

Tuberculosis in Indonesia: Epidemic Projections and Opportunities to Accelerate Control

Findings from an Optima TB analysis

2020



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Abbreviations

ART	Antiretroviral therapy
BCG	Bacillus Calmette-Guérin
BPOM	Badan Pengawasan Obat dan Makanan/National Food and Drug Authority
DOT	Directly observed treatment
DR	Drug-resistant
DS	Drug-sensitive
GeneXpert	GeneXpert MTB/RIF or Xpert
GOI	Government of Indonesia
HIV	Human immunodeficiency virus
IPT	Isoniazid preventive therapy
LKPP	Lembaga Kebijakan Pengadaan Barang dan Jasa/National Procurement Agency
LTBI	Latent tuberculosis infection
MDR	Multidrug-resistant
MTB	<i>Mycobacterium tuberculosis</i>
NSP	National Strategic Plan
NTP	National Tuberculosis Program
PLHIV	People living with HIV
Puskesmas	Community health centers
RIF	Rifampicin
SDG	Sustainable Development Goals
SN	Smear negative
SP	Smear positive
TB	Tuberculosis
WHO	World Health Organization
XDR	Extensively drug-resistant

Executive Summary

Indonesia is the third largest contributor to the global tuberculosis (TB) burden and among the top 20 countries in the world for TB-HIV (human Immunodeficiency virus) coinfection, and multidrug-resistant TB (MDR-TB). In 2017, 842,000 people fell ill with TB, including 36,000 people living with HIV, 116,000 people who died, and 23,000 who were affected by drug-resistant TB.



842,000 people
fell ill with TB



116,000
TB deaths



23,000 people
with drug-resistant TB

In addition to the significant toll of TB to health and human capital, the economic burden of TB is substantial. Based on a business-as-usual-scenario, estimates suggest an overall cost of US\$6.9 billion from the loss of productivity due to illness, with premature death by far accounting for the largest share. But an appropriate public health and medical response can mitigate the economic impact. In 2017, the Ministry of Health's National Strategic Plan (NSP) estimated an annual budget of US\$185 million to respond to the TB epidemic. Approximately 30 percent was funded domestically and 25 percent by international development partners, leaving an annual funding gap of US\$83 million. As Indonesia nears upper-middle income status, it will gradually lose access to international funding, potentially leaving an even larger funding gap.

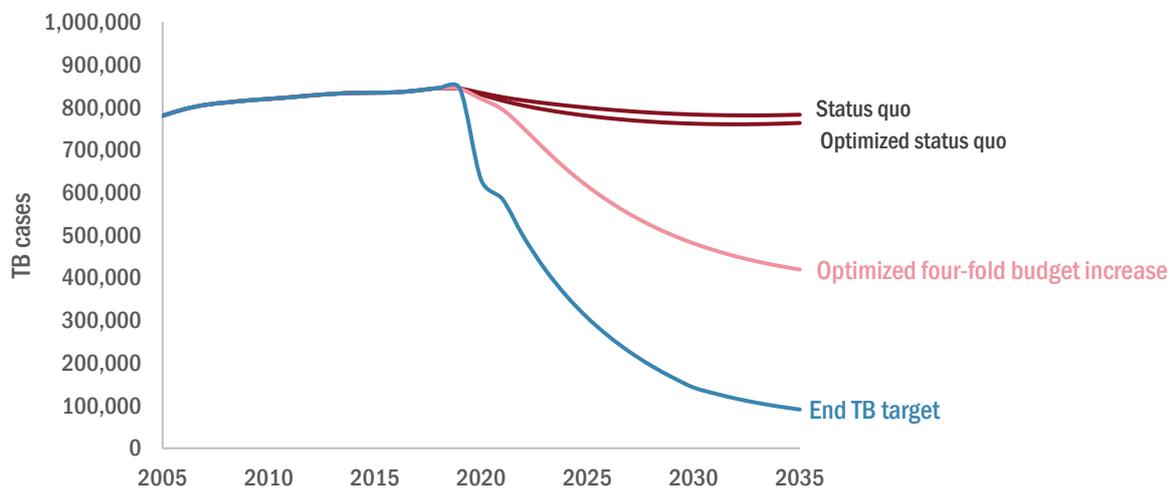
Controlling TB in Indonesia will require not only that the Government of Indonesia (GOI) spend more on TB but that it spends better. This means that decisions on which interventions or programs to prioritize and how best to implement them will be critical to maximizing health outcomes. The Optima TB modeling analysis was conducted to estimate (i) how existing and additional resources might be optimally allocated to maximize the impact of the national TB response, and (ii) which gaps in the TB treatment cascade offered the greatest scope for improvement. The model looks at several scenarios and compares projections on TB incidence, prevalence, and deaths with the GOI's own targets of reducing the incidence of TB by 90 percent and TB-related deaths by 95 percent, by 2035, relative to 2016, in accordance with global End TB targets. The main scenarios explored are projections based on (i) status quo spending, (ii) an optimized allocation of status quo spending among TB interventions, and (iii) an optimized allocation of a four-fold increase in spending.

Projections indicate that TB incidence will remain relatively stagnant under status quo spending and that there is limited scope for improving allocative efficiency. Under status quo spending conditions, by 2035, the number of new TB infections would decrease by 6 percent (780,000 new TB infections), the number of TB-related deaths by 16 percent (110,000 TB-related deaths), and the number of prevalent TB cases by 22 percent (1,470,000 prevalent TB cases) relative to 2016. Optimizing the allocation of current spending would add modest gains – a less than 2 percent decrease in the number of new TB cases, TB-related deaths, and prevalent TB cases compared to status quo. This implies that resources are already allocated efficiently. Given the level of current spending, the GOI prioritizes the treatment of drug-sensitive (DS) cases detected through passive case-finding, as it should; however, limited resources mean that the TB program's ability to expand active case-finding, to ensure protocol-

based treatment especially for MDR-TB, and to provide preventive therapy to all contacts is not currently possible even though these interventions are necessary to further advance the GOI's goals.

Even if TB spending increased four-fold and allocations were optimized, TB incidence falls far shy of End TB 2035 targets.

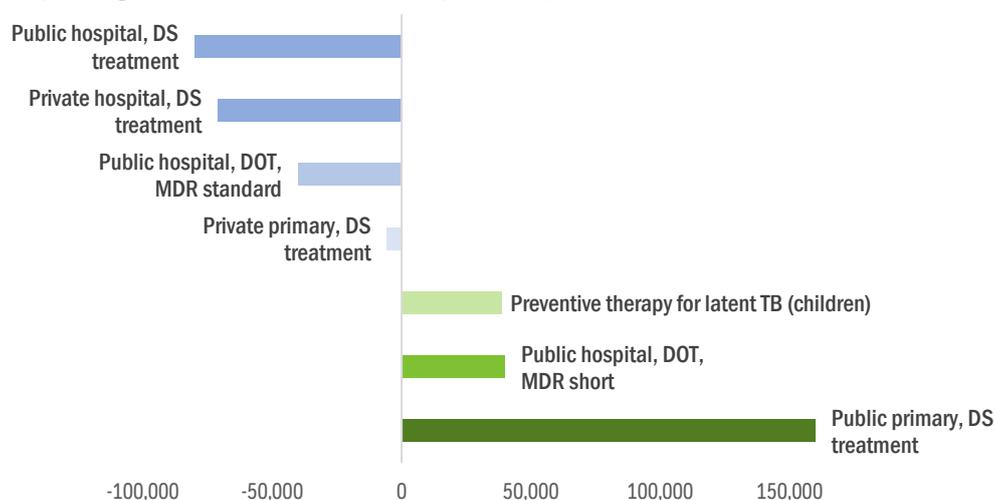
Total Number of Incident Cases for Different Spending and Resource Allocation Scenarios



Nevertheless, allocative efficiencies could be gained from treating more drug-sensitive TB cases in primary health care facilities and fewer in hospitals, shortening standard MDR-TB treatment regimens, and increasing preventive therapy for children among active TB contacts. In fact, whether the TB budget increases or decreases in the future, optimization will always prioritize more spending in these three areas. At higher spending levels if more resources were available, isoniazid preventive treatment for latent TB among people living with HIV (PLHIV) and contact tracing at the household level also become cost-effective.

A more efficient allocation of public TB resources would see more spending at puskesmas, shorter MDR-TB regimens, and more preventive therapy for children.

Change in Spending if Current Allocations Were Optimized (in IDR Millions)



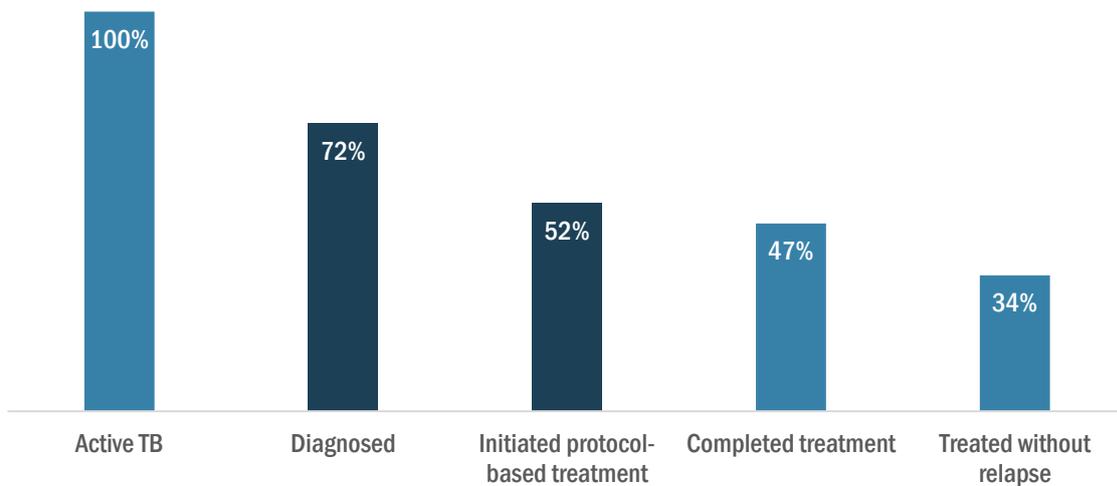
Note: DS=drug-sensitive; DOT=directly observed therapy; MDR=multi-drug resistant.

However, even much higher levels of spending would not allow Indonesia to reach its End TB targets without significant improvements in the quality of service delivery along the entire TB care cascade.

