**Summary of the support given by quantitative modelling, for country and global level policy and practice TB decisions (2017-2021)**

**TB MAC 2021\_08\_22**

Quantitative modelling evidence has supported numerous country and global level policy and practice decisions since 2017.

This document only contains examples for which a document or statement is available from countries, showing a link between a modelling activity and a policy or practice decision. Statements or publications from modelling groups were excluded as evidence. The evidence was identified from narrative literature review on documents from 2017-current by TB MAC, and an independent survey by Logical Outcomes of 10 countries (Full report in Appendix below), both carried out in 2021. More details are available on request.

**Global burden and strategies**

* Modelling was used to support advocacy on impact and mitigation of COVID on TB at [global](https://drive.google.com/file/d/17Paqw7bvYrI_BBbXDO2KjWnMtjW3fk5a/view?usp=sharing) and country level (eg [1](https://www.who.int/publications/i/item/9789240013131), [2](https://drive.google.com/file/d/17Paqw7bvYrI_BBbXDO2KjWnMtjW3fk5a/view), [3](https://docs.google.com/document/d/1NOTV1NN24fMPqusYmrqKHLxnPsre94oH5la7ImLeoB4/edit?usp=sharing)). At least eight countries have now expressed an interest in additional planning support (Bangladesh, India, Indonesia, Malaysia, Myanmar, Nepal, Peru and Zimbabwe). 2020
* Modelling is used by WHO each year to estimate [global and country level TB burden](https://www.who.int/publications/i/item/9789240013131), 2020, including, this year, to estimate the impact of COVID on TB burden, 2021 (ongoing)
* Modelling was used by GFATM to inform the TB [Investment Case](https://www.theglobalfund.org/media/8279/publication_sixthreplenishmentinvestmentcase_report_en.pdf?u=636852020830000000), 2019
* Modelling was used by StopTB to inform the [Global Plan](http://www.stoptb.org/global/plan/plan1822.asp), 2018
* [Modelling](https://drive.google.com/open?id=15DQyBSAcWF9yduwjyNXyRl-jINIiifY_) was used to update estimate of [WHO global burden of LTBI](https://drive.google.com/file/d/1MnBOX17y-RHZ5KFOowdXASa20inr6KpO/view?usp=sharing) ([from ⅓ to ¼](https://drive.google.com/open?id=15DQyBSAcWF9yduwjyNXyRl-jINIiifY_)), 2018

**New tools**

* Modelling provided evidence to WHO to develop [consensus document](https://www.who.int/tb/areas-of-work/research/m72as01_clinical_development_who_meeting_report_final.pdf?ua=1) on clinical development pathways for M72 vaccine, 2019
* [Modeling and cost-effectiveness analysis](https://drive.google.com/file/d/1Q1k8tsZLqfEwC2S-pJnqiO2p-nfeX7XC/view) supported change to WHO guidance recommending use of LF-LAM for diagnosis and screening of active tuberculosis among people living with HIV ([1](https://apps.who.int/iris/bitstream/handle/10665/329512/WHO-CDS-TB-2019.19-eng.pdf)), 2019
* Modelling used to support new [European policy for latent TB treatment](https://drive.google.com/file/d/1sJeFi6xN9dUYV2wHwbQHuHDgTV5Nj16S/view), 2019
* Modelling work was used [to support development](https://www.who.int/immunization/sage/meetings/2017/october/2_EvidencetoRecommendationFramework_BCG.pdf) of the [WHO Preferred Product characteristics for new TB vaccines](https://apps.who.int/iris/bitstream/handle/10665/273089/WHO-IVB-18.06-eng.pdf?ua=1) ([1](https://www.pnas.org/content/111/43/15520), [2](https://www.ncbi.nlm.nih.gov/pubmed/27448625)), 2018.
* [Modelling](http://bmcmedicine.biomedcentral.com/articles/10.1186/s12916-016-0685-4) was used as evidence to support the retention and strengthening of the WHO recommendation of BCG vaccination at birth or at the earliest opportunity thereafter ([WHO evidence-to-recommendation](https://www.who.int/immunization/sage/meetings/2017/october/2_EvidencetoRecommendationFramework_BCG.pdf), page 2 and [WHO SAGE report, page 4](https://www.who.int/immunization/sage/meetings/2017/october/1_BCG_report_revised_version_online.pdf)), 2017
* Modelling on the [impact of BCG shortages](http://bmcmedicine.biomedcentral.com/articles/10.1186/s12916-016-0685-4) was used as evidence to support the need to “pre-empt vaccine shortages” within the [WHO SAGE BCG recommendations (page 37)](http://www.who.int/immunization/sage/meetings/2017/october/1_BCG_report_revised_version_online.pdf), 2017
* [Modelling](https://pubmed.ncbi.nlm.nih.gov/28045934/) was used to support new [WHO policy on shorter regimens Drugs TRP/PPCs](https://apps.who.int/iris/bitstream/handle/10665/250044/9789241511339-eng.pdf?sequence=1&ua=1) , 2017

**Country and within-country level**

**2021**

* **Rwanda:** TIME model evidence was used to support selection of interventions to scale up that may lead to highest impact on TB incidence and mortality - TB screening among high risk groups, and expanded use of molecular test and chest x-ray - for a [Global Fund funding request](https://drive.google.com/file/d/1o3uphVXoWUM85-sO1hl_zqiVE9YHsYaE/view) (page 20)

