transportation/referrals for registered TB patients to be tested for HIV. Among a total of 118,983 TB patients in 77 ODs, 97,129 were screened for HIV (CENAT cohort 2011- 2013). In TB CARE I's 22 ODs the performance exceeded that of other ODs. This is 81.63% of all patients which meets the life of project target of a screen rate of greater than 80%. In 2013, the HIV positivity rate among TB patients newly tested for HIV was 0.59% (184/31,252).

TB/HIV has never been a primary driver of the TB epidemic in Cambodia. The steady decline of HIV prevalence since 1999 has likely impacted the falling HIV co-infection rates among TB patients, which has declined from a peak of 11.8% in 2003 to 6.3% in 2009. Routine HIV screening of TB patients, which has been expanded to cover 82% of TB patients by 2011, confirms the low level of HIV among TB patients: HIV prevalence continued to fall, to 5.1% in 2011, although it is noticeably higher in Phnom Penh, by the Thai border, and along the coast. The general population prevalence of HIV fell from an estimated 2% in 1996-1999 to 1.8% in 2002 and 0.6% in 2011-12. TB/HIV diagnosis and treatment are well integrated within the DOTS services, with TB and HIV staff members meeting on a regular basis in referral hospitals to exchange information. Rates of TB screening among PLHIV increased substantially from 2009 (60%) to 2011 (85%).

TB CARE I's role for this technical area is to fill the gap for 22 ODs to maintain the country's high performance for HIV testing among TB patients. Given the project's performance on this indicator, it was a success.

Health System Strengthening (HSS)

Technical Outcomes

Outcome	Indicator	Indicator Definition	Baseline (2010)	Target	Result
				LoP	LoP
6.2 TB control components (drug supply and management, laboratories, community care, HRD and M&E) form an integral part of national plans, strategies and service delivery	6.2.2 People trained using TB CARE funds	**Description**: Health care workers at all levels trained on any area of TB control using TB CARE funds. **Indicator Value:** Number **Level**: National **Source**: TB CARE project **Means of Verification**: Training reports **Numerator**: Number of people trained disaggregated by gender	427	>750	2,591 (M:1,959 , F: 632)

Key Results

FHI 360 and WHO provided strong support to government agencies, including the Ministry of Health, the National Center for Tuberculosis and Leprosy Control (CENAT), and the National Tuberculosis Program. Strengthening the health system was done in the following key priority areas:

1. **Mobilizing funding**: the TB CARE I team successfully supported the country to mobilize more than $2 million USD from TBREACH/WHO for 2011-2014 for active case finding among key risk groups, including migrants, urban poor, and close contacts, especially in operational districts with high poverty rates and poor access to services.
2. **Applying for grants and negotiating funding:** As outlined below in section 5, TB CARE I provided comprehensive support to CENAT for Global Fund proposal preparation, including technical assistance on the financial and programmatic gap analysis, priority setting, and

writing of the proposal for Round 11. When the Global Fund canceled that Round of funding, TB CARE I continued to prepare the country for the next available funding from the Global Fund, namely, the interim funding in 2014 and new funding mechanism from 2015 using the NSP 2014 to 2020 application, further discussed below in Section 5.

3. **Advocating for key health policy changes** including a very effective ban in 2011 on importation and sale of anti-TB drugs of poor quality in the for-profit sector.
4. **Assisting with securing emergency supply** of anti-TB drugs during prolonged negotiations to extend Global Fund Round 7/Phase II when funding ended in March 2014. Negotiations with the Global Drug Facility were critical in securing the emergency supply, as well as successfully securing grant funding to support three years of anti-TB drugs starting in 2014. The TB CARE I project also supported the country to get multi-year grants of USD 1.5 million per year for adult and pediatric anti-TB drugs from the Global Drug Facility/WHO until 2017.
5. **Coordinating and participating in key CENAT technical working groups**: MDR-TB, laboratory, and childhood TB TWG meetings were held regularly. These provided a valuable forum to develop CENAT documents such as the diagnostic algorithms for GeneXpert, recording and reporting forms for PMDT, standard operating procedures for sputum specimen transportation and referral system for MDR-TB, and information exchange from GeneXpert implementation and active case finding.
6. **Supporting the development for the National Strategic Plan for TB control (2014-2020) based on** the joint program review conducted in 2012 and in consultation **with** all stakeholders. The new plan incorporates new evidence on effective implementation strategies and will help the country to mobilize resources from all possible funding sources, particularly from the new funding mechanism of the Global Fund.

