

JUNE 2020

# Prospective Country Evaluation

## Guatemala

2019–2020 ANNUAL COUNTRY REPORT

Commissioned by the Technical Evaluation Reference Group (TERG) of the  
Global Fund

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# LIST OF ACRONYMS

AOP	Annual Operative Plan
ARV	Antiretroviral drug
CAS	Colectivo de Amigos contra el Sida
CCM	Country Coordinating Mechanism
CDC	US Centers for Disease Control and Prevention
CHAI	Clinton Health Access Initiative
CIESAR	Centro de Investigación Epidemiológica en Salud Sexual y Reproductiva
ColVols	Colaboradores voluntarios (community volunteers)
CONASIDA	National Multisectoral Commission of Organizations for Care and Prevention
CT	Global Fund Country Team
CUI	Código Único de Identificación (Unique Identification Code)
DAS	Dirección de Área de Salud (Health Area Office)
DHIS2	District Health Information System
DOTS	Directly Observed Treatment, Short-course
DPI	Documento Personal de Identificación (Personal Identification Document)
EMTCT	Elimination of mother-to-child transmission
HIVOS	Humanist Institute for Cooperation with Developing Countries
HMIS	Health management information system
IHME	The Institute for Health Metrics and Evaluation
INCAP	The Institute of Nutrition for Central America and Panama
IRS	Indoor residual spraying
KII	Key informant interview
KP	Key population
LLIN	Long-lasting insecticide-treated net
M&E	Monitoring and evaluation
MDR-TB	Multidrug-resistant tuberculosis
MoF	Ministry of Finance
MoH	Ministry of Health
MoU	Memorandum of Understanding
MSM	Men who have sex with men
NGO	Non-governmental organization

NMS	National Malaria Subprogram
NTP	National Tuberculosis Program
PAAR	Prioritized Above Allocation Request
PAHO	Pan American Health Organization
PCE	Prospective Country Evaluation
PR	Principal Recipient
PrEP	Pre-exposure prophylaxis
PU/DR	Progress update and disbursement request
RDT	Rapid diagnostic test
RMEI	Regional Malaria Elimination Initiative
RSSH	Resilient and sustainable systems for health
SEGEPLAN	Secretaría de Planificación y Programación de la Presidencia (Planning and Programming Secretariat of the Presidency)
SICOIN	Sistema de Contabilidad Integrada (Integrated Accounting System)
SIGES	Sistema de Gestión (Management System)
SIGPRO	Sistema Integral de Gestión de Proyectos (Project Management Integrated System)
SIGSA	Sistema de Información Gerencial de Salud (Health Management Information System; HMIS)
SR	Sub-recipient
STC	Sustainability, transition and co-financing
STI	Sexually transmitted infection
SW	Sex worker
TERG	Technical Evaluation Reference Group
VfM	Value for money
WHO	World Health Organization

# EXECUTIVE SUMMARY

The Prospective Country Evaluation (PCE) is an independent evaluation of the Global Fund commissioned by the Technical Evaluation Reference Group (TERG). Guatemala is classified as a core country portfolio, with the HIV burden designated as high and the tuberculosis and malaria burdens as low. In 2019, the objectives of the PCE were to: 1) Report on grant implementation progress for the HIV, TB and malaria programs; 2) Report on in-depth investigations in specific areas affecting Global Fund investments (referred to as Deep Dives); and 3) Examine how aspects of the Global Fund business model and country contextual factors help or hinder the implementation of Global Fund grants.

The PCE employs a mixed-methods research design using qualitative and quantitative data. Qualitative data sources include key informant interviews (KIIs), fact-checking interviews, non-participant meeting observations and document review. Quantitative data sources include data from HMIS, internal monitoring systems provided by Principal Recipients (PRs), Global Fund Progress Update and Disbursement Request (PU/DRs) and estimates from the Global Burden of Disease Study at the Institute for Health Metrics and Evaluation (IHME). Whenever possible, the PCE uses multiple data sources to triangulate findings. As part of the evaluation, the PCE has tracked grant expenditure in order to understand how it compares to grant allocations. The PCE also considers thematic areas including sustainability, transition and co-financing (STC), value for money (VfM) and resilient and sustainable systems for health (RSSH).

## **Tuberculosis (TB)**

The 2016–2019 TB grant, awarded to the Guatemala Ministry of Health (MoH), closed on June 30, 2019. Financial absorption improved considerably during the last year of grant implementation, with an absorption ratio of 65% as of June 2019 in comparison to 35% in the previous year (PUDR/FR). The current TB MoH grant began on July 1, 2019 and is in early implementation. TB grant signing was timely in comparison to earlier grant signing processes due to a number of factors, including that the national TB program (NTP) was able to build on experiences from the previous malaria grant. At the time of writing, the 2019–2022 MoH TB grant had been underway for eight months, with the majority of activities implemented on time and as planned. During 2019, the NTP (i) made strides toward standardization of guidelines by publishing and disseminating two manuals, one for susceptible TB and the other for multidrug-resistant tuberculosis (MDR-TB), (ii) revised and launched a new algorithm for molecular testing (Xpert MTB/RIF), and (iii) trained health care workers on the updated guidelines. To verify competencies and compliance with standards, the NTP, as PR of the TB grant, put together a supervision team to carry out on-site support and training to health care workers in prioritized municipalities. The supervision was well received by local health care workers as an opportunity for learning. The grant also financed detection of new TB cases by increasing the coverage of the outreach strategy. The “*extramuros*” (beyond walls) strategy seeks to provide comprehensive TB services to families and follow-up TB patients and contacts at household level.

The first disbursement occurred shortly after signing the grant, but the PR was not able to use the funds in the first quarter, while the government of Guatemala completed the steps to make funds available. This length of time between signing and disbursement is considered average.

During early implementation (Semester 1 of 2019), the NTP reported an increase in case notifications of all forms of TB, surpassing the target for S1 (of 1,784 cases notified) as set forth in the Performance Framework. This increase was due in part to more widespread use of molecular-based technologies

(Xpert MTB/RIF). However, microscopy-based screening of persons with respiratory symptoms is affected by the low quality of sputum samples. In a detailed analysis, or Deep Dive, conducted by the PCE, it was found that 49% of persons with respiratory symptoms who were screened in 27 randomly selected health facilities provided “inadequate” samples. The labs in the study area report that 43% of the samples they receive are inadequate, based on volume or sample characteristics. The departments located on the Southern Pacific Coast and the Western highlands had the highest proportion of inadequate samples as registered in health facility lab logbooks.

Ensuring a high-quality sputum sample is critical for TB patients not only to diagnose the disease but also to measure progress two months after beginning treatment and to ensure the patient is cured at the end of the treatment course. The Deep Dive found several causes of inadequate sample production, including: 1) lack of a consistent and uniform set of instructions (a common “script” that standardizes the protocol) for effective patient counseling; 2) testing patients that deviate from eligibility criteria, partly driven by the pressure to fulfill screening targets set by the MoH; 3) insufficient private areas for patients to provide samples; and 4) a disconnect between clinical and laboratory personnel, with no existing mechanism for mutual feedback between the two cadres.

## **Malaria**

Guatemala is scheduled to eliminate malaria by 2021 and has documented significant declines in malaria incidence in recent years.<sup>(1)</sup> Stakeholder perceptions attribute the decline to a number of factors, including intensified vector control measures, training laboratory technicians in microscopy techniques, expanded public-private partnerships with sugar cane mills and collaborations with private pharmacies to limit self-diagnosis and treatment.

The current malaria grant was awarded in January 2019, but funds were not disbursed until August 2019 due to delays in grant signing, which occurred in May 2019. Additional challenges included identifying a local procurement agent and a logistics operator. Due to delays in grant signing, the PR, the National Malaria Subprogram (NMS), had to reschedule some activities that were dependent on grant funds. The PCE also conducted an analysis of the relationship between declines in case notification and the distribution of long-lasting insecticide-treated nets (LLINs), which concluded that an estimated 1,412 cases were prevented by LLIN distribution in Guatemala from 2015 to early 2018, adjusting for other factors.

In addition to LLIN distribution, Guatemala uses community-based case detection volunteers (CoVols) to diagnose and treat patients in endemic areas. In 2018, CoVols performed 84% of screening in Alta Verapaz and 54% in Escuintla, the departments with the highest number of malaria cases. Despite their central role in the malaria elimination process, CoVols faced several challenges, including historically low resource allocations, lack of written guidelines, few opportunities for advancement and a lack of official recognition within the health system. CoVols interviewed by the PCE expressed a desire for non-monetary incentives (e.g., training) and accreditation options within the health system, as well as resources to help support the services they provide. Support for CoVols was stronger in Escuintla than Alta Verapaz, where supervision was infrequent and rapid diagnostic tests (RDTs) were not routinely available. CoVols were also allowed to provide treatment in Escuintla, but not in Alta Verapaz. Given the discrepancy in treatment protocols by department, the NMS should examine the role of CoVols in treatment provision and disseminate standardized protocols.

## **HIV/AIDS**

Two HIV grants were awarded in 2018: a continuation of the previous HIV grant to the Humanist Institute for Cooperation with Developing Countries (HIVOS; US\$4.9 million) and the current HIV grant to the Instituto de Nutrición de Centro América y Panamá (INCAP; US\$14.8 million), which began in October



2018. Early implementation of the current grant overlapped with the HIVOS extension, which finalized activities in December 2018. Initial implementation focused on selecting sub-recipients (SRs) and scaling up a new reporting system administered via the District Health Information System (DHIS2). An additional US\$2.7 million was added to the grant in 2019, with funds provided by the nonprofit organization Comic Relief and designated primarily for elimination of mother-to-child transmission (EMTCT). The grant has also undergone several revisions, including using cost savings generated from implementation delays for SR travel per diems and prevention programs for incarcerated persons. At the time of writing, discussions regarding development of the 2021–2023 funding request were underway.

### **Cross-cutting factors**

In order to examine the role of VfM<sup>2</sup> in grant implementation, the PCE analyzed trends in financial absorption for both domestic and donor funds and their relationship to annual operative planning by the MoH from 2013 to 2018. This analysis found that public sector investments in the three disease areas have increased steadily, in line with sustainability and transition goals, while Global Fund investments have decreased. However, financial absorption was low for both public and donor funds, with no national program reporting more than 85% mean budget absorption from 2013 to 2018. Public sector absorption percentages were higher than absorption for Global Fund investments, which may result from the high percentage of public sector funding allocated to health care worker salaries (which are sent using an expedited payroll transaction). The Global Fund, however, experienced delays in commodities procurement due to lack of staff training in procurement processes and complex national legislation, which may have affected absorption rates.

RSSH modules were included in all three grants, with the largest proportion allocated to HMIS and monitoring and evaluation (M&E). However, ongoing political instability, including changes in leadership within national disease programs, has sometimes resulted in a lack of continuity of health initiatives.

Guatemala is now classified as upper-middle income and was notified in late 2019 that it is now eligible for transition funding for malaria and TB for the Global Fund's 2020–2022 allocation cycle. Although co-financing is difficult to track, there have been advances toward sustainability. The government of Guatemala has absorbed procurement of all ARVs, as well as first and second-line TB treatment regimens. However, some interventions remain highly dependent on Global Fund investments, including procurement of LLINs and HIV-related services for key populations. Improvements in the Country Coordinating Mechanism (CCM), which underwent significant changes in 2018 as a part of the "CCM Evolution" process, signal that the CCM could play a decisive role in the transition process, including advocating for the government to assume financial responsibility for the aforementioned interventions.

In 2020, the change in government following the 2019 elections may pose a challenge to grant implementation, as the MoH leadership will undergo a significant transition and new staff will require time to understand the Global Fund model and the responsibilities of the government as Principal Recipient and implementer relevant to Global Fund grants, and to fulfill commitments for STC.

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<sup>2</sup> VfM refers to maximizing the impact and outcomes of Global Fund investments and includes the five pillars of economy, efficiency, effectiveness, equity, and sustainability.

# 1. INTRODUCTION

## 1.1 Background of the Prospective Country Evaluation (PCE) in Guatemala

The PCE is an independent evaluation of the Global Fund commissioned by the Global Fund's TERG in eight countries. The PCE was launched in Guatemala in May 2017 with a five-month inception phase during which Centro de Investigación Epidemiológica en Salud Sexual y Reproductiva (CIESAR) and the global evaluation partners (IHME and PATH) worked together to build an effective platform for implementing the PCE.

In 2019, based on guidance from the TERG, there was a shift in PCE methods to focus on select topic areas with a greater depth of data collection through "deep dives." A "deep dive" refers to a more specific, more focused and comprehensive method of addressing a topic of interest within a short time. The PCE engaged stakeholders to identify priority topic areas based on several criteria:

- The topic is a critical component of the results chain being affected by Global Fund investments.
- The information will contribute substantially to understanding the Global Fund business model and to improving programming related to the Global Fund strategy.
- The issue is important for country stakeholders and the Global Fund Country Team (CT).
- Data on the issue are available and evaluable.

This process resulted in an agreement to focus on the following:

### **Tuberculosis:**

1. Health system modeling;
2. Mixed-methods deep dives on case detection and diagnosis;

### **Malaria:**

3. Qualitative deep dive on community responses and systems, focusing on the work of malaria volunteers (ColVols);
4. An impact evaluation model of LLIN distribution; and

### **Value for Money (VfM):**

5. Examination and comparison of budget execution and Annual Operative Plans (AOPs) of the MoH.

In addition to deep dives, the PCE continued to prospectively track grant implementation progress for the national disease programs and other PRs and to examine how country contextual factors and the Global Fund business model help or hinder grant implementation.

## 1.2 Methods

### 1.2.1 Data collection and overview of data sources

Primary data were collected through meeting observations, KIIs, and fact-checking interviews (Table 1). Secondary sources of routine quantitative data were also analyzed, including health management information systems, Sistema de Contabilidad Integrada (Integrated Accounting System) (SICOIN), PU/DRs, and programmatic data.

Table 1. Data sources

Type (#)	Description: January - November 2019	
Document review (Total=26)	<ul style="list-style-type: none"> <li>• Global Fund allocation letter and associated memos</li> <li>• Funding request and related annexes</li> <li>• Implementation and feedback letters</li> <li>• Global Fund VfM Update, 2019</li> <li>• World Health Organization (WHO) reports (i.e., Green Light Committee)</li> </ul>	<ul style="list-style-type: none"> <li>• Global Fund PU/DRs</li> <li>• Memoranda of Understanding</li> <li>• TB Guidelines (Manuals)</li> <li>• Meeting minutes: CCM, CT, INCAP, Technical Group TB and others</li> <li>• Bibliography and databases (SICOIN, SIGES, national programs)</li> <li>• NTP Laboratory records (red books)</li> </ul>
Interviews / Groups (Total=76 KII, 7 discussion groups)	<ul style="list-style-type: none"> <li>• National level KIIs: TB: 3 / Malaria: 7 / HIV: 6</li> <li>• Subnational-level KIIs: TB Deep Dive: 58</li> <li>• Other KIIs: 2</li> <li>• Discussion Groups with stakeholders and health care workers: 7</li> </ul>	
Meeting observations (Total=54)	<ul style="list-style-type: none"> <li>• CCM</li> <li>• National programs: TB, HIV and Malaria</li> <li>• Global Fund CT missions</li> <li>• Other: expert consultations and presentation to national program staff</li> </ul>	

### 1.2.2 Data analysis methods and analytical approach

The PCE employs a mixed-methods approach to analysis. Often qualitative analyses are used to support, explain, or provide context for quantitative findings. For instance, as part of the TB deep dive, the analyses of national programmatic data were complemented by key informant interviews as well as TB health system modeling (described in Annex 2). The PCE's analytical approach, detailed in previous reports, includes triangulation across multiple data sources and an assessment of data quality, which informs the strength of evidence (robustness) rating along a 4-point scale according to the criteria described in Table 2. Robustness ranking helps to identify which findings need additional triangulation and validation, particularly if rated as a "3" or "4." For grant tracking of main performance indicators, the PU/DR were consulted for the two different semesters from 2018 and 2019.

Table 2. Strength of evidence (robustness) for process findings on a 4-point scale

Rank	Rationale
1	The finding is supported by multiple data sources (good triangulation), which are generally of strong quality.
2	The finding is supported by multiple data sources (moderate triangulation) of lesser quality, or the finding is supported by fewer data sources of higher quality.
3	The finding is supported by few data sources (limited triangulation) of lesser quality.
4	The finding is supported by very limited evidence (single source) or by incomplete or unreliable evidence. In the context of this prospective evaluation, findings with this ranking may be preliminary or emerging, with active and ongoing data collection to follow up.