**2020**

* **Indonesia.** Modeling evidence used to support setting national 2020-2024 NSP and subnational TB burden using SUBSET tool ([personal communication from Imran Pambudi, NTP manager](https://docs.google.com/document/d/1Z3ciTZL5hAj8kzSoo47cOnC5eCNlQPcKviKvXnIxmr8/edit?usp=sharing))
* **Indonesia:** TIME model evidence was used to support selection of intervention coverage targets to meet the End TB Goals using estimated ICERs for a [Global fund Funding request](https://drive.google.com/file/d/1VXwsJTmcJW-s1RFSiyWkIuYFnneJrYpT/view) (page 10)
* **Bhutan:** AutuMN modelling evidence used to support NTP aim of aminimum of 1000 cases per annum of active TB diagnosed and treated for the next five years, with at least 10% of these through active case finding activities in [Funding request form 2021-2024](https://drive.google.com/file/d/1vnO_xnKRifawVQGGFI59w03IGHB9fKiT/view?usp=sharing) (page 23)
* **Ghana:** The TIME model evidence was used to support setting impact targets for prevalence, incidence, mortality and outcome target case detection and treatment coverage for Ghana’s [Global fund Funding request](https://drive.google.com/file/d/18PKEeHE10OhMJfpXiii-HKGMgON80Peu/view) (pg17 & 20)
* **Uganda:** Modelling evidence used to support setting [NSP target populations and services coverage (see pages 69, 100-104)](https://drive.google.com/file/d/1ak9uMWSlXGV6XPVhozUwDoadDGTabgI9/view?usp=sharing). Used alongside People-Centred Framework (PCF). NTP intends to use modelling in decision making during plan
* **Viet Nam:** Modelling evidence used to support setting [NSP Active Case Finding targets (page 97)](https://drive.google.com/file/d/1y5EOwlseFWCaKloxw1DDxIFDcfzHo0N9/view)
* **Ethiopia:** Modelling evidence supported [National Strategic Plan (page 125-8)](https://drive.google.com/file/d/1q-o5Q-TvliaTUcZ7Qttp474clqgylVGR/view?usp=sharing) by identifying interventions for prioritisation eg move away from only prioritising GeneXpert expansion to include chest x-rays for screening, and prioritising household contact tracing
* **Rwanda:** Impact and CE modelling evidence used to support selecting between intervention package and supporting policy change to TPT among PLHIV in NSP; creating a ‘data based GF funding request’; and mobilize funds through another partner to fund the expansion of use of molecular test as initial diagnostic ([email from NTP](https://docs.google.com/document/d/1xiwYQQzOgnQOCbWzH9u2QXpBl02X54MjxQjp7LY1H0o/edit))

**2019**

* **Mongolia:**  Modelling study used to support change in National guidelines to include GeneXpert as a initial test to replace smear microscopy for detection of MDR- TB and to halt transmission (page 4), TB epidemiology modelling evidence was also used to determine priority areas and areas of improvement for the TB response (page 13) for [Funding request Form Mongolia 2020-22](https://drive.google.com/file/d/1tcszd5JewfaHgPLeMNXs_e0TbfryDPhl/view?usp=sharing)
* **Bangladesh:** SEARO modelling evidence was used to assess the potential impact of alternative interventions and support setting the country's case detection ratio to 90+% by 2020 in [Funding Request Form 2020-22](https://drive.google.com/file/d/1J6l2AlNTPMYt-YA16_nuBjM__sxYCBjl/view?usp=sharing) (page 20-21)
* **Malawi**: Modelling evidence used to inform the differentiated HTS strategy for the 2020-25 NSP and support prioritization in the [Funding request 2020-2022](https://drive.google.com/file/d/12buaVeJlFHT2tQsZUImeIHxLJc9l0r3k/view?usp=sharing) (page 6)
* **Mozambique:** Optima modelling evidence was used to support setting targets for TB incidence (page 2), TB treatment coverage (page 5), total number of newly notified TB cases registered (page 9), TB treatment success (page 10) and newly identified MDR/RR-TB cases (page 11) in [Global Fund performance framework indicators](https://drive.google.com/file/d/1SghP6eYYMvWjMmimz7c2DEISTBb5mEL3/view?usp=sharing)

**2018**

* **Mozambique:** TB targets for incidence, prevalence and mortality were set supported using evidence from a model developed by NTP and CDC (with plan to update with TIME model) for [global fund performance framework indicators](https://drive.google.com/file/d/1CYA-y3Dzhwo3mNOHL-dkRbQ54gd4nV_D/view) (page 1)
* **Kenya**: Modelling evidence was used to calculate ICERs and for resource optimisation, as well as support the calculation of impact targets and priority setting in the [National Strategic Plan 2019-2023](https://drive.google.com/file/d/1z2SE14z6Jr9CVuPCK2v02rFw8cN8kIh7/view?usp=sharing) (page xxii and 104-109)

**2017**

* **Nigeria:**  Modelling evidence was used to support identification of populations for targeted TB intervention [Funding Request application form 2018-2020](https://drive.google.com/file/d/1FmTStzJA_jQrnKG9V6VoCf-uVA6FsRaJ/view?usp=sharing) (page 12/13)
* **Sri Lanka:** Modelling evidence used to identify interventions to reach End TB targets in the [NSP (page 15)](https://drive.google.com/file/d/1c80C8lfwpJYNpB5OzjPrwuD-LjEVmTqs/view?usp=sharing)
* **Nigeria:** Modelling evidence used to evaluate impact of a range on interventions and support prioritization of ACF in GFATM funding request note and [Epi review report (page 56-9)](https://drive.google.com/file/d/1QixYv6YaykI7hhWVm2cv9tKNKnwkj27V/view)
* **Indonesia:** TIME model evidence used for TB roadmap, strategic and programmatic decision making (Pg 32), including: to develop epidemiological profiles including for vulnerable populations (pg 3), to estimate the impact of achieving targets on TB incidence (pg 24), to estimate the impact of the rapid scale-up of Xpert testing and treatment on the MDR-TB (page 36) for [Global funding reques](https://drive.google.com/file/d/1PVhjEtGzzp6xesw0xlPpqRJ_e_mXGhxU/view)t
* **Viet Nam:** TIME model evidence was used to develop targets for TB detection in the general population to reach NSP targets (page 15) for [Funding request 2018-20](https://drive.google.com/file/d/1li_-0A_bpkVwkuHjeF0xppUbH8dSyzqH/view?usp=sharing)
* **Bangladesh:** TIME model evidence used to estimate impact of alternative interventions to reach End TB targets [Funding request application form 2018-2020](https://drive.google.com/file/d/10yob54A1fFZSIyobMe1u20aibz2aKX7P/view?usp=sharing) (Page 8-9) and estimate impact on TB incidence [Performance framework](https://drive.google.com/file/d/1hWM1IStH1WHu1tHf-PjBUs9PIQfdOdQE/view?usp=sharing) (page 1)
* **Bhutan:** Modelling evidence used to identify maximum impact of selected interventions in [Funding request 2018-2021](https://drive.google.com/file/d/1tONk-TCkLxXcFp9jxhBK904NjKenwO_d/view?usp=sharing) (page 10)