Monitoring & Evaluation, Surveillance and OR

Technical Outcomes

Outcome	Indicator	Indicator Definition	Baseline (Year)	Target LoP	Result LoP
7.1 Strengthened TB surveillance	7.1.1 An electronic recording and reporting system for routine surveillance exists at national and/or sub-national levels	**Description**: The routine Electronic Recording and Reporting (ERR) TB surveillance for all TB patients is based on at least all standard variables which are included in the TB treatment register. The record/case-based data flow from data collection level to national level (via intermediate/regional levels) is digital. Note that having an ERR just for MDR-TB or at district level with case-based data (not aggregate) also fulfills this indicator. **Indicator Value:** Yes/No **Level**: National and TB CARE geographic areas **Source**: NTP and TB CARE project **Means of Verification**: Electronic system and data extracted from system are available for review.	Yes Y:2010	Yes	Yes
7.2 Improved capacity of CENATs to analyze and use quality data for the management of the TB program	7.2.1 Data quality measured by NTP	**Description**: Any aspect of data quality has been measured in the last year (internal consistency, timeliness, completeness, accuracy, etc.) at national, intermediate/regional or peripheral levels. If yes, list the dimensions being measured. **Indicator Value**: Yes/No **Level**: National **Source**: NTP **Means of Verification**: Data quality report	Yes Y:2010	Yes	Yes
7.3 Improved capacity of NTPs to perform operations research	7.3.1 OR studies completed	**Description**: TB CARE-supported OR studies completed in the last 12 months. **Indicator Value**: Number (of OR studies) **Level**: National or sub-national level **Source**: TB CARE project **Means of Verification**: OR study reports	2 Y:2013	2 Y:2014	1 Y:2014

Key Results

The monitoring and evaluation technical area was led by Management Sciences for Health (MSH) and WHO with a pilot M&E tool also developed by FHI 360.

The e-TB Manager (e-TBM) software is a comprehensive web-based tool for Programmatic Management Drug Resistance TB (PMDT) developed by MSH to track MDR-TB cases from their diagnosis, treatment, and treatment completion/cure along with the associated second line drug management. e-TBM is currently being used by CENAT for registering all on-going cases in 10 of the 11 MDR-TB treatment sites. The system is linked to 3 culture laboratories. Nine e-TBM sites are uploading their required information onto the medicine module, keeping the country's second-line drug supply updated for CENAT. Treatment sites can thus order their supply needs in a timely fashion from CENAT central pharmacy. During FY14, accelerated implementation supported by two trips from external MSH experts enabled the system to be fully customized, with hand-over for day-to-day management to CENAT anticipated in late 2014; however, hand-over has not yet occurred and is anticipated in 2015.

TB CARE I also introduced a system for on-going, internal peer review of CENAT performance as a means for self-assessment, to enable cross-learning and serve as a data quality audit. In 2012, six randomly selected ODs were visited by a joint team from CENAT and TB CARE I to review performance in the ODs and provide recommendations for improvement. Issues that required attention of higher officials were raised during debriefing meetings with district and provincial authorities. This system for self-assessment and internal monitoring was recommended for scale-up by the Joint Program Review team.

