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MAKING THE CASE FOR INCREASED INVESTMENT IN TUBERCULOSIS DETECTION AND CONTROL IN CAMBODIA

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HP+
HEALTH POLICY PLUS

JULY 2020

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Abbreviations

C-DOTS	community directly observed treatment–short-course
CENAT	National Center for Tuberculosis and Leprosy Control
Global Fund	Global Fund to Fight AIDS, Tuberculosis and Malaria
HIV	human immunodeficiency virus
HP+	Health Policy Plus
MDR-TB	multi-drug resistant tuberculosis
TIME	TB Impact Model and Estimates
TB	tuberculosis
USAID	U.S. Agency for International Development
WHO	World Health Organization

Executive Summary

Cambodia's National Center for Tuberculosis and Leprosy Control (CENAT) has made significant strides in tuberculosis (TB) case detection and treatment, contributing to an estimated 55 percent reduction in TB-related mortality and 43 percent reduction in TB-related incidence from 2000 to 2017. However, Cambodia remains a high-burden country, the majority of TB funding comes from external sources, and about two in five patients experience TB-related costs that exceed 20 percent of their household income. CENAT has prioritized strategies such as scaling up active case finding and use of GeneXpert to overcome these challenges and reduce incidence by 80 percent from 2016 to 2030.

Additional government investment in TB is needed to achieve program targets, improve equity in access to TB services, and reduce the financial burden on households for seeking TB services. Estimates of the resources required for increasing coverage and effectiveness of TB services, as well as estimates on health and household economic impacts, is needed to negotiate budgetary allocations for TB. To support CENAT, the Health Policy Plus (HP+) project, funded by the U.S. Agency for International Development, set out to answer the following questions:

- What are the financial resource requirements and funding available from 2019 to 2025 for scaling up TB prevention, case detection, and treatment?
- What are the health benefits in terms of reduced incidence and mortality from scaling up TB services from 2019 to 2025?
- How will improved health outcomes from scaling up TB services affect household spending on direct and indirect costs associated with TB from 2019 to 2025?

Methods

CENAT worked closely with HP+ to define four scenarios for analysis, provide input data, and validate preliminary results. The four scenarios include a base scenario that assumes constant coverage of TB services, a scale-up scenario that increases coverage of screening and preventive therapy, a diagnostic improvement scenario that improves diagnostic accuracy, and an ambitious scenario that assumes more aggressive screening to meet national TB targets.

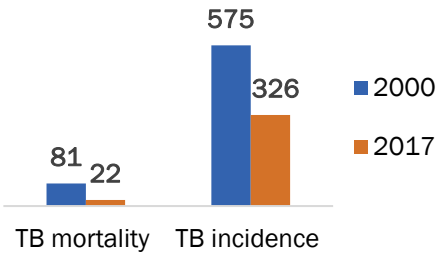
HP+ used the TB Impact Model and Estimates (TIME), an epidemiological transmission model, to estimate the number of people to receive TB services each year and the health impacts of scaling up TB prevention, detection, and treatment. Outputs from TIME and other data were used to estimate TB program resource requirements and direct and indirect TB costs borne by individuals.

Results

Total resource requirements from 2019 to 2025 range from US$71 million for the base scenario to US$185 million for the ambitious scenario. Across all scenarios except for the base scenario, projected levels of funding are insufficient to cover TB-specific costs; for example, the country faces nearly a US$91 million funding gap from 2019 to 2025 under the most ambitious scenario.

Cambodia's TB Investment Case: Resource Needs and Impacts of Meeting Targets under the Ambitious Scenario

TB Burden (rate per 100,000 population)



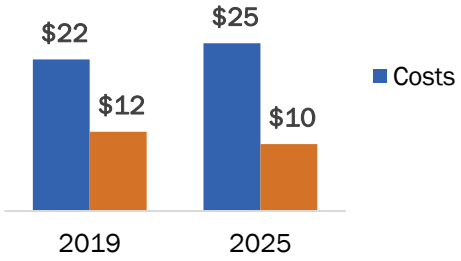
13th highest incidence rate globally in 2017*

66% of 2018 TB funding came from external

2 in 5 TB patients experience catastrophic TB-related costs**

Cambodia has significantly reduced TB incidence and mortality, yet remains a high-burden country with financial and program challenges

Investment Need (USD millions)



$185 million is needed from 2019 to 2025 to reach program targets†

The TB program faces a **$91 million** funding gap from 2019 to 2025 given likely declines in external financing

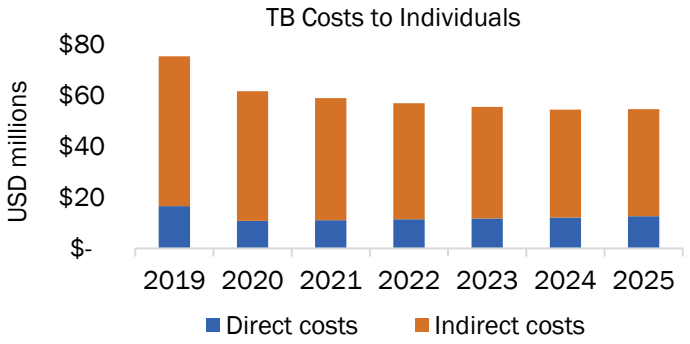
Health and Economic Benefits

Filling the funding gap would avert:

89,099
TB infections

39,515
TB-related deaths

(from 2019 to 2025)



Improved health would decrease patient TB costs by **27%** from 2019 to 2025

By 2025, **1,127** (**8%**) fewer individuals would experience catastrophic TB costs compared to a base scenario

* WHO, 2018
** Morishita et al., 2016; catastrophic costs are defined as direct and indirect costs accounting for at least 20 percent of household income.
† Cost projections are based on the ambitious scenario. Costs exclude human resources for health salary costs that are not paid for by CENAT.

Results from the TIME application show that scaling up TB services while improving diagnostic testing will reduce TB incidence and TB-related mortality. Scaling up pagoda-based screening nationwide is estimated to have the largest health impact compared to any other TB control intervention analyzed. Under the ambitious scenario, TB incidence and TB-related mortality is estimated to decrease by 33 percent and 46 percent, respectively, from 2019 to 2025.

Scaling up and improving TB services in Cambodia not only reduces adverse health outcomes but also the economic burden on households from TB. Under the ambitious scenario, costs borne by individuals are estimated to decrease by 27 percent from 2019 to 2015. Compared to the base scenario, individuals would spend an estimated 42 percent less on direct and indirect costs associated with TB and 1,127 (8 percent) fewer individuals would experience catastrophic TB costs in 2025 under this scenario.