A four-fold increase in spending would still fall far shy of End TB targets. This suggests systemic changes are needed in how TB services are delivered. Currently the TB care cascade shows significant gaps in diagnosis and treatment because 28 percent of all active TB cases remain undiagnosed and only 34 percent are successfully treated without a relapse within 2 years. Improvements in the quality of service delivery along the entire TB care cascade are needed to shorten the time to diagnosis, ensure protocol-based treatment, and verify treatment success.

The breakdown in service delivery happens early in Indonesia’s care cascade at the initiation of diagnosis and treatment.

TB treatment outcomes along Indonesia's continuum of care



1. Introduction

1.1 Country Context

Indonesia is the third largest contributor to the global tuberculosis (TB) burden. The burden of TB disease can be measured in terms of: (i) prevalence – the number of cases of TB at a given point in time; (ii) incidence – the number of new and relapse cases of TB arising in a given time period, usually 1 year; and (iii) mortality – the number of deaths caused by TB in a given time period, usually 1 year. By all measures, Indonesia is a high burden country. In 2017, it accounted for 1.6 million or 8 percent of the 10 million TB cases worldwide; had a TB incidence of 391 per 100,000 people (1) or more than 842,000 people, including 36,000 people living with HIV (PLHIV); and lost 116,000 people to TB, including 9,400 deaths among PLHIV. In addition, Indonesia also faces a rising burden of multidrug-resistant TB (MDR-TB) with an estimated total of 23,000 people falling ill with drug-resistant TB.

Besides the significant toll to health and human capital, the economic burden of TB is also substantial. In a recent study on the economic burden of TB in Indonesia by Collins et al. (2), the overall annual cost of TB was estimated to be US\$6.9 billion, with the loss of productivity due to illness and premature death by far accounting for the largest share. The direct burden on households due to out-of-pocket expenses was estimated at US\$74 million, the costs to the healthcare system amounted to US\$156 million, with the remainder attributed to the loss of productivity due to illness (US\$700 million) and to premature death (US\$6 billion). A targeted public health and medical response can mitigate the economic impact.

Fortunately, programs to treat TB are some of the most cost-effective of all health programs. However, it is imperative to identify active TB cases and initiate their treatment early on. Directly observed therapy, short course (DOTS),¹ which promotes standardized treatment with patient supervision and patient support, is the preferred response because it enables compliance throughout the treatment period. However, rising resistance to drugs threatens progress in TB treatment success. In Indonesia, late diagnosis or undetected TB and incomplete treatment lead to longer treatment periods and significantly costlier care for rifampicin resistant TB (RR-TB) and MDR-TB (Figure 1.1). While Indonesia has one of the most widespread installations of GeneXpert machines,² considered the gold standard in TB diagnostics, the primary method used remains clinical diagnosis and X-ray because it is 5.2 times cheaper.³

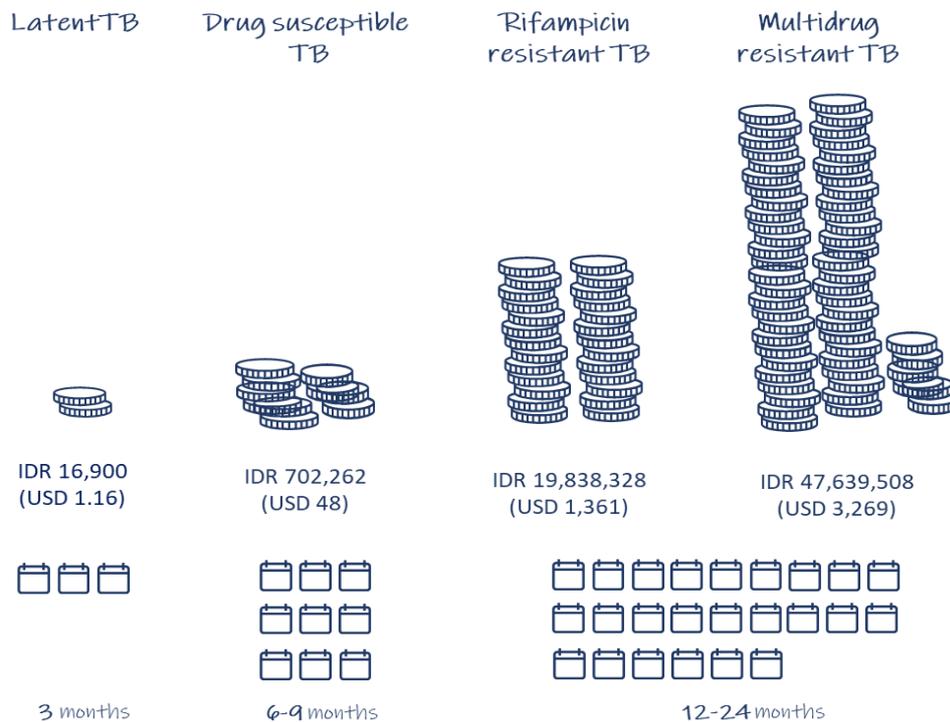
¹ Isoniazid and rifampicin are the main drugs used.

² Over 900 machines nationwide.

³ Smear and culture have a unit cost of IDR 26,194 (US\$2) and a turnaround time of 2-3 days for smear, several weeks for culture; X-ray has a unit cost of IDR 69,841 (US\$5) and is immediate; GeneXpert has a unit cost of IDR 367,240 (US\$26) and a turnaround time of 2 hours.

Multidrug-resistant TB is 68 times more expensive to treat than drug sensitive TB.

Figure 1.1: Comparison of Treatment Costs at Different Stages of TB



Note: Exchange rate: US\$1=IDR 14,573. Source: National TB Program

Health remains an underfunded and underprioritized sector in Indonesia, which has direct implications for the TB response. Public expenditure on health—at 1.5 percent of gross domestic product (GDP), or 8.8 percent of total government expenditure, in 2018—is about half of that in countries with a similar level of income (averaging about 2.7 percent of GDP). This amounts to just US\$56 per capita, well below regional and lower middle-income averages, as well as the recommended US\$110 per capita needed to deliver an essential universal health coverage (UHC) package. This suggests that current public health spending in Indonesia should double. In 2017, the Ministry of Health’s National Strategic Plan (NSP) estimated an annual budget of US\$185 million to respond to the TB epidemic. Of the estimated US\$185 million, US\$54 million (30 percent) was funded domestically and US\$45 million (25 percent) by international development partners, leaving an annual funding gap of US\$84 million.

As Indonesia nears upper-middle income status, it will need to find additional fiscal space to ensure the continuity of delivery of TB services. Indonesia has just recently been classified as an upper-middle-income country with a gross national income (GNI) per capita of US\$4,050 (Atlas method, current US\$) – although this is before COVID-19 broke out – threatening its access to development assistance because eligibility criteria is frequently tied to income thresholds. In particular, donor resources are predominantly used to fund 2nd line TB drugs for rifampicin and multidrug-resistant TB, GeneXpert machines and cartridges for TB testing, and sputum collection and transport – much needed services for the continued early detection and treatment of TB, especially MDR-TB. Even though Indonesia remains eligible to access support from the Global Fund to Fight AIDS, TB, Malaria (the main donor for TB), at least until 2022, there is a strong push to increasingly use domestic resources from the government.

Following a request for technical assistance from the Government of Indonesia (GOI) on how to make available TB resources go further, especially in a context of shrinking external funding, consultations were held with program managers and experts in the National TB Program, the Ministry of Health, and the Ministry of Finance. From these discussions, it emerged that a TB allocative efficiency analysis would be helpful in identifying (i) how existing and additional resources might be optimally allocated to maximize the impact of the national TB response, and (ii) which gaps in the TB treatment cascade offered the greatest scope for improvement.

2. Methodology

2.1 Optima TB model

Optima TB is a mathematical optimization model that informs policy makers and program managers on how to allocate the available resources across TB programs to maximize impact. Optima TB's scenario planning helps program managers answer “what-if” questions (for example, what would TB prevalence look like if current epidemiologic and spending remained the same or if we spent more; and what would we have to spend on TB if we wanted to reach national TB targets?). In contrast, the model's optimization function helps answer “how-to” questions (for example, how could we allocate (current, more, or less) resources more efficiently to optimize outcomes?). By comparing an infinite number of allocations to each other using a mathematical optimization algorithm (3), the model is able to find how to optimally allocate resources among different programs to reach specific TB program objectives (for example, reducing new infections or disease-related deaths, increasing the number of patients on treatment, minimizing the costs required to achieve specific targets, or a combination thereof) within a given resource envelope.

Optima TB is a dynamic, population-based model that partitions the Indonesian population by population group,⁴ TB health state (for example, suspect, latent TB, active TB), diagnosis and drug resistant status, and tracks people's movement among health states. The model brings together three types of data: (i) epidemiological data (for example, disease burden, including transmission and progression patterns); (ii) service coverage data (for example, intervention coverage and related outcomes); and (iii) cost information, for example, intervention unit cost data and budget allocation (See Figure 2.1, the Optima Modeling Approach). In addition, in consultation with national TB experts, the Optima TB model was calibrated to match available epidemiologic data as listed in T2.1. To assess how incremental changes in spending – including optimized resource allocation – might affect TB outcomes, data on coverage, unit cost, and expenditures was collected on 18 current and prospective TB programs (five prevention programs, six screening and diagnosis protocols, and seven treatment regimens. Sources are listed in Table 2.1 and full program details, assumptions, and constraints are given in [Appendix A: Program](#)

⁴ The five populations included in this modeling analysis are: children aged 0-14; males aged 15-64; females aged 15-64; adults aged 65 and over; and people living with HIV (PLHIV)

Figure 2.1: The Optima Modeling Approach

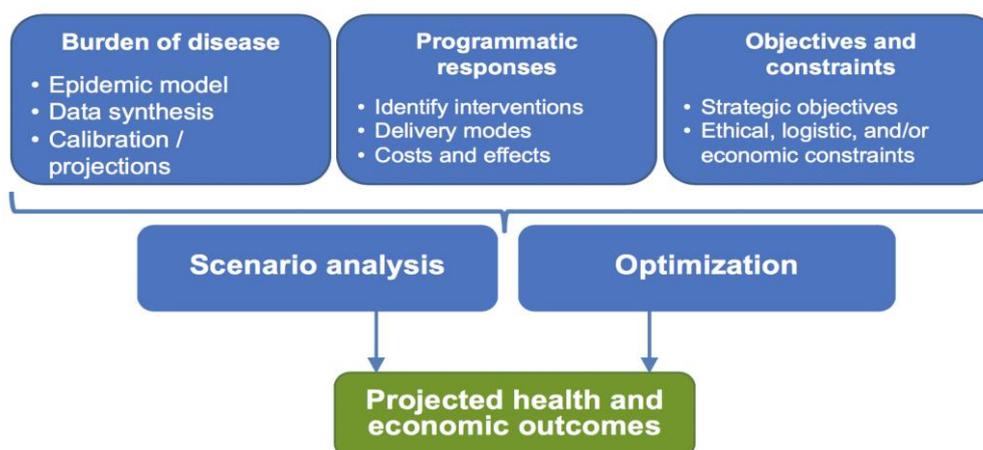


Table 2.1: Sources of Data Used in the Optima TB Model

Data type	Source
Epidemiologic data	National TB Program (2017); National TB Prevalence Survey (2013-2014) (4); WHO Indonesia population estimates (5); UNAIDS Indonesia PLHIV population estimates (6); Additional epidemiology supplemented by (7, 8).
Program coverage data	Treatment initiations and outcomes by smear status, strain, and program modality supplied by National TB Program (2017). Additional Indonesian program efficacy data from (9-17).
Cost data	Program unit cost estimates: National TB Program (2017). Top-down budgeting: Ministry of Health (2017) with reference to OneHealth costing estimates (2018) and previous estimates (18).