**Appendix - LogicalOutcomes report**

**ASSESSMENT OF USE OF TB MODELLING**

**FOR COUNTRY-LEVEL POLICY DEVELOPMENT AND DECISION MAKING**

**FINAL REPORT**

**JUNE 1, 2021**

**CONTACT: MARTHA MCGUIRE**

# **Abbreviations**

BMGF Bill and Melinda Gates Foundation

BRR Benchmarking, Reporting and Review Framework

GDRP General Data Protection Regulations

GF Global Fund to Fight AIDS, Tuberculosis and Malaria

ICER Incremental cost effectiveness ratio

NTP National Tuberculosis Program

OECD-DAC Organization for Economic Cooperation and Development/Development Assistance Committee

PCF4NSP People-Centred Framework process for National Strategic Planning

PIPEDA Personal Information Protection and Electronic Documents Act

RSC Country-level TB Modelling Roadmap Steering Committee

TB Tuberculosis

TB MAC TB Modelling and Analysis Consortium

UNEG United Nations Evaluation Group

WB World Bank

WHO World Health Organization

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# **Introduction**

## **The TB Modelling and Analysis Consortium (TB MAC)**

TB MAC aims to *increase the effectiveness and efficiency of TB care and prevention policy and practice by:*

* *building stronger and more effective links between decision makers, modellers, economists and subject matter experts*
* *creating new, high quality modelling resources, and making them available and accessible to decision makers, and*
* *enabling better informed decision making communities and modellers, and ensuring TB decision makers are better equipped to integrate these modelling resources in their decision making[[1]](#footnote-1)*

TB modellers have been working with over 40 different countries to inform strategic planning and decision-making, using different model applications in each (TIME, Imperial, Optima and AuTuMN). Four different funders are involved: World Bank (WB), Global Fund to Fight AIDS, Tuberculosis and Malaria (GF), USAID, and the Bill and Melinda Gates Foundation (BMGF). TB MAC’s activities to support this modelling include:

1. *Identifying high priority research questions concerning TB control that require input from mathematical modelling or other quantitative research*
2. *Facilitating sharing of data, information and expertise to achieve consensus on current knowledge and knowledge gaps, methodological standards and current best practice for TB control decision making*
3. *Funding small analytical/modelling research projects*
4. *Disseminating results and tools to key stakeholders including TB control programmes and donors.[[2]](#footnote-2)*

The GF and BMGF are in the process of evaluating the People-Centred Framework process for National Strategic Planning (PCF4NSP) on behalf of the Country-level TB Modelling Roadmap Steering Committee (RSC). As part of this initiative, GF and BMGF wish to evaluate country-level TB modelling activities that have taken place both within the PCF4NSP process and outside of it. The framework’s aim is to facilitate a systematic approach to country-led, data-driven and people-centred planning, prioritization and decision-making.

The aim of the people-centred framework is to help countries to develop fully prioritized and budgeted NSPs based on a culture of making full use of the available data, which are aligned with national planning cycles and which provide the basis for a robust national response that can accelerate progress towards the goal of ending TB. In addition, applying the framework for other possible applications according to the country’s planning and policy cycle encourages the culture of data utilization and evidence translation into decision-making and planning.[[3]](#footnote-3)

## **Modelling in Each Country**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Previous application years | Model application | Part of PCF | BRR country | Funder |
| Ethiopia | 2016, 2020 | TIME | Yes |  | GF |
| India | Ongoing | Imperial |  |  | Gates |
| Indonesia | 2017, 2019, 2020 | TIME |  |  | GF |
| Kenya | 2019 | Imperial | Yes | Yes | Gates |
| Malawi | 2020 | Optima | No |  | WB |
| 2019 | TIME |  |  | GF |
| Mongolia | 2019 | AuTuMN |  | Yes | GF |
| Mozambique | Ongoing | Optima |  | Yes | WB |
| Nigeria | 2017, 2019, 2020 | TIME |  |  | GF |
| Pakistan | 2017, 2020 | TIME |  |  | GF |
| South Africa | 2015, 2016, 2017, 2020 | TIME |  |  | GF |

## **Descriptions of Models**

Models are highly technical tools that use assumptions based on existing data. The models are used to project things like TB incidence, effectiveness of an intervention, or efficiency of an intervention, and can be used by funders and counties to optimize investments. Any model is only as effective as the accuracy of the data underlying the assumptions. Following is a brief description of the four ‘models’ used by the countries in this review.

**AuTuMN** is the acronym for Australian TB Monitoring Network, a group that does TB modelling based in Australian. It is not a single model, rather models are developed to fit the need.

**Imperial** is also not a single model, but the name of the group that does TB modelling. Similar to AuTuMN, models are developed to fit the need.

**Optima** can produce projected levels of impact informed by country-based evidence.

**Time** is an established model for TB. It is primarily used for estimating the impact of interventions.

## **Purpose of the Evaluation**

This study will look at the extent to which epidemiological and economic modelling has supported better policy development and decision-making in ten of the countries using modelling. It is intended to explore the results chain and better understand the contribution that modelling makes.