### 1.3. Status of Global Fund Grants in Guatemala

Guatemala has a high HIV and moderate malaria burden, and in 2018 shifted from a moderate to low TB burden. As an upper-middle-income country, in late 2019 Guatemala was notified that it is now eligible for transition funding for malaria and TB for Global Fund's 2020–2022 allocation cycle. Over time, the Guatemalan government has increased its contribution for the national response toward HIV, TB and malaria; nevertheless, the Global Fund is still a major contributor to TB and malaria, accounting for 23% and 22%, respectively, of total investment for these two programs according to the Financial Landscape (Funding Request, 2019). In the case of HIV, the contribution of the Global Fund has decreased from 28%

in 2013 to 11% in 2018, according to the National AIDS Spending Assessment (NASA). During 2019, the grants were in various phases of startup and early implementation as shown in Table 3.

*Table 3. Status of Global Fund Grants in Guatemala*

Disease & PR	Amount (US\$)	Grant Strategy	Start – End Dates	Status of the Grant
TB MoH	\$6,522,671	DOTS within the framework of the STOP TB Strategy (for TB concentrated in key and vulnerable populations)	Jul 2016 – Jun 2019	Closed
	\$5,849,483		Jul 2019 – Jun 2022	Early implementation
Malaria MoH	\$5,582,629	Seeking elimination	Jan 2019 – Jun 2021	Updated budget Early Implementation
HIV INCAP	\$14,786,681 + \$2,674,539 from Comic Relief: Total of \$17,461,220	Prevention, diagnosis and HIV comprehensive care in high-burden areas, Concentrated Epidemic	Oct 2018 – Dec 2020	Ongoing implementation Budget increase to include EMTCT component funded by Comic Relief

## 2. TUBERCULOSIS

### 2.1 2016–2019 Grant Closeout

The 2016–2019 TB grant closed in June 2019. Financial absorption improved considerably during the last year of implementation, achieving an overall execution of 65% as of June 2019, in comparison to 35% in the previous year according to PU/DR June 2019. The improvement was attributed to a change in personnel for the head financier role to an individual with more experience in public procurement. Below is a summary of the main activities and key achievements on selected indicators related to the 2016–2019 TB Grant.

Main activities:

1. Comprehensive training to all health workers (face-to-face and via video conference) on TB case detection and diagnosis. This included an updated manual on diagnosis, treatment, HIV co-infection, MDR-TB and infection control and a new Xpert MTB/RIF algorithm.
2. Strategies to reach out to vulnerable/prioritized populations and improve surveillance. Since 2017, the Global Fund has been the primary funder for the active case detection strategy by financing outreach workers (called “extramuros”), which will be increased in number in the current grant.
3. The Global Fund grant financed comprehensive supervision and in-service training from the central level to clinic and laboratory staff in prioritized municipalities.
4. The Global Fund grant supported an increase in GeneXpert coverage, which is currently available in 20 sites with high burden of TB and located in strategic locations to serve as referral diagnosis centers. Nevertheless, GeneXpert machines are currently used at only 25% of their capacity, as stated in the preliminary report of the Pan American Health Organization (PAHO)/World Health Organization (WHO) M&E mission to Guatemala, in September 2019. According to the report, the theoretical number of tests for the 50 modules in place is 16,128 tests, but only 3,948 tests were performed in the first six months of 2019. (2)

Key achievements on Performance Framework indicators (Source: PU/DR Jan–Jul 2019):

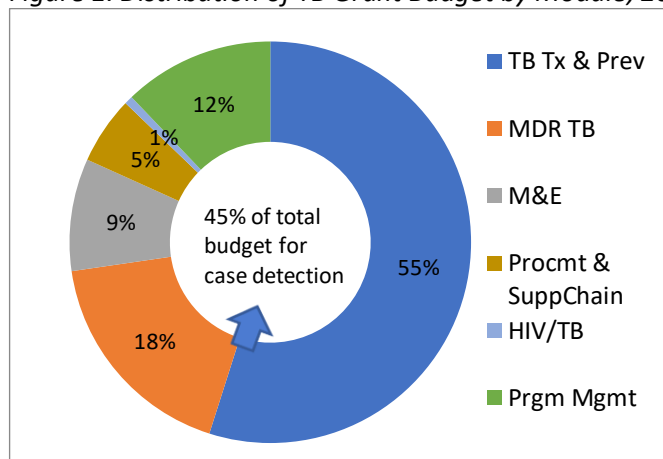
- The NTP reached the targets for the reporting period in the following indicators:
  - Treatment success rate for susceptible TB;
  - Notifications of TB in all its forms;

- Screening TB positive cases for HIV; and,
- Adherence to treatment of TB-RR and/or TB-MDR cases that started treatment (at 6 months follow-up).
- The NTP reported performance below targets in the following performance framework indicators:
  - Sensitivity testing for persons previously treated for TB is below target: 77% of the target was met. Nevertheless, the actual coverage of sensitivity testing was 29%. In other words, only 77 out of 266 persons previously treated were tested for sensitivity, a slight increase from previous years: 16% in 2016; 30% in 2017; and 23% in 2018. This indicator has been a concern for the Global Fund because there has been significant grant investment in supplies for sensitivity testing Xpert TB/RIF and MGIT liquid culture. PAHO/WHO also issued recommendations in this regard in September 2019 (to be achieved by January 2020): “Implement at the earliest possible sensitivity testing using the MGIT method in the National Reference Lab.”
  - Coverage of TB preventive therapy with INH in children <5 years in contact with a person with TB continues to be an area of concern (35% of performance framework target). Expanding the outreach worker teams of “extramuros” is a strategy for improvement in this indicator. Results for 2019 have not been published by the NTP, but a Feedback Letter from the Global Fund in December 2019 stated that areas with presence of “extramuros” workers perform better in this indicator.
  - MDR-TB case notifications experienced an improvement from 54% of the performance framework target in 2018 (57/105) to 85% of the performance framework target in mid-2019 (50/59). The improvement can be explained by the launch of a new algorithm for Xpert diagnosis in early 2019. Despite these positive milestones, only 72% of diagnosed MDR cases initiate treatment.
  - Screening of prisoners has leveled off since the previous reporting period at 75% of the target. This situation is attributed by the NTP to problems in the transport of samples. The new grant has a provision to address the constraint posed by transport. All samples for prisoners are tested with Xpert technology so specimens are referred to the closest lab with Xpert capacity.

## 2.2 Early Implementation of the 2019–2022 TB Grant

The 2019–2022 Global Fund TB grant has an allocation of US\$5.8 million. The largest investment is allocated to case detection, which comprises 45% of the overall budget, driven by the need to close the gap between WHO incidence estimates and national notifications (Figure 1). The modules comprising investments for case detection are Treatment and Prevention and MDR-TB. Together they represent approximately half of the total allocation in each module.

Figure 1. Distribution of TB Grant Budget by Module, 2019–2022



Source: TB Funding Request 2019–2022

A comparison of the previous and current budget allocations, presented in Figure 2, shows variations in the following modules: a) an increase in allocation for TB treatment and prevention due to hiring of more personnel for outreach activities; b) increase in M&E due to studies and purchase of computer equipment; c) increase in procurement and supply chain module allocated for equipment and a study; and d) a decrease in program management due to reduced allocation for human resources, travel expenses, equipment maintenance and fuel.

*Figure 2. Comparison of TB Grant Budgets, 2016–2019 and 2019–2022*



Source: TB Funding Request 2016–2019 and 2019–2022

## Key Findings:

### Finding 1 - Robustness of evidence: 1

**A proactive strategic leadership of TB central staff allowed rapid authorizations within the MoH for the new TB grant agreement**, which was signed by the Vice Minister of Health on June 9, 2019. One factor that contributed to the fast agreement process was that it followed the malaria grant, which paved the way. Many of the bottlenecks that the malaria grant encountered were worked through (i.e., which institutions had to review the agreement, appointment of the Vice Minister, opening accounts in the Central Bank, etc.). Despite this, and the efforts by the NTP, the Ministry of Finance (MoF) and the central bank of Guatemala, it took three months to approve the budget and authorize initiation of implementation (refer to Annex 1: Route for Approval of Global Fund Agreement). Consequently, there was a delay in payment of salaries for central and field staff. However, as the NTP anticipated a slow process to make funds available by the MoF, all procurement of grant-dependent activities was scheduled toward the end of the first quarter. The first disbursement was received on July 12, 2019, for US\$199,690 out of a total open commitment of US\$3,230,057 to cover the period from July 2019 to June 2020. Nevertheless, the funds were not available until November 2019 due to internal government procedures, such as opening a dedicated bank account. The latest disbursement is earmarked for salaries for outreach workers and central staff hired with grant funds and for payments to providers.<sup>(3)</sup> Despite the lag in the disbursement, workers continued in the name of duty without pay, at personal sacrifice.

### Finding 2 - Robustness of evidence: 1

**The NTP faces challenges in case detection, with a persistent gap between estimated and reported new cases despite achieving performance framework targets for case detection in the first semester of 2019.** According to WHO, for 2018, the estimated incidence of TB is 26 per 100,000 inhabitants. The NTP is reporting an incidence of 20.2 per 100,000 for the same year. Correspondingly, case detection comprises a large share of Global Fund investment in TB in the current grant (2019–2022), as illustrated

in Figure 1 above. Nonetheless, health system modeling using data from 2010 to mid-2018 identified that active case detection financed by the Global Fund had a weaker relationship with TB case notifications than other interventions (see Annex 2: TB health system modeling, methodological annex). This points to the relatively small scale at which active case finding has been implemented relative to standard (passive) case reporting. However, while performance in case notifications for susceptible TB reached greater than 100% achievement of performance framework targets, trends in case detection show an almost invariable curve in the last 10 years.

Deficient quality in sputum samples for screening persons with respiratory symptoms was identified by the NTP as a potential contributor to breaches in case detection. The PCE launched a deep dive to investigate this issue, as described in the following section.

#### **TB Deep Dive on Pre-analytical Phase of TB diagnosis**

**Context:** In early 2019, the PCE team consulted the National TB Program and the Global Fund Country Team on potential areas of interest for in-depth analysis. The topic of quality of sputum specimens used for screening, related to TB case detection, was proposed and accepted.

The National Health Lab reports an average of 40% of inadequate sputum specimens at the national level, with wide variations between regions. According to NTP guidelines, no more than 25% of specimens in any given lab should be inadequate. Adequate sputum samples are defined as those with purulent or blood-tinged material (rather than mucoid sputum or saliva), and a minimum volume of at least 4 ml. Currently, the national guidelines dictate that all sputum samples should be processed, and results reported regardless of quality.

Guatemala is not unique with regard to this difficulty, as other countries have faced a similar challenge. In the Latin American region, Bolivia published a paper about the strategies implemented to improve screening in the busy hospital of Cochabamba where more than 33% of sputum specimens were unusable. (4) Likewise, studies in Asia (Republic of Korea) have confirmed a difference of 21.4% in smear positivity between saliva and mucoid or purulent specimens.(5)

**Objectives:** 1) Investigate the main causes for a high percentage of inadequate sputum samples by type of health facility; 2) Assess the efficacy of screening for TB based on inadequate versus adequate specimens (positivity yield); and 3) Provide recommendations to the NTP for amendments based on the findings.

**Methods:** The sampling design for the study had two steps. The first step was to select municipalities from the population of prioritized municipalities defined by the TB Program. The selection of the municipalities was done randomly using a stratified design. The second step, described further below, was sampling of entries in the lab logs known as red books.

Stratification was based on two criteria: TB incidence (< 10 per 100,000 and > 20 per 100,000 inhabitants)<sup>3</sup> and the percentage of inadequate samples (<25% and >25%) as reported in the NTP database. From a list of 47 municipalities prioritized in the TB grant, a sampling universe of 23 municipalities was defined and grouped into the four strata as shown in Table 4. Within each stratum, municipalities were chosen randomly out of the total number in the stratum. No municipalities were included from the LH stratum.<sup>4</sup>

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<sup>3</sup> The intermediate prevalence interval 10 to 20 per 100,000 inhabitants was not considered in the sampling because the NTP had expressed interest in comparing the highest to the lowest.

<sup>4</sup> During the deep dive implementation, data on inadequate samples was updated by the NTP and the municipality of Totonicapán fell into the LH category.

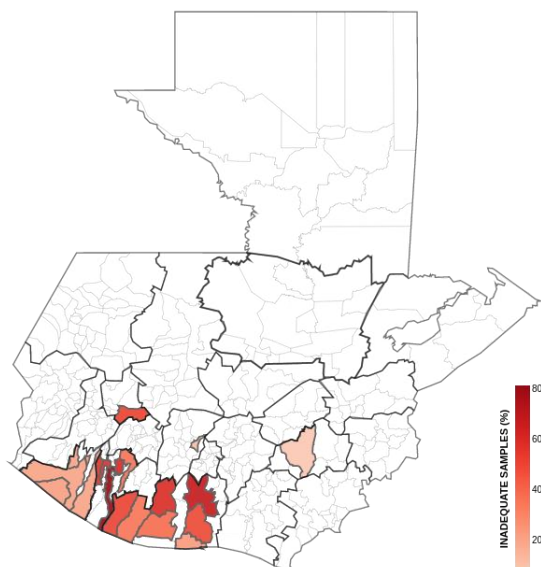


The final sample size consisted of 10 municipalities (health districts) in six departments (Health Area or DAS), which included 11 labs and 16 district health facilities (health centers and hospitals) and six DAS. The sample size was defined by the feasibility of covering fieldwork expenses.

*Table 4. Stratified Design of the Study*

Stratification Criteria		TB Burden	
		High (H) >20 per 100,000 Inhabitants	Low (L) <10 per 100,000 Inhabitants
Inadequate Specimens %	High (H) >25%	HH: 4/11	LH: 0/0
	Low (L) <25%	HL: 3/8	LL: 3/4
n = 10 municipalities randomly selected from the 23 municipalities in the sampling universe			

*Figure 3. Location of Sites in TB Deep Dive Study Sample*



Quantitative data were collected from all labs in the sample municipalities (n=10) using as a sole source the patient records in 11 labs, which are contained in 19 lab logs called red books. The second step of selection consisted in sampling entries from each red book.

Entries corresponding to patients were selected from the red books following a stratified cluster design. A stratum was defined by the following criteria: 1) the reporting lab and 2) the year (2017, 2018 or 2019), for a total of 30 strata.<sup>5</sup> A stratum cluster was defined as months of reporting. A random sample of six clusters was selected for each of the 30 strata. Within each cluster, all the entries in the red book were used, corresponding to individual patients.

For the estimates, a weighted variable was created to account for the sampling design.<sup>6</sup> The final sample

<sup>5</sup> Information for 2019 is only available through June 30.

<sup>6</sup> The weighted variable is calculated as the inverse of the odds of selection probability of the cluster within the stratum.



comprised 11,134 registries (patients) for the study period. The following set of variables was analyzed using C SAMPLE Epi Info DOS 6.04d: patient age and sex, number and quality of samples provided per person with respiratory symptoms (adequate and/or inadequate), remitting facility, TB diagnosis results (positive or negative), other complementary data including the dates tests were performed and whether a sample was remitted for Xpert MTB/RIF test.

Qualitative data were obtained through several methods: 1) on-site interviews with NTP section heads, chief administrative nurses, district nurses (health centers and hospital), nurses in TB clinics and lab technicians. In addition, a limited number of interviews with patients (n=18) were conducted in a high-burden health facility<sup>7</sup>; and 2) three discussion groups ranging in size from 10 to 17 participants (Table 5). The interview guides were tailored to informant type. Informed consent was obtained verbally and documented for all interviews. Data were collected and analyzed in accordance with IRB approval through the ethics committee of the Ministry of Health of Guatemala (No. 25.2017.) Interview data were analyzed using MaxQDA software for qualitative analysis.