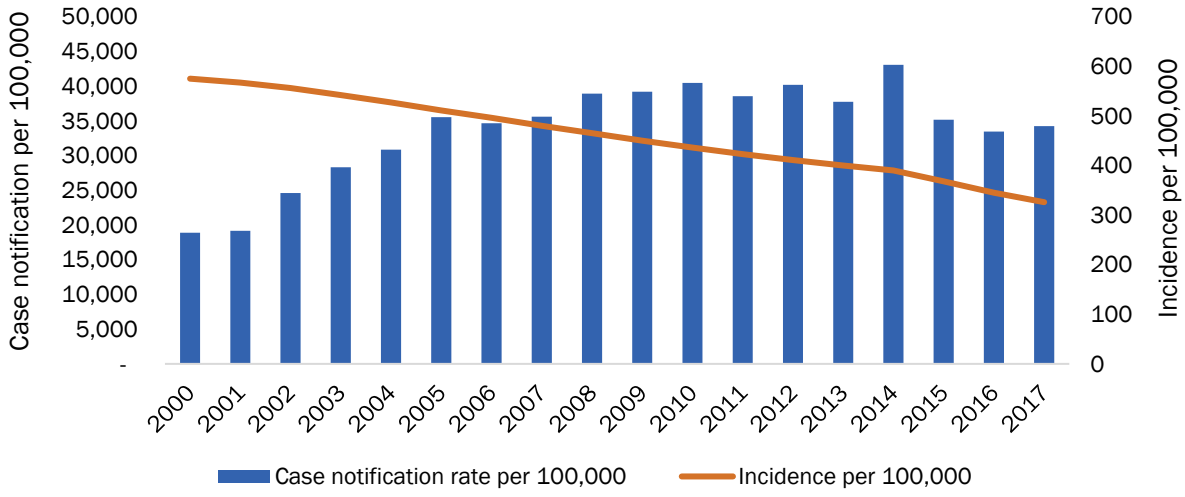
Discussion

The Royal Government of Cambodia needs to invest more in TB prevention, case detection, and treatment to reduce the burden of TB, achieve national TB targets by 2030, and reduce the financial burden of TB on households. The recent integration of TB services into the Health Equity Fund presents an opportunity for improved financial protection among poor and vulnerable populations with TB. Still, CENAT needs to identify more sustainable financing options for TB, carry out sustained and systematic advocacy efforts, and explore opportunities to expand financial protection mechanisms for TB patients. This should include advocating for inclusion of TB services in social health insurance benefits packages, designing new payment mechanisms that cover some of the significant indirect costs borne by TB patients, scaling up service delivery models (e.g., active case finding and community directly observed treatment–short-course) that reduce the financial burden to patients due to reduced travel to a facility for testing or treatment, and spreading awareness of reimbursable TB costs within high-risk communities.

Introduction

Cambodia has made significant strides in tuberculosis (TB) case detection and treatment through the introduction and scale-up of active case finding, contact tracing, community directly observed treatment–short course (C-DOTS), use of GeneXpert, and other interventions over the last two decades (CENAT, 2014). Treatment success remains very high, at 94 percent for all new and relapse cases, and the country has low prevalence of multi-drug resistant TB (MDR-TB) and co-morbidity with HIV. These programmatic achievements have contributed to an estimated 55 percent reduction in TB-related mortality and 43 percent reduction in TB-related incidence from 2000 to 2017 (see Figure 1) (WHO, 2018).

Figure 1. Trends in TB Case Notification and Incidence in Cambodia



Source: WHO, 2018

Despite this progress, the country still has one of the highest burdens of TB in the world. The TB incidence rate in Cambodia was estimated to be 326 per 100,000 people in 2017, which is 2.5 times the global average and 1.4 times the rate for Southeast Asia (WHO, 2018). The TB program also still relies heavily on external funding support from the Global Fund to Fight AIDS, Tuberculosis and Malaria and the U.S. Agency for International Development (USAID)—approximately 66 percent of the TB program's 2018 budget was funded by external sources (WHO, 2018). Similar to other countries, TB disproportionately affects the poor in Cambodia and places a significant financial burden on households. Direct and indirect costs of TB exceed 20 percent of household income for about two in five TB patients in Cambodia (Morishita et al., 2016).

The National Center for Tuberculosis and Leprosy Control (CENAT) seeks to overcome these challenges and rapidly scale-up services to meet ambitious program targets, aiming to reduce TB incidence by 80 percent (to 125 per 100,000 people) by 2030. Strategies to achieve this target include scaling up coverage of innovative case detection approaches, increasing use of diagnostic tools that are more sensitive and specific, increasing integration of TB into the health system, and improving financial protection for TB patients.

Additional government investment in TB is needed to scale up TB prevention, case detection and treatment services, improve equity in access to TB services, and reduce the financial

burden on households for seeking TB services. However, there is a lack of detailed analyses of the resources required for increasing coverage and effectiveness of TB services, as well as estimates on health and household economic impacts. This evidence is needed for CENAT to make the case to the Ministry of Health to increase investment in TB, which the Ministry of Health can then use in budget negotiations with the Ministry of Economy and Finance. To support CENAT, the USAID-funded Health Policy Plus (HP+) project supported CENAT to answer the following questions:

- What are the financial resource requirements and funding available from 2019 to 2025 for scaling up TB prevention, case detection, and treatment?
- What are the health benefits in terms of reduced incidence and mortality from scaling up TB services from 2019 to 2025?
- How will improved health outcomes from scaling up TB services affect household spending on direct and indirect costs associated with TB from 2019 to 2025?

This report provides a summary of the methodology and key findings from these analyses.

Methods

HP+ worked closely with technical experts from CENAT and the USAID-funded Challenge TB project to develop scenarios for the analysis, collect data inputs, and interpret modeling results. The analysis began in June 2018, when HP+ hosted a four-day workshop in Phnom Penh to train CENAT and other TB stakeholders on the TB investment case methodology, decide on scenarios, and begin reviewing data parameters and data needs. Following the training, HP+ followed up with CENAT to fill data gaps, review assumptions, and validate preliminary findings. Results were finalized in May 2019.

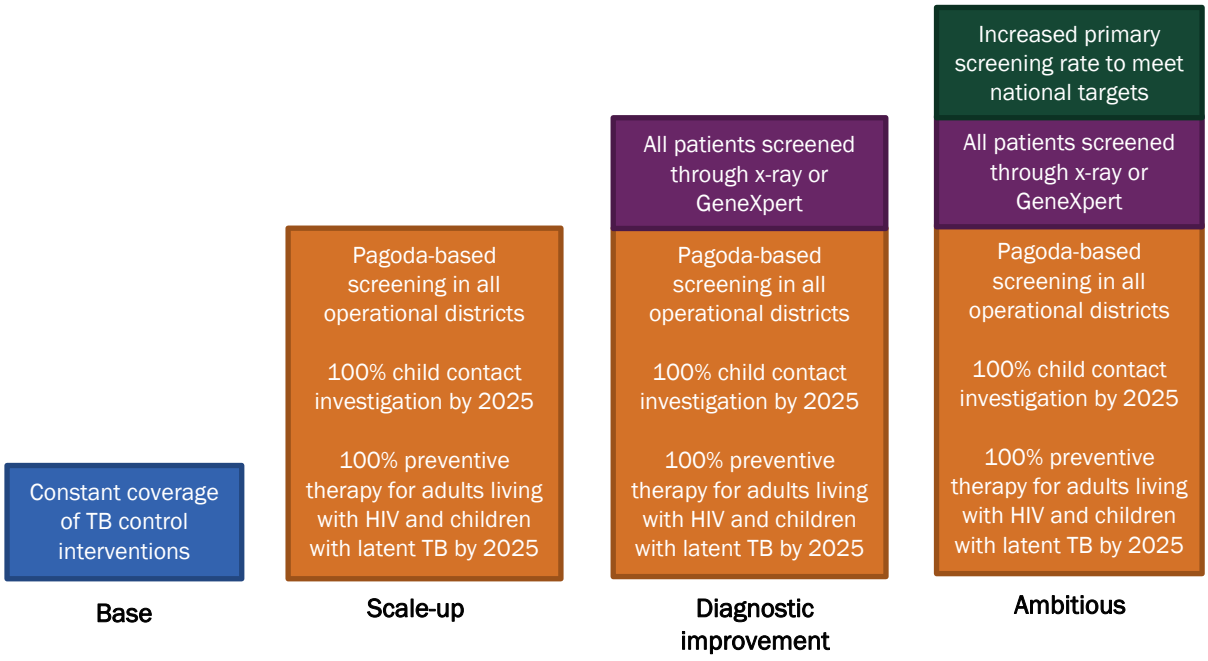
Scenarios

CENAT decided to analyze the costs and impacts of scaling up TB services across four scenarios that build upon one another (see Figure 2). The base scenario assumes constant coverage of existing interventions, representing a status quo to compare with other scenarios. The scale-up scenario assumes scale up of three interventions including expanding pagoda-based screening (where health workers visit pagodas to check community members for TB symptoms and collect sputum samples) from 46 operational districts to all 94 operational districts. This is estimated to increase the primary screening rate from 100 percent in 2017 to 150 percent in 2025.[1] Child contact investigation and preventive therapy for adults living with HIV and children with latent TB are also scaled up under this scenario—by 2025, 100 percent of those in need of each intervention are estimated to receive it. The diagnostic improvement scenario has the same assumptions as the scale-up scenario, except the only diagnostics used to screen patients for TB are x-ray and GeneXpert by 2020. Finally, the ambitious scenario has the same assumptions as the diagnostic improvement

[1] In the TB Impact Model and Estimates, the primary screening rate is the rate at which smear-positive cases are screened for TB. It is expressed in units of percent for convenience but does not represent coverage or proportion of cases screened. Roughly, neglecting competing rates of mortality and self-cure, the screening rate can be interpreted as the inverse of the average time in years from onset of active disease until screening. A screening rate of 100 percent corresponds to an average time of 1 year, 50 percent to 2 years, and 200 percent to 6 months. In practice, typical values range from 40 percent for low historical screening up to 400 percent for intense modern screening.

scenario, except there is a more ambitious plan for scaling up case detection so that the screening rate increases to 165 percent by 2025. This scenario was designed to identify what is necessary for the country to meet its national incidence and mortality targets.