2.2 Scope of Analysis

The analysis examined the following policy questions:

Question 1. What is the projected trend for Indonesia’s TB epidemic if status quo conditions were maintained?

Question 2. What is the optimized allocation of resources across TB programs at current budget levels in order to minimize the number of TB-related deaths?

Question 3. What is the optimized allocation of resources at varying budget levels ranging from 60 percent of the most recently reported spending up to 800 percent of the most recently reported spending?

Question 4. How would a future TB epidemic be influenced by the implementation of specific programmatic changes?

- How would prioritizing GeneXpert testing (that is, increasing GeneXpert coverage from 20 to 75 percent) ahead of other programs impact TB incidence and TB-related deaths?
- How would scaled up antiretroviral therapy (ART) coverage (that is, increased ART coverage from 11 to 75 percent among TB-HIV co-infected) impact TB incidence and TB-related deaths in people living with HIV?

Question 5. What changes in the TB care cascade would be necessary to support reaching the End TB targets?

The scope of the analysis was further expanded to examine the impact of the ongoing COVID-19 epidemic on TB outcomes. These findings are included as a separate box following question 5.

3. Results

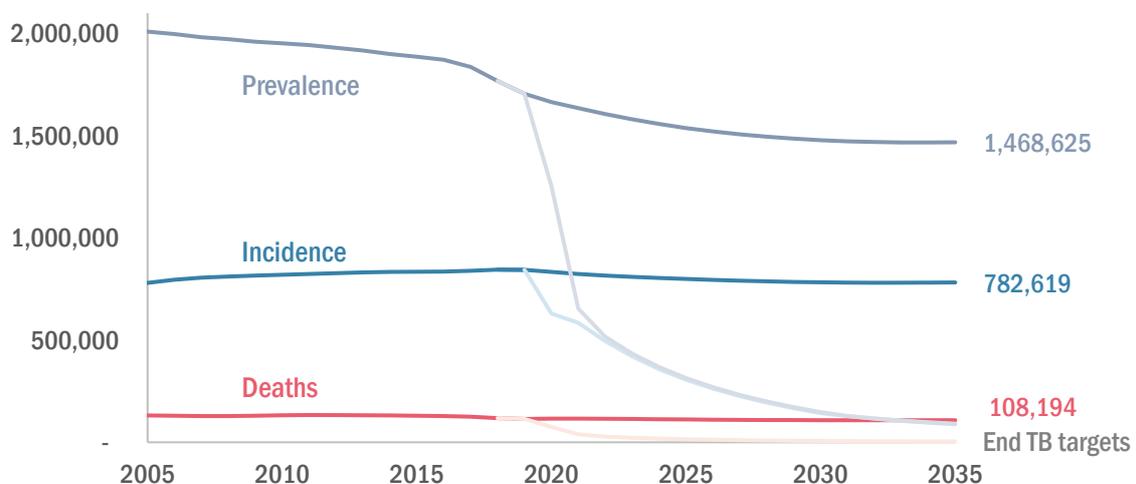
3.1 Question 1 – What is the projected trend for Indonesia’s TB epidemic if status quo conditions were maintained?

According to the modeling results, Indonesia is unlikely to meet key program targets as defined by its National Strategic Plan for Tuberculosis 2016-2020 as well as the End TB 2035 targets. The government of Indonesia’s (GOI) “Temukan Obati Sampai Sembuh” (TOSS) or “Find And Treat Until Cured” strategy has committed to decreasing TB incidence by 50 percent and reducing the number of TB deaths by 70 percent by 2025 from a baseline of 2016. The GOI has also signed on to the global End TB Strategy initiative 2016-2035, which has even more ambitious targets of slashing TB incidence by 90 percent and reducing TB deaths by 95 percent. However, under status quo conditions – that is assuming no changes to current spending, transmission dynamics, or service delivery – TB incidence is projected to remain relatively stagnant, decreasing by just 6 percent from 835 to 783 thousand from 2016 to 2035 (Figure 3.1). TB deaths are projected to decline by 16 percent from 128 thousand to 108 thousand per year during the same period. TB prevalence is projected to decline by 22 percent from 1,871,887 to 1,468,625.

Incident cases are predicted to decline most rapidly among children aged 0 to 14 years with a projected 36 percent decline, with smaller decreases in incident cases and prevalence among adults aged 15 to 64. These gains are projected to be partially offset by a 25 percent increase in incident cases among PLHIV and a 30 percent increase in people aged 65 and older (Figure 3.1).

Projections indicate that under status quo spending Indonesia is far off track from reaching the End TB 2035 targets.

Figure 3.1: Total Number of TB Deaths, Prevalent Cases, and Incident Cases



3.2 Question 2 – What is the optimized allocation of the current budget?

The bulk of current TB spending is allocated towards treatment instead of active case finding or preventive therapy. According to most recently available estimates, the GOI allocated IDR 1,486 billion (US\$102 million⁵) to programmatic TB spending, excluding management, monitoring and evaluation, and antiretroviral treatment for PLHIV that is not covered under the NTP. The largest expenditure item is for the treatment of drug-sensitive TB (DS-TB), accounting for over IDR 1 trillion or 67 percent of total TB spending. Passive case findings at health facilities account for IDR 270 billion (18 percent) while bacillus calmette-guerin (BCG) vaccination for infants and treatment of drug-resistant TB account for approximately IDR 100 billion each (7 percent). More than half (56 percent) of DS-TB treatment expenses occur at community health centers (puskesmas), 25 percent at public hospitals, and the remainder through private care. There is limited spending on active case finding or preventive therapy. Diagnosis using GeneXpert accounts for over 60 percent of diagnosis budget in Indonesia, even though it covers only 20 percent of screened TB patients. See Appendix A: [Program](#) for full details of the most recently reported spending and constraints on reallocation of resources as determined by the National Tuberculosis Program (NTP).

An optimized allocation of TB resources would result in more DS-TB cases being treated in lower level facilities, increased preventive therapy for children of TB contacts, and shorter treatment regimens for MDR-TB in hospitals. Treatment of DS-TB cases and passive case finding using GeneXpert continue to dominate program spending even under optimized allocation. While highly desirable, increased spending on preventive measures and more active case detection is not possible given the current budget constraints. However, it is more cost-effective to shift DS-TB treatment downward to primary health care facilities. On average, treatment for DS-TB patients is more effective at puskesmas because follow-up and continuity of care throughout the 6 to 9 month regimen is better if they are provided closer to a patient's home.⁶ The cost per person treated is also almost double at hospitals or in private care settings compared with treatment in puskesmas.⁷ The potential savings are best reinvested in preventive therapy for child contacts of active TB cases leading to a projected 35 percent reduction in TB incidence and TB-related deaths in children.⁸ Finally, switching to shorter MDR-TB treatment regimens would also lead to better outcomes because patients would be less likely to be lost to follow-up. In keeping with World Health Organization (WHO) guidelines on drug-resistant tuberculosis treatment (19, 20) and other emerging evidence (21) that the shorter duration MDR-TB treatment regimen of 6 months of bedaquiline is noninferior to the standard duration MDR-TB treatment regimen of 18 months or more, the switch to a shorter and cheaper treatment regimen⁹ would also allow more people to be treated. While the optimization model does suggest an increase in spending on passive case finding program at private facilities, this should not be considered a recommendation, but rather a reflection of the need to prioritize treatment of diagnosed drug-sensitive cases because of the limited available resources (Figure 3.2).

Nevertheless, optimizing current spending yields limited improvement in TB outcomes compared to status quo conditions suggesting that what limited TB resources are available are already being allocated efficiently (Figure 3.3). **Error! Reference source not found.** This shows that allocating

⁵ Exchange rate US\$ 1=IDR 14,573.

⁶ Puskesmas report a 94 percent treatment completion rate compared to 85 percent at higher level facilities. Conversely, puskesmas only report a 3 percent loss to follow-up compared with 11-12 percent at other facilities.

⁷ The cost per person treated is IDR 1.9 million per course at puskesmas, IDR 2.8 million per course at hospitals, and IDR 2.9 million per course in private settings.