The TB CARE I team assisted the program with regular supervisory visits. The team provided feedback from these visits to the decision-makers regularly during technical working group meetings. TB CARE I also supported the country for the annual national and subnational data analysis and reporting. Operational research was also conducted during each year throughout the life of the project. TB CARE I contributed to the publication of many significant papers in reputed journals, which have been useful for Cambodia as well as globally. Please refer to Annex I for the full list of TB CARE I publications and abstracts.

The study *Boost the Effectiveness of CDOT Watchers Referral and Case Detection* was conducted among 372 C-DOT watchers and 53 private providers who received risk factor training, and 446 C-DOT watchers and 26 private providers received standard TB symptom training in 409 villages in two ODs in Kampong Cham. In six months, C-DOT volunteers self-reported 2,242 referrals in the intervention arm vs. 883 in the control. In addition, 404 of 445 (91%) TB cases detected were attributable to referrals of the intervention villages and 175 of 345 (51%) total TB cases were referred in the control villages. The enhanced training on TB risk factors boosts both referrals and TB case detections when compared to routine TB symptom screening.

TB CARE I's support to Global Fund implementation

In the last decade, CENAT successfully achieved many of its ambitious goals, and the Global Fund has been a strong foundation, supporting core essential TB activities and contributing to CENAT's achievements. Still needed, however, are quality technical assistance and innovative solutions using multi-disciplinary approaches, which are essential to address the current challenges.

In addition to the Global Fund, USAID and JICA have supported CENAT's achievements, focusing on delivery of TB services beyond the public health care network (C-DOTS) and for the national TB prevalence survey respectively. The JICA project is ending in 2012 and the current Global Fund grant (Round 7) for TB ended in March 2014, leaving uncertainty of funding beyond that period. In year 2013, Cambodia was identified as an interim applicant for the Global Fund, eligible to receive 3 million indicative funding in 2014. Through TB CARE I, FHI 360 and WHO assisted with the development of concept notes and other documents for CENAT's interim application to the Global Fund for this indicative funding. During the transition, TB CARE I also provided budget support where there was inadequate capacity – such as procurement of PPD and X-ray supplies, EQA for sputum microscopy, HIV testing of TB patients, new diagnostics tools, support of childhood TB and PMDT. TB CARE I has and will continue to support CENAT to mobilize resources for sustaining these activities through future rounds of the Global Fund. TBCARE I also played an important role in advocating for domestic resource allocation to CENAT.

In FY14, TB CARE I assisted CENAT to prepare a full application to the Global Fund, including leading the development of the National Strategic Plan (NSP) for TB control (2014-2020) and accompanying documents to guide future applications. TB CARE I was a member of the task force for the NSP development and played a key role: organizing consultation workshops with partners for initial discussion and recruiting a senior consultant (Dr. Paul Nunn) to coordinate and write the first draft of the NSP during Year 4. Two TB CARE staff are members of the oversight committee for the Global Fund Country Coordinating Mechanism and participate in site visits and meetings of the group. The full application in the budget of $16.4 million USD for five years had been submitted to the Global Fund and queries on budget, M&E and grant management have been clarified. The grant agreement is expected to be signed in December 2014.

The Way Forward

The successes and challenges of the USAID TB CARE I project provide valuable information to guide priorities for future funding. The largest technical area, Universal Access, contained activities that were high impact (active case finding in the hospital setting, among children, and prisoners; SMS Alert System) as well as those with variable impact (public-private mix, chest X-ray training). A high proportion of TB cases were identified through active case-finding in the hospital setting and among children who were close-contacts. Whether these strategies are cost-effective needs to be analyzed - particularly with scale-up and sustainability as future goals—although they certainly appear very promising. Active case finding in prisons doubled the case notification rates early in the project, although the proportion of cases diagnosed declined slightly in FY14. It is unclear whether the lower rate of diagnosis at the end of the project was due to a rapid decline in prevalence within the 10 prisons supported by TB CARE I, or whether the decreased rate is due to missed cases. Lack of active case finding in the 10 prisons supported by TB CARE I during FY14 likely also contributed to the lower case notification rate during that year. Operationalizing a clear strategy for identification of presumptive TB cases in the prison setting is critical in the coming years. This should include policy guidelines enabling TB staff to access patients in need of health care as well as clear mechanisms for diagnostic testing (sputum transport, chest X-rays, etc.). The SMS Alert System for diagnostic results, currently implemented in 43 HCs until the end of the project, demonstrated significant decrease in turn-around time for diagnosis. Given that the country's TB/MDR-TB diagnosis gap is more critical than its treatment gap, it is imperative to identify key points within the process that may have the greatest impact on expediting diagnosis.