Figure 2. TB Program Scenarios



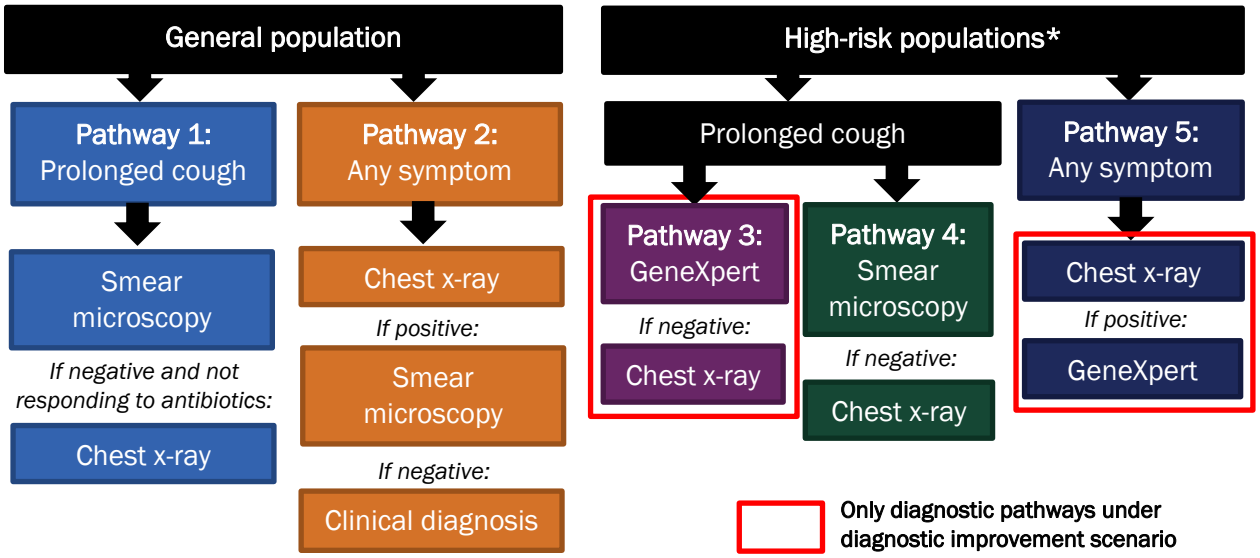
Estimating Number of People Reached and TB Health Impacts

HP+ used the TB Impact Model and Estimates (TIME), an epidemiological transmission model available within the open-source Spectrum suite of policy models, to estimate the number of people to receive TB services each year and the health impacts of scaling up TB prevention, detection, and treatment (Houben et al., 2016). Model inputs include epidemiological and programmatic data on TB control. For some parameters, default country-specific data are available from the World Health Organization's (WHO's) Global TB Programme. Outputs include the number of people to be screened, notified, and put on treatment, as well as TB-related incidence, prevalence, and mortality.

TIME is a dynamic model linked to other models in Spectrum, such as DemProj, which includes demographic projections based on the latest estimates published by the United Nation's Population Division, and the AIDS Impact Model, which estimates the number of people living with HIV and on antiretroviral therapy. TIME reflects key aspects of the various stages of TB including primary and latent infection, reinfection, and reactivation of latent TB. Smear positivity, negativity, and smear conversion are explicitly handled in the model. The model also accounts for the characteristics of pediatric TB, treatment history, and drug resistance. Houben et al., 2016 provides additional information on TIME.

In calibrating TIME for Cambodia, HP+ used TIME's Diagnostic Algorithm Tool to characterize case finding. This tool allows users to define a set of diagnostic pathways and change the relative proportion of the population tested by each pathway over time. The diagnostic pathways reflect CENAT's diagnostic algorithm guidance, which considers differences in population group, symptoms, and availability of GeneXpert in determining which diagnostic test to use (see Figure 3). For the diagnostic improvement scenario, it is assumed that all people are diagnosed through the third and fifth pathways.

Figure 3. TB Diagnostic Algorithms in Cambodia



Source: CENAT, 2018.
*High-risk populations include elderly people, people in contact with pulmonary smear-positive TB patients, people living with HIV, people with diabetes, and prisoners.

For other model parameters, including baseline coverage of TB control interventions, HP+ used a combination of default data from the WHO's Global TB Programme and CENAT data. Select baseline parameters and intervention coverages are shown in Box 1.

Estimating Household Economic Impacts

HP+ developed an Excel-based model to estimate the direct and indirect costs borne by households for TB testing and treatment services. Direct costs refer to both medical and non-medical costs and indirect costs refer to lost wages and dissaving as a result of TB (see Box 2) (Morishita et al., 2016). Although TB services are provided free of charge in Cambodia, some patients still sometimes pay out-of-pocket expenses for medical care.

As CENAT scales up TB prevention, case detection, and treatment—which reduces the burden of TB in Cambodia—households are expected to spend less on TB services (see Figure 4). Active case finding approaches, which include contact investigation and pagoda-based screening, have the potential to detect cases sooner while also reducing the

Box 1. Baseline TIME parameters

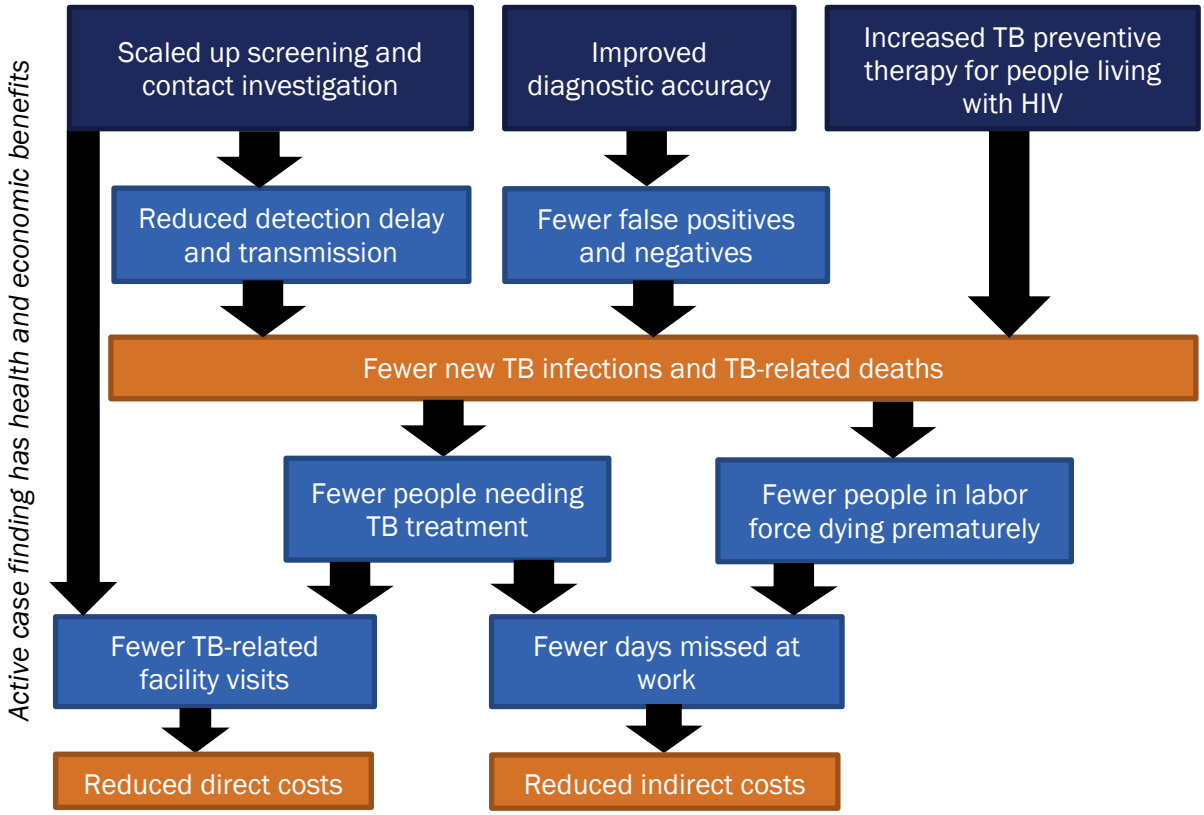
- Screening rate: 100%
- Child contact investigation coverage: 25%
- Preventive therapy coverage (people living with HIV): 5%
- Preventive therapy coverage (children): 60%