*Table 5. Type and Number of Qualitative Data Collection Activities*

Key Informant Interviews (KII):	Interview Count
Central Staff of NTP/NHL	3
Chief Department Nurses	6
District and Hospital Nurses	14
TB Clinic Nurses	3
TB Clinic Lab Technicians	5
District and Hospital Lab Technicians	6
Other (QB, Lab Coordinator, MD, EXM)	6
TB Clinic Users	18
<b>TOTAL</b>	<b>61</b>
Discussion Groups	Discussion Group Count
Supervisors, Outreach staff and TB clinic nurses	3

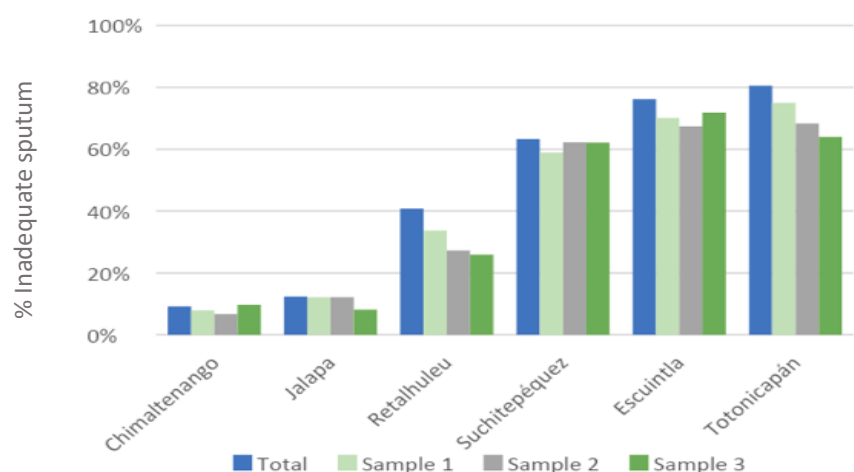
## Key Findings:

### Finding 1: Robustness of evidence: 1

**In the study sample, 8,080 out of 11,134 persons provided from one to three sputum specimens (the rest provided other type of specimens); 43% were inadequate samples in comparison to 40% at national level.** The results by region are the following: the high-burden/intermediate departments Escuintla, Suchitepéquez and Retalhuleu, located in the Pacific coast, had a high/intermediate percentage of inadequate samples (76%, 63% and 41%, respectively); and the low TB burden departments Jalapa and Chimaltenango, located in the central and southwest plateau, had a low percentage of inadequate samples (12% and 9%, respectively). The outlier was Totonicapán in the Western highlands, with a low TB burden but the highest percentage of inadequate samples (81%).

<sup>7</sup> Interviews with patients took the form of “exit interviews” at the health facility. All interviewed patients had provided a sputum sample at some point in time and had been diagnosed as positive or were consulting for follow up.

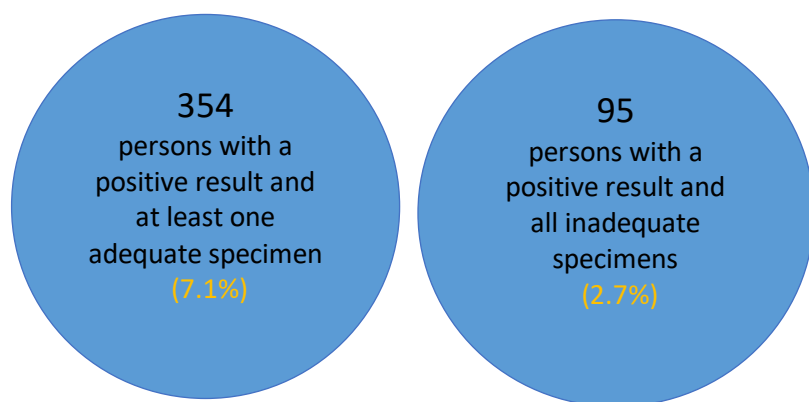
Figure 4. Percentage of Inadequate Sputum Specimens by Department, 2017 – June 2019



Source: CIESAR analysis of TB laboratory records, TB Deep Dive, October 2019

**Positivity Yield:** As expected, smear positivity declines when specimens are of poor quality, particularly when diagnosis is based only upon inadequate samples, with a yield of 7.1% versus 2.7% (Figure 5).

Figure 5. Positivity Yields in Adequate vs. Inadequate specimens




Source: CIESAR analysis of TB laboratory records, TB Deep Dive, October 2019

**False Negatives:** It was found that out of 770 persons who provided both types of samples, 702 were negative and 39 were positive in both samples, however more importantly, there was a difference in the patterns of discordant results. There were 25 persons with a negative result in the inadequate sample but a positive result in the adequate sample (false negatives), which indicates that 39% of these cases (25/64) would have been missed if only inadequate samples were used. This poses a substantial risk of a false negative result when diagnosis is based solely on inadequate sputum specimens (Table 6).

Table 6: Positivity in adequate vs. inadequate sputum specimens

Type of Specimen		Inadequate		Total
		Negative	Positive	
Adequate	Negative	702	False Positive: 4	706
	Positive	False negative: 25	39	64
Total		727	43	770



$25/64 = 39\%$

This risk may be substantial considering that 3,235 persons in the study period (2017–mid 2019) were diagnosed based solely on inadequate specimens.

#### Finding 2 - Robustness of evidence: 2

**Counseling to persons with respiratory symptoms to obtain sputum samples is erratic due to lack of a set of clear and standard instructions and audiovisual materials.** This likely contributes to persons receiving insufficient, inconsistent or contradictory advice on the steps to produce an adequate sputum specimen. The SR reported challenges in obtaining a “good” sputum specimen or phlegm. On the other hand, patients reported that they receive friendly treatment from nurses in the high-burden facility where patient interviews were conducted and expressed satisfaction with the service provided.

#### Finding 3 - Robustness of evidence: 2

**National targets set for the expected number of people with respiratory symptoms to be screened had not been reached by any of the health facilities in the sample.** Furthermore, there is a perception among head nurses and lab technicians that targets have created a perverse incentive as health workers who do not reach targets can be subject to administrative disciplinary measures. Consequently, there is a risk of screening patients regardless of whether they fulfill the criteria. It was found that this likely cannot be attributed to lack of knowledge or guidelines, given that the vast majority of health workers recited the definition of a person with “respiratory symptomatology of TB.” Furthermore, in many facilities the definition is posted on the wall, in contrast to a lack of material depicting the steps for providing adequate sputum specimens.

#### Finding 4 - Robustness of evidence: 1

**There is a disconnect between clinical and lab personnel, which prevents adequate feedback on the quality of sputum specimens and other lab-related issues, for example delays in the delivery of time-bound samples for culture.** Even though the quality of the specimen must be reported in specific lab forms upon delivery of results, clinical staff claim that lab technicians did not inform them that the samples they delivered were inadequate. Joint training sessions and team meetings are not held periodically to provide opportunities for clinic and lab staff to come together and discuss this problem or other situations related to lab and clinical services.

#### Finding 5 - Robustness of evidence: 1

**There is no accountability for health facilities with high percentages of inadequate sputum samples.** No one “owns” the problem, and therefore, no corrective measures are pursued. The analysis from the red books show that health centers (HC) with TB clinics perform better in sample quality, measured by their effectiveness index: HC TB clinics: 59% (n= 1,768) versus HC: 29% (n=1,951). This index is calculated by dividing the number of inadequate samples over the total number of samples received by the facility. Specimens from the one prison included in the study sample almost always are inadequate (91%, n=516);

the two HIV clinics in the sample also had poor performance (58% and 72%), even though the number of samples remitted to the corresponding labs was small (n=237). Currently, prisoners and persons with TB-HIV co-infection should be tested with GeneXpert precisely due to the difficulties in obtaining adequate samples in these populations.

#### **Finding 6 - Robustness of evidence: 1**

**Data disaggregation by sex shows that men have 1.3 times higher probability (OR) of providing an inadequate sample compared to women (53% and 47% respectively). Age was also found to be a factor, with a higher percentage of inadequate samples among younger persons (72% for ages 15-29 years old and 70% for ages 30-44 years old in comparison to 60%-63% for ages 45 years old and older.)** A potential explanation for this finding is that older persons tend to have a more advanced disease or other lung disease with productive cough in comparison to younger persons. The current algorithm establishes that children below 15 years old should be tested using GeneXpert and not by microscopy.

#### **Finding 7 - Robustness of evidence: 2**

**All health workers interviewed indicated that shortages of supplies to process samples seldom occur and usually do not interrupt the process, due to reserve stocks in the department warehouse.** Transport of samples was not an issue in health facilities located in the municipal main towns but was mentioned by supervisors as a problem for remote clinics and for outreach workers who sometimes must pay for transportation out-of-pocket.

The PCE team conducted a Root Cause Analysis, which identified three main root causes: i) testing the wrong people; ii) no accountability for delivering inadequate samples; and, iii) no systematic feedback on sample quality from lab technicians to clinic staff.

Recommendations derived from the Deep Dive:

- The National Health Lab and the NTP should consider changing guidelines so that no person is diagnosed based only upon inadequate sputum specimens due to a substantial risk of missing positive cases.
- Reports on the number and percentage of inadequate sputum specimens should be disaggregated by remitting health facility to create a sense of accountability and implement corrective measures
- Be aware of not creating perverse incentives that can derive from setting targets for screening. Furthermore, targets should be adjusted to account for differences in high and low TB burden regions.
- Prepare a set of simple instructions for counseling by health care workers on how to produce a sputum sample in order to reduce improvisation and standardize the messages.
- Given the findings derived from the deep dive that persons are screened without indication, retrain health workers and outreach personnel in the pre-analytic phase, with an emphasis on quality, and refresh guidelines for screening of contacts.
- Beyond routine contact, it is key to hold periodic joint trainings and technical meetings with clinical and lab personnel to promote a better integration of services.

## **3. MALARIA**

### **3.1 Background**

Guatemala has experienced a progressive decline in malaria cases for more than a decade. (6) The number of reported cases declined 66% between 2017 and 2018, and, as of June 2019, cases declined by a further 37.4%.(7) The decline is especially notable in Alta Verapaz, where cases decreased by 58.8%.(7)

The National Malaria Subprogram (NMS) technical team attributes the decline in cases to several factors, including the following:

- Extension of the micro-stratification approach and Diagnosis, Treat, Investigate, Response (DTIR) strategy to new regions, as this strategy was previously only applied in Escuintla. Technical assistance from the PAHO was also extended to four additional prioritized departments;
- Intensified vector control of breeding sites;
- Expansion of public-private partnerships and collaborative work with sugar cane mills. Screening for all migrant workers at the end of their travel was successfully implemented in one of the largest mills, with plans to expand to all major mills in the targeted areas;
- Collaborative work with private pharmacies aimed at reducing self-medication and loss to follow-up. Currently, work has advanced in one municipality in Escuintla;
- Training national-level lab technicians, including those working in private labs, to improve skills in conducting parasitological testing via microscopy. Certifications were granted to lab technicians who successfully completed the training;
- NMS staff commitment, as many staff members continued working without payment during disbursement delays. This sacrifice by staff members prevented program interruption.

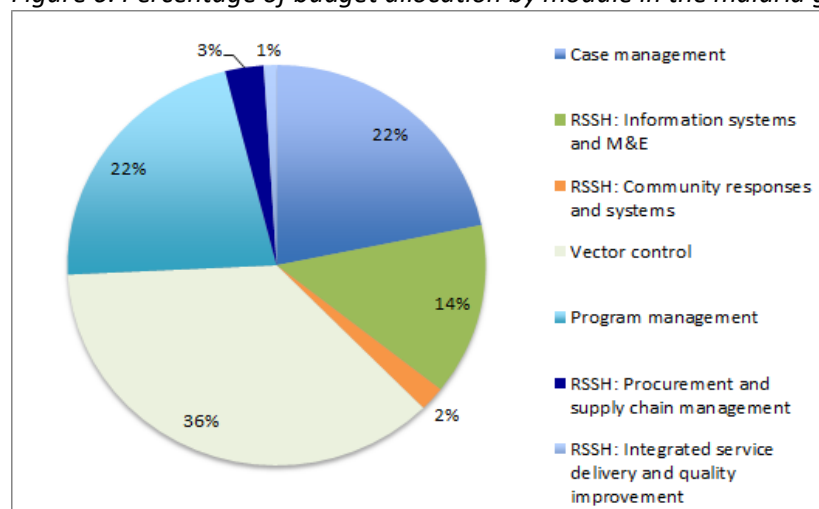
In the Mesoamerican Region, several countries are on the path to elimination by 2020; however, El Salvador is the only country that has achieved three years without reporting a native case. El Salvador attributes its success to strong political will, a National Strategic Plan with involvement by multiple sectors, educational activities for the public and the commitment of community volunteers.(8)

### 3.2 Early implementation of the 2019–2021 Grant

The Global Fund sent the 2019–2021 malaria grant agreement to the MoH in November 2018, and the agreement was signed in May 2019. In August 2019, after revising the budget, the first Global Fund disbursement was received by the MoH and was earmarked to pay the salaries of NMS central staff and field technicians in Escuintla. In October 2019, an update to the budget was incorporated to adjust the list of health products, which had not been procured due to delays in the start of grant implementation.

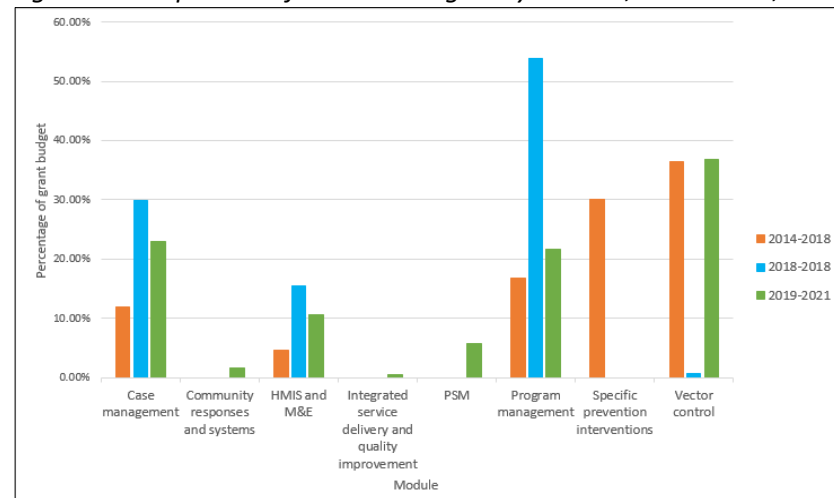
**Financial Distribution of the 2019–2021 Grant:** The largest allocation in the current grant is for the vector control module (US\$2.1 million), followed by case management (US\$1.3 million) and program management (US\$1.2 million; Figure 6). The allocation for RSSH is divided into four modules, including “community responses and systems” which has the lowest allocation after “integrated service delivery and quality improvement” and appeared for the first time in the 2019 grant. Figure 7 compares the malaria budget distribution by module for the current and previous malaria grants. Key budget revisions include a 26% increase for information systems, primarily for the procurement of equipment and software for national-level implementation. This allocation also includes additional administrative costs for a logistics operator and materials and equipment for information, education and communication (IEC).

Figure 6. Percentage of budget allocation by module in the malaria grant, 2019–2021



Source: Malaria budget funding request, 2019–2021

Figure 7: Comparison of malaria budgets by module, 2014–2018, 2018 and 2019–2021



Source: Approved malaria grant budgets, 2014–2018, 2018, and 2019–2021

## Key Findings:

### Finding 1 - Robustness of evidence: 1

There were significant delays in accessing Global Fund investments for malaria in 2019 due to several factors, including complicated bureaucratic practices in the Guatemalan public sector, turnover in MoH leadership and a protracted process for responding to Global Fund management actions. Once the grant agreement was signed, the NMS was slow to respond to the management actions, which were previously known to the NMS given that they had been approved by the Grant Approval Committee (GAC) and communicated with the sending of the grant agreement in November 2018. Furthermore, the CT sent multiple letters and electronic messages notifying of the need to complete these actions, which were not addressed by the NMS until June 2019. The disbursement from the Global Fund occurred immediately after the MoH opened a new account, almost three months after the grant agreement had been signed.

Two requirements proved particularly challenging for the NMS authorities: 1) signing a Memorandum of Understanding (MoU) with PAHO as technical/financial facilitator as proposed in the funding request as

a solution to mitigate low financial absorption (the MoU is still unsigned at the time of writing); 2) ensuring adequate warehousing and distribution of health products procured by the grant. The MoH does not currently have the capacity to fully safeguard and distribute health products procured by the grant. For the previous grant cycle, HIVOS acted as the local procurement agent, but the MoH decision to transition to PAHO resulted in a delay.