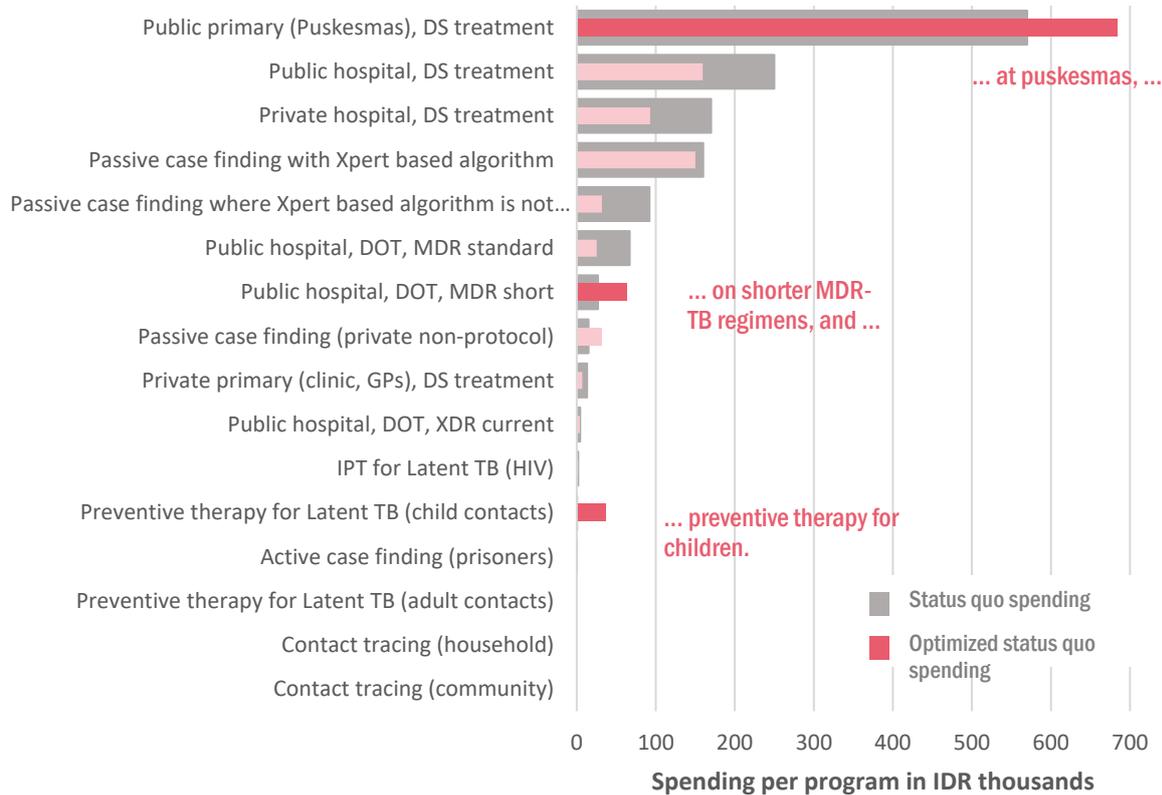
⁸ Preventive therapy for latent TB has a lower cost-effectiveness in other populations and hence lower priority in view of current budget constraints.

⁹ The unit cost for the shorter regimen is IDR 18 million versus IDR 30 million for the standard regimen (see Appendix B).

resources more efficiently across various TB programs, holding all else constant, would decrease TB incidence by just 2.5 percent by 2035 compared to the status quo spending allocations. Similarly, the change in TB prevalence and TB deaths is less than 1 percent. This highlights the severely constrained spending environment under which the TB program operates where the treatment of diagnosed drug-sensitive cases through passive case finding are prioritized.

Optimizing current resource allocations means spending more...

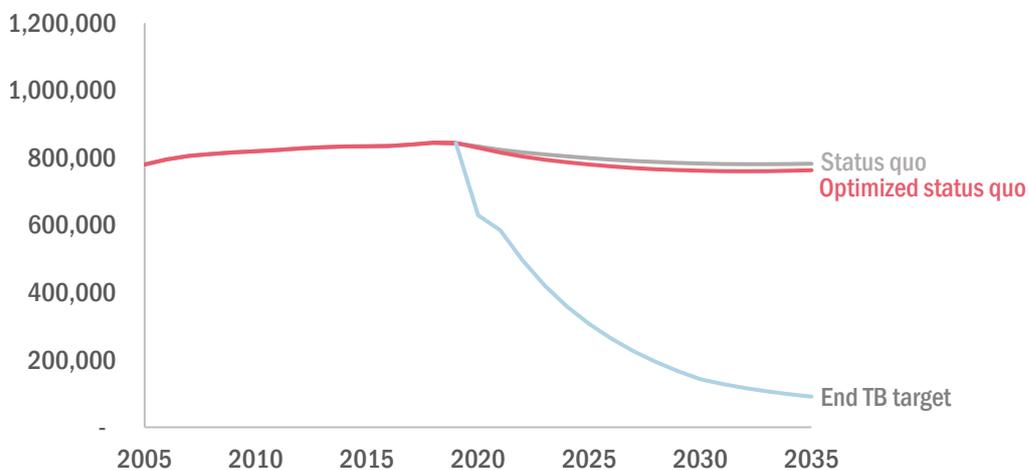
Figure 3.2: Current and Optimized Spending per Program in IDR Thousands



Notes: DS=drug sensitive; DOT=directly observed therapy; MDR/XDR=multi/extensively drug resistant; GP=general practitioner; IPT=isoniazid preventive therapy

Projections indicate that optimizing current spending yields limited improvement in TB outcomes.

Figure 3.3: Total Projected TB Incidence



3.3 Question 3 – What is the optimized allocation at varying budget levels?

Any reduction in funding will jeopardize Indonesia’s TB response at large and lead to an upsurge in TB burden. A 40 percent reduction in spending (the current estimated contribution from the Global Fund) would result in TB prevalence increasing by 52 percent (an additional 760 thousand cases), the number of incident cases increasing by 23 percent (an additional 180 thousand new cases), and the annual number of TB-related deaths rising by 56 percent (an additional 60 thousand deaths) compared to the status quo (Figure 3.4). However, even if the budget were to decrease, DS-TB treatment at primary health care facilities, preventive therapy for children aged 0-14 of known contacts and shorter MDR-TB treatment regimens would always be prioritized. At higher spending levels, additional programs become cost-effective, as discussed below.

Also, while a four-fold increase of the budget would result in significant gains to TB outcomes, achievements still fall shy of End TB targets, and any further budget increase would only yield limited improvement. Optimizing and increasing resources four-fold would see the number of incident cases drop by 46 percent to 419 thousand, the number of prevalent cases decline by 62 percent to 552 thousand, and the number of TB deaths fall by 61 percent to 42 thousand compared with the status quo (Figure 3.4). Even if the TB spending increased four-fold, TB incidence still falls far shy of End TB 2035 targets. Budget increases beyond four-fold were explored in this analysis but are not recommended without introducing new program modalities, because the modeled programs begin to reach “saturation” coverage as they reach the limit at which additional spending is able to increase coverage in a cost-efficient way. This leaves an achievement gap of 40 and 28 percent relative to End TB targets for TB incidence and deaths, respectively (Figure 3.5).

The suggested expansion of TB programs as the budget gradually increases¹⁰ is summarized in Figure 3.5, with the full allocation of spending and projected impact at each budget level detailed in Appendix B. Recommendations include:

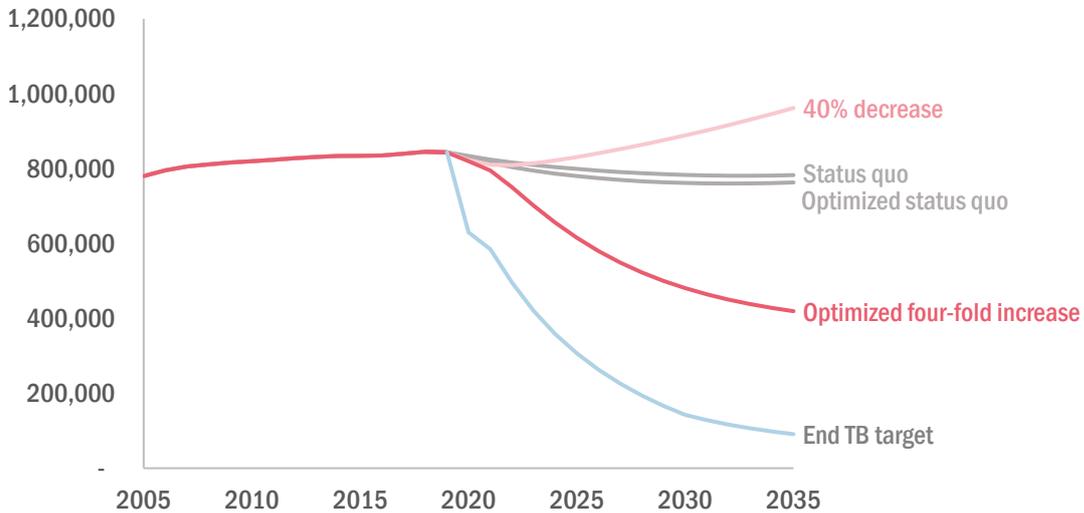
1. **At current spending levels**, scale-up preventive therapy for children aged 0-14. This would come from savings from treating more patients at lower level public facilities versus hospital settings. At current spending levels, expanding GeneXpert testing is not possible without compromising care for those already diagnosed through passive case-finding at health facilities.
2. **With a 20% (1.2-fold) increase of the budget**, scale-up preventive therapy for PLHIV who are receiving ART as a high-risk key population in addition to children aged 0-14.
3. **With a 40% (1.4-fold) increase of the budget**, increase coverage of GeneXpert testing. Only at higher spending levels does expanding GeneXpert coverage and associated treatment of both DS-TB and MDR-TB become recommended (see GeneXpert expansion scenarios below).
4. **With a 100% (two-fold) increase in budget**, increase contact tracing in households of people with active TB to identify cases earlier and prevent the spread of TB, especially MDR-TB.
5. **With a 300% (four-fold) increase in budget**, expand preventive therapy to adult contacts of active TB cases. Only if significant additional resources are available does expanding preventive therapy to adults become attractive as adults are much less likely to develop TB than child contacts. Nevertheless, even with this level of increased spending, a 40 percent gap to the End TB 2035 targets is projected.
6. **Beyond a 300% (four-fold) increase in budget**, the program modalities begin to reach saturation – that is expanding coverage further is unlikely given current service delivery arrangements. Community contact tracing is also not deemed cost-effective unless they could be targeted to higher-risk communities such as boarding schools or urban poor enclaves. For this reason, implanting novel service delivery arrangements and/or improving the

¹⁰ Budget optimizations were conducted at each 20 percent budget increment from 60 percent to 200 percent of the most recently reported spending (2017), and additionally at 400 percent and 800 percent.

implementation efficiency of current service delivery modalities is recommended rather than budget increases beyond this point (see section below on the TB care cascade).