Box 2. TB Costs Borne by Patients

- **Direct medical**: Out of pocket expenses for facility administration, lab tests, x-rays, drugs, or hospitalization.
- **Direct non-medical**: Out of pocket expenses for patient and caregiver food, supplements, transportation, accommodation, and interest payments on borrowed money.
- **Indirect**: Patient and caregiver lost income and value lost due to sold property.

number of visits to a facility for diagnostic testing, which may reduce out-of-pocket expenses. A 2016 study in Cambodia, by Morishita et al., found that out-of-pocket expenses were lower among patients reached through active compared with passive case finding.

Figure 4. Potential Pathways to Reduce TB Costs Incurred by Households



Model inputs include disease burden and program data from TIME (e.g., number of notifications and TB-related deaths per year by type of TB) and secondary data on TB costs, household spending on TB, household income of TB patients, and lost productivity from TB (Morishita et al., 2016). Outputs include total annual household spending on TB-related costs and number of households experiencing catastrophic TB costs.

The model considers differences in household economic impacts by type of TB, since MDR-TB costs more to patients than other types of TB due to the intensity of treatment. The model also considers differences in costs borne by patients identified through active versus passive case finding, as those tested and treated for TB through active case finding approaches (e.g., pagoda-based screening) spend less than those tested and treated through passive case finding. The model considers the impacts of those who do not seek services and either self-cure or pass away. Lastly, the model accounts for reductions in costs borne by TB patients due to patient subsidies provided by CENAT for poor adults and children and MDR-TB patients.

The model does not estimate the cumulative cost due to premature death from TB or end-of-life costs borne by households, such as funeral expenses. It also does not measure the impact of recent integration of TB services into the Health Equity Fund's benefits package, which would allow the Ministry of Health to reimburse health facilities for TB services accessed by fund beneficiaries and would reimburse transportation and cost for referrals to hospitals for poor patients. It is unclear at this time the amount that would be reimbursed under the Health Equity Fund and how this may replace or supplement CENAT subsidies.

Estimating TB Program Resource Requirements

Across each of the four scenarios, HP+ estimated the cost of health worker time, TB diagnostic and treatment commodities, patient transport and other subsidies, and program management. Program management includes the cost of equipment procurement, support activities, and management staff. Many of the data inputs for the cost analysis came from the costed National Strategic Plan 2014-2020 and were revised based on consultations with CENAT staff. Costs are presented in constant U.S. dollars.

HP+ estimated health worker costs for TB based on data from a 2016 application of the OneHealth Tool in Cambodia (Cantelmo et al., 2018). The OneHealth Tool, a national strategic planning tool used to cost health systems that is integrated into the Spectrum suite of models, derives health worker costs for delivering TB interventions based on the amount of time each type of health worker spends with a patient in a year and average salaries by health worker. Total health worker costs were based on TIME outputs of how many people are projected to receive each TB intervention annually.

CENAT provided data on commodity costs for select diagnostic tests, first- and second-line treatment, and preventive therapy. HP+ then derived average unit costs per person reached for each intervention based on the percentage of patients who use each commodity, the quantity needed per person per year, and commodity prices. In some cases, CENAT did not have cost data for some diagnostics, such as a culture test. In these cases, HP+ used average regional cost per test from the OneHealth Tool. TIME outputs—including the number of people to receive certain diagnostic tests, number of notifications, and number of people to receive preventive therapy—were multiplied by intervention unit costs to calculate total commodity costs. The commodity costing does not assume any wastage of commodities nor account for safety stock.

HP+ compared estimates of the resources required for the TB program to resources available from the government and donors to estimate the potential funding gap across the four scenarios. CENAT provided projections and assumptions of future funding levels by source based on consultations with the government and donors.

Results

This section presents estimates of the number of people to receive TB services, TB costs, and the health and household economic impacts of TB across the four scenarios from 2019 to 2025.

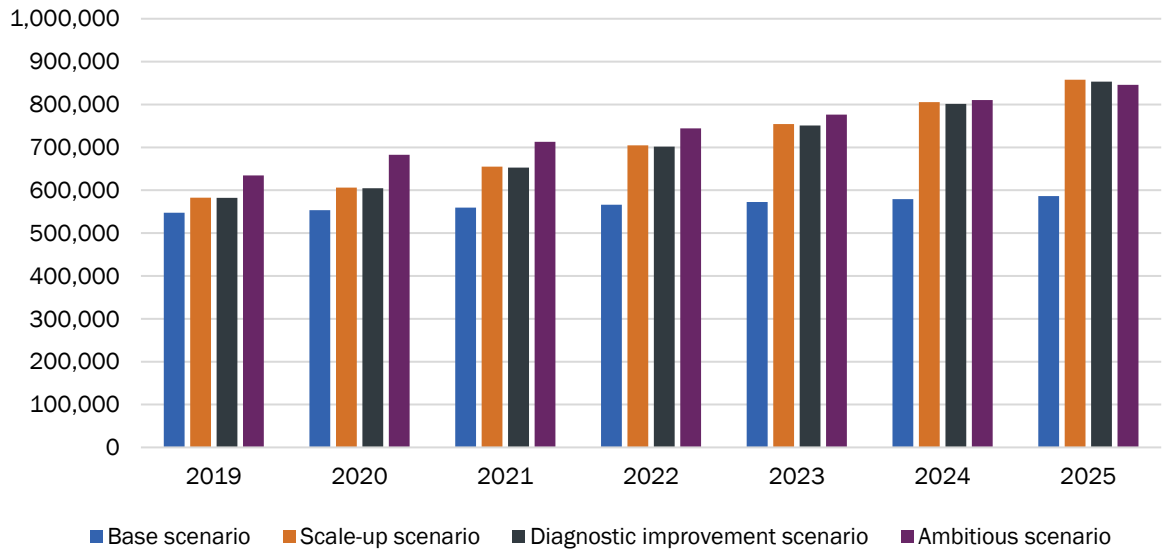
TB Service Delivery Needs by Scenario

The scale-up, diagnostic improvement, and ambitious scenarios all assume that preventive therapy coverage will reach 100 percent by 2025 for adults living with HIV and children with latent TB infection. Under these scenarios, the number of people estimated to receive preventive therapy increases from 25,086 in 2019 to 65,408 in 2025. In comparison, the numbers estimated to receive preventive therapy under the base scenario stay relatively constant each year at about 3,000 people.