For the activities within Universal Access that had variable impact, a careful analysis of true potential for impact and cost-effectiveness should be done prior to decisions to continue or stop implementation. Training in chest X-ray skills, for example, is a potentially important intervention given the dependence on chest X-rays for diagnosing AFB smear-negative and asymptomatic TB cases, both categories that are known to be unreached populations from Cambodia's most recent prevalence survey. Another example of an activity with variable impact was the laboratory's external quality assurance (EQA). Although EQA performance was very high throughout the project, there was unclear impact on decreasing false negative results on AFB smears, as well as a plateau in smear-negative cases in the latest case notification rates from CENAT (through 2012). These data suggest that further decentralization of EQA should be done at lower level facilities to increase the impact on diagnosis; continuing EQA and focusing on further decentralization may therefore have greater impact.

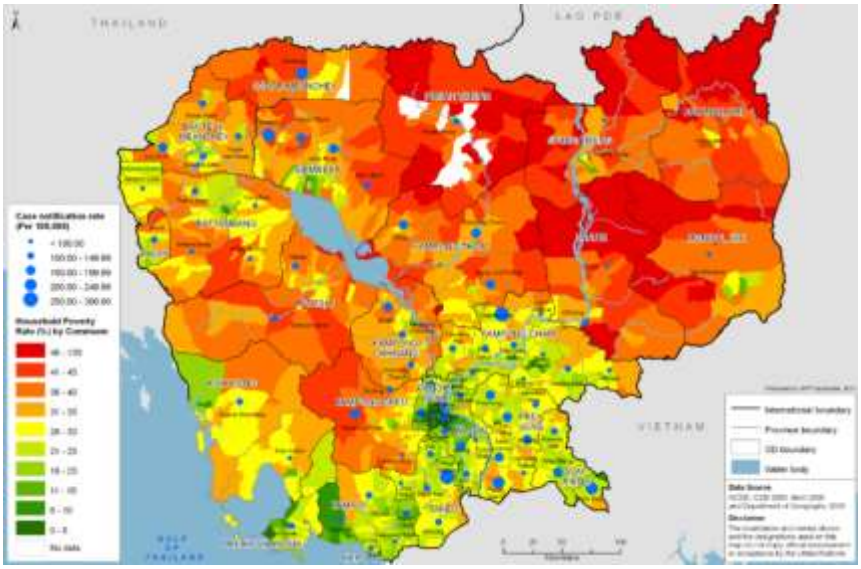
There were also technical areas that showed early promise during the life of the project and may warrant continuation with future funding. These include the monitoring and evaluation technical area, in which eTB manager software was implemented in 10 of the country's 11 PMDT treatment sites. Given the importance of recording and reporting to document MDR-TB treatment SLD management and track the country's performance on PMDT, it is important to ensure that an electronic system for surveillance is in place, with full adoption, ownership and management of the system by CENAT.

Finally, there were technical areas where the performance was excellent, mirroring the country's own performance. Determining the added value of TB CARE I and its contribution to CENAT's achievement is therefore necessary. The PMDT technical area is a prime example in this regard, for which the country's treatment success rate for MDR-TB has been maintained at an average of > 75% with >90% of those diagnosed placed on treatment. There is, however, a significant diagnosis gap that must be addressed and is consistent with a similar diagnosis gap for drug-susceptible TB.