In addition, because of the protracted grant signing process and the restitution of funds related to ineligible expenses from the previous grant, a budget revision was required (Letter to the Minister of Health from the Global Fund's Recoveries Committee, July 2019). The Executive Director's designate also approved a sanction of a 2:1 allocation reduction which will reduce the recently signed GTM-M-MSPAS grant agreement (2019–2021) by US\$61,988.

Despite these delays, the NMS continued to operate using national funds. However, some activities that are highly dependent on grant funding, including training and supervision and some key commodity procurements, were not implemented or were scaled down. Mitigation measures by the NMS included re-prioritization of activities to areas with higher need, borrowing surplus LLINs from other health districts, and the commitment of staff who continued working without pay for almost eight months.

### **Analysis of long-lasting insecticide-treated net (LLIN) distribution**

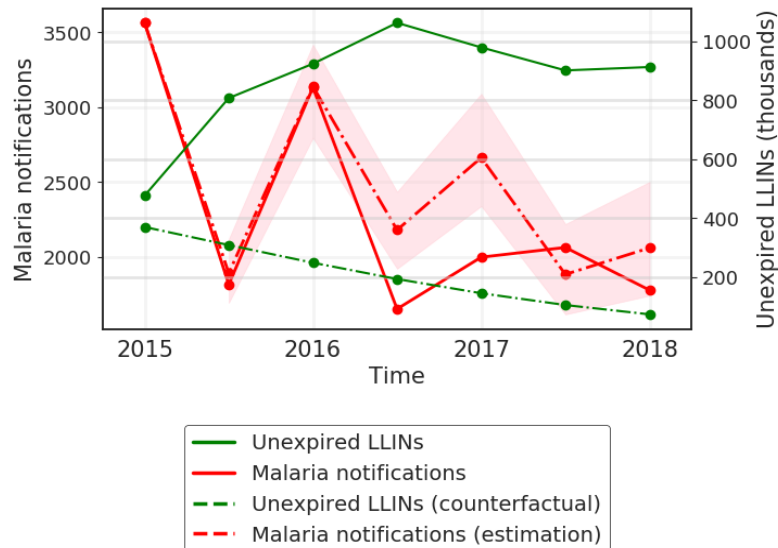
A linear mixed model was used to estimate the effect of LLIN distribution on malaria notification rates using recent data from the NMS. The Global Fund contributed US\$9.7 million for LLIN distribution between Q1 2015 and Q4 2017, accounting for 100% of total expenditure on LLINs in Guatemala.

This analysis estimated that 1,412 (95% CI: -331, 3,346) cases of malaria were prevented by LLIN distribution in Guatemala from 2015 through the first semester of 2018 (Figure 8). Although the confidence interval does not rule out the null hypothesis (no effect), the effect size in terms of prevented cases is epidemiologically relevant and the large confidence interval may be due to the small sample size.

Estimates take into account the effects of indoor residual spraying (IRS) and treatment of breeding sites; however, these data, available from official sources, are reportedly of lower quality than case notification and LLIN distribution data and may introduce some bias in the estimated effect. For this reason, we compared models with and without these intervention variables. Additional details regarding the methods and results for this analysis are provided in Annex 3: Evaluation of effects of the impact of distribution of LLINs.

Figure 8 shows the observed malaria notification counts per semester between 2015 and the first semester of 2018 and the observed cumulative distribution of LLINs, taking into account LLIN expiration (LLINs that have presumably expired based on average lifespan are removed from the annual total). Figure 8 also displays model estimates for cumulative distribution of LLINs and malaria notification counts by semester under the counterfactual scenario in which distribution of LLINs stopped in 2015. This comparison allows us to observe differences between scenarios and the magnitude of the resulting effect.

Figure 8. Malaria notifications and unexpired LLIN, observed and counterfactual, 2015–2018



Source: CIESAR analysis of MoH and NMS data, 2019

### Malaria Deep Dive on Community Volunteers

**Context.** For many decades, case detection by volunteers (CoVols) has been a key strategy in Guatemala's effort to achieve malaria elimination, and this strategy is reflected prominently in the latest Funding Request narrative. In 2018, CoVols performed up to 84% of screening in Alta Verapaz and 54% of case detection in Escuintla, the two departments with the highest burden of disease (Figure 9). Despite their essential contribution to elimination efforts, the resources allocated to the CoVol program have typically been low. In the current malaria grant (2019–2021), only 2% of the total budget is allocated to community response. To our knowledge, this is the first assessment that incorporates the perspectives of CoVols on program functionality and areas for program improvement.

Figure 9. Study areas for Malaria Deep Dive: Alta Verapaz and Escuintla Departments



Source: NMS database, 2019



**Objectives:** The deep dive had two objectives: 1) Determine how ColVols and their supervisors perceive the functionality of the volunteer system in the two areas with the highest malaria case notification counts (Escuintla and Alta Verapaz), and 2) Identify bottlenecks to better performance and grant implementation.

**Methods:** The deep dive analysis utilized a qualitative approach based on interviews and focus group discussions conducted with ColVols, field technicians and other personnel from the NMS, and relevant international organizations in Guatemala City, Alta Verapaz and Escuintla. Colvols and malaria field technicians completed a self-assessment focused on 10 key components of the ColVol system utilizing USAID's matrix for assessing the functionality of community health worker programs. (9)

### **Key Findings:**

#### **Finding 1 - Robustness of evidence: 1**

**Results of the self-assessment indicate that ColVol program components that are dependent on the field technicians (i.e., selection of ColVols, training and supervision) were functioning well.** This positive functionality is explained by good relationships between field technicians and ColVols and the mutual perceived benefits of the partnership. The ColVols value the guidance, supplies and presence of the technicians in their communities, while the field technicians value the assistance provided by the ColVols for case management. Accreditation, integration into the health system, opportunities for advancement and incentives were reportedly less functional. There was also variation between Alta Verapaz and Escuintla regarding data flows and community integration, which are reported to function well in Alta Verapaz but not in Escuintla.

#### **Finding 2 - Robustness of evidence: 1**

**Significant differences in how malaria programming (including ColVols) is prioritized, supported and delivered in Escuintla and Alta Verapaz were observed and may be contributing to uneven progress toward elimination.** The MoH prioritized the Department of Escuintla for malaria elimination interventions as it accounts for over half of case notifications in the country. Escuintla has received significant support from technical partners and the NMS. Supervision in Escuintla is frequent and systematic, and refresher trainings are implemented with financial support from technical partners. In Alta Verapaz, volunteers receive infrequent supervision, limited in-service training and scarce RDTs, which are restricted to a few areas. As a result, there is a lag between taking blood smears and the delivery of results (diagnosis); only 79% of cases in Alta Verapaz received a diagnosis within 72 hours, compared to 97% in Escuintla. In addition, volunteers in Alta Verapaz are not allowed to provide treatment, which exerts pressure on the technicians to travel to deliver treatment when a positive blood smear is notified.(7)

#### **Finding 3 - Robustness of evidence: 1**

**The budget allocation for volunteers remains low, resulting in a mismatch between their significant contribution to malaria elimination and the financial support for their work.** While ColVols are not requesting payment, they would like to receive badges and other non-financial incentives (e.g., T-shirt or caps with the NMS emblem, ColVol ID cards, etc.). Most of the ColVols consulted in this deep dive were eager to expand their knowledge about the epidemic and wished to receive additional training. Some training activities have occurred in Escuintla, to the satisfaction of both ColVols and their supervisors. While the malaria grant contains funds for training, it covers only "trainings for trainers," and funds have not yet been committed to extend capacity building directly to ColVols themselves.

#### **Finding 4 - Robustness of evidence: 2**

**The NMS is having trouble increasing the number of ColVols, which may be related to the limited recognition that ColVols currently receive.** ColVols have expressed their desire to be more involved with health facilities, promoting a comprehensive approach and health system integration. According to ColVols, in order to recruit new volunteers (including younger, educated applicants), the NMS will need to offer additional non-monetary incentives, especially public recognition and trainings.

Recommendations derived from the Deep Dive:

The NMS should consider the implementation of several actions (with minimal associated cost) to facilitate the work of the ColVols, including:

- Promote community recognition of ColVols in local assemblies, school meetings and other spaces to disseminate their role and contribution to the fight against malaria.
- Foster a collaborative relationship between ColVols and community leaders.
- Engage ColVols with nearby health units and microscopy centers to build an effective system for referrals and counter referrals.
- Provide ColVols with an official ID or appropriate credentials to support their role as health workers.

In addition, the NMS should consider other actions which would require a small investment, but will go a long way to engage and further motivate ColVols:

- Identify other sources of financing to extend training on the new Manual for Malaria Volunteers to ensure direct teaching and reduce reliance on cascade training (i.e., training of trainer) as currently planned, which are not always reliable.
- Design and produce audiovisual materials on prevention, diagnosis and treatment, both for field technicians and ColVols to be used in their work in the communities (for example, an App for mobile phones).
- Create and support additional non-monetary incentives to encourage current ColVols to stay active and attract new volunteers.
- Examine mechanisms for ensuring adequate supplies for ColVols to perform their work in optimal conditions, including rapid diagnostic tests and antimalarial drugs.
- Promote the creation of a network of ColVols that offers channels of communication between ColVols residing in different geographical areas to share knowledge and experiences, with the goal of creating a stronger and sustainable community response to the epidemic.

## **4. HIV/AIDS**

### **4.1 HIV Grant progress**

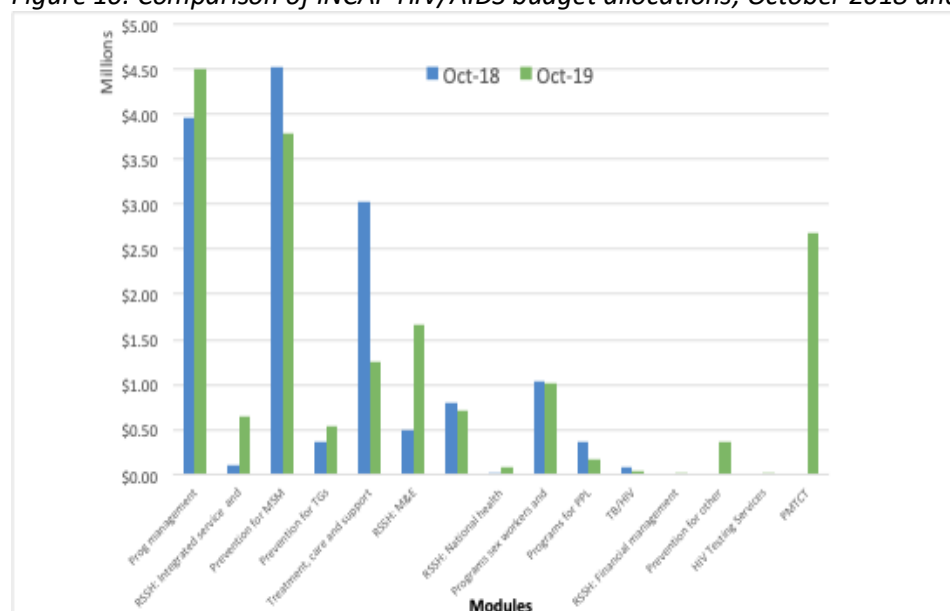
Guatemala's HIV epidemic is highly concentrated in key populations (KPs), with UNAIDS estimating 2018 HIV prevalence of 0.4% but higher estimated prevalence in men who have sex with men (MSM; 8.0%), transgender people (22.2%) and sex workers (SWs; 1.6%).<sup>(10)</sup> Two HIV grants were awarded in 2018: a continuation of the previous HIV grant awarded to the PR HIVOS to finalize activities (US\$4.9 million) by December of 2018 and the new HIV grant, beginning in October 2018, to the *Instituto de Nutrición de Centro América y Panamá* (INCAP; US\$14.8 million). Detection of HIV cases in KPs is a priority for the National AIDS Program as set forth in the HIV National Strategic Plan (*Plan estratégico nacional para la prevención, atención y control de ITS, VIH y SIDA 2017–2021*; NSP), in which the five main thematic areas align with the activities in the HIV grant. Both the NSP and the HIV grant prioritize the following population groups: people living with HIV (PLHIV), MSM, transgender people, pregnant women and their

children, and persons with TB/HIV co-infection. During early implementation of the current grants, stakeholders also began discussions surrounding the upcoming 2021–2023 funding request.

Financial analysis of the current grant: In 2019, INCAP's HIV grant allocation increased by 17.6% to US\$17.5 million, including additional funds designated primarily for EMTCT. These funds were provided by Comic Relief, a nonprofit organization; the activities were transitioned from the Prioritized Above Allocation Request (PAAR) and approved by the CCM, with EMTCT scheduled for implementation by the National HIV Program with the administrative support of INCAP. The PR also hired three health professionals for the National HIV Program to help implement the program. Cost savings from delayed implementation of the current grant were re-distributed to the Program Management module in order to cover SR travel expenses.

In addition, funding from the Treatment, Care and Support module was re-distributed to fund prevention activities for incarcerated persons. Stakeholders reported that finding an appropriate implementing partner for prison settings was challenging; as a result, INCAP directly hired health care workers to perform prevention activities in prisons, rather than operating through a SR. In addition, some savings resulting from the implementation of the DHIS2 software platform were reallocated for the following activities: a) capacity building workshops for the PR INCAP and SRs; b) technical assistance by the University of Oslo to the PR and SRs; and c) equipment and support for M&E and epidemiological surveillance for the National HIV Program. A comparison of the original, approved budget as of October 2018 and a revised budget as of October 2019 is depicted in Figure 10 below.

*Figure 10. Comparison of INCAP HIV/AIDS budget allocations, October 2018 and 2019*



Source: Approved HIV Grant Budget, 2018-2019

## Key Findings:

### Finding 1 - Robustness of evidence: 2

**Consultancies to address specific topics are delayed, which will have an impact on implementation. Not all of the contracts for studies have been awarded yet, and those that are awarded are undergoing implementation with variable progress. It is expected that the majority of studies will have only one year left for implementing activities and providing recommendations.**

Activities to address human rights-related barriers were slow to initiate, and the terms of reference for these consultancies were not all finalized at the time of writing. As of January 2020, out of 29 consultancies, 15 were awarded and are at different phases of implementation<sup>8</sup>, while 14 are awaiting approval. In the previous grant, human rights activities were implemented by SRs with specific expertise in human rights (including SOMOS, OMES, REDSO, OTRANS and Red Legal). Previous interventions included: 1) public monitoring to improve health care workers' compliance with human rights and the provision of quality care for KP at health facilities; 2) legal services for counseling victims of human rights violations, and 3) lobbying for improvements in legislation. Instead, INCAP opted to contract with Red Legal and LAMDA to provide these services, resulting in negotiations which took more time than expected and could potentially affect the number of scheduled interventions by the end of the year.

The Pre-exposure prophylaxis (PrEP) study, scheduled to begin in the second quarter of 2019, is also expected to generate critical information on implementation of this HIV prevention strategy for KPs. However, the study was delayed because no offers to the tendering bid were initially received. The Global Fund SR *Colectivo de Amigos contra el Sida* (CAS) was then selected to conduct the study in MSM, and the study is currently in early implementation.

#### **Finding 2 - Robustness of evidence: 1**

**Performance on identification of new HIV cases has been consistently low for the majority of SRs.** During 2019, HIV test positivity yields were lower than in 2018. Test positivity rates among SRs in 2019 have been consistently low relative to targets, with the majority of SRs reporting low rates of case identification per test performed for both MSM and transgender women. Positivity rates were also lower in 2019 compared to 2018, with 2.3% test positivity for MSM in 2019 compared to 3.2% in 2018 (80% of performance framework target), and 1.8% test positivity for transgender women in 2019 compared to 2.2% in 2018 (40% of performance framework target.) (11)

PR and SRs mention the following potential reasons for falling below targets: a) the high mobility of KP, particularly the transgender population; b) the need to implement different strategies to reach “hidden” persons who do not attend hotspots or do not self-identify as MSM or transgender; c) the inexperience of some SRs in screening and linkage to care; and d) other contextual factors that represent barriers to case detection, including the parental consent requirement for HIV testing for minors under 18 as established under Guatemalan law, leading to potential missing cases among adolescents.