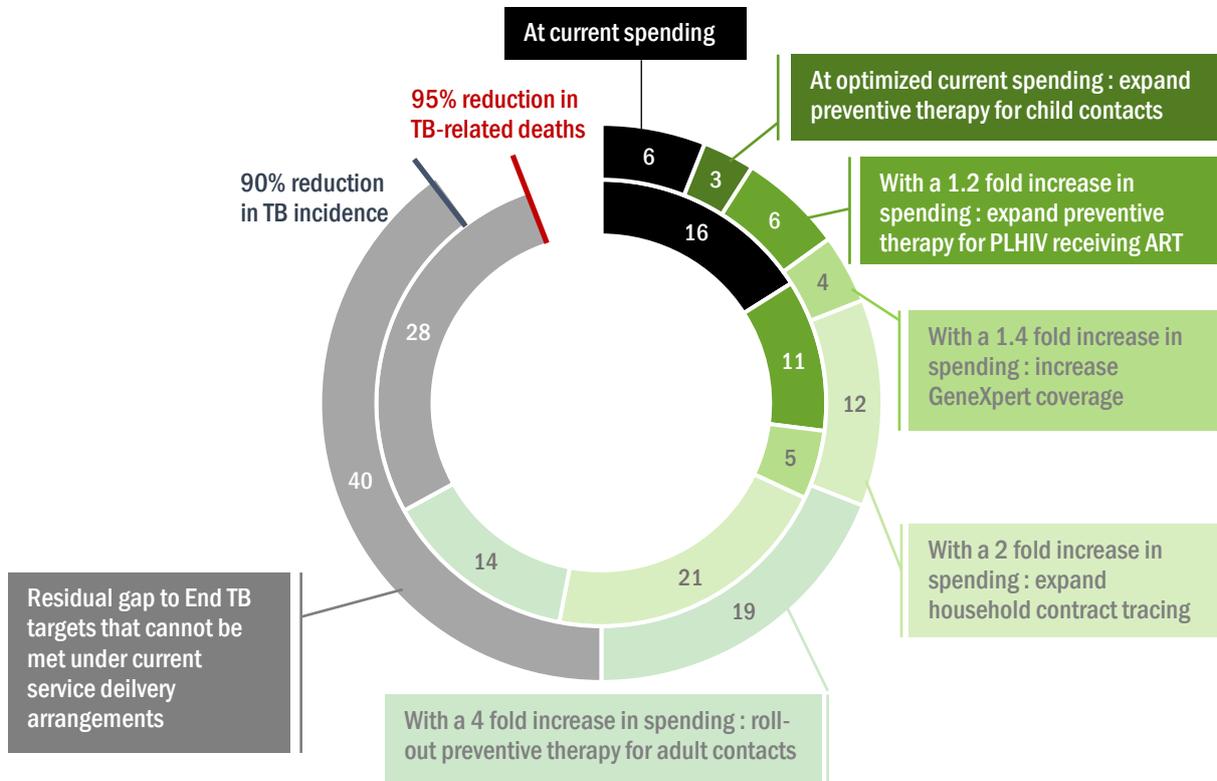
Even if the TB spending increased four-fold, TB incidence still falls far shy of End TB 2035 targets.

Figure 3.4: Total Number of TB Incident Cases for Different Budgets and Resources



Suggested expansion of TB programs with increased budget will still leave gaps of 28 percent and 40 percent in TB-related deaths and incidence respectively, compared to End TB 2035 targets.

Figure 3.5: Percentage Reduction in TB Incidence (Outer Ring) and Deaths (Inner Ring) as Budgets and



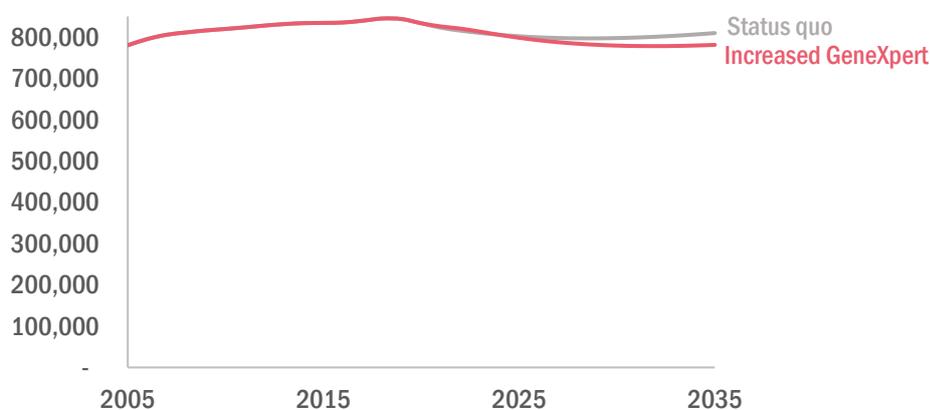
3.4 Question 4 – How would a future TB epidemic be influenced by the implementation of specific programmatic changes?

3.4.1 Increased GeneXpert Coverage

Increases in GeneXpert testing only become cost-effective if the total budget increases 1.4-fold, although the benefits would be relatively modest. In recent years, there has been a push for expanding the availability of rapid diagnostic machines such as GeneXpert in Indonesia because they provide accurate results within 45 minutes. As mentioned earlier, Indonesia already has one of the most widespread installations of GeneXpert machines. However, despite the availability of these machines, only 20 percent of TB testing is done using GeneXpert – mostly for drug resistant patients – leading to far larger diagnosis gaps (2,400 to 31,000 days) for drug-resistant patients. Even at this limited level of coverage, GeneXpert consumable costs account for over 90 percent of the TB testing and prevention budget and is reliant on donor funding (see footnote 3 on the unit costs of various TB diagnostic methods). If protocol-based GeneXpert coverage were increased to 75 percent in 2020, in line with the 2016-2020 National Strategic Plan target, the prevalence of drug-resistant TB and TB-related deaths among people with MDR-TB would decrease by nearly 20 percent by 2035, relative to status quo coverage (Figure 3.6). However, without additional spending on treatment or preventive therapy, it would only lead to an overall reduction in TB incidence of less than 5 percent (11).

Expanded GeneXpert coverage leads to modest improvements in TB incidence without additional spending on treatment and preventive therapy.

Figure 3.6: Total Number of TB Incident Cases if GeneXpert Is Increased



3.4.2 Increased Antiretroviral Therapy Coverage

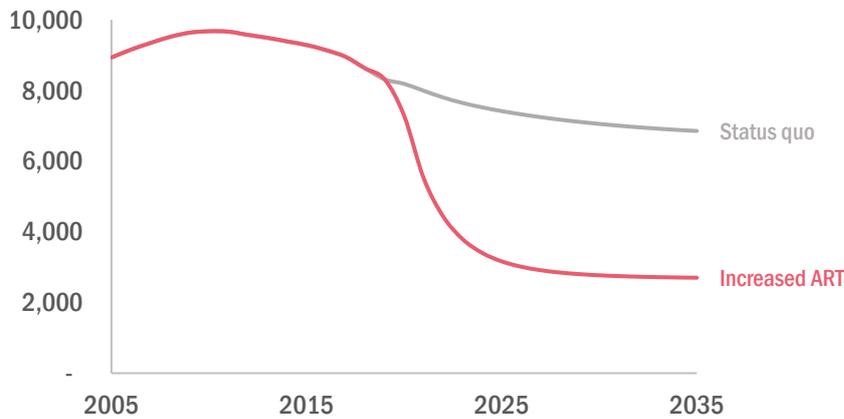
Increased ART coverage would dramatically reduce new TB infections among PLHIV. Approximately 5 percent of incident TB cases are among PLHIV, despite this group representing only 0.4 percent of the total Indonesian population. While the TB program is not responsible for funding HIV treatment,¹¹ an additional scenario was estimated that increased ART coverage from 11 percent to 75 percent among TB-HIV co-infected patients, in line with 2020 National Strategic Plan targets. Under expanded ART coverage, estimates show that TB prevalence among people living with HIV would decrease by 70 percent from over 9,000 in 2016 to 2,700 in 2035, and TB incidence among PLHIV and new HIV infections would reduce by nearly 50 percent by 2035 relative to 2016 (Figure 3.7). Without increases

¹¹ As such, this cost was not included in the budget optimization.

in ART coverage (that is, under status quo ART coverage rates), TB incidence and related deaths among PLHIV are both projected to increase by 28 percent.

Increased ART coverage leads to a dramatic drop in TB prevalence among PLHIV.

Figure 3.7: Total Number of TB Prevalent Cases per 100,000 PLHIV if ART Expanded



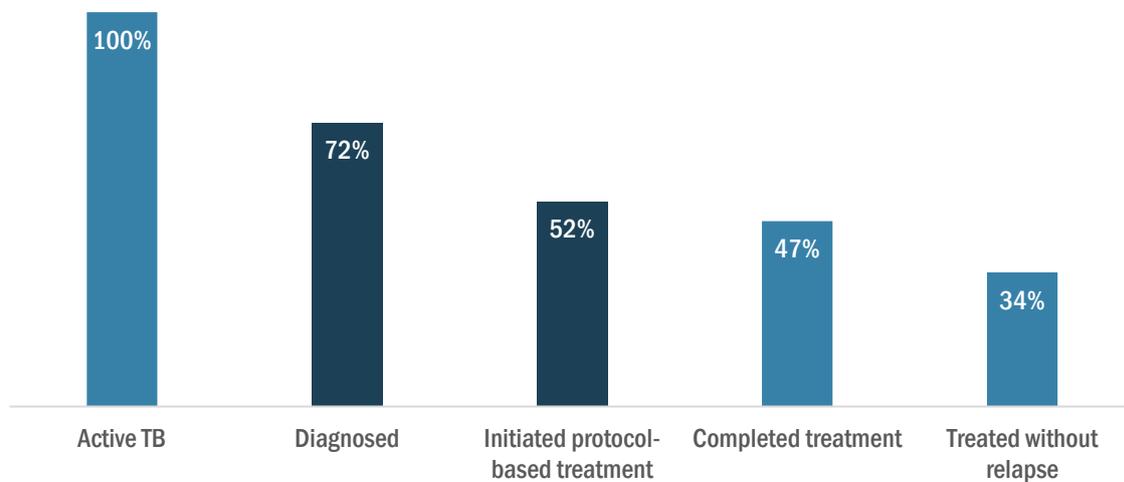
3.5 Question 5 – What changes in the TB care cascade would be necessary to support reaching the End TB targets?

Indonesia’s current TB care cascade shows significant gaps in diagnosis and treatment. Based on 2019 calibrated model parameters, the TB care cascade in Figure 3.8 shows the outcome probabilities for each stage in the continuum of care. Twenty eight percent of all active TB cases remain undiagnosed and only 34 percent are successfully treated without a relapse within 2 years. Reliance on passive case finding from patients who go with symptoms to health care facilities leads to an average time to diagnosis of over a year and to more advanced cases. While the treatment success rate is high, a little over half of TB active patients ever even initiate protocol-based treatment. This gap includes those who delay treatment initiation and those who receive a non-protocol-based treatment regimen. Among active TB, smear positive (SP) DS cases are more likely to be diagnosed (85 percent) compared with smear negative (SN) DS cases (60 percent) but they are also more likely to die (not shown). This is due to a combination of care-seeking behavior, more pronounced symptoms, and better testing accuracy for high bacilli counts found in advanced infections.¹² Multidrug resistant mortality is especially high (42 percent) given the even lower diagnosis of MDR-TB – only 20 percent of MDR-TB are diagnosed (Figure 3.9).