As stated in the request for proposal (RFP), the primary purpose of this evaluation is to:

* identify the decision(s) that would not have been as well supported/been different if modelling was not used, and gather evidence to support this claim
* gather detail on how the modelling was used to support the decision, including the extent to which the modeling work adhered to recommended approaches
* assess the satisfaction of decision makers with modelling technical assistance

## **Key Evaluation Questions**

The key evaluation questions used to guide this review are:

1. What areas was modelling used to assess (including estimate of epidemiological and/or cost impact of interventions, annual costs of intervention strategy, incremental cost effectiveness ratio (ICER) per intervention compared to the status quo, allocative efficiency)?
2. What evidence is there that modelling supported that decision, such as citation in a policy document or NSP?
3. How were the modelling results actually used to inform the NSP/Global Fund funding request, including what decision would not have been as well supported/been different if modelling was not used?
4. How was the relationship with NTP established?
5. What drove the development of policy questions?
6. How useful was the epidemiological and economic modelling perceived to be?
7. How satisfied was the NTP/other stakeholders with the process and the support provided?

# **Overview of Methodology**

## **Data Collection Methods**

#### *Desk Review*

The list of documents reviewed is in Annex A

#### *Interviews*

Effort was made to interview modellers and the National TB Programme (NTP) staff for each of the countries. This was not always possible because some were too busy supporting efforts to address COVID-19 in their countries. In some instances the funders provided insights into the country’s use of modelling. The list of people interview by country is in Annex B.

## **Analysis and Synthesis of the Data**

Content analysis was used to determine emerging themes in relation to each evaluation question. The data was synthesized at the country level, then rolled up into a consolidated evaluation report. The findings matrix is attached in Annex C.

## **Strengths and Limitations**

### **Strengths**

The narrow focus of this study allowed in-depth exploration of the contribution that economic and epidemiological modelling makes to policy development and decision-making in the countries where it is used. It allowed exploration of the process elements that contribute to improved policy development and decision-making, supporting the development of grounded theory which can be tested further. It allowed exploration of the sustainability of modelling in the countries in which it was occurring.

### **Limitations**

This study uses qualitative data only (existing documents and interviews). It provides an initial look at how modelling is being used in each of the countries. While it may support the development of grounded theory, it will not be possible to draw strong conclusions from this review.

Reaching the relevant people internal to the country was extremely difficult because of COVID-19. In some countries, we were unable to reach anyone in the NTP (Kenya, Ethiopia, Mongolia, South Africa).

# **Findings**

## **Findings by Country**

### **Ethiopia**

Information is limited for Ethiopia, as NTP staff were unavailable for interview. Information was obtained from the modeller, the national strategic plan and the Global Fund application. Ethiopia was an early adopter of modelling for Tuberculosis and began using the TIME model in 2016 to support intervention decision-making and funding requests. TIME modelling was used to support an Epidemiological Review in 2018, as well as a review of the TB National Strategic Plan. Modelling has also been used to inform Global Fund funding request.

Ethiopia has recently conducted a costing review for TB interventions, which enabled cost-effectiveness modelling and the prioritization of resource allocation.

The Global Fund application for Ethiopia refers to investing in cost-effective interventions to increase domestic resources for health to enable greater efficiency and effectiveness of health spending. However, this is not specific to TB, and there is no explicit reference to the use of TB modelling to support this.[[4]](#footnote-4)

### **India**

Information was obtained from modellers, the NTEP, numerous articles, and the Global Fund application. India is quite advanced in the use of modelling for decision-making. According to staff in the National TB Elimination Program (NTEP), they have been using modelling since 1956 to project TB incidence at the national level. In an effort to carry out more accurate and sophisticated modelling, they contacted Imperial, who has now been working with India since 2013, building a collaborative trust relationship and India’s capacity to do its own modelling. They regularly put out calls for academic research papers using modelling. The acceptance decisions are made by a group including the NTEP and Imperial.

Two Imperial mentees are now working within the NTEP. India takes the lead in determining the issues to be addressed. Some examples of use include:

* National Strategic Plan 2017 – 25 which makes direct reference to the use of modelling: *Early modelling exercises show that increased coverage of care both in public and private sector will result in a decline by roughly half the TB incidence in the country over a decade. Activities to address determinants of TB such as urbanization, housing, malnutrition, and interventions such as active case finding in high risk population, are expected to further reduce the incidence. Ongoing analysis is incorporating these interventions to understand the additional reduction in incidence that may be possible and commensurate activities to achieve the ambitious goals of this NSP.[[5]](#footnote-5)*
* Presentation by Nimalan Annamipathy to the Ministerial Meeting Towards Ending TB in Southeast Asia hosted by WHO South East Asia Regional Office*: Preliminary results of a mathematical model of tuberculosis transmission dynamics in the 11 WHO South-East Asia Region countries, presented at the meeting, shows impact of three sets of interventions—strengthening existing tuberculosis services, accelerating case detection, and implementing preventive therapy. Comprehensive adoption of all proposed interventions will require additional annual average spending of US$0·90 per person between 2017 and 2035, and will be cost-effective, according to the model. “The modelling exercise highlights that we need a substantial escalation of interventions. Countries need to fix fragmented health-care systems and assure high-quality TB services wherever TB patients seek care, take intensified measures to detect TB cases early, and fully engage the private sector”.[[6]](#footnote-6)*

Several articles were published in peer-reviewed journals providing information on the issues explored through modelling. These were not necessarily tied to policy decisions although both the modeller and NTEP staff reported the modelling is used to make decisions regarding the following:

* Determining the potential for new drug regimens
* Gaining a better understanding of what is needed at a sub-national level
* Assessing the effect of moving towards private sector engagement in a systematic manner.
* Assessing the impact of investment in and scale up of interventions
* Projecting the effect of bringing in GeneXpert.
* Exploring the best ways to address latent TB
* Looking at the relative contribution of different interventions in addressing the disease