#### **Finding 3 - Robustness of evidence: 1**

**INCAP's new HIV data collection software, administered via DHIS2, is being used by SRs for reporting HIV performance framework indicators, and stakeholders are becoming increasingly receptive to the change in software.** However, implementation was delayed and some aspects of the software, including a mobile app, continue to experience implementation challenges.

As of March 2019, SRs began using INCAP's new HMIS for data collection and reporting. This system is administered via the open source software platform DHIS2, which was selected over the system used by the previous PR (*Sistema Integral de Gestión de Proyectos*; SIGPRO) for cost savings and efficient integration with data from the national HMIS (*Sistema de Información Gerencial de Salud*; SIGSA). In addition, SIGPRO requires maintenance fees and is proprietary software that does not allow for user modifications. DHIS2 system implementation (technical assistance, informatics and office operations costs) is therefore a priority in the INCAP HIV grant, of which 14% is allocated to RSSH.

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<sup>8</sup> Status of Consultancies provided by INCAP, January 2020

Several positive developments have occurred since implementation. First, the new DHIS2 Reporting Tool was used to generate information for the 2019 Semester-2 HIV PU/DR. Second, the PR was able to exchange data in January 2020 between SIGSA and DHIS2; while the two systems are not yet interoperational, the MoH showed a renewed interest in cooperation and incorporating data from the PR. The future of a more comprehensive HIV module in SIGSA is a highly relevant topic for the new Funding Request.

While implementation is largely seen as successful, both the PR and University of Oslo, who assisted with software development, underestimated the time required for design and programming. As a result, software development has taken nearly a year to complete and has presented some challenges, including the creation of unique patient identifiers and the development of a mobile app for health promoters working in the field.

During early implementation, SRs experienced challenges registering clients when the client lacked an official ID (DPI). In the INCAP DHIS2 system, clients can be tracked using two possible unique identifier codes: one is based on the client's DPI, or, if a client lacks a DPI, an identifier is "constructed" using personal identifying data (name, age, sex etc.; "*Código Único de Identificación [CUI] construido*"). The lack of official ID disproportionately affects key populations: 42% of SWs and 31% of transgender people did not present an official ID when registering for HIV prevention services. For SWs, a possible explanation is the migratory nature of some sex work, in which many SWs do not possess a Guatemalan DPI. In such a scenario, a CUI would be created. However, the MoH hopes to increase the number of KP presenting official documentation.

In addition to capturing data in health care settings, the PR needed to capture SR field data. In June of 2019, INCAP was required to add HIV-related data to the S1 2019 PU/DR, but, given delays in app development, it was not yet possible to capture data from SRs in the field. In response, the PR collected data manually from each SR and hired temporary personnel to enter data into computers set up at the PR headquarters. This rushed data-entry process was challenging for SRs, who, at the time, expressed frustration with the process. Since that time, the mobile app has been fully developed and is currently installed on the cell phones of field workers (HIV promoters).

While stakeholders expressed confidence in the future of the app, during January 2020 interviews by the PCE team SRs reported some challenges with its operation. SRs stated that the app often crashes or stalls in field settings and is time-consuming for data entry. Some health care workers also reported concerns about cell phone theft in the areas in which they work. As a result, data entry often occurs outside of work hours, which presents an additional burden for field-based workers. Despite these initial challenges, the SRs expressed overall optimism about the DHIS2 platform but noted that: "*we know it is a good software, but it needs more refining particularly to correct the problems with the App.*" The PCE team looks forward to tracking progress on data systems and surveillance implementation during the final year of the grant implementation period.

## 5. CROSS-CUTTING TOPICS

### 5.1 Value for Money (VfM)

#### Financial Deep Dive: Assessment of the Cycle of Budgeting and Annual Operative Planning in the MoH

To optimize the impact of every dollar spent, national programs must effectively draft and implement operative plans and execute budgets efficiently. The PCE team analyzed trends in budget absorption for both domestic and donor funds and the relationship between absorption and operative planning in the MoH. Findings show low performance in all areas, which can hinder the conversion of inputs (domestic and donor capital) into outputs and outcomes. The scope of this analysis is to identify trends in the budget cycle and the key drivers that lead to low absorption and differences between grants and implementation planning by the MoH.

**Context:** Several stakeholders attribute deficiencies in disease response to low investment in national disease programs. However, even when funding is provided, the MoH struggles to implement budgets according to its own annual operative plans (AOP) and the Global Fund's grant frameworks. In order to explore this issue in more depth, the PCE team conducted an in-depth analysis of trends in allocation and budget absorption and the efficiency of annual operative planning in the MoH.

**Objective:** To analyze the budgetary cycle for the three diseases (TB, malaria and HIV) and its relationship to the AOP in order to inform the Global Fund and national stakeholders on MoH performance as it relates to the pillars of VfM (economy, efficiency, effectiveness, equity and sustainability).

**Methods:** This analysis covers the period from 2013 to 2018 and uses two data sources: SICOIN and Sistema de Gestión (Management System) (SIGES). SICOIN is specifically designed to fit the programmatic structure of the MoH budget, spanning input to activity to project, sub-program and program. This analysis is therefore limited to funds that are managed by the MoH. It covers the three phases of the budgetary cycle for each national program by funding source (domestic and donor funding): the allocated budget, the current (valid or *vigente*) budget and expenditures. The allocated budget refers to the allowable operating budget as approved by the national congress. The current or "valid" budget refers to the annual operating budget after the original budget allocation is modified by government entities (this process usually occurs after budget approval but during the associated calendar year). And expenditure refers to the amount of funding from the budget that is spent by the implementing entity. Financial absorption is defined as the funds spent by the implementing entity (expenditure) divided by the current budget, which is the budget used for operations by implementing partners.

The SIGES database was used to retrieve data that links budgets to activities, outputs and outcomes (i.e., the results chain). Additionally, interviews were conducted with current and former officials of the MoH, the MoF and technical partners to explore their opinions on the quality of the SIGES and SICOIN data.

Results in this report represent a summary of a more extensive analysis of the public financial management system, which will be circulated in early 2020.

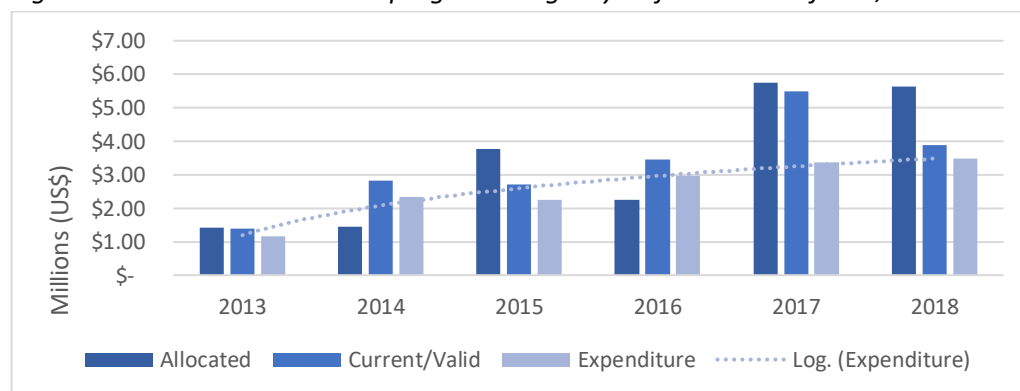
#### Key Findings:

##### Finding 1 - Robustness of evidence: 2

The National Congress allocates public sector resources to the MoH annually, based on operative plans drafted by health facilities and national programs. **Public sector budget allocations have steadily increased for the three diseases during the period studied (2013–2018), gradually overtaking Global**

**Fund investments.** In response, Global Fund investments are decreasing in preparation for the 2020 malaria transition and 2022/23 TB transition. As depicted in Figure 11, domestic resources for malaria increased from 2013 to 2018.

*Figure 11. National Malaria Subprogram budget cycle for domestic funds, 2013–2018*

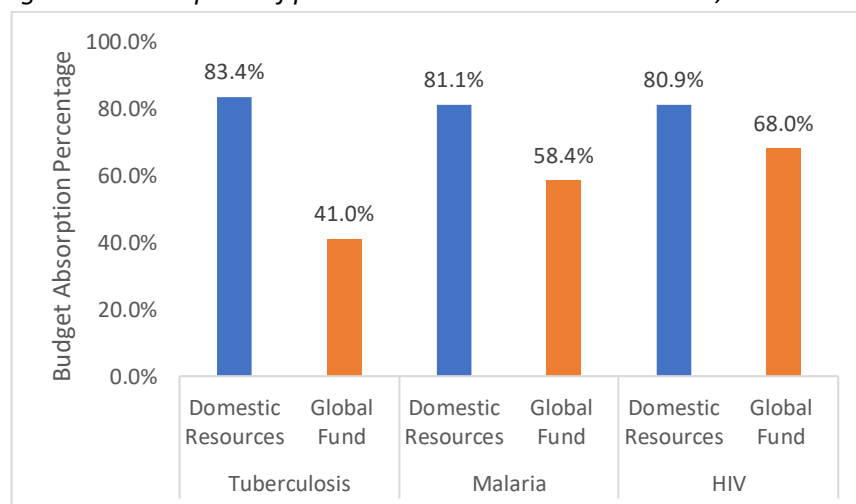


Source: SICOIN

## Finding 2 - Robustness of evidence: 2

**Despite an increase in budget allocations to national programs, absorption remains low, particularly for Global Fund investment.** No national program spent more than 85% of its domestic budget, and absorption of was lower for donor funds (Figure 12).

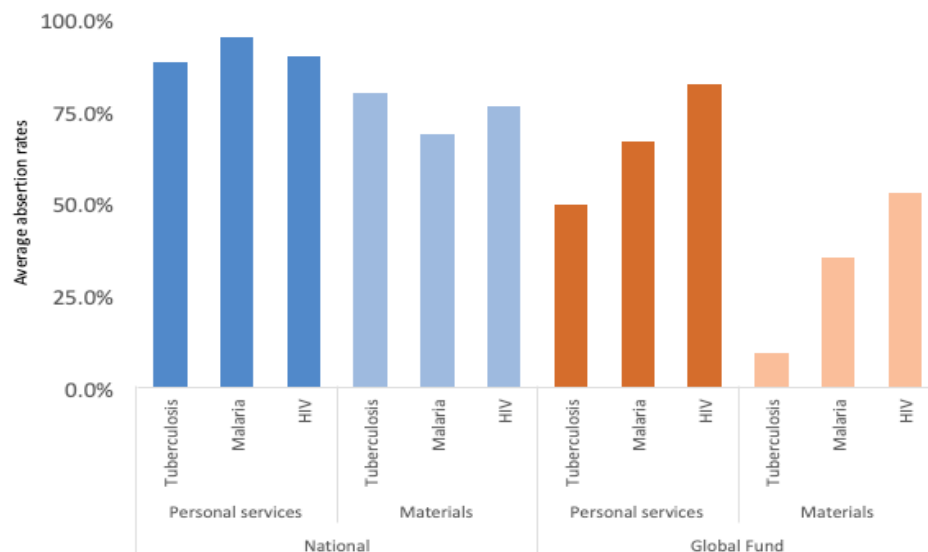
*Figure 12. Absorption of public and Global Fund investments, 2013–2018*



Source: SICOIN

A possible explanation for lower absorption rates for donor funding may be the high proportion of public spending for salaries, which represented up to 70% of MoH expenditures and is executed by an expedited payroll transaction. (12) Historically, the assigned budget for human resources has a higher absorption rate than the absorption rate for medical consumables or medicines (Figure 13).

Figure 13. Average absorption rate for public and Global Fund investments, by expenditure item, 2015–2018



Source: SICOIN

\*Materials refers to commodities or medical consumables, including medications but excluding some medical equipment (definition from SICOIN data source)

In comparison, Global Fund resources managed by the PR had low absorption for the procurement of commodities, which are subject to lengthy and complex requirements associated with the Law of Procurement of Goods and Services. The MoF is responsible for training staff on procurement procedures, but trainings are rare.<sup>9</sup> The PCE found that between 2016 and 2017, no MoH employees were trained and less than 5% of employees were trained in 2018. (13) The lack of training is further exacerbated by staff turnover.

Limited ability to navigate the procurement mechanism may be a relevant factor for low absorption rates. For example, within the NTP, a change from a financier with limited experience in public procurement to an experienced financier increased execution of the Global Fund grant budget from 35% to 65% from July 2018 to June 2019. (National level KII)

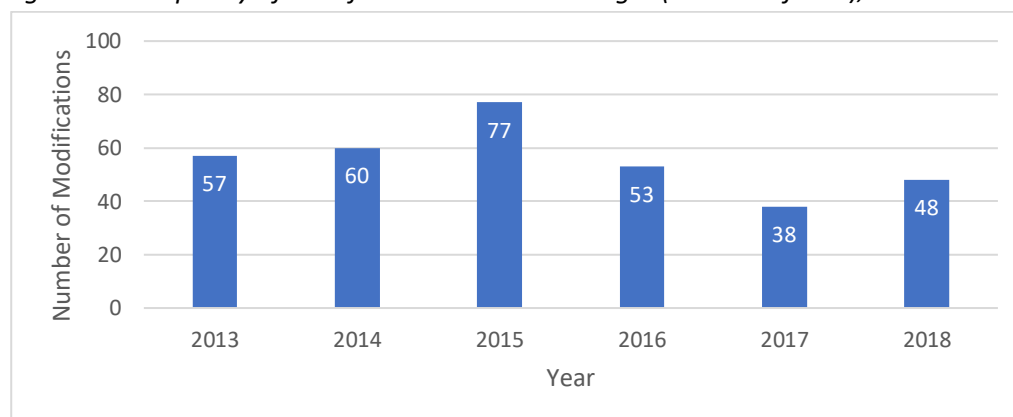
### Finding 3 - Robustness of evidence: 2

**Budget formulation is a major cause of low national budget absorption.** An ill-designed budget is very difficult to execute efficiently: program financiers performed an average of 55 budgetary revisions per year from 2013 to 2018 (see Figure 14). Revisions from one budget line to another are sometimes due to management adaptation; however, revisions across programs can delay execution as they require authorization from three high-level entities: the MoF, Secretaría de Planificación y Programación de la Presidencia (Planning and Programming Secretariat of the Presidency) (SEGEPLAN) and the Comptroller General. Revisions that constitute more than 15% of the total budget also highlight deficiencies in budget formulation and undermine the credibility of the planning exercise. (14)

<sup>9</sup> As confirmed in the following response to an inquiry by PCE: Access to Information DFCFCG-PROV-02-2019, “no training has been given to employees of the MoH in the topic of the Procurement Law for Goods and Services by the Ministry of Finance during the years 2015, 2016, 2017 and 2018.”



Figure 14. Frequency of modifications to the TB budget (domestic funds), 2013–2018

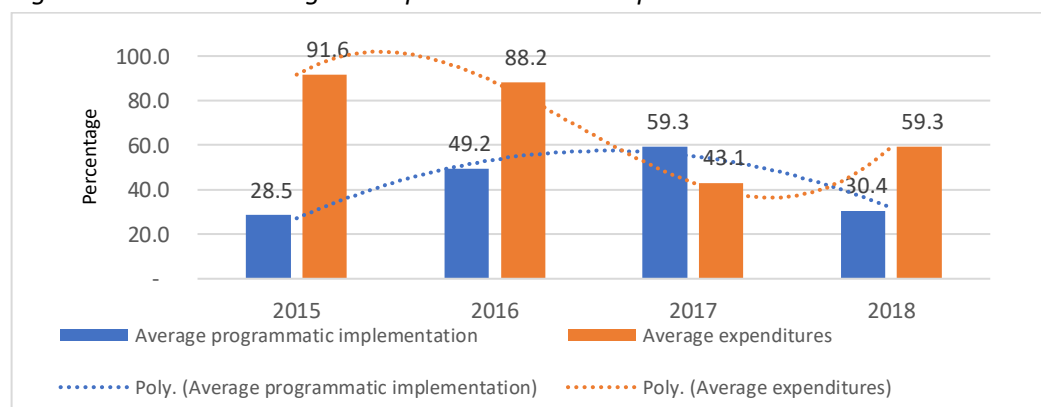


Source: SICOIN; Based on request to the MoH through the Law on Free Access to Public Information, Resolution 503-2019

#### Finding 4 - Robustness of evidence: 2

**The PCE did not observe a correlation between expenditures of domestic funds and program implementation.** Program implementation is quantified as the percentage of people intended to be reached by key services that were reached (recipients reached/intended recipients). For the NTP, the relationship was especially weak. This inconsistency could be the result of an ill-designed AOP. In 2015, 2016 and 2018, programmatic implementation fell markedly below expenditures, while in 2017 the percentages were more comparable (Figure 15).