¹² This is consistent with findings from the national TB prevalence survey 2013-14 (4), and the number of notified smear positive cases relative to smear negative cases in Indonesia (NTP program data).

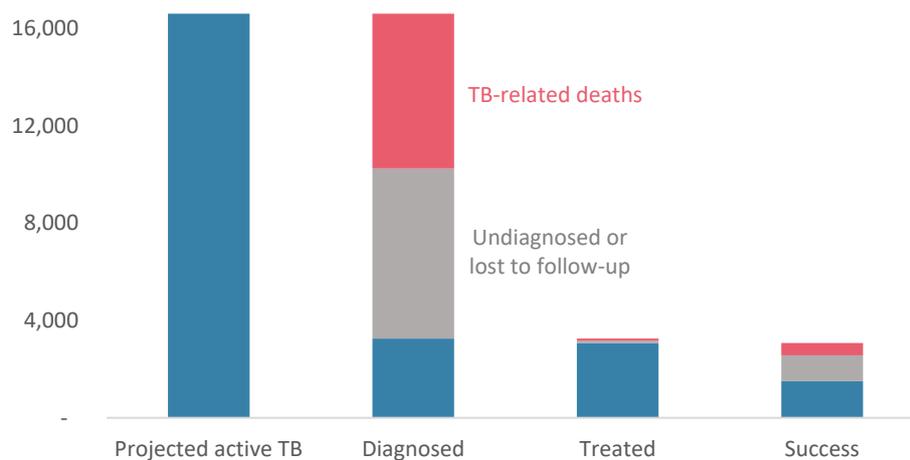
The breakdown in the TB care cascade happens early on with delayed or undiagnosed TB and initiation of protocol-based treatment.

Figure 3.8: TB treatment outcomes along Indonesia's continuum of care



MDR-TB cases are diagnosed too late or not at all leading to high mortality rates.

Figure 3.9: Number of MDR-TB Cases that are Treated Successfully, Go Undiagnosed or Lost to Follow-up, or Die



Significant improvements in the quality of care along the entire TB care cascade are needed to shorten the time to diagnosis, ensure protocol-based treatment, and verify treatment success. Table 3.1 shows the dramatic parameter changes that are needed to reach End TB 2035 targets, without defining which new interventions or implementation efficiencies would be necessary. In particular, the average number of days until treatment initiation would have to be slashed from 560 to 5 days for DS-TB diagnosed patients and from 390 to 10 days for DR-TB diagnosed patients. The average number of days for diagnosis itself would have to drop from 200 days for smear positive and 900 days for smear negative patients down to 30 days. Treatment success rates, particularly for DR-TB would also need to improve to 85 percent.

Table 3.1: Necessary Parameter Changes Needed to Achieve End TB 2035 Targets

<i>Parameter</i>	<i>Status quo conditions in 2019</i>	<i>End TB 2035 targets</i>	
		<i>Implemented in 2020</i>	<i>Achieved by 2030</i>
Average days until treatment initiation for diagnosed DS-TB	560 days (reflects gap in protocol-based treatment rather than delay for diagnosed cases)	30 days (reflecting further improved linkages to care, all diagnosis being conducted through rapid protocol-based screening and testing and elimination of loose drugs to ensure all treatment is protocol-based)	5 days
Number of LTBI treatment initiations through contact tracing	2,300 children (0-14 years only)	145,000 people (all populations, reflecting a rapid scale up of contact tracing in both children and adults)	109,000 people (all populations, reflecting a decline after the initial rapid scale up as new infections fall in the future)
Number of LTBI treatment initiations through mass screening	0	0	0
Average days until treatment initiation for diagnosed DR-TB	90 days (MDR) 390 days (XDR)	10 days (reflecting improved availability of treatment for DR-TB and improved linkages to care)	10 days
Average days until diagnosis for SP-DS	From 190 (Females 15-64) to 1,700 days (People living with HIV)	90 days (reflecting effective combinations of contact tracing and active case finding)	30 days
Average days until diagnosis for SN-DS	From 610 (0-14 years, Females 15-64) to 2,600 days (People living with HIV)	90 days (reflecting effective combinations of contact tracing and active case finding, combined with the use of GeneXpert-based diagnostic routines to make SN cases as likely to be diagnosed as SP cases)	30 days
Average days until diagnosis for DR-TB	Very low rates of diagnosis from 2,400 to 31,000 days	180 days (reflecting a substantial increase in the use of GeneXpert-based diagnostic routines to make DR cases as likely to be diagnosed as DS cases)	60 days
Treatment success rate for DS-TB	Approximately 90%	90%	95% (reflecting implementation efficiencies)
Treatment success rate for DR-TB	Approximately 50%	75% (reflecting implementation efficiencies such as improved treatment regimens)	85% (reflecting implementation efficiencies)
Relapse rate after successful treatment	20%	10%	5%
Progression to active TB for people infected with latent TB more than 5 years previously	Varies by population, reflecting environmental factors	Reduced rate of progression from status quo by 50% (reflecting improvements in environmental factors such as general public health improvements and a reduction in non-modeled comorbidities)	Reduced rate of progression from status quo by 75%

Notes: DS=drug-sensitive; LTBI=latent TB infection; DR = drug-resistant; SP=smear positive; SN=smear negative

BOX 3.1: How Will the Coronavirus Outbreak Impact TB Health Outcomes in Indonesia?

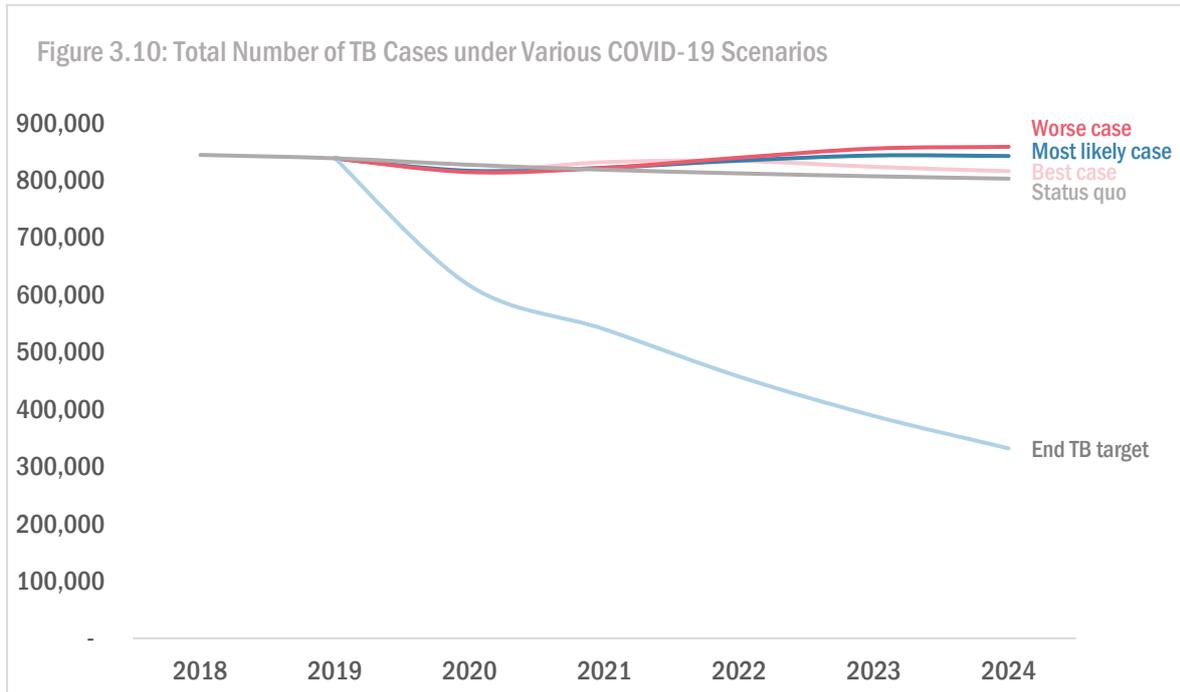
Background: Indonesia accounts for the largest coronavirus (COVID-19) outbreak in the East Asia and Pacific region, with the number of cases (and fatalities) set to rise sharply in the coming months. Although the government was reluctant to impose a strict lockdown, it did implement social distancing measures on April 1, 2020, which were gradually lifted during June. In addition to the lockdown, over half of the districts (52 percent) reported 50-75 percent of their total TB budget shifted towards COVID-19 response and up to 60 percent of TB personnel were mobilized to work on the pandemic. GeneXpert machines are also being repurposed to ramp up COVID-19 testing capacity. This has led to increases in TB treatment failure and loss to follow-up. Using the same Optima TB approach, additional scenarios were carried out to help estimate the potential impact of COVID-19 on TB outcomes.

COVID-model scenarios: Projections were estimated based on assumptions concerning i) the interruption of services such as suspended outreach activities, supply chain disruptions, movement restrictions, and unwillingness to visit health care facilities; ii) reduced resources including personnel, equipment, GeneXpert machines, and direct funding; and iii) catch-up activities such as immunization drives to catch up on BCG vaccinations and expanded active case finding. The impact of service disruptions during 2020 and 2021 was examined over 5 years from April 1, 2020 to March 31, 2024. Neither the direct impact of COVID-19/TB comorbidities nor the likely impact of interrupted treatments may have on increases in TB drug resistance were modeled and therefore results may be underestimates. The main scenarios include:

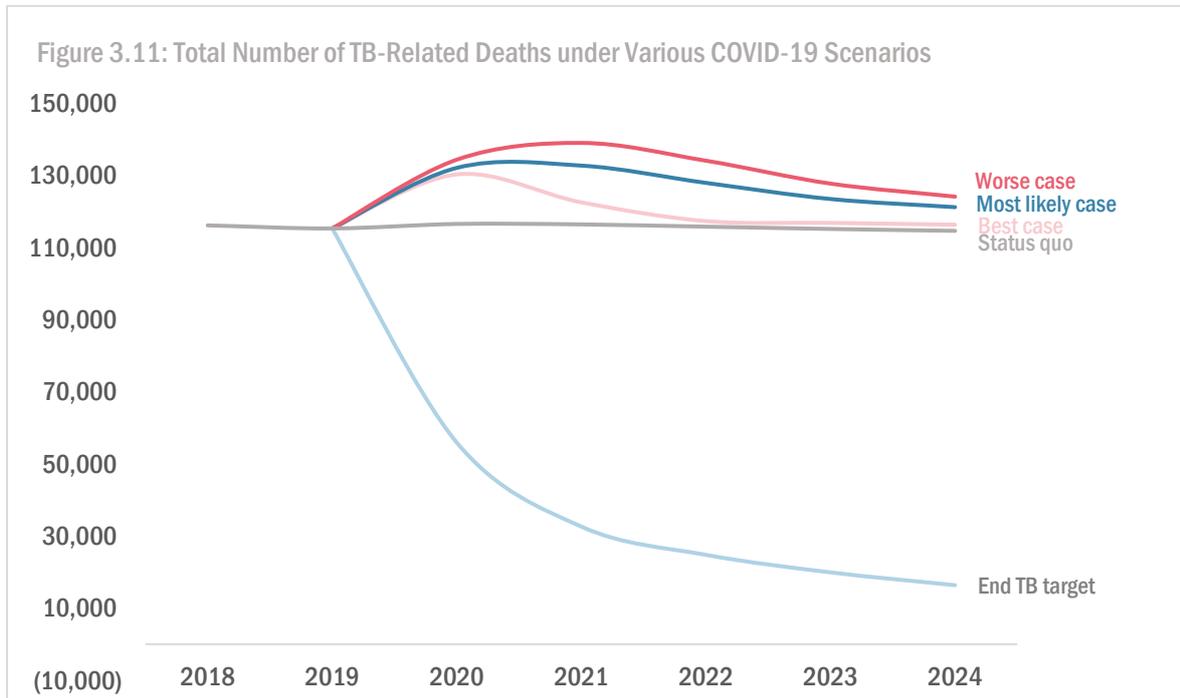
- Baseline: no interruption
- Best case: 3-month interruption with low severity, followed by additional investment of resources over 12 months to catch-up on TB programs such as BCG and preventive therapy
- Most likely: 3-month interruption with low severity suggested by initial data, followed by resources continuing to be diverted from TB to respond to COVID-19 for an additional 12 months
- Worse case: 6-month interruption representing extended or additional periods of lockdown with a more severe impact on TB service delivery, followed by resources continuing to be diverted from TB for 12 months.

Results: As detection and diagnosis is delayed even under normal circumstances, COVID-19 interruptions will likely show a relatively minor short-term impact on TB incidence. The number of new incident cases is projected to increase by 2 percent from 2020 to 2024 relative to what would have happened in the absence of COVID-19 – an additional 90,000 (50,000 to 120,000 depending on the scenario) cumulative new cases (Figure 3.10). TB prevalence is projected to increase by 6 percent or an additional 100,000 active cases by 2024. TB-related deaths due to COVID-19 are projected to increase by 10 percent by 2024 corresponding to an additional 60,000 (25,000 to 80,000 depending on the scenario) cumulative TB-related deaths (Figure 3.11). If TB resources continue to be diverted due to an ongoing burden of COVID-19, it is projected that increased deaths will continue until 2024. To return incidence and TB-related deaths to status quo levels by 2024, additional investments over the next 12 months are needed to catch-up missed BCG vaccinations, expand diagnosis by 20 percent and double preventive therapy program from status quo.

COVID-19 will have a modest impact on TB incidence due to delayed detection even under normal circumstances ...



... but will have a larger impact on TB-related deaths.



4. Discussion

Indonesia is far off-track to meeting 2035 End TB targets. Given status quo spending, TB incidence will remain relatively stagnant, although prevalence per capita is estimated to decrease partly because of population growth. However, even if the NTP were to increase spending four-fold, inefficiencies in program implementation would still leave achievement gaps of 40 and 28 percent for TB incidence and TB-related deaths respectively relative to targets. This highlights the need for systemic changes in TB service delivery. This is a problem that more money cannot solve on its own.

The limited scope to improve the allocative efficiency of NTP's existing resources puts the focus squarely on improving implementation efficiency. The bulk of NTP's available resources are spent on treatment – a mostly optimal allocation for their constrained budget. However, the Optima model did recognize some efficiency savings from shifting TB treatment from hospitals towards primary health care facilities and from adopting shorter MDR-TB regimens. With these savings, preventive treatment for child contacts among active TB cases should be increased. In order to encourage the behavior changes needed to improve implementation efficiency, both financial and nonfinancial incentives should be considered.

Fundamental to improving implementation efficiency is having better information and management systems. As Indonesia operationalizes its National One Data Plan, it should consider a whole-of-government approach that brings together stakeholders from the Ministry of Health, the Food and Drug Authority (BPOM), the National Procurement Agency (LKPP), province and district health offices, and the health insurance agency (BPJS-K). The more integrated the data systems, the easier it will be to facilitate performance monitoring, disease surveillance, and logistics and inventory management. It would also help strengthen the reference lab network, enhance specimen transport, and improve communication between laboratories, health facilities, and drug warehouses. In particular, better information systems allow for facility benchmarking and/or financial incentives to be used to improve treatment outcomes. For example, given that the bulk NTP's resources are focused on treatment, actively benchmarking facilities' performance on notification rates, time-to-treatment initiation, loss-to-follow, and relapse rates and/or introducing performance-based payments tied to these measures would ensure that diagnosed patients can be monitored and cured more effectively. Combined with TB diagnostic and treatment protocols, the TB notification and management system can trigger prompts for follow-up visits, services, and pending tasks based on the information in each patient's profile. Improved case management could also be part of ongoing national data collection initiatives that use community health workers and mobile applications to facilitate daily workflow.

The hospital tariff and payment structure for TB services could also be revised to better incentivize desired behaviors. At secondary and tertiary care facilities, providers are paid a bundled amount (case-based rate) per visit which includes a visit fee, diagnostics, and treatment. Currently there is no inpatient payment rate for TB at hospitals; instead TB admissions are coded as respiratory infections, costing the system 8.5 to 14.8 times more than what it actually costs to treat a noncomplicated TB case as an inpatient. This presents a strong financial incentive to admit TB patients unnecessarily. Instead, introducing an inpatient payment code and tariff for TB that better reflects actual costs encourages outpatient treatment.

Similarly, the payment method for primary care providers could better encourage TB detection and notification and push care down from hospitals. While notification is mandatory for all providers, enforcement is weak. Importantly, only confirmed cases are notified. At the primary care level, the diagnostic testing fee is included under the National Health Insurance (JKN) capitation rate that is paid to all JKN contracted providers – both public and private. However, the budget for testing equipment, medical supplies, and technicians comes out of facilities' fixed operational budgets; this encourages an incentive therefore to refer to hospitals for diagnosis or forgo formal testing. In 2016, the most

common reason given for not doing a diagnostic test among puskesmas was lack of reagent and supplies (49 percent) while the unavailability of a medical lab analyst was most common for private clinics (41 percent). Private providers also resist referring patients for testing altogether because they do not want to lose business that comes with prescription treatments. It is estimated that 74 percent of initial care-seeking for TB occurs at private providers, but only 27 percent offer diagnostic tests. Given that TB is a priority program, introducing a fee-for-service type arrangement to encourage testing at the primary care level among both public and private providers may be another option to consider increasing earlier detection.

Without improvements in implementation efficiency, only at significantly higher spending levels does additional preventive therapy and active case finding become cost-effective. The suggested expansion pathway would be to first provide isoniazid preventive therapy (IPT) for latent TB among PLHIV; then expand GeneXpert coverage to ensure that health workers prescribe the correct treatment regimen for DS-TB and MDR-TB; and finally to carry out household contact tracing, including preventive therapy among adult contacts. As active case-finding has been limited to date, the data on yield (percentage of positive tests among those tested for TB) for different modalities of active case-finding has also been limited. Conception and trialing of active case-finding programs among additional high-risk populations including those with comorbidities beyond HIV and those in higher-risk settings (for example, boarding schools, urban poor) should be explored because they may have higher yields compared with testing in the general population and could potentially be introduced earlier in this sequencing.

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Appendix A: Program Details and Model Constraints

	Most recent reported spending (2017, IDR)	Unit cost (IDR)	Assumptions and constraints
TB prevention programs			
BCG vaccination	113 billion	25,000 per vaccinated child in puskesmas with government subsidy	Spending cannot decrease from 113 billion (NTP priority program).
Preventive therapy for latent TB (child contacts)	500 million	81,728 per child receiving preventive therapy, estimated at 213,000 per child with latent TB based on an assumption that 30 percent of child contacts have recently acquired latent TB based on findings from active case finding from the Roadmap Towards Eliminating Tuberculosis in Indonesia 2020-2030 (22).	Most recently reported (2017) approximately 7 percent of child contacts of active TB cases (7,681 children) received preventive therapy. It is estimated that maximum possible coverage with increased spending is 35 percent of child contacts (NTP estimate).
Preventive therapy for latent TB (adult contacts)	0	81,728 per adult receiving preventive therapy, estimated at 1,816,000 per adult with recently acquired latent TB, based on an assumption that 4.5 percent of adult contacts have recently acquired latent TB based on active cases found in Jakarta (23). There is high uncertainty concerning this value, but adults have lower susceptibility than infants, as well as having had previous exposure to TB in many cases, so the effective unit cost for preventive therapy in adults will be higher than children.	Most recently reported 0 percent of adult contacts of active TB cases received preventive therapy. It is estimated that maximum possible coverage with increased spending is 35 percent of adult contacts (NTP estimate).
Isoniazid preventive therapy (IPT) for latent TB among PLHIV	1.8 billion	292,552 per year based on continuous coverage (national TB program).	ART coverage among PLHIV capped at 34 percent, so maximum possible coverage of IPT among PLHIV is also 34 percent (NTP estimates).
Antiretroviral therapy (ART) for PLHIV	N/A (estimated 460 billion)	N/A (based on regional ART cost of US\$337 per person, estimated to be 4.5 million IDR per person per year)	Assumed that ART coverage will continue at most recently reported levels, because funding is not through the TB program and cannot be reallocated, but the impact of higher coverage is considered in additional scenarios.
Screening and diagnosis programs			