Despite the many successes of the TB CARE I project in Cambodia over the past four years, challenges remain in the goal to eliminate TB and MDR-TB. One of the biggest challenges is the diagnosis gap, which exists for both drug-susceptible and drug-resistant TB. Increasing case notification rates among the poor and elderly (both of whom are high prevalence risk groups), children, prisoners (in whom there is very high prevalence), and the hospital setting may help to close this gap. In contrast, CENAT has been very successful in initiating treatment, thus there is no significant treatment gap in Cambodia at this time. In addition, treatment success rates have been consistently high for both drug-susceptible and drug-resistant TB, highlighting the successful strategies for effective treatment support-- through decentralization of DOT, effective mobilization of the community, and well-

coordinated multi-disciplinary teams that conduct home visits and support patients. Finally, although prevalence rates of MDR-TB have not been high in the two previous drug resistant surveys, continued monitoring and surveillance is necessary given the relatively recent introduction of the 6- month regimen, in which rifampicin is used in the continuation phase.

The persistently high prevalence rates among both men and women > 45 years old emphasize the urgency to reach the middle-aged and the elderly (>55), a risk group that has not been effectively diagnosed in the current health system. The prevalence of smear positive and bacteriologically positive TB in the elderly is approximately four times that of the general population, and although the elderly constitute 4% of the population, they comprise 24% of those with TB. Asymptomatic patients, both AFB smear positive and negative, also comprise an unreached population, pointing to the need for improved active case finding among certain at-risk groups. Smear negative patients, in addition, face challenges in diagnosis given the dependence on chest x-ray, which is subject to reader interpretation.



The last prevalence survey conducted in 2006-2007 also showed higher prevalence rates in rural areas, which parallel high rates of poverty in the same regions of the country. In the rural setting, long distances from home to health facilities, low population density, and low vaccination coverage all contribute to difficulty in accessing the health system. Given that 80% of the country is categorized as rural, reaching the rural poor may be one important focus for future funding. As shown in the figure (above), case notifications (blue dots) are lower in areas with higher poverty rates: household poverty rate is associated with a decrease in sputum-positive TB case notification rate in Cambodia. This necessitates geo-targeting of people who are at high risk for TB, using a multi-symptom screening approach combined with more sensitive diagnostic tools such as GeneXpert.

These priorities, highlighted by TB CARE I successes and challenges, may help to guide CENAT, donors, and collaborators as they look to the post-2015 development framework, with the goal to end the global TB epidemic.

Annex I: Knowledge Exchange

Below is a list of tools and publications that were developed with support from TB CARE I-Cambodia over the life of the project. Please contact the project staff for copies of or links to any of the listed documents.

Technical Tools:

1. PPM/CDOTS referral slip
2. TB infection control Standard Operation Procedures, May 2010
3. Standard Operation Procedures for HIV, STI and TB/HIV Prevention, Care, Treatment and Support in Prison in Cambodia, January 2012
4. TB Treatment Card for RH/HC
5. TB Treatment Card for Patient
6. TB Treatment Card for DOTS Watcher
7. Sputum Examination Request form
8. TB Patient Register
9. The Sputum Collection and Referral Book
10. Refresher Training Programme on TB Detection and Treatment for Health Center and Referral Hospital, October 2013
11. Standard Operation Procedures for MDR-TB suspect referral developed and updated every year.
12. Xpert Algorithm for Diagnosing MDR-TB including PLHA who are at High Risk for MDR-TB* by Xpert MTB/RIF
13. Xpert Algorithm for Diagnosing TB and MDR-TB among PLHA Who Are Not at High Risk for MDR-TB by Xpert MTB/RIF
14. Algorithms for TB Screening and Diagnosing for TB among PLHA Where Xpert is not available
15. Sputum examination request form for MDR
16. MDR-TB treatment register
17. MDR-TB suspect screening register
18. MDR-TB treatment card and patient card
19. Standard Operation Procedures for Non-tuberculosis management
20. PMDT expansion plan developed and updated
21. Clinical audit tool