Figure 15. Overall TB Program Implementation vs. expenditures



Source: SIGES/SICOIN

Below are recommendations derived from the financial deep dive. The party or organization responsible for implementing each recommendation is noted at the end of the recommendation in parenthesis.

Short- to medium-term recommendations derived from the financial deep dive:

- Conduct more frequent and higher-quality trainings to implement the “management by results” methodology. The government mandates that all financial resources and activities should be linked to clear results achievement. (SEGEPLAN and The Financial Unit of the MoH)
- Conduct more frequent and higher-quality trainings to promote effective use of the Law for Procurement of Goods and Services. (SEGEPLAN and The Financial Unit of the MoH)

Medium- to long-term recommendations derived from the financial deep dive:

- Simplify the Law for Procurement of Goods and Services; this requires high-level lobbying at the level of the national government. (MoF and Congress)
- Build capacity among civil society stakeholders to advocate for better formulation and execution of public and Global Fund budgets. (CCM with potential support from technical partners)

## 5.2 Resilient and sustainable systems for health (RSSH)

All three current disease grants contain RSSH investments prioritizing HMIS and M&E, with the highest proportion of RSSH funding for HMIS and M&E in the current TB grant (88%), followed by 81% in the HIV grant and 58% in the malaria grant. Key strategic plans for RSSH include the following:

**Tuberculosis:** The NTP has been working on a TB HMIS module capable of capturing information on the set of indicators listed in the National Strategic Plan. Training and procurement of equipment is expected to take place in early 2020, pending a plan for improvements in data collection. An additional investment in M&E aims to follow up on the recommendations from the Epi Review 2019. Combined, these two activities account for 64% of the total budget for RSSH as it appears in the TB funding request for 2019–2022.

**Malaria:** The NMS will update the information system in SIGSA with four new modules: case management, entomology, IEC, and a dashboard analysis that will be developed with the Clinton Health Access Initiative's (CHAI's) support. The case management module will be ready for testing and be certified by SIGSA in the first months of 2020. The entomology HMIS module will be completed by the lab technicians in charge of microscopy and will produce epidemiological data. Full implementation of the modules depends on procurement of computers, software, and applications, which in turn depend on a diagnosis of information technology capabilities and required resources, to be performed by the MoH and CHAI. As the diagnosis takes place, the other HMIS modules will be developed.

**HIV:** The MoH proposed and presented an M&E plan in the second semester of 2019 (Plan para el Fortalecimiento del Monitoreo de la Respuesta a la Epidemia de VIH y su Sistema de Información) to address the current fragmentation and lack of interoperability of the M&E system at a total cost of US\$8,411,225. The budget was to be financed mainly with public funds (94%), by the Global Fund (3.4%) and the remainder by technical partners (PAHO, Centers for Disease Control and Prevention (CDC), and PrevenirSida). The M&E Plan was approved at the CCM Assembly on October 29, 2019, as requested by the Global Fund, however it has not yet been thoroughly developed or implemented. The plan has four objectives:

1. Design and implement the M&E system.
2. Improve the information system to accommodate dynamic strategies for addressing the HIV/AIDS epidemic.
3. Upgrade the information and communication resources of the MoH.
4. Disseminate information on the national response to sexually transmitted infections (STI) and HIV.

## 5.3 Sustainability, transition and co-financing (STC)

Guatemala is in the process of transitioning away from Global Fund investments for malaria and TB, with the government making some important advances toward STC. For example, it has assumed support for the procurement of ARVs, first- and second-line treatment for TB, and diagnostic supplies for HIV testing and GeneXpert MTB/RIF testing. There are several areas, however, that remain highly dependent on Global Fund investment:

- HIV preventive services provided by non-governmental organizations (NGOs) working with key populations. Although stakeholders discussed a proposal for the government to subcontract NGOs with expertise in reaching key populations, there is a law that precludes the government from subcontracting with NGOs to provide public services. This legal situation has generated uncertainty as to the sustainability of HIV prevention, advocacy and care services provided by civil society organizations after transitioning away from Global Fund support.
- For malaria, the government has not assumed responsibility for the procurement of LLINs, a key intervention for vector control. Failing to secure funding for this activity in the public sector could jeopardize malaria elimination. Nevertheless, the potential influx of funds from the Regional Malaria Elimination Initiative (RMEI) could temporarily mitigate the loss of funds for this intervention while Guatemala transitions away from Global Fund Support.

In addition, there are other challenges to long-term STC:

- The low effectiveness of Annual Operating Plans and the failure to execute the public budget, as discussed in the VfM section, is a barrier to sustainability.
- Ongoing political instability, including changes in disease program heads, has resulted in interruption of grant activities when key processes are dependent on government action. The information health system has been particularly affected by lack of will from the MoH to reform the current platform. For example, the adoption of DHIS2 by the HMIS stalled due to failure in coordination between the head of SIGSA and the MEASURE Evaluation partnership, which was spearheading the initiative.

Table 7 summarizes the status of various STC policy components for each of the three diseases.

*Table 7. Advances in STC policy in Guatemala, 2018-2019*

STC Policy Component	HIV	TB	Malaria
Transition preparedness assessment/ transition strategies and assessments	<ul style="list-style-type: none"> <li>• Transition not expected before 2024</li> </ul>	<ul style="list-style-type: none"> <li>• Will receive a transition grant at the conclusion of the current grant in June 2022. A transition plan will be developed during the current grant.</li> </ul>	<ul style="list-style-type: none"> <li>• Transition funding has been announced for 2020-2022; a transition plan in alignment with RMEI strategy is in development</li> </ul>
Progressive and accelerated financing by government	<ul style="list-style-type: none"> <li>• Progressive takeover of national response</li> <li>• Trend to increase allocations to national program</li> </ul>	<ul style="list-style-type: none"> <li>• High dependency on Global Fund</li> <li>• Trend to increase allocations to national program</li> </ul>	<ul style="list-style-type: none"> <li>• Progressive takeover of national response</li> <li>• Trend to increase allocations to national program</li> </ul>
Enhanced focus on KPs and structural barriers to health for vulnerable populations	<ul style="list-style-type: none"> <li>• Dependency on Global Fund and external partners to sustain preventive services for KPs</li> </ul>	<ul style="list-style-type: none"> <li>• Comprehensive prioritization based on multiple variables to reach vulnerable populations</li> </ul>	<ul style="list-style-type: none"> <li>• Micro stratification to reach vulnerable populations living in sites with active foci</li> </ul>
Enhanced focus of Global Fund grants on addressing transition gaps including contracting non-state actors and improvement of M&E and procurement systems	<ul style="list-style-type: none"> <li>• All grants have prioritized M&amp;E and HMIS and have achieved important advances despite structural deficiencies in the official information system of the MoH and lack of stakeholder buy-in.</li> <li>• Procurement continues to act as a bottleneck due to complex procedures required under the Law of Procurement for Goods and Services.</li> <li>• A government decree imposes limits on the contracting of non-state actors.</li> </ul>		

CCM Evolution, a step toward sustainability of CCM in Guatemala: Enrollment of the Guatemalan CCM in the “CCM Evolution” initiative was facilitated by the CT as a strategy to improve governance for all three diseases, with special attention to HIV given the broad participation from civil society. Despite these efforts, there is a perception that the CCM will not continue after the end of Global Fund investments, as expressed by national stakeholders and external partners.<sup>(15)</sup> The CCM appears to be functioning more effectively now, compared to 2017. As reported in 2017, the CCM was in disarray, with tangible discontent from most stakeholders. As part of the changes derived from the CCM Evolution initiative, the CCM was reduced in size from 23 to 11 members and received technical assistance to improve organization and efficiency. Observations of CCM meetings have shown more constructive participation by members of civil society organizations and increased involvement of the malaria and TB members, resulting in a more energetic and proactive group. The constant support from the Secretariat has improved the functionality of a Small Executive Committee, which has been having positive interactions among its members along with strong leadership and management. The oversight committee has also received considerable attention, including the addition of a local officer and an international consultant. Members have received additional training and communication between stakeholders has improved. A well-designed dashboard has been produced and will be incorporated into the CCM webpage; the dashboard tracks programmatic and financial data milestones for the three diseases.

The future of the CCM must be decided, but discussions held in 2019 with the presence of consultants from CCM Evolution indicate that when the Global Fund leaves, the CCM will not continue to exist in its present structure. In the discussions, stakeholders have mentioned that an alternative national organization might assume the leadership of the HIV national response, for example, the former CONASIDA, the National Multisectoral Commission of Organizations for Care and Prevention of STI/HIV/AIDS. Nevertheless, CONASIDA did not live up to its mandate and did not include malaria and TB. The discussion of the future of the CCM will continue, but at present its sustainability is uncertain.

## 5.4 Summary of grant implementation barriers and facilitators

A series of potential barriers and facilitators were identified across disease grants that both constrained and enabled timely, effective implementation of Global Fund investments (and indeed national disease programs more broadly).

*Table 8. Summary of barriers and facilitators to grant implementation.*

Possible barriers for grant implementation:
<p><b>1. Frequent turnover in MoH leadership</b></p> <ul style="list-style-type: none"> <li>• A frequent shift in MoH high-level authorities, heads of national programs and coordinators have caused instability and loss of continuity in program implementation plans.</li> </ul> <p><b>2. Bureaucratic government procurement processes:</b></p> <ul style="list-style-type: none"> <li>• There was a significant lag for the HIV PR to sign the necessary MoU with the MoH, which caused a 6-month delay in early implementation (2018–2019).</li> <li>• The current malaria grant period officially started in January 2019, but due to delays in signing the agreement and fulfilling precedent conditions, early implementation did not begin until August 2019 when funds were disbursed.</li> <li>• Despite early signing of the current TB grant, it took more than three months to access the first grant disbursement (November 19, 2018) due to administrative steps; nevertheless, early implementation started with selected activities.</li> </ul> <p><b>3. Gaps in formal guidelines and accountability measures:</b></p> <ul style="list-style-type: none"> <li>• There is a lack of formal written guidelines on who can provide malaria treatment, which has caused variations in norms across regions.</li> <li>• There is weak accountability for the low quality of sputum samples collected for screening of respiratory suspects.</li> </ul>

#### **4. Separate contracts for human rights activities may have contributed to implementation delays:**

- The terms of reference for human rights activities consultancies, which required approval by the Global Fund, took longer than anticipated and the tendering process was still ongoing as of March 2020. Delayed contracts will shorten the period of implementation.
- The lengthy approval process (requiring sign off by the Global Fund and partners) is constraining timely implementation of these activities.

#### **Possible facilitators for grant implementation:**

##### **1. Cross-cutting**

- The Global Fund support to Guatemala since 2005 has allowed upscale of lab and health infrastructure as well as building capacity in MoH human resources, introduction of new technologies and improvement in governance by creating the CCM to lead the response to the three epidemics.

##### **2. TB-specific**

- The TB supervision team is well-regarded as helpful, supportive, and dedicated staff; both at the central level and in decentralized units and have a high degree of acceptance by TB service users.
- The PCE has found no shortage of anti-TB medications and lab supplies, and there is an adequate coverage of labs, surpassing the WHO recommendation (1 lab per 100,000 inhabitants). Guatemala reports 1.7 labs per 100,000 inhabitants.
- Introduction of new technologies, such as GeneXpert MTB/RIF.

##### **3. Malaria-specific**

- Joint planning between key stakeholders aimed at malaria elimination – a model of Multisectoral cooperation (RMEI, MoH/National Malaria Subprogram, PAHO, CHAI, CCM [with representation of civil society], and private sector). Nevertheless, the CT has brought attention to duplication of actions in the field between external partners, encouraging better resource optimization.
- RMEI will provide funding to achieve malaria elimination as was informed by the health specialist from the Inter-American Development Bank in a meeting sponsored by PAHO to analyze the status of the malaria grant in May 2019 in Guatemala City. The Global Fund is a contributor to the regional initiative. The exact amount of the RMEI contribution to the country has not been officially disclosed at the time of drafting this report.

##### **4. HIV-specific**

- Completion of PR transition and achievement of key milestones in early implementation (SR selection, information system migration to DHIS, and tendering processes to contract research consultancies).
- Selection of SRs with experience and skills to work with KP and that had shown good performance in prior grants.
- PR has significant administrative experience based on a long-term existence (50 years in Central America and Panama), with an integrated financial system in place.
- Implementation by INCAP of a field-monitoring program to assess compliance of programs by SR and verify the quality of data reported. Although, from the perspective of the SRs, this activity is rendered ineffective.
- Good relationship of INCAP with MoH and external partners and overall good reputation of INCAP among national authorities and HIV stakeholders.

## **6. STAKEHOLDER ENGAGEMENT, USE OF FINDINGS AND RECOMMENDATIONS**

### **6.1 Stakeholder engagement and use of findings**

The CIESAR team has maintained frequent communication with stakeholders to ensure timely use of PCE findings and to support national programs, as feasible. Key examples of the PCE value added in Guatemala and use of findings are summarized below:

1. The PCE has raised visibility on issues related to low absorption and poor financial management of the Global Fund and government funds, which hinders response to the challenges of sustainability and efficient program implementation by MoH.
2. Revision to the district TB prioritization process: the TB program made a compound index and the PCE recommended adding six departments and removing two based on a revision of the index. The CT recommended that program use the revised prioritization for the current grant.

## 6.2 Summary of key recommendations

Table 9 summarizes key recommendations previously detailed in this report.

*Table 9. Summary of Key Recommendations*

<b>Tuberculosis</b>
<ul style="list-style-type: none"> <li>• The National Health Lab and the NTP should consider changing guidelines so that no person is diagnosed based <u>only</u> upon inadequate sputum specimens due to a substantial risk of missing positive cases. The consequences can be catastrophic for both the individual and the community. All specimens should undergo a careful visual inspection to reduce delays and the need for additional samples (the norm is two per person in consecutive days).</li> <li>• To improve the effectiveness of screening persons with respiratory symptoms, the NTP must ensure the consistency of counseling. This could take the form of providing a “cheat sheet” for health workers or the use of digital formats (i.e. instructive videos that can be displayed on mobile phones.) Counseling should address the younger population with age-appropriate methods as this group was found to have a higher percentage of inadequate specimens (70%-72% for ages 15-44 years old compared to 60%-63% for ages 45 and older.)</li> <li>• Take care to avoid the creation of perverse incentives that can result from setting performance targets for screening persons with respiratory symptoms.</li> <li>• Better integration of laboratory services and clinical services is critical.</li> <li>• Increase accountability for low quality sputum samples by tracking performance to specific sites.</li> </ul>
<b>Malaria</b>
<ul style="list-style-type: none"> <li>• The MoH should standardize guidelines for on-site antimalarial treatment provided by community volunteers to improve performance on starting treatment within 72 hours of diagnosis. Currently only volunteers in Escuintla are trained and authorized to start treatment.</li> <li>• Improve the linkage between CoVols and local health units (and microscopy centers) to ensure the functionality of referrals and counter-referrals.</li> <li>• The role of malaria volunteers is key for sustainability. The MoH should consider convening a task force to explore the best approach to training, equipping and provisioning non-monetary incentives for volunteers.</li> </ul>
<b>HIV</b>
<ul style="list-style-type: none"> <li>• Adoption of DHIS2 for HIV reporting has rendered positive results, but prompt action is required by the PR to address the issues experienced by SRs with the mobile application.</li> <li>• Despite advances in the coverage of prevention services to key populations, the MoH and PR face a challenge posed by persistently low positivity rates. SRs must tailor strategies to the new trends of the epidemic and move beyond the visible KP, currently reached by HIV services, to hidden populations who exhibit different behaviors (e.g. online dating.)</li> </ul>
<b>Financial</b>
<ul style="list-style-type: none"> <li>• Conduct more frequent and higher quality training for financial/administrative staff to facilitate more effective utilization of the Law for Procurement of Goods and Services.</li> <li>• In the long term, the Minister of Finance must seek to simplify the Law for Procurement of Goods and Services, which has become overly complex in an attempt to prevent corruption.</li> <li>• It is necessary to redesign the performance-based management system (SIGES) to align with NSPs and MoH Annual Operative Plans. If these frameworks are disconnected, the linkage between budget execution and programmatic activities will remain flawed and unreliable.</li> </ul>

## 7. DISSEMINATION

### 7.1 Dissemination activities conducted in 2019

CIESAR held a stakeholder workshop during the first quarter of 2019 and presented results and strategic considerations from the 2018–2019 Annual Country Report. More than 50 representatives participated in the workshop, including representatives from civil society. The workshop featured a lively and constructive debate and the conclusions were positively received. Stakeholders actively engaged in co-constructing recommendations that were incorporated in a Spanish final version of the report, which was circulated to stakeholders.