### **Indonesia**

Information was gleaned from the modeller, the NTP, local WHO representative, the national strategy and the Global Fund application. Indonesia has used Tuberculosis modelling to inform the development of both their Global Fund funding concept note for 2018-2020 and for the development of their National Strategic Plan for TB control. In 2019, the TB sub-directorate of the Indonesia Ministry of Health planned to renew the TB Control Strategic Plan for 2020-2024. Using the WHO People-centred framework as a guide, the MoH engaged external consultants and the London School of Hygiene and Tropical Medicine to conduct TB modelling for programme planning. In both cases, Indonesia used the TIME model. Scenario analyses for interventions primarily focused on the expansion of screening and diagnostic algorithms, and the increased use of GeneXpert. TB prevention interventions were also modeled; however, this analysis was limited. Indonesia is also exploring the use of the Optima model to inform the optimization of strategic interventions for TB. Simple modelling has also been used to calculate estimates for sub-national incidence, contributing to prioritization for local intervention. Following the development of the Indonesia NSP, the NTP is prioritizing detection and notification interventions.

The following intervention priorities were modelled:

* Managing latent TB
* Screening of TB high-risk groups
* Achieving a high level of confirmed bacteriological diagnosis
* Expand use of molecular rapid tests
* Increase resource investment to improve TB services

Indonesia maintains a strong research group within the country and is actively working to model HIV burden and interventions as well. However, modelling expertise within the NTP is limited, and external consultants must be engaged to perform modelling work. Due to the complexity and timeframe needed to perform comprehensive modelling, the NTP indicated that in the future it would be better to begin modelling analyses before the process for NSP development is begun.

The Global Fund application (see Annex F) for Indonesia describes the use of TIME modelling to optimize target selection for five key indicators in order to achieve the NSP TB incidence reduction target for 2020-2024:[[7]](#footnote-7)

1. Expansion of diagnosis using molecular rapid diagnostic by 75%;
2. Coverage of treatment of 90%;
3. Treatment success rate of 90%;
4. Coverage of TPT among household contacts by 68% in 2024, and
5. The coverage of TB screening among DM patients of 40%.

### **Kenya**

Information regarding Kenya is limited to that provided by the Global Fund, the Imperial modeller and a review of the National Strategic Plan (NSP). Kenya contacted Imperial for modelling to support their NSP. The acknowledgements section of the NSP makes reference to the contribution made by the Imperial College. Further the NSP indicates*: Mathematical modelling of impact was applied in combination with cost models to consider the Incremental Cost-Effectiveness Ratios of interventions. A sub-set of interventions were selected to optimise the impact of available resources on the epidemic overall and for selected special populations. Reduced impact targets aligned to the reduced level of effort are presented.[[8]](#footnote-8)*

The NSP indicates that modelling will be used to support programmatic management of drug-resistant tuberculosis.[[9]](#footnote-9) It specifically refers to the use of modelling for setting priorities in the NSP: *Mathematical modelling of Kenya’s TB epidemic was completed to project the potential epidemiological impacts and cost-effectiveness of different measures in Kenya’s National Strategic Plan 2019 - 2023. Quantifications of the impact took into account the direct benefit of TB care for people with TB as well as the indirect benefits experienced by others in the community due to reduced opportunities for transmission.*

Global Fund staff reports that modelling helped to produce a robust plan and the Global Fund application provided three possible funding scenarios, with projections for each scenario. Frequent reference is made to the NSP in their funding application to Global Fund. See Annex F.

### **Malawi**

Information was obtained from the modellers, the NTP and the Global Fund application. The NTP in Malawi contacted Optima and led the decision-making process. The process followed by Optima included a scoping trip to understand potential uses of Optima. Optima developed the concept and reviewed with NTP. They provided training in South Africa to Mozambique and Malawi on the use of modelling. Malawi currently does not have the capacity to do their own modelling

Malawi had been using TIME, but began using Optima in order to help refine their projections at the sub-national level. They used three districts (high, medium and low burden) to help them project the needs of districts with similar burden levels. NTP staff report that they have used the modelling to:

* Help make intervention decisions at the sub-national level
* Optimize their investments
* Determine the effect of COVID-19 on TB treatment
* Support their Global Fund application

It was not used in their strategic plan as that was completed prior to the modelling work. Their funding request to Global Fund states: *Malawi has completed 3 comprehensive modelling and estimation exercises to inform the differentiated HTS strategy for the 2020-25 NSP, and the prioritization in this funding request[[10]](#footnote-10)* and *Investments prioritised for funding were selected based on evidence based in line with NSP modelling findings.[[11]](#footnote-11)* See Annex H.

### **Mongolia**

The information on Mongolia was gleaned from funders, modellers and the GF funding application. National Centre for Communicable Diseases (NCCD) staff were unable to contribute because of COVID-19 demands. Modellers from AuTuMN worked with the NCCD to determine the uses of modelling. The NCCD led the process, obtaining input from country stakeholders. NCCD approached AuTuMN after hearing a presentation at a conference. The modeller reported that modelling was used to support Mongolia’s Global Fund application and to better understand the trends of TB for people living in gherts and what preventive interventions are needed. The local Global Fund staff reported that modelling has been used to determine the need for GenXpert to support active case findings in the ghert population and the effectiveness of the TB short regimen.