The numbers screened for TB vary for each scenario (see Figure 5). Scaling up pagoda-based screening nationwide and child contact investigation under the scale-up scenario significantly increases the number of people to be screened for TB each year. By 2025, over

271,000 additional people are expected to be screened for TB under the scale-up scenario compared to the base scenario. A rapid initial increase in the screening rate under the ambitious scenario (10.7 percent annual increase in 2019 and 2020) leads to many more people being screened under this scenario compared to others; however, annual increases in the screening rate drop to 6.6 percent from 2020 to 2025. By 2025, there are relatively small differences in the number of people screened for TB between the scale-up, diagnostic improvement, and ambitious scenarios.

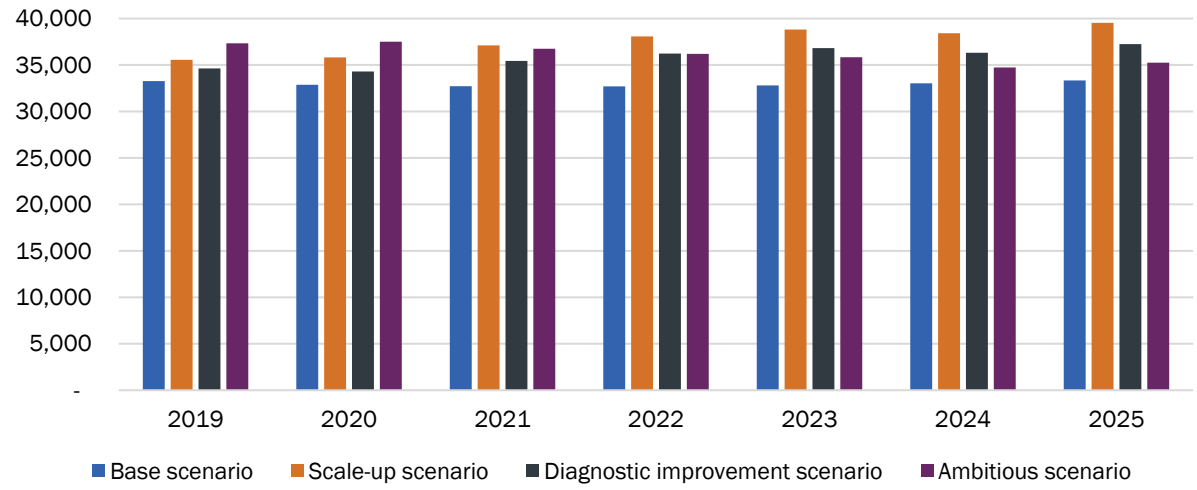
Figure 5. Number of People Screened by Scenario and Year



Currently, nearly a third of all TB diagnostic tests are conducted using smear microscopy. If Cambodia were to exclusively use GeneXpert and chest x-ray for diagnosing TB, the number of false positive and negative test results would decrease. Comparing the scale-up and diagnostic improvement scenarios reveals that these changes to the diagnostic algorithm could prevent 16,624 false positive and 28,057 false negative diagnoses from 2019 to 2025. Accurate diagnostics prevents the spread of TB and results in efficient use of treatment resources.

Increases and improvements in TB testing generally lead to increases in the number of TB notifications each year (see Figure 6). From 2019 to 2020, notifications increase most rapidly under the ambitious scenario. However, notifications under this scenario start to decline in 2021 as TB incidence declines. By 2025, the number of notifications is highest under the scale-up scenario (39,531) due to the relatively higher number of people screened for TB as well as less accurate diagnostics compared with the diagnostic improvement and ambitious scenarios. Across all scenarios, the majority of notifications are for non-MDR, treatment-naïve individuals. Cambodia has high rates of linkage to care—90 percent of those notified each year are projected to receive treatment across all scenarios.

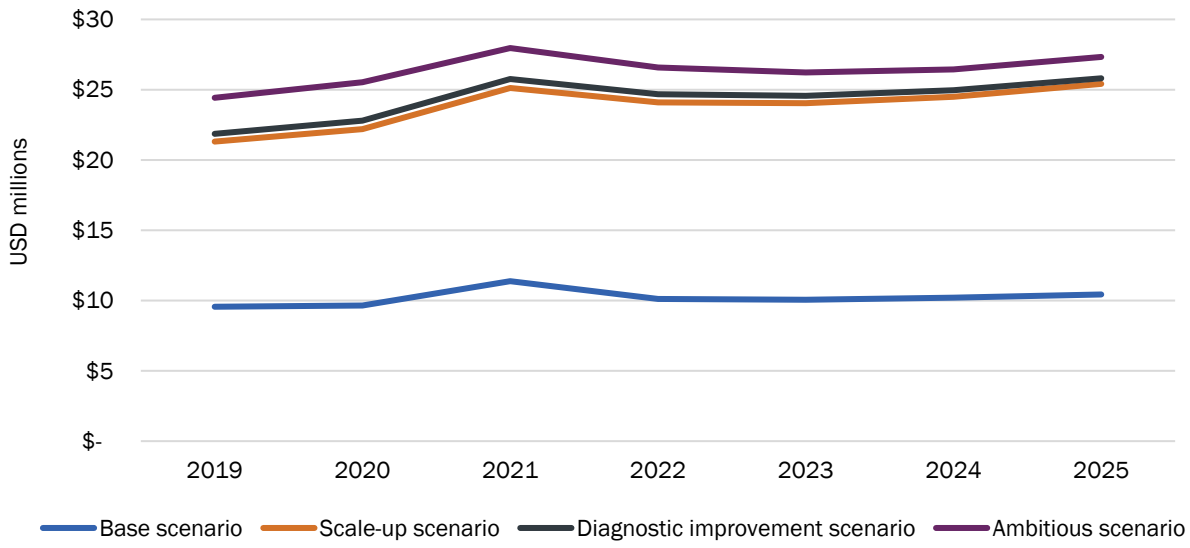
Figure 6. Number of People Notified by Scenario and Year



TB Program Resource Requirements

Total resource requirements from 2019 to 2025 range from US$71 million for the base scenario to US$185 million for the ambitious scenario. Costs are relatively constant each year across all scenarios (see Figure 7). There is a slight increase in costs in 2021 due to the planned TB prevalence survey, which is estimated to cost US$1.7 million for implementation.

Figure 7. TB Program Costs by Scenario and Year



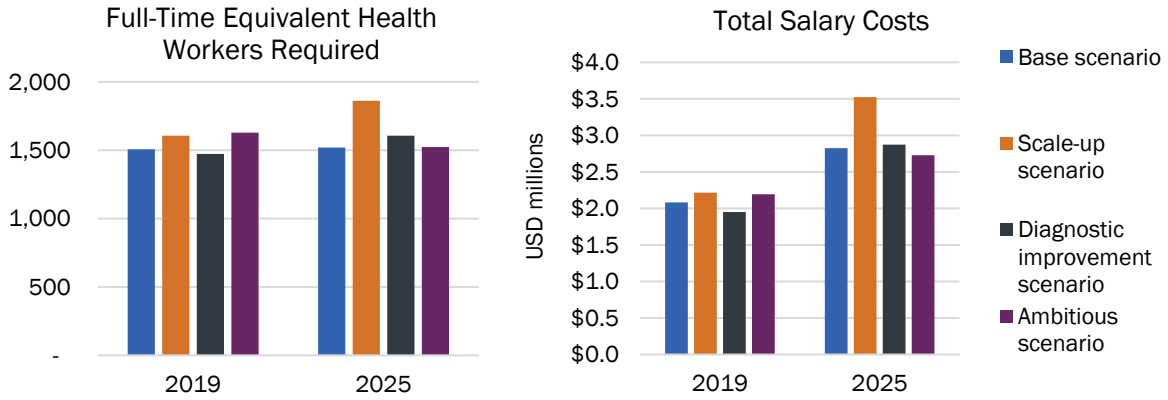
Program management accounts for most of the costs in the scale-up, diagnostic improvement, and ambitious scenarios. Depending on the scenario, program management costs in 2025 range from US$2.9 million to US$18.5 million. This includes costs for procuring equipment and non-medical supplies, conducting research, holding coordination and technical meetings, and other program activities. Equipment procurement costs may be underestimated under the diagnostic improvement and ambitious scenarios as a more detailed assessment is needed to understand the GeneXpert and x-ray machine needs under these scenarios.