The 39th TERG Meeting was held in Antigua, Guatemala, which provided an opportunity to present advances and emerging findings from the Guatemala deep dive analyses.

As a platform for disseminating the description, objectives, activities, and findings of the Guatemala PCE, the CIESAR team actively upkeeps a PCE Web page (<https://epp.ciesar.org.gt/>) and publishes a PCE newsletter every two months. Thematic Global Fund video interviews are posted to the website, along with PCE presentations and reports.

### 7.2 Dissemination plans for 2020

CIESAR intended to host a stakeholder meeting on March 20, 2020 to disseminate and solicit feedback on findings from the draft annual report, and to further develop recommendations. This meeting had to be cancelled due to the COVID-19 crisis. In place of the dissemination meeting, CIESAR plans to publish and distribute English and Spanish language versions of the 2019 Annual Report in April 2020. Briefs on the TB and malaria deep dives will be posted on the CIESAR website and distributed to interested parties and stakeholders in digital and printed formats. CIESAR will explore additional opportunities to disseminate 2019 findings as they emerge.

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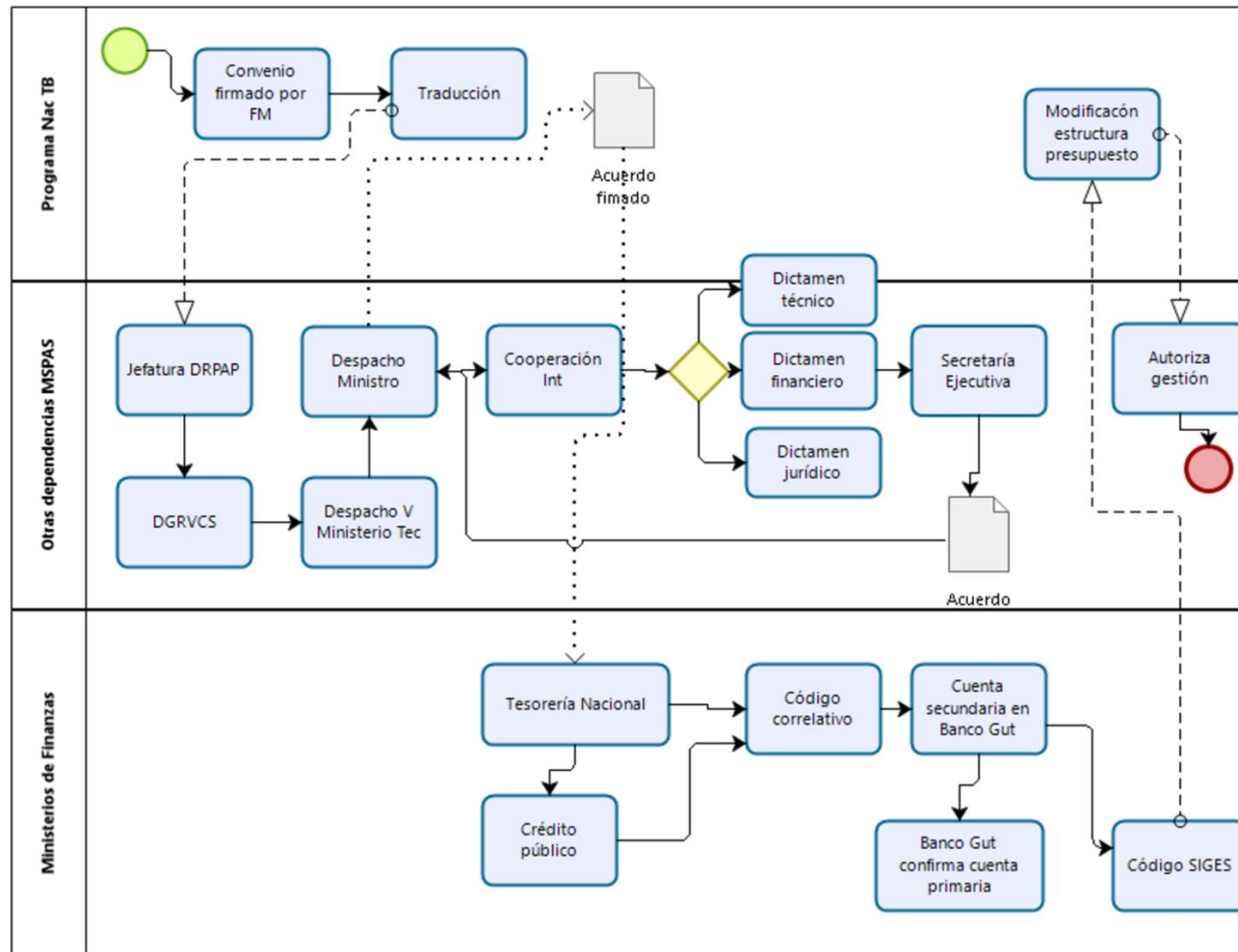
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# ANNEXES

1. Route for approval of Global Fund agreement (Spanish)
2. TB health system modeling, methodological annex
3. Impact evaluation of long-lasting insecticide-treated net (LLIN) distribution

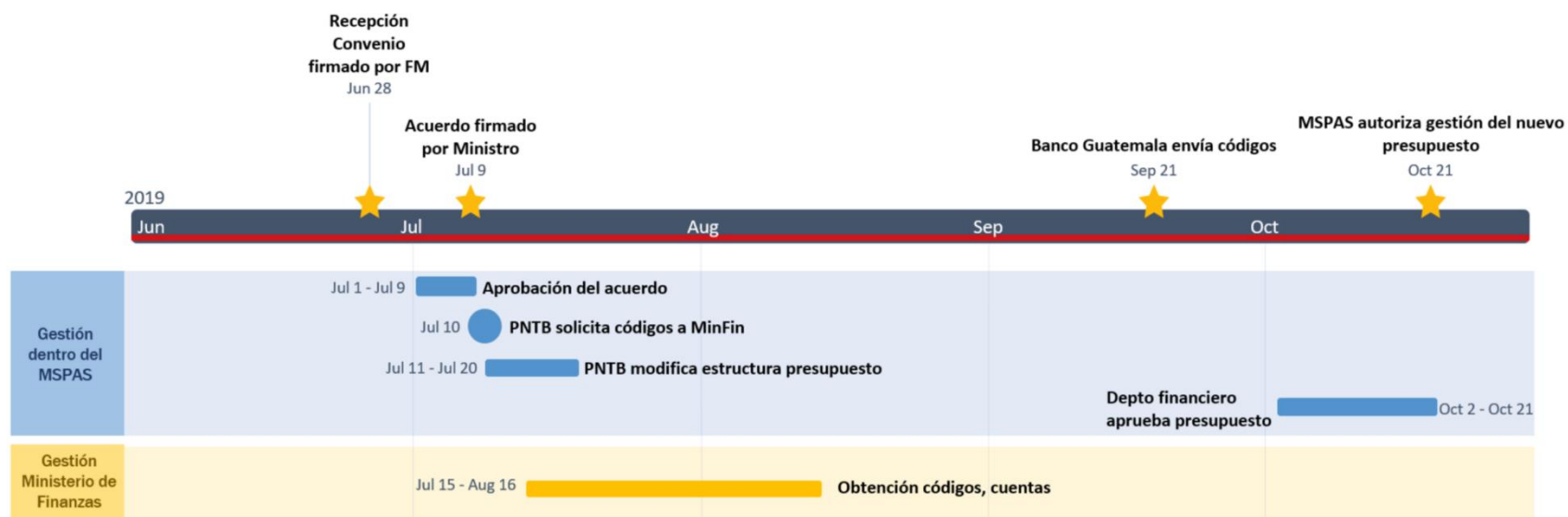


## Annex 1: Route for approval of Global Fund agreement



ruta de la  
aprobación del  
convenio y del  
presupuesto de la  
nueva subvención

programa  
nacional de TB



# PROCESO DE APROBACIÓN DE FONDOS DE NUEVA SUBVENCIÓN, PROGRAMA NACIONAL DE TB

## Annex 2: TB health system modeling, methodological annex

The PCE developed a novel evaluation tool referred to as a health systems model. While the concept of health systems modeling (HSM) has been established in the academic literature, it has not to our knowledge been applied as part of a prospective evaluation. The PCE has applied HSM in five disease-country scenarios to date to assess the following evaluation objectives:

- Identification of potential bottlenecks in program implementation
- Statistical measurement of technical efficiency, defined as activity or output per dollar
- Statistical measurement of implementation effectiveness, defined as the translation of outputs to outcomes
- Examination of subnational patterns in implementation effectiveness

The HSM approach adopted by the PCE was motivated by the prospective and use-focused nature of the PCE itself. As such, several important model limitations are described below. The purpose of HSM in the PCE is to serve as one of many tools to learn about how grants contribute to the national programs and to lend evidence-based guidance to other evaluation approaches. Thus, the HSM should not be seen as a stand-alone product, but rather a component of a larger evaluation product.

The PCE developed an HSM model in Guatemala to supplement the other PCE evaluation methodologies. TB was selected as the focal disease for the Guatemala HSM because of the robust data available to populate the model and the TB deep dives in 2018 and 2019 that provide mixed-methods analysis to complement the model findings.

### Results chain conceptual framework

Before applying any statistical models, the PCE first developed a theoretical model of how health systems in each country translate financial and other inputs into health outcomes. Using an interactive online tool, the PCE drew from its diverse group of in-country and international experts to diagram the “results chain”, or sequence of related pathways by which inputs become activities, activities become outputs, outputs become outcomes and outcomes become impact. This framework detailed both the theoretical constructs along each pathway as well as lists of potentially-measurable indicators within each construct. One framework was developed for each of the three diseases (HIV, TB and malaria) and was reviewed and validated by experts from all eight PCE country evaluation partners, by the five global evaluation partners and select members of the Global Fund. Results chain development was conducted in a series of in-person workshops and subsequent online collaboration.

The results chain implemented in the Guatemala HSM model is shown below in Figure 1. The results chain shown in this diagram is tailored from the multicountry TB results chain to include activities that are specific to the context of Global Fund activities in Guatemala, such as active case finding by outreach teams and TB screening efforts prioritized to persons residing in prisons. Additionally, only results chain indicators for which high-quality data are available are included in the HSM results chain.

### Data sources

Once the conceptual frameworks were developed, the PCE teams collated data from all available sources in order to populate as many elements of the results chain with empirical indicators as possible. A separate exercise was carried out in each country to map data sources to indicators in the results chains. The elements of the Guatemala TB HSM are defined in Table 1 below.

Figure 1 - Diagram of the Guatemala TB results chain implemented in the health systems model

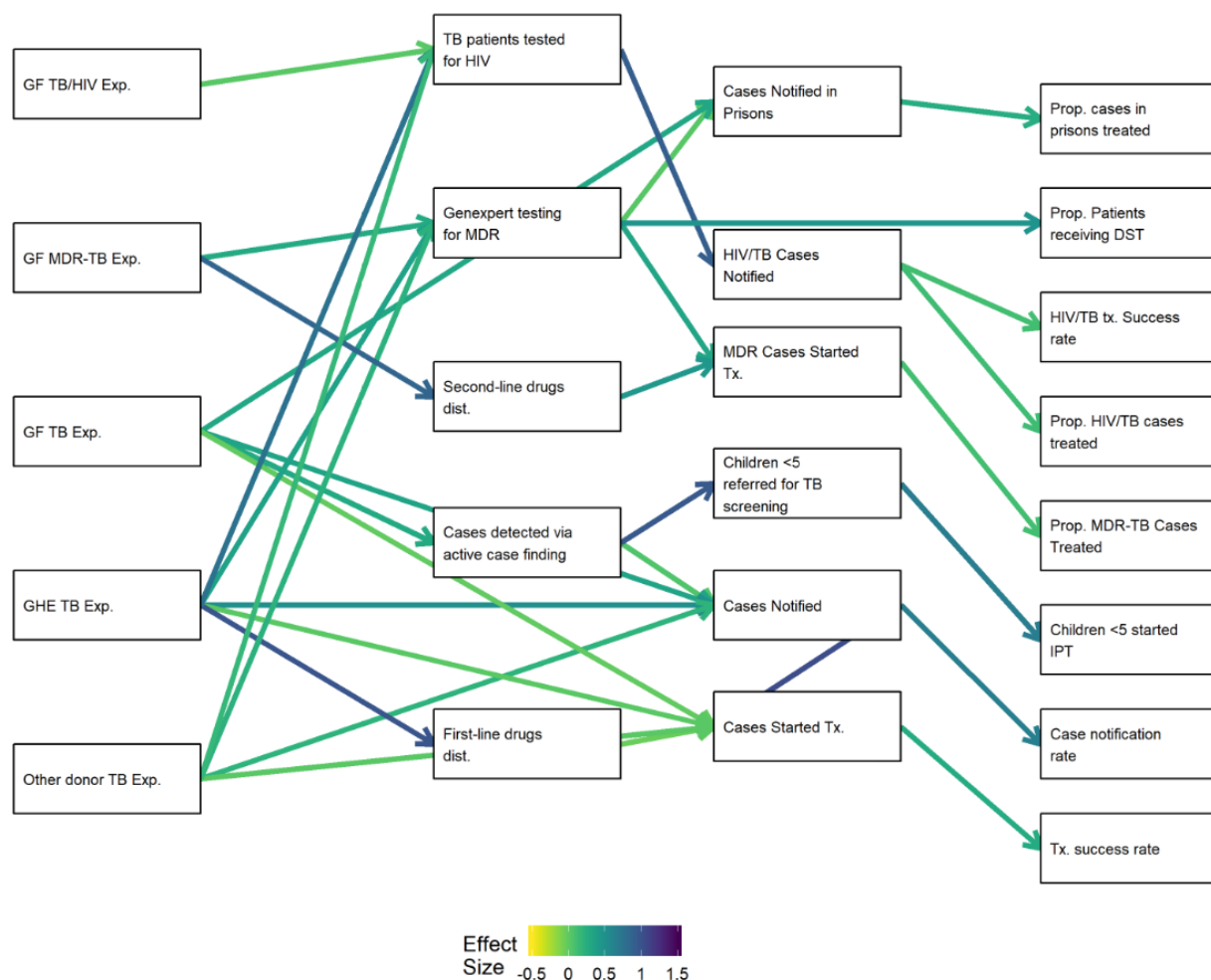


Figure 1 - Diagram of Guatemala TB results chain implemented in the health systems model. Columns ordered from left to right represent inputs, activities, outputs, and outcomes. Arrows between the boxes represent the modeled linkages between results chain indicators. Arrow colors indicate the effect size, which is a standardized representation of the regression coefficient for each modeled linkage. (Source: PCE analysis, see Table 1 for detailed information on data sources).