The Global Fund application (see Annex I) makes reference to the AuTuMN modelling exercise:

* *The revised NTP TB guidelines, currently under revision, will include TB Prevention Therapy (TPT) for all contacts. This is in line with the AuTuMN report of 2020*[[12]](#footnote-12)
* *A recent modelling study suggested to use the GeneXpert, as a front-line diagnostic test, replacing smear microscopy to improve the detection of MDR-TB and to halt transmission[[13]](#footnote-13)*
* *The determination of priority areas and areas for further improvement of the TB response was predominantly guided by findings of recent studies, estimations and evaluations* including the 2020- TB Epidemiological Modelling report[[14]](#footnote-14)

### **Mozambique**

Information for Mozambique was obtained from modellers, the NTP and the Global Fund application. The World Bank had suggested using Optima for modelling. NTP saw that it had worked well in Malawi so decided to try it in Mozambique. The head of the NTP was very involved in the process. The process used was similar to Malawi: first a scoping exercise followed by training. Modelling was used to determine:

* The efficiency of TB interventions
* Support the application to Global Fund
* Determine targets related to TB monitoring indicators
* Support the development of the strategic plan (not able to share because it has not been completed)

The Global Fund application (see Annex J) indicates: *To make strategic investment decisions, the prioritization of modules and interventions in this funding request was guided by scenario modelling[[15]](#footnote-15).* The performance monitoring framework accompanying the application also indicates the used of modelling:

* *This indicator assesses country performance in detecting cases of TB and enrolling them in treatment. The numerator is based on Optima modelling data that shows cases peak in 2022 and then it begins to fall in 2023. The denominator is based on modelled estimates of total new TB cases of all forms for the same year. Population levels of TB burden are currently unknown.*
* *This indicator measures the total number of newly notified TB cases registered in the health care system during the reporting period. The target is based on Optima modelling estimates that show that cases peak in 2022 and begin to fall in 2023. The denominator is based on total estimated cases.[[16]](#footnote-16)*

### **Nigeria**

Information was obtained from modellers, the NTP and the Global Fund application. In 2016, the Nigeria NTP was looking for a method to estimate TB burden in the country. This led to the development of a relationship with the London School of Hygiene and Tropical Medicine (LSHTM), and an ongoing engagement to use the TIME model to inform TB estimates and intervention impact. TB modelling has not been used in the development of the Nigeria NSP; however, it was used to inform an epidemiological analysis and the Global Fund concept note in 2017. The epidemiological analysis primarily focused on case-finding interventions and drug-resistant TB. In 2018, Nigeria updated the model and generated current situation analyses of the country’s TB programme, which enabled the modelling of selected interventions for the 2019-2020 Global Fund TB grant. These interventions included the rollout of a new diagnostic algorithm, expanded contact tracing, improved drug susceptibility testing coverage, and outpatient department screening. This work supported the allocation of resources and selection of control strategies in Nigeria, has enriched the decision-making process, and enabled Nigeria to better understand the TB situation in-country.

The Nigeria Global Fund application for 2020 does not reference the use of modelling to support decision-making for TB policy and interventions, however it is stated that the impact and cost-effectiveness of interventions to bridge notification gaps for TB were used in informing intervention selection.[[17]](#footnote-17)

### **Pakistan**

Information came from modellers, NTP, the national strategic plan and the Global Fund application. Pakistan has been using modelling to support their TB control activities since 2017, when they used a simple model to estimate the cost of their national TB programme and to select a plausible TB notifications target. As of the Fall of 2019, Pakistan has maintained a mature modelling engagement with external consultants during an update their TB NSP and to support their Global Fund concept note. Pakistan is unique in that their health system is very decentralized, with multiple provincial health departments that decide their own disease control priorities.

There is no evidence of use of TB modelling in their Global Fund application. As reported in an interview with a Pakistan NTP representative, TB modelling in Pakistan has underlined the impact of improved case detection, and as such the NTP is prioritizing case detection interventions. Modelling activities have also led to a decision to change the TB diagnostic algorithm used, and to expand the use of GeneXpert machines. Alongside intervention modelling, KIT Amsterdam has assisted the Pakistan NTP to model prevalence at the sub-national and district levels to enable prioritization of interventions where prevalence is high but case detection is low.

Overall, the Pakistan NTP is very satisfied with support from external consultants, organizations and particularly the Global Fund. International efforts have been well coordinated to support Pakistan in their modelling efforts. However, Pakistan has some unique barriers to the use of modelling for TB interventions. The primary challenge in Pakistan is that the scale of the unregulated private sector health system where many TB patients seek care and reporting is limited. Pakistan has also reported that there is limited funding for the development of local modelling expertise to assist in further modelling activities.

### **South Africa**

Information was obtained from modellers, the monitoring and evaluation plan for the NSP, and the Global Fund application. South Africa maintains a high level of local capability to manage TB modelling activities. Although the South African Ministry of Health does not have a dedicated TB Control Programme, many local institutions provide support for both TB and HIV modelling. It was reported in interviews that the use of the TIME model informed the development of a TB Investment Case, as well as the South Africa Global Fund concept note. Alongside the University of Cape Town and other external partners, South Africa is working towards the development of their own TB model that better fits the local context of their TB control priorities, is better aligned with the format and availability of TB data in the country. The MoH is working to introduce new TB screening strategies, expanded active case finding, and follow-up for patients who were previously treated for TB.

Although it was reported in interviews that TB modelling has supported the South Africa Global Fund concept note, there is no reference to TB modelling in the most recent application. However, the Global Fund application for 2019 -2022 indicates that modelling is used extensively for HIV.[[18]](#footnote-18)

## **Findings by Evaluation Issue**

### **Use of Modelling**

Everyone interviewed indicated that modelling enhances the ability to assess potential effectiveness and efficiency of prevention and treatment interventions. Modelling enhances the ability to plan. Planning has occurred without modelling in the past. Almost all said they believe that better planning can be carried out with modelling, which allows them to look at various scenarios. For example, Kenya provided three projections regarding outcomes for three different funding levels in their application to Global Fund. Modelling makes it possible to develop more realistic goals and hence makes their applications to funders more credible.