One of the largest program management cost drivers under the scale-up, diagnostic improvement, and ambitious scenarios is expanding community-based provision of services, which includes costs for conducting enhanced case finding in villages (US$1.5 million per year), quarterly meetings between health center staff and community TB providers (US$1.3 million per year), and hiring C-DOTS coordinators at all levels of the health system (nearly US$1 million per year). A significant program management cost under the ambitious scenario is US$1.7 million for annual performance incentives for facility staff.

Annual costs of health worker time to deliver TB services are at least US$2 million per year, depending on the year and scenario. These costs are for health workers supported through the Ministry of Health wage bill rather than through CENAT-specific funding, and do not include costs of TB supervisors or other staff not involved in direct service delivery. CENAT management staff costs are costed separately under the program management cost category.

Health workforce costs are based on how many people will receive preventive therapy and be tested and treated for TB each year, as well as how much time it takes to deliver each service. The analysis assumes real wages will increase by 5 percent each year. Figure 8 shows the number of full-time equivalent health workers needed for TB and related salary costs across scenarios.

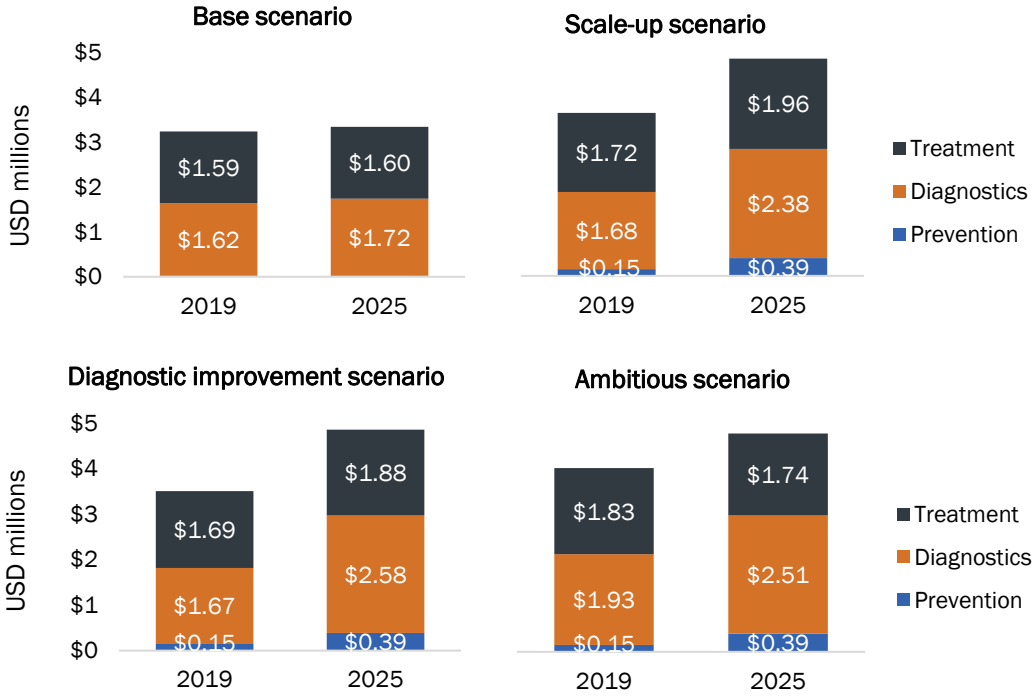
Figure 8. Number of Full-Time Equivalent Health Workers and Related Salary Costs to Provide TB Services



The scale-up scenario requires the most resources for health workers due to the relatively higher number of people to be tested, notified, and put on treatment under this scenario. Health workforce requirements and costs under the base scenario are similar to that under the diagnostic improvement and ambitious scenarios for two reasons: 1) as TB incidence decreases under the diagnostic improvement and ambitious scenarios, the difference in number of people on treatment between these scenarios and the base scenario is reduced and 2) the base scenario assumes that a third of all tests conducted in Cambodia will be through smear microscopy, which requires more staff time per person tested than GeneXpert and chest x-rays (the only diagnostics used under the diagnostic improvement and ambitious scenarios).

Commodity costs increase each year, with diagnostics representing the biggest proportion of commodity costs across all scenarios (see Figure 9). The ambitious scenario requires upfront investment in commodities and has the highest commodity costs in 2019 and 2020; however, this investment leads to declines in TB incidence that reduces the need for future treatment and results in relatively lower commodity costs by 2025 compared to other scenarios.

Figure 9. Prevention, Diagnostic, and Treatment Commodity Costs by Scenario



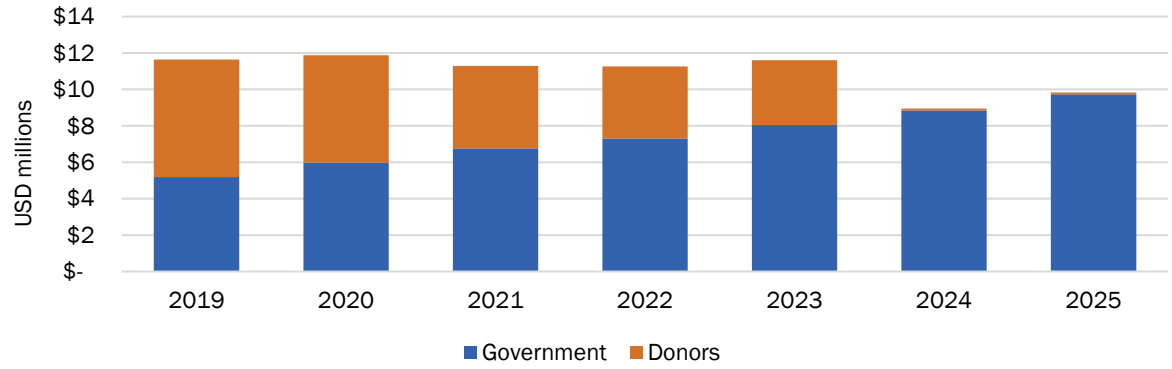
In 2025, commodity costs are estimated to range from US$3.3 million under the base scenario to US$4.9 million under the diagnostic improvement scenario. The diagnostic improvement scenario requires more financial resources for commodities than other scenarios as it calls for increased use of GeneXpert, which can cost three to five times more than other diagnostic tests. For example, GeneXpert costs approximately US$10 per test, while smear microscopy tests range from US$0.98 to US$2.48 per test. While the ambitious scenario also assumes increased use of GeneXpert testing, fewer people will need to be tested for TB in 2025 due to more rapid reductions in transmission under this scenario compared with the diagnostic improvement scenario. Due to more people being on treatment under the scale-up scenario compared to the other scenarios, the scale-up scenario has the highest treatment costs.

Another cost dependent on how many people receive certain TB services is transportation stipends and MDR-TB patient support. These costs are estimated to be more than US$1 million per year and range from US$1.4 million under the base scenario to US$1.7 million under the scale-up scenario by 2025. Children and poor adults who have TB receive a small transportation stipend of US$5; some or all of this cost could be covered by the Health Equity Fund in the near future but is assumed as a cost to CENAT in the current analysis. MDR-TB patients receive about US$1,045 per year for transportation to the facility, food, and other supplies involved in managing their care.