Passive case finding (private, nonprotocol)	15 billion	43,613 per person tested (national TB program). Estimated at 281 per capita per year in the population for this testing modality to be available for those who are symptomatic, given the current testing rate	20 percent of TB suspect cases are estimated to be screened in private sector without following the national TB testing protocols (Error! Reference source not found.) (based on NTP estimates). This may include diagnosis by clinical symptoms, x-rays, and/or smear tests.
Passive case finding where GeneXpert-based algorithm is not available	92 billion	91,714 per person tested (national TB program). Estimated at 590 per capita per year in the population for this testing modality to be available for those who are symptomatic, given the current testing rate	60 percent of the population (based on NTP estimates). This includes diagnosis by protocol-based tests such as cultures, smears and x-ray as defined in Error! Reference source not found. where GeneXpert machines are not available.
Passive case finding with GeneXpert-based algorithm	164 billion	491,858 per person tested (national TB program). Estimated at 3,165 per capita per year in the population for this testing modality to be available for those who are symptomatic, given the current testing rate	20% of the population (based on NTP estimates). This includes protocol-based testing using GeneXpert machines as defined in.
Contact tracing (household)	0	91,714 per person tested (typically through protocol-based testing without GeneXpert) Estimated at 2 million IDR per person diagnosed given an assumption of 4.5 percent yield based on a 2011 review of case contacts at a lung clinic in Jakarta. Because this study was carried out almost a decade ago and is geographically limited, it is important to collate evidence for any new implementations of active case finding studies.	Most recently reported coverage of household contact tracing is 0 percent. The maximum coverage achievable through this program was capped at 20 percent (based on NTP estimates).
Contact tracing (community)	0	91,714 per person tested (typically through protocol-based testing without GeneXpert). Estimated at 4 million IDR per person diagnosed given an assumption of 2.5 percent yield, as the midpoint	Most recently reported coverage of household contact tracing is 0 percent.

		between household contact tracing (4.5 percent) and the estimated prevalence of undiagnosed active TB among adults (0.4 percent). This assumption should also be revised should any new evidence become available.	The maximum coverage achievable through this program was capped at 10 percent (based on NTP estimates).
Active case finding (prisoners)	250 million	Based on reported diagnoses through this program, estimated cost per person diagnosed 2.2 million IDR. As many diagnoses are reported through puskesmas, actual cost per diagnosis may be lower.	Coverage capped at current levels (NTP estimated program could not be expanded).
Treatment programs			
Public primary (puskesmas), DS treatment	565 billion	1,919,751 per person treated including services and drugs (national TB program)	Currently 56 percent of DS-treatment costs, constrained to the range of 28% to 78% of DS-treatment costs.
Public hospital, DS treatment	250 billion	2,806,357 per person treated including services and drugs (national TB program)	Currently 25 percent of DS-treatment costs, constrained to the range of 12.5% to 63% of DS-treatment costs.
Private primary (clinic, GPs), DS treatment	13 billion	2,946,675 per person treated including services and drugs, estimated at 5 percent higher than public hospital costs (national TB program)	Currently just over 1 percent of DS-treatment costs, constrained to the range of 0.5 percent to 50 percent of DS-treatment costs.
Private hospital, DS treatment	173 billion	2,946,675 per person treated including services and drugs, estimated at 5 percent higher than public hospital costs (national TB program)	Currently 18 percent of DS-treatment costs, constrained to the range of 9 percent to 60 percent of DS-treatment costs.
Public hospital, directly observed treatment (DOT), MDR standard	67 billion	29,774,693 per person treated including services and drugs (national TB program)	Drug-resistant (DR-) TB was constrained to the latest reported budget level for two reasons: (i) Ethical constraints on equity of access suggest that we should not deny treatment to those with DR-TB despite the greater cost, and (ii) The NTP reports that funding sources for DR-TB are separated from DS-TB (funded by donors rather than government), so it would be logistically challenging to reallocate spending away from DR-TB. Spending may be reallocated between DR-treatment programs, but a minimum of 20 percent of MDR cases (29 percent of MDR spending) must continue to be treated through standard duration MDR courses.
Public hospital, DOT, MDR short	27 billion	18,206,034 per person treated including services and drugs (national TB program)	
Public hospital, DOT, XDR current	4.3 billion	59,549,386 per person treated including services and drugs (national TB program)	

Total targeted TB spending	1,486 billion		<p>This total excludes all other nontargeted costs that cannot be directly attributed to program implementation, as well as ART.</p> <p>For all programs, the minimum spending in the optimized allocation is 50 percent of the most recently reported allocation, based on discussion with the country team, to represent realistic constraints on rapid change between programs and personal preferences, for example, private treatment.</p>
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Six additional prospective and cross-cutting programs were considered as part of this analysis but were not included in the optimization due to insufficient data or estimates on the direct impact of these programs on TB diagnosis, treatment, or transmission.

<p>Prospective and cross-cutting programs (not modeled)</p> <ul style="list-style-type: none"> Active case finding (among high-risk groups including those from boarding schools and the urban poor) Strengthened management and more streamlined health information systems Performance-based provider payments Patient incentives Communication and advocacy Management and coordination

Appendix B: Detailed Optimization Results

Table B.1 and Table B.2 give the projected absolute number of new active TB infections and TB-related deaths in 2035 if the most recently reported spending (2017) or optimized allocations of that spending as defined in Table B.3 were projected from 2019 until 2035. The percentages given are the relative change from 2016 values under each scenario.

Table B.1: Differences Estimated for New Active TB Infections with Varying Resource Availability

New active TB infections	Optimized		Most recently reported spending	Optimized						
	60% 2019	80% 2019		100% 2019	120% 2019	140% 2019	160% 2019	180% 2019	200% 2019	400% 2019
Children 0-14 years	63,000 (-20%)	47,000 (-40%)	50,000 (-36%)	37,000 (-52%)	30,000 (-62%)	28,000 (-65%)	22,000 (-72%)	21,000 (-74%)	20,000 (-74%)	15,000 (-81%)
Females 15-64	278,000 (12%)	243,000 (-2%)	222,000 (-11%)	220,000 (-11%)	204,000 (-18%)	196,000 (-21%)	173,000 (-30%)	167,000 (-32%)	164,000 (-34%)	114,000 (-47%)
Males 15-64	342,000 (13%)	306,000 (1%)	284,000 (-7%)	282,000 (-7%)	265,000 (-13%)	256,000 (-16%)	231,000 (-24%)	224,000 (-26%)	220,000 (-27%)	161,000 (-54%)
Older adults 65+	105,000 (56%)	95,000 (41%)	89,000 (31%)	88,000 (30%)	84,000 (24%)	81,000 (20%)	74,000 (9%)	72,000 (6%)	71,000 (5%)	52,000 (-23%)
People living with HIV	52,000 (63%)	44,000 (39%)	40,000 (25%)	40,000 (24%)	36,000 (13%)	35,000 (8%)	31,000 (-3%)	30,000 (-7%)	29,000 (-9%)	24,000 (-26%)
Total (sum)	841,000 (15%)	735,000 (1%)	684,000 (-6%)	667,000 (-9%)	618,000 (-15%)	595,000 (-19%)	531,000 (-27%)	514,000 (-30%)	505,000 (-31%)	366,000 (-50%)

Table B.2: Differences Estimated for TB-related Deaths with Varying Resource Availability

TB-related deaths	Optimized		Most recently reported spending	Optimized						
	60% 2019	80% 2019		100% 2019	120% 2019	140% 2019	160% 2019	180% 2019	200% 2019	400% 2019
Children 0-14 years	4,000 (-21%)	3,000 (-47%)	2,000 (-53%)	2,000 (-62%)	1,000 (-73%)	1,000 (-76%)	1,000 (-84%)	1,000 (-86%)	1,000 (-87%)	<500 (-91%)
Females 15-64	55,000 (46%)	42,000 (10%)	34,000 (-9%)	34,000 (-10%)	29,000 (-22%)	27,000 (-28%)	21,000 (-43%)	20,000 (-47%)	19,000 (-49%)	13,000 (-67%)
Males 15-64	66,000 (13%)	49,000 (-15%)	41,000 (-30%)	41,000 (-30%)	35,000 (-39%)	33,000 (-43%)	26,000 (-56%)	24,000 (-59%)	23,000 (-61%)	16,000 (-73%)
Older adults 65+	21,000 (49%)	17,000 (19%)	14,000 (-1%)	15,000 (2%)	13,000 (-11%)	12,000 (-16%)	10,000 (-33%)	9,000 (-37%)	9,000 (-39%)	6,000 (-56%)
People living with HIV	23,000 (74%)	19,000 (46%)	17,000 (25%)	17,000 (28%)	15,000 (13%)	14,000 (7%)	9,000 (-29%)	9,000 (-33%)	9,000 (-35%)	7,000 (-49%)
Total (sum)	169,000 (32%)	130,000 (2%)	108,000 (-16%)	108,000 (-16%)	94,000 (-27%)	87,000 (-32%)	67,000 (-48%)	62,000 (-51%)	60,000 (-53%)	42,000 (-67%)

Table B.3: Optimized Spending Allocation with Varying Resource Availability. All Values in Millions of IDR (Indonesian Rupiah)

TB program	Optimized 60% 2019	Optimized 80% 2019	Most recently reported spending	Optimized 100% 2019	Optimized 120% 2019	Optimized 140% 2019	Optimized 160% 2019	Optimized 180% 2019	Optimized 200% 2019	Optimized 400% 2019
Active case finding (prisoners)	180	240	250	310	250	290	220	250	250	250
Contact tracing (community)	0	0	0	0	0	0	0	0	0	41,000
Contact tracing (household)	0	0	0	0	0	0	160,000	180,000	190,000	145,000
Passive case finding where Xpert based algorithm is not available	21,000	28,000	92,000	34,000	97,000	110,000	81,000	91,000	99,000	0
Passive case finding (private non-protocol)	20,000	26,000	15,000	33,000	20,000	23,000	11,000	12,000	5,500	0
Passive case finding with Xpert based algorithm	99,000	130,000	160,000	160,000	170,000	200,000	190,000	210,000	230,000	822,000
IPT for Latent TB (HIV)	1,100	1,400	1,800	1,800	28,000	32,000	25,000	28,000	28,000	29,000
Preventive therapy for Latent TB (adult contacts)	0	0	0	0	0	0	0	0	0	1,676,000
Preventive therapy for Latent TB	23,000	31,000	500	39,000	100,000	120,000	110,000	120,000	130,000	156,000

(child contacts)										
Public hospital, DS treatment	100,000	140,000	250,000	170,000	220,000	260,000	320,000	360,000	420,000	510,000
Public primary (Puskesmas), DS treatment	440,000	580,000	570,000	730,000	730,000	850,000	910,000	1,000,000	1,100,000	1,345,000
Private primary (clinic, GPs), DS treatment	4,400	5,900	13,000	7,400	11,000	13,000	16,000	18,000	21,000	26,000
Private hospital, DS treatment	60,000	79,000	170,000	99,000	140,000	170,000	220,000	240,000	280,000	345,000
Public hospital, DOT, MDR standard	16,000	22,000	67,000	27,000	34,000	39,000	46,000	51,000	57,000	114,000
Public hospital, DOT, MDR short	40,000	54,000	27,000	67,000	82,000	96,000	110,000	130,000	140,000	280,000
Public hospital, DOT, XDR current	2,500	3,400	4,300	4,200	4,300	4,300	4,300	4,300	4,300	4,300