Countries, modellers and funders report that modelling has been used in the following ways:

* Determine prevalence (Indonesia, India, Malawi, Mozambique, Mongolia, Ethiopia, Pakistan, Nigeria, Indonesia)
* Assess the efficiency of TB interventions (Mozambique)
* Support the application to Global Fund (Mozambique, Malawi, Ethiopia, Indonesia, Nigeria, Pakistan, South Africa)
* Determine targets related to TB monitoring indicators (Mozambique, Indonesia)
* Support the development of the strategic plan (Mozambique, Kenya, Ethiopia, Indonesia, Nigeria, Pakistan)
* Assess the effectiveness of interventions (Mongolia, India, Nigeria, Indonesia, Pakistan, South Africa)
* Determine the need for GeneXpert (Mongolia, India, South Africa, Indonesia, Nigeria)
* Help make intervention decisions at the sub-national level (Malawi, India, Pakistan, South Africa)
* Optimize their investments (India, Ethiopia, Indonesia, Nigeria, South Africa)
* Determine the effect of COVID-19 on TB treatment (India)
* Determine the potential for new drug regimens (India)
* Assess the effect of moving towards private sector engagement in a systematic manner (India)
* Assess the impact of investment in and scale up of interventions (India, Ethiopia, South Africa)
* Case detection (Mongolia, Indonesia, Nigeria, Pakistan, South Africa)

### **Implementation Process**

The implementation of modelling varied from country to country. However there were come common elements across countries:

* The process was highly collaborative with the country’s TB experts being the driver in determining the issues to be explored
* With the exception of India, Nigeria and South Africa, countries did not build their internal capacity to do modelling, so remained dependent on the modellers
* In all instances Global Fund and often other funders such as World Bank encouraged and supported the use of modelling
* In all cases, the countries contacted the modellers and engaged their services

The length of the relationship varied with each country. For example, it appears that Kenya engaged modellers one time only to assist with developing their National Strategic Plan, while India has a long-term relationship with Imperial, spanning several years. Modelling was fully integrated into TB planning India prior to the relationship with Imperial. That relationship allowed them to do more sophisticated and, they believe, accurate planning. Most of the countries see themselves at the beginning of using modelling. For some countries, like Mongolia, the connection with the modellers has been put on hold because of COVID-19. However they see the value it has brought to their decision-making. It is likely that all countries will continue and perhaps broaden their use of modelling for decision-making and planning.

India emphasized the importance of building a long-term relationship with a modeller in order for the modeller to better understand the country and for trust to be built between the modeller and the NTP. For example, while Malawi and Mozambique indicated they believe they can do better planning and decision-making with modelling, they also want to see how accurate the information from modelling proves to be.

### **Perception of Usefulness and Satisfaction**

All NTP staff that were reached indicated they perceived modelling to be very useful and indicated they were very satisfied with the process. In all instances, they felt in control of the process and that modellers supported them in gaining information regarding their country’s priorities. NTP staff underlined the importance of external consultants and stakeholder to continue to support modelling activities. Most countries are looking forward to using more modelling in the future.

### **Challenges**

While countries generally see the value of modelling, limited NTP capacity makes it impossible to implement modelling without external support. As well, modellers reported not having strong turn out from Ministry of Health officials when doing presentations. With COVID-19 some countries have delayed the modelling work, while other countries have used it to determine the impact of COVID-19 on TB interventions.

The underlying assumptions are sometimes questioned by Ministry of Health. Modelling is only as good as the underlying assumptions. In most instances the underlying assumptions were perceived as credible.

# **Conclusions and Recommendations**

## **Conclusions**

Tuberculosis modelling in the 10 countries has been used to inform decision-making, resource allocation and prioritization, the development of National Strategic Plans for TB control and prevention, and to improve understanding of disease trends.

It appears that countries are increasingly seeing the usefulness of modelling to support decision-making and planning, which ultimately enhances their ability to make successful funding applications.

The process of modelling has several benefits:

* Precipitates interest within NTP to better understand disease trend
* Improves the knowledge base used for decision-making and resource prioritization
* Increases stakeholder engagement during NSP development
* Increases the interest in evaluating the value of changing priorities based upon disease trend, e.g. expanding notification/detection/screening

There is a growing trend towards use of modelling, with countries believing they are better able to make decisions and with more funders expecting stronger evidence of need and efficacy in funding applications.

## **Recommendations**

The following recommendations build on what we found works in countries that have a long-standing use of modelling. The funders and TB MAC need to:

1. Build capacity with National TB programmes by training local staff in order to ensure full knowledge of modelling activities and by developing champions with the NTP to promote the use of modelling.
2. Co-ordinate the collation and potential sharing of simpler models (e.g. in excel) from, and between countries, in order to build on approaches used by countries already and decrease dependence on external modellers.
3. Continue to support efforts for the review of modelling exercises, including modelling data and assumptions.
4. Strengthen the engagement with NTPs by:

* Helping NTPs assess their capacity to use modelling and adjust the engagement process accordingly
* Encouraging ownership of intervention prioritization
* Encouraging international organizations and funders to support modelling through advice
* Strengthening the support mechanisms through developing a global roundtable for sharing use of modelling and capacity building, annual modelling workshops and refresher courses
* Providing approaches that will turn modelling results into implemented changes.

# **Annex A: Documents Reviewed**

**Ethiopia**

Global Fund Application for 2020 - 2022

National Strategic Plan Tuberculosis and Leprosy Control 2006-2013 (2013/14-2020) With Update for 2010-13 (2018-20/21)

**India**

Global Fund Application January 2018 – December 2020

India Ministry of Health with Family Welfare (March 2017) National Strategic Plan for Tuberculosis: 2017 – 25 Elimination by 2025

Kuldeep Singh Sachdeva, Neeraj Raizada, Radhey Shyam Gupta, Sreenivas Achuthan Nair, Claudia Denkinger, Chinnambedu Nainarappan Paramasivan, Shubhangi Kulsange, Rahul Thakur, Puneet Dewan, Catharina Boehme, Nimalan Arinaminpathy (July 2015) The Potential Impact of Up-Front Drug Sensitivity Testing on India’s Epidemic of Multi-Drug Resistant Tuberculosis, PLOS ONE

N. Arinaminpathy, D. P. Chin, K. S. Sachdeva,3 R. Rao, K. Rade, S. A. Nair, P. Dewan (2020) Modelling the potential impact of adherence technologies on tuberculosis in India, International Journal of Tuberculosis and Lung Disease