TB Program Funding Gaps

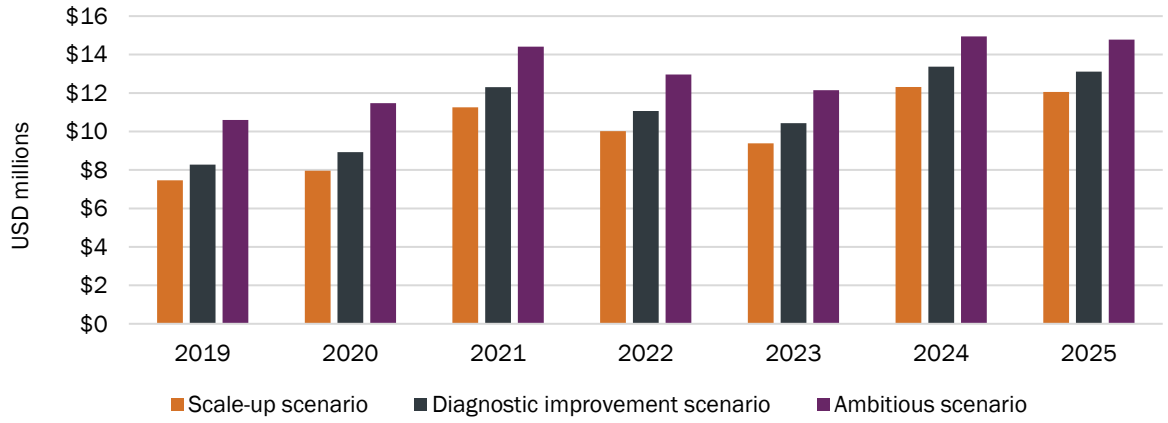
In terms of funding available for the TB program, CENAT projects that government funding will nearly double from $US5.2 million in 2019 to US$9.7 million 2025. Over the same time period, donor funding could decrease from US$6.4 million to just US$100,000 (see Figure 10). This assumes discontinued U.S. Government and Global Fund financing support.

Figure 10. Annual TB Funding Projects by Source



Across all scenarios except for the base scenario, these funding levels are insufficient to cover TB-specific costs (excluding health workforce costs covered separately through Ministry of Health budget). For example, the country faces nearly a US$91 million funding gap from 2019 to 2025 under the most ambitious scenario (see Figure 11).

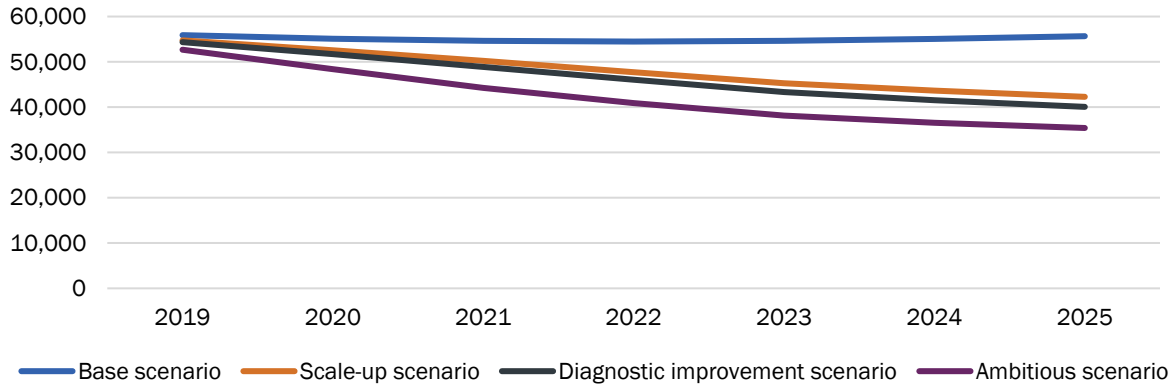
Figure 11. Annual Funding Gap by Scenario



Health Impacts of Investing in TB Control

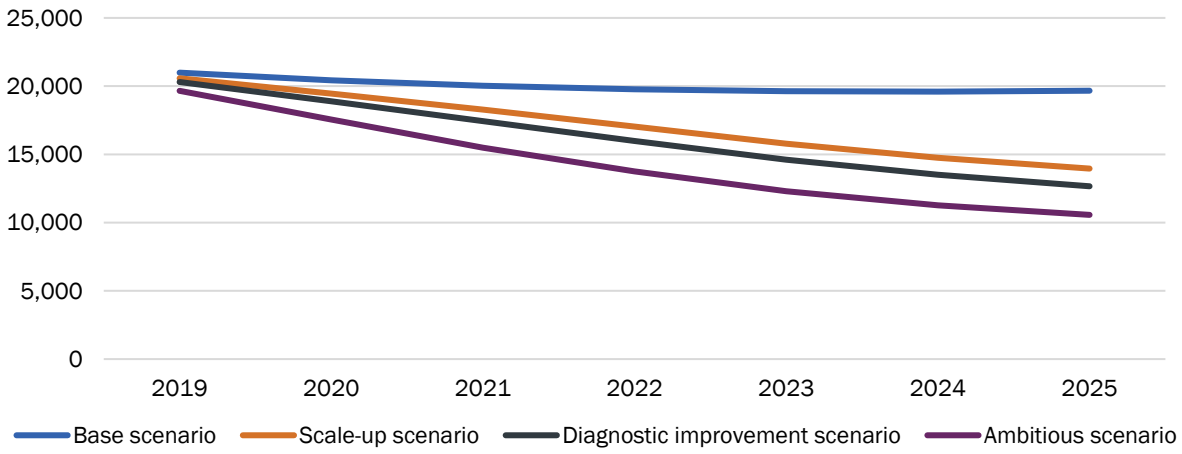
Results from the TIME application show that scaling up TB services while improving diagnostic testing will reduce TB incidence and TB-related mortality. Under the scale-up scenario, the combination of expanding pagoda-based screening, increasing child contact investigation, and increasing coverage of preventive therapy results in reducing incidence by 23 percent from 2019 to 2025 (see Figure 12). Much of this reduction is attributable to the pagoda-based screening program rather than the other two interventions. Improving diagnostic sensitivity and specificity under the diagnostic improvement scenario results in an additional 5 percent reduction in the number of incident TB cases by 2025. Under the ambitious scenario, TB incidence is expected to decrease even more dramatically, by 33 percent from 2019 to 2025, due to more aggressive screening.

Figure 12. Number of Incident TB Cases by Scenario and Year



TB-related mortality is expected to decline across all scenarios—even under the base scenario–from 2019 to 2025. Reductions in mortality are larger than reductions in TB incidence. For example, TB-related mortality is estimated to decline by 46 percent from 2019 to 2025 under the ambitious scenario (see Figure 13).

Figure 13. Number of TB-Related Deaths by Scenario and Year



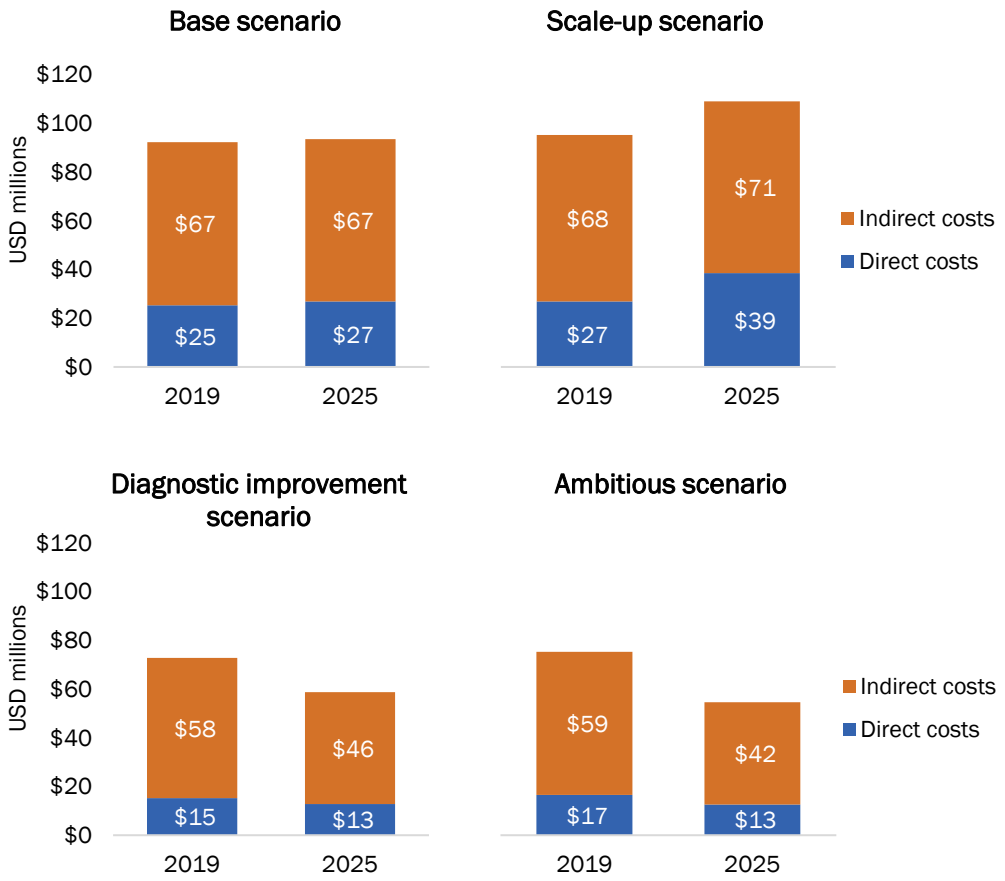
When comparing the ambitious and base scenarios, the incremental cost per infection averted from 2019 to 2025 is estimated to be US$1,269. This is slightly below the gross domestic product per capita in Cambodia (estimated to be US$1,384 in current U.S. dollars in 2017; World Bank, 2018), which suggests that the additional investment in TB control under the ambitious scenario is cost-effective.