*Table 1 – Definitions of the elements and associated data sources that form the Guatemala TB health systems model*

Group	Label in diagram	Definition
Inputs	GF TB Exp.	Global Fund expenditure on tuberculosis, excluding MDR-TB and TB/HIV modules, cumulatively summed since 2009.* <sup>1</sup>
Inputs	GF MDR-TB Exp.	Global Fund expenditure on multidrug-resistant tuberculosis, cumulatively summed since 2009.* <sup>1</sup>
Inputs	GF TB/HIV Exp.	Global Fund expenditure on HIV/TB, cumulatively summed since 2009.* <sup>1</sup>
Inputs	GHE TB Exp.	Government health expenditure on tuberculosis, cumulatively summed since 2009. <sup>2</sup>
Inputs	Other DAH TB Exp.	Development assistance from other donors for tuberculosis, cumulatively summed since 2009. <sup>3</sup>
Activities	First-line drugs dist.	Drugs distributed which are first-line for the treatment of drug-susceptible TB (rifampicin, isoniazid, pyrazinamide, and ethambutol), cumulatively summed since 2009. <sup>4</sup>
Activities	Second-line drugs dist.	TB drugs distributed which are not in the first-line category above. This category includes drugs used for treatment of MDR-TB, cumulatively summed since 2009. <sup>4</sup>
Activities	Cases detected via ACF	Cases detected via active case finding by outreach workers, cumulatively summed since 2009 (activities did not start until 2017 for this variable.) <sup>5</sup>
Activities	Genexpert testing for MDR	Number of tuberculosis patients tested with Xpert MTB/RIF, cumulatively summed since 2009. <sup>5</sup>
Activities	TB patients tested for HIV	Number of tuberculosis patients tested for HIV, cumulatively summed since 2009. <sup>5</sup>
Outputs	Cases Started Tx.	Persons with tuberculosis started on treatment, not counting MDR-TB or HIV/TB, cumulatively summed since 2009. <sup>5</sup>
Outputs	Cases Notified	Number of persons with all forms of TB notified to surveillance, cumulatively summed since 2009. <sup>5</sup>
Outputs	Children <5 referred for TB screening	Children under 5 evaluated for TB screening through household contact investigation, cumulatively summed since 2009. <sup>5</sup>
Outputs	MDR Cases Started Tx.	Persons with multidrug-resistant TB started on treatment, cumulatively summed since 2009. <sup>5</sup>

Outputs	HIV/TB Cases Notified	Persons with HIV/TB co-infection notified to surveillance, cumulatively summed since 2009. <sup>5</sup>
Outputs	Cases Notified in Prisons	Persons who reside in prisons and have TB notified, cumulatively summed since 2009. <sup>6</sup>
Outcomes	Case notification rate	Persons notified with all forms of TB per 100,000 population, quarterly since 2009. <sup>5,6,7</sup>
Outcomes	Tx. success rate	Proportion of persons with drug-susceptible TB who complete treatment or have documentation of cure, quarterly since 2009. <sup>8</sup>
Outcomes	Prop. HIV/TB cases treated	Proportion of HIV/TB cases notified who are started on treatment, quarterly since 2009. <sup>8</sup>
Outcomes	HIV/TB tx. Success rate	Proportion of persons with HIV/TB co-infection who complete treatment or have documentation of cure, quarterly since 2009. <sup>8</sup>
Outcomes	Prop. MDR-TB Cases Treated	Proportion of MDR-TB cases notified who are started on treatment, quarterly since 2009. <sup>8</sup>
Outcomes	Children <5 started IPT	Children in contact with tuberculosis who started IPT, cumulatively summed since 2009. <sup>9</sup>
Outcomes	Prop. Patients receiving DST	Proportion of persons with TB who were tested by WHO approved rapid diagnostic test (Xpert MTB/RIF), quarterly since 2009. <sup>5</sup>
Outcomes	Prop. cases in prisons treated	Proportion of persons residing in prison who were found to have TB who were treated, quarterly since 2009. <sup>6</sup>

*\* Includes a proportional amount of RSSH funding from the TB grant. Investment in health system strengthening by the Global Fund was added to direct intervention investment to account for the sizable contribution of the Global Fund to RSSH. This was allocated proportionally to the size of each module-specific spend by quarter.*

*Data sources: 1) Global Fund Documentation; 2) SICOIN; 3) Financing Global Health; 4) National TB Program monthly drug distribution database; 5) National TB Program case notification database, 2012-2018; 6) National TB Program Prison database [PPL], 2016-2018; 7) WorldPop; 8) National TB Program treatment outcome database, 2014-2016; 9) National TB Program prophylaxis database*

Data sources on “Inputs” are from Global Fund documentation (Budgets, PU/DRs, and the Grant Operating System), SICOIN and the IHME Financing Global Health study.<sup>1</sup> Data on “Activities”, “Outputs” and “Outcomes” are from case notification, treatment outcome and drug distribution data maintained by the National TB program.<sup>2</sup> Population estimates are based on data from WorldPop.<sup>3</sup>

### Data processing

Several data processing steps were carried out in order to a) ensure standardization of indicators to enable modeling and b) correct for known data quality limitations.

All indicators were extracted from their original data system using standardized scripts written in the R statistical programming language to ensure reproducibility. In some cases, indicators were available at different levels of geographic and temporal aggregation (e.g., municipality versus department and per month versus per quarter). After identifying all available indicators, the PCE modeling team determined that the most granular level of aggregation that was possible for a majority of indicators for TB in Guatemala was by department and quarter-year. Where necessary, indicators were then aggregated or disaggregated to that level. To disaggregate by geography, indicators were divided in proportion to the subsequent indicator in the results chain. To disaggregate temporally, log-linear interpolation was used, with the available data assumed to reflect the midpoint of its respective time period.

All data were then systematically corrected for missing values and outliers. The PCE modeling team used a combination of visual examination and quantile regression to screen for extreme values, and a combination of the expectation-maximization algorithm and generalized linear models to impute missing values (including those created by outlier screening).

Data transformations were applied prior to fitting each model. All rate variables were log-transformed and all proportion variables were logit-transformed to ensure univariate-normal distributions. Count variables were cumulative-summed over their available time series (starting from the first date in their time series, even if other indicators were only available for a shorter time frame) to more accurately reflect financial processes according to theory. Six-month time lags were applied to each financial variable to ensure a more realistic temporal relationship between inputs and activities, and six-month leads were applied to TB treatment success variables to ensure a more realistic temporal relationship between treatment initiation and completion.

### Statistical methods

Structural equation modeling was selected as the primary statistical method. Following an initial trial of a structural equation-based model for TB in Guatemala, the PCE modeling team elected to proceed with a simpler modeling approach due to sample size constraints in the data and time constraints in the PCE work plan. To simplify the structural equation model, we used independent generalized linear models (GLM), fitting each equation in the overall system of equations separately.

In all, the model amounted to a system of 29 regression equations. For example, a single equation from the model might be:

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<sup>1</sup> Institute for Health Metrics and Evaluation (IHME). Financing Global Health Visualization. Seattle, WA; IHME, University of Washington, 2019; Available from <http://vizhub.healthdata.org/fgh/>

<sup>2</sup> These data were obtained by the PCE upon public request to the National TB Program.

<sup>3</sup> WorldPop. Southampton, UK; University of Southampton; Available from [www.worldpop.org](http://www.worldpop.org)

$$\text{Number of GeneXpert tests conducted}_{it} \sim \beta_1 * \text{Global Fund expenditure on case detection and diagnosis}_{it} + \beta_2 * \text{other donor expenditure on case detection and diagnosis}_{it} + \beta_3 * \text{Global Fund expenditure on MDR TB}_{it} + \beta_4 * \text{other donor expenditure on MDR TB}_{it}$$

Where the above indicators are measured for each department (i) and quarter (t). Regression coefficients ( $\beta$ ) were expressed on a z-standardized scale, thereby reflecting the expected standard deviation change in a particular outcome variable associated with a one standard deviation change in a particular explanatory variable.

Sensitivity analyses were conducted to explore the effect of using simultaneous versus unrelated equations, and the effect of including or excluding completeness and population control variables. Sensitivity analyses were conducted to explore the effect of including RSSH as an additive effect versus an interaction term.

### Model findings and interpretation

The color of each arrow in the diagram shown in the Figure 1 represents an effect size corresponding to the standardized regression coefficient from the modeled linkage. Darker blue colors indicate larger effect sizes and lighter green colors indicate smaller effect sizes. Larger effect sizes reflect linked indicators that are changing in the same direction (e.g., both increasing or both decreasing) over time in similar subnational geographies.

The effect sizes shown in the HSM correspond to several relationships that were anticipated by the PCE. For example, the large effect sizes between the government health expenditure and first-line drugs distributed versus Global Fund expenditure and second-line drugs distributed reflects the relevant funding streams for these activities. Similarly, there were strong spatial and temporal relationships (large effect size) between persons notified with TB and persons started on TB treatment.

The PCE used the HSM to trace linkages between indicators in the results chain and explore pathways. One pathway of interest corresponded to the PCE deep dive into active case detection by outreach worker teams with Global Fund funding. This pathway shows large effect sizes between active case detection activities and the number of child household contacts receiving TB screening (output) and TB preventive therapy with isoniazid (outcome). This positive finding shows close linkages over space and time in this pathway. In contrast, the case detection activity has a small effect size with overall TB case notifications. The team hypothesizes that this is because many epidemiological factors, activities, and funding inputs affect patterns in TB case notifications.

### Model limitations

As mentioned above, there are several methodological limitations to the HSM approach used in the PCE.

**Static model:** The modeling approach selected for this analysis does not incorporate dynamic effects of any explanatory variable on its subsequent outcome variable. In other words, each coefficient is estimated as an average across the time series of available data and is assumed to be constant over time. In addition, no features were added to the model to account for the reality of declining marginal returns associated with approaching saturated coverage of certain interventions.

**Generalized linear model:** Due to sample size and time constraints, the HSM was simplified by using GLM instead of the more statistically-robust structural equation modeling. This means that changes to one variable can only affect coefficients in the single equation in which that variable is fit, and cannot propagate through the rest of the results chain. It also limits our ability to include non-directional correlations between variables in separate equations.



**Simplification of conceptual framework:** As described above, the PCE team developed a theoretical conceptual framework of the results chain, detailing all relevant constructs and indicators involved in national programs. Due to data availability, and for the purposes of feasibly developing a model in a timely manner, many of the indicators in the theoretical model were not included in the statistical model. In some instances, this may have led to important gaps between adjacent indicators, leaving some pathways only superficially-represented

**Uniform lagged effects:** As described above, the PCE implemented 6-month lags between expenditure and activities/outputs, and 6-month lags between outcomes and treatment success rates (where relevant). The purpose of this was to more realistically reflect the time delays inherent to national programs and treatment regimens, but it was necessarily a simplification. In reality, there may be variable lags depending on the intervention, geography or other factors, but this model assumed constant lag terms throughout.

**Level of disaggregation:** Most of the financial input variables have been aggregated for the purposes of feasibility and interpretability of the model results. For example, all MDR-TB expenditures were summed together to form a single variable in the model, when in reality this “module” in the Global Fund and other budgets is comprised of many separate activities. Furthermore, data availability constraints led us to include variables for government health expenditure and other donor expenditure that were not disaggregated by intervention at all, instead reflecting overall spending on TB.

**Sociodemographic confounding:** Many factors from outside of the health system (health behavior, access to services, perceptions, economic conditions etc.) are not reflected in this model. While many linkages, such as the linkage between supply chain shipment of a commodity and in-facility utilization of it, may be assumed to be unaffected by changes in sociodemographic variables, others, such as the linkage between coverage of services and changes in burden of disease, are inarguably confounded. This limits our ability to reliably measure those aspects of the results chain. Importantly this pertains to the final linkage between outcomes and impact in the results chain. Without further theory-development, data and modeling, the PCE elected to exclude this final linkage from the model.

## Annex 3: Impact evaluation of long-lasting insecticide-treated net (LLIN) distribution

Long-lasting insecticide-treated nets (LLINs) are a core prevention tool to fight the malaria epidemic. The Global Technical Strategy for malaria 2016–2030, developed by WHO, recommends the distribution of LLIN and maintaining full coverage in endemic areas [1]. These were introduced in Guatemala in 2005–2006 along with other interventions by the Global Fund through World Vision. Before this, the malaria notification rate in Guatemala had a decreasing trend and after World Vision grant implementation, a larger decrease was observed [2]. The impact that may be attributed to LLIN distribution during the years of introduction is evidently high. However, in recent years, LLINs have shown a more modest impact on the epidemic, meanwhile other factors such as diagnosis and treatment services have played a major role in decreasing the number of cases. Here we propose a generalized linear mixed model (GLMM) to evaluate the impact of LLIN distribution over the count of malaria notification cases in Guatemala between years 2015–2018.

Exposure to LLIN was modeled as a weighted cumulative exposure (WCE) function with an exponential decay as described in Abrahamowicz et al, 2006 [3]. In other words, we constructed an estimate of the number of LLIN remaining in circulation at any given time, by measuring the cumulative number of LLIN that had been distributed up to that point, while simultaneously accounting for their expected lifespan. In this exponential decay function, the half-life of LLIN was set to 3 years. This exposure variable can be interpreted as the number of unexpired available LLIN among the population.

The notification rate was used as the dependent variable and exogenous variables included indoor residual spraying (IRS), treatment to breeding sites and the weighted cumulative exposure to LLIN. An AR(1) term was included to account for unconsidered confounding factors, time trends and the dynamics of the epidemic. After testing for possible lagged effects of the WCE term, a term with one semester lag was selected.

The IRS and breeding site treatment data is available from 2015 to 2018 by month and municipality and was obtained by making a formal public information access request to the Ministry of Health. These two variables have been aggregated by semester and department. Notifications are available from 2015 to 2018 and LLIN distribution data is available from 2012 to June 2018. Notifications and LLIN distribution data have been aggregated by semester and department as well. Because these four variables are counts of events, they have been log-transformed in the GLMM. Thanks to LLIN data availability since 2012, the weighted cumulative exposure is correctly estimated for years 2015 to 2018.

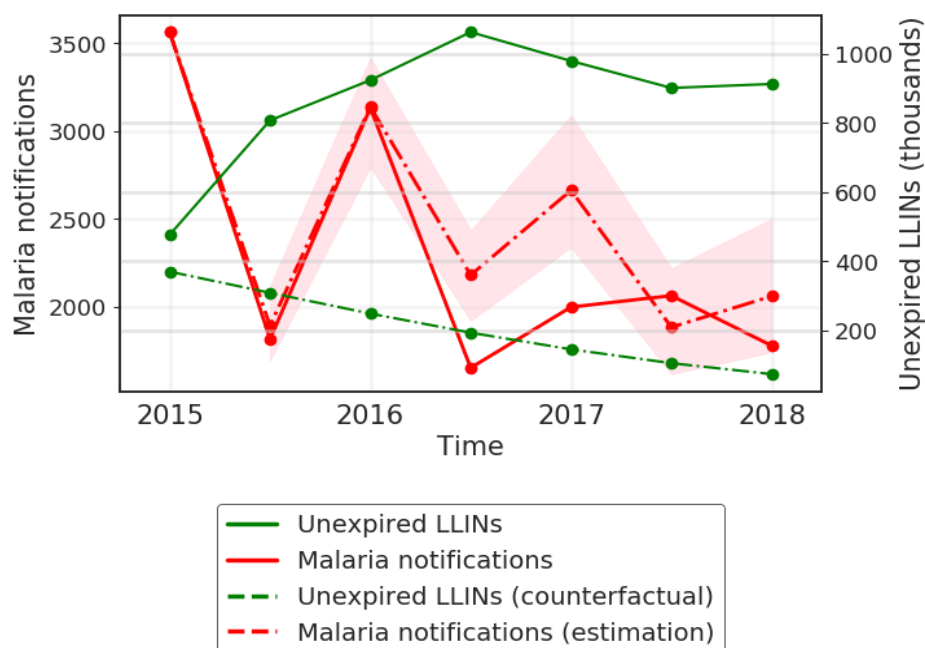
Assessment of data quality for both case notifications and LLIN was deemed high-quality, as these data sources are maintained by the malaria subprogram. However, IRS and breeding site treatment data are known to be low quality and are not guaranteed to be complete due to lack of data quality assurance of the official information systems.

The model included statistical terms known as random effects in order to account for variability between locations, rendering the model more robust. These random effects included a random intercept, a random slope of the autoregressive term and random terms for the alternative interventions (IRS and breeding sites treatment), all grouped at the department level.

Finally, regression results were expressed using counterfactual analysis to aid interpretability. We examined the counterfactual scenario that no further LLIN were distributed after 2015.

Figure 1 shows the observed scenario between 2015 and the first semester of 2018 (continuous lines) and a hypothetical scenario (counterfactual) of what would happen if LLIN stopped being distributed since 2015 (dotted lines). The results indicate that the weighted cumulative exposure decreases and the estimation of malaria notification cases departs from the observed value. During the three years of the estimation, the model estimates 1,412 (CI: -331 to 3,346) cases were prevented because of LLIN redistribution.

Figure 1: Malaria notifications and unexpired LLIN, observed and counterfactual, 2015–2018



Source: CIESAR analysis of MoH and NMS data, 2019

Data quality is a concern and including more years of data could improve the model power. Despite this, the model shows a confirmatory result for the importance of LLIN in fighting the malaria epidemic. Guatemala health authorities must ensure the sustainability of LLIN distribution strategies.

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