Scientific Publications or presentations:

1. Community DOTS Program Evaluation in Cambodia, December 2010
2. A Qualitative Assessment Among 17 Cambodian Factories, August 2011
3. Tuberculosis Annual Report 2011
4. Patient-Centered Approach for TB Care services implementation of QUOTE TB Light and Patients' Charter in Kampong Speu, Cambodia, September 2012
5. Patient-Centered Approach for TB Care services implementation of QUOTE TB Light and Patients' Charter in Five Hospitals: Khmer Soviet, Samdach Ov, Batty, Takeo and Kampong Speu Hospital, Cambodia, December 2013
6. Poster Presentation at 43rd World TB Conference in Kuala Lumpur: Implementation of TB activities in prisons in Cambodia
7. Poster Presentation at 44th World TB Conference in Paris: Effectiveness of an SMS alert system in reducing turnaround time for test results and initiation of treatment for TB patients in Kampong Cham, Cambodia, October 2013
8. Oral Presentation at 44th World TB Conference in Paris: Using quote TB light tools to improve quality of TB services in Cambodia
9. Poster Presentation at 44th World TB Conference in Paris: Deploying web based SMS alert system for delivering sputum smear test result
10. Poster Presentation at 44th World TB Conference in Paris: Improving childhood TB management in Cambodia: Isoniazid Preventive Therapy (IPT)
11. Poster Presentation at 44th World TB Conference in Paris: Using quality improvement model to improve TB case finding in Cambodia
12. Oral Presentation at 44th World TB Conference in Paris: Assessment of diagnostic algorithm including Xpert MTB/RIF for pulmonary tuberculosis in Cambodian settings

13. Oral Presentation at 44th World TB Conference in Paris: Linkage of presumptive Multidrug resistance tuberculosis (MDR-TB) patients to diagnostic and treatment services in Cambodia
14. Early detection of tuberculosis through community-based active case finding in Cambodia. BMC Public Health, 12(1), 469. doi:10.1186/1471-2458-12-469
15. The multi-step process of building TB/HIV collaboration in Cambodia. Health Research Policy and Systems / BioMed Central, 10(1), 34. doi:10.1186/1478-4505-10-34
16. Linkage of Presumptive Multidrug Resistant Tuberculosis (MDR-TB) Patients to Diagnostic and Treatment Services in Cambodia. PloS one, 8(4), e59903. doi:10.1371/journal.pone.0059903
17. The association between household poverty rates and tuberculosis case notification rates in Cambodia, 2010. Western Pacific Surveillance and Response Journal, 4(January), 1–9. doi:10.5365/wpsar.2013.4.1.002
18. Oral presentation at 45th World TB Conference in Barcelona: Randomized Control Trial Boost the Effectiveness of CDOTS Watchers Referral and Case Detection in Cambodia
19. Cost-Effectiveness of a tuberculosis active case finding program targeting household and neighborhood contacts in Cambodia. Am. J. Trop. Med. Hyg., 90(5), 2014, pp. 866–872. doi:10.4269/ajtmh.13-0419.

Educational materials:

1. Poster: TB Infection control, developed in 2010
2. Book (directory): TB public and private TB services, developed in 2012
3. Book (Health Messenger): Tuberculosis, developed in 2012
4. Poster: TB treatment regiment, developed in 2013
5. Poster: Algorithms for childhood TB Diagnosis 2014
6. Poster: Algorithm for TB Diagnosis among general population, developed in 2014
7. Leaflet: Hand Hygiene, developed in 2012
8. Stand board: SAKSIT TB awareness promotion, developed in 2012
9. Mask: SAKSIT TB awareness promotion and infection control, develop in 2012
10. Comedy video: entitled "SAKSIT village" TB awareness education for community, developed in 2013