Economic Impacts of Investing in TB Control on Households

Scaling up and improving TB services in Cambodia not only reduces adverse health outcomes but also the economic burden on households from TB. Under the base scenario in 2019, TB direct and indirect costs borne by individuals are nearly US$92 million. Assuming two in five TB patients experience catastrophic health costs (exceeding 20 percent of their household income), approximately 13,787 individuals in Cambodia would incur such costs in 2019. Most of these costs borne by individuals are indirect, as direct medical costs associated with TB are primarily covered through free TB service provision in public facilities.

Under the base scenario, TB costs borne by individuals remain relatively constant each year (see Figure 14). The only scenario where TB costs borne by individuals increases over time is the scale-up scenario. This is a result of the number of people being screened and treated for TB increasing by 47 percent and 12 percent, respectively. Under the diagnostic improvement and ambitious scenarios, improvements in diagnostics and more aggressive case detection lead to more drastic reductions in TB incidence and mortality, thereby reducing costs borne by individuals from 2019 to 2025.

Figure 14. Direct and Indirect TB Costs Borne by Individuals by Scenario



Under the ambitious scenario, costs borne by individuals are estimated to decrease by 27 percent from 2019 to 2015. Compared to the base scenario, individuals would spend an estimated 42 percent less on direct and indirect costs associated with TB and 1,127 (8 percent) fewer individuals would experience catastrophic TB costs in 2025 under this scenario. Reductions in costs borne by individuals under the ambitious scenario are a result of two factors: 1) reductions in mortality significantly reduce lost wages from premature death and 2) the scale-up of active finding approaches such as pagoda-based screening reduces the average cost borne by an individual in accessing TB services.

These findings show that investing in TB control in Cambodia under the ambitious scenario would avert US$96 million in direct costs and US$132 million in indirect costs borne by individuals from 2019 to 2025 compared with the base scenario. The return on investment ratio is two to one, and this is likely an underestimate. Economic impacts would be even greater if the analysis considered the cumulative costs of premature mortality, reduced investment in education, and slowed economic growth from reduced labor productivity.

Discussion

The Royal Government of Cambodia needs to invest more in TB prevention, case detection, and treatment to reduce the burden of TB, achieve national TB targets by 2030, and reduce the financial burden of TB on households. Although the ambitious scenario requires significant up-front investment in TB and the most financial resources from 2019 to 2025 compared to any other scenario, this level of investment will achieve the greatest impact in terms of reducing TB incidence, TB-related mortality, and TB costs borne by patients. If the government invested an additional $91 million in TB control from 2019 to 2025, the country could avert 89,099 TB infections and 39,515 TB-related deaths.

Further, TB costs borne by individuals would be 42 percent lower in 2025 compared to a base scenario that assumes constant coverage of TB control interventions, resulting in 1,127 (8 percent) fewer TB patients experiencing catastrophic health costs in 2025. Since a disproportionate number of TB patients are estimated to be poor—TB patients' average annual household income is estimated to be US$2,403, below the national average—increased government investment to reduce TB costs borne by patients is particularly important. Even though the analysis only considers select household economic benefits from increased investment in TB, the return on investment is two to one, indicating that the benefits of investing in TB far outweigh the costs.

Programmatic Recommendations

Increasing government investment in screening programs—particularly nationwide pagoda-based screening—is estimated to reduce TB incidence and mortality more than any other intervention analyzed. Investing in diagnostics, particularly use of GeneXpert and chest x-ray testing, would reduce the number of false positive and negative test results, allowing for reduced delays in case detection, reduced transmission of TB, and more efficient use of limited treatment resources. Additional analysis is needed to determine the equipment requirements to implement the improved diagnostic scenario; resource requirements in this analysis may be underestimated. Since program management drives TB program costs, it is recommended to evaluate the effectiveness of the high-cost interventions and determine if there are any opportunities for efficiency gains.

Improving Financial Protection among TB Patients

Although TB services are provided free of charge in public facilities through Ministry of Health and development partner budgetary support, direct and indirect costs associated with TB are significant, even after accounting for CENAT transport subsidies for poor adults and children seeking TB services and MDR-TB patient support. More than 12,000 individuals will experience catastrophic TB costs by 2025, even if the government fills the funding gap for achieving national TB targets. Social health insurance schemes for civil servants and formally employed workers do not currently include TB services in their benefits packages. However, the Health Equity Fund will soon start to reimburse public facilities for TB service provision for beneficiaries. Depending on the number of TB patients who are Health Equity Fund beneficiaries and the allowable amounts to be reimbursed, this could contribute to significant reductions in direct TB costs faced by the poor. Still, TB patients and their caretakers will likely continue to face large indirect costs associated with lost wages and dissaving unless new mechanisms, such as an income-generation fund, are introduced in Cambodia.

As Cambodia may face declines in external financing support for TB and competing health sector budget priorities, CENAT needs to identify more sustainable financing options for TB, carry out sustained and systematic advocacy efforts, and explore opportunities to expand financial protection mechanisms for TB patients. This should include advocating for inclusion of TB services in social health insurance benefits packages, designing new payment mechanisms that cover some of the significant indirect costs borne by TB patients, scaling up service delivery models (e.g., active case finding and C-DOTS) that reduce patient transportation costs, and spreading awareness of reimbursable TB costs within high-risk communities.

References

Cantelmo, C.B., M. Takeuchi, K. Stenberg, L. Veasnakiry, R.C. Eang, et al. 2018. "Estimating Health Plan Costs with the OneHealth Tool, Cambodia." *Bulletin of the World Health Organization*, *96*(7), p.462.

Houben, R.M.G.J., M. Lalli, T. Sumner, M. Hamilton, D. Pedrazzoli, et al. 2016. "TIME Impact–A New User-Friendly Tuberculosis (TB) Model to Inform TB Policy Decisions." *BMC medicine*, *14*(1), p.56.

Morishita, F., R.P. Yadav, M.T. Eang, S. Saint, and N. Nishikiori. 2016. "Mitigating Financial Burden of Tuberculosis through Active Case Finding Targeting Household and Neighbourhood Contacts in Cambodia." *PLOS ONE*, 11(9), e0162796.

National Center for Tuberculosis and Leprosy Control (CENAT). 2014. *National Strategic Plan for Control of Tuberculosis, 2014-2020*. Phnom Penh, Cambodia: Ministry of Health, Kingdom of Cambodia.

National Center for Tuberculosis and Leprosy Control (CENAT). 2018. *Technical Guideline on TB Control*. Phnom Penh, Cambodia: Ministry of Health, Kingdom of Cambodia.

World Bank. 2018. "GDP per capita (current US$)." Databank. Available at: https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=KH.

World Health Organization (WHO). 2018. *Global Tuberculosis Report 2018*. Geneva, Switzerland: WHO.

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