N.Arinaminpathy, G.B.Gomez, K.S.Sachdeva, R.Rao, M.Parmar, S.A.Nair, K.Rade, S.Kumta, D.Hermann, C.Hanson, D.P.Chin, P.Dewan (no date) The potential deployment of a pan-tuberculosis drug regimen in India, a modelling analysis, not published

Nimalan Arinaminpathy, Sarang Deo, Simrita Singh, Sunil Khaparde, Raghuram Rao, Puneet Dewan (January 2019) Modelling the impact of effective private provider engagement on tuberculosis control in urban India, Scientific Reports

Vineet Bhatia, Rahul Srivastava,1 K Srikanth Reddy, Mukta Sharma,Partha Pratim Mandal, Natasha Chhabra, Shubhi Jhalani, Sandip Mandal, Nimalan Arinaminpathy, Tjandra Yoga Aditama, Swarup Sarkar (January 2020) Ending TB in Southeast Asia: current resources are not enough, BMJ Global Health

World Report (March 2017) New *plan to end tuberculosis in south and southeast Asia*, Lancet

**Indonesia**

Global Fund Application for 2020 - 2022

National Strategy of Tuberculosis Care and Prevention in Indonesia 2020-2024

The Republic of Indonesia Joint External Monitoring Mission for Tuberculosis

**Kenya**

Global Funding Request January 2018 – December 2020

Republic of Kenya National Tuberculosis, Leprosy and Lung Disease Program (2019) National Strategic Plan for Tuberculosis, Leprosy and Lung Health (2019 – 2023)

**Malawi**

Global Fund Application for 2020 - 2022

**Mongolia**

Global Fund Application for 2020 - 2022

**Mozambique**

Global Fund Application for 2020 – 2022

**Nigeria**

Global Fund Application for 2020 – 2022

TIME Modelling Application: Final Report, Nigeria

Nigeria NSP for TB Control, 2015-2020

A Report of Modelling to Inform Tuberculosis Case Finding Interventions in Nigeria

**Pakistan**

Global Fund Application for 2020 – 2022

National End TB Strategic Plan 2017 – 2020

National End TB Strategic Plan 2020 - 2023

**South Africa**

Global Fund Application for 2020 – 2022

The cost and cost-effectiveness of TB interventions in South Africa: Current evidence and future plans

TB Modelling in South Africa: Progress and Future Plans (SACEMA and Stellenbosch University)

Monitoring and Evaluation Plan for the NSP on HIV, TB and STI (2017 – 2022)

University of Cape Town – TB Estimates for South Africa: Updates from Thembisa

# **Annex B: List of people interviewed**

**Ethiopia**

Rein Houben – modeller

Nabilia Shaikh – modeller

**India**

Nim Pathy – modeller

Kuldeep Sachdeva - NTEP

Sameer Kumta -funder

**Indonesia**

Jamie Rudman – modeller

Gita Parwati – WHO/KNCV

Ari Probandari - Universitas Sebelas Maret, Indonesia

**Kenya**

Nim Pathy – modeller

Shufang Zhang – funder

**Malawi**

Lung Vu – modeller

Sherrie Kelly –modeller

Belanine Girma – NTP

Kuzani Bendera - NTP

**Mongolia**

Romaine Raggnet – modeller

Dr. Gerelchimeg - Funder

**Mozambique**

Lung Vu – modeller

Sherrie Kelly –modeller

Pereira Mandanbo Zindoga – NTP

Dr. Ivan Manhica - NTP

**Nigeria**

Jamie Rudman – modeller

Matt Hamilton – modeller

Dr. Jens Levy – modeller

Charles Ohikhuai – Institute of Human Virology, Nigeria

Dr. Obioma O Chijioke-Akaniro – email discussion, NTP

**Pakistan**

Matt Hamilton – modeller

Abdullah Latif - NTP

**South Africa**

Nabila Shaikh – modeller

Rein Houben – modeller

Carel Pretorius – modeller, consultant and local expert

# **Annex C: Findings Matrix**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Country | Model/ Description | Modellers | | |  | NTP / In-Country | | | Funders comments |
| Implementation process | Examples of use | Factors contributing to/ detracting from use | Implementation process | Examples of use | Factors contributing to/detracting from use | Supporting documents |
| Ethiopia | TIME | Ethiopia has been using TIME modelling since 2016 and was one of the first to adopt the model. Collaborating with external TIME resources.  Has recently completed a comprehensive review of TB intervention costs, to be used in future models | Used to support an epidemiology review in 2018, development of National Strategic Plan, and for Global Fund Funding Requests  Used to identify interventions to include in NSP, and how to cost effectively implement those interventions and prioritize | New cost review has enabled more comprehensive modelling of intervention cost effectiveness.    Local expertise is limited | No response from NTP | | | GF funding application  National Strategic Plan |  |
| India | Imperial – not really a single model. Models are developed for specific use | Been working with India for seven years, collaborating with NTP  Government defines the research question. Imperial develops the model that is needed, using an iterative process. It usually requires a few iterations before government feels the model is giving them what they need. | Government uses modelling to prioritize interventions  Plan to compare districts with each other  Research examples:  *The Potential Impact of Up-Front Drug Sensitivity Testing on India’s Epidemic of Multi-Drug Resistant Tuberculosis*  *Modelling the potential impact of adherence technologies on tuberculosis in India* | Imperial responds to requests  While government uses the modelling in decision-making, they take other factors such as cost and available resources into consideration.  While planning occurs with those who will use the information, sustainability and ongoing use of a model is not a consideration | India has been using modelling since 1956, but not all that good. Starting in 2013 they decided to actively improve modelling. WHO/Gates Foundation brought together 11 countries in order to strengthen findings. India makes decisions regarding the uses for modelling collaboratively with | Strategic plan  Use of new drug regimens  Moving towards private sector engagement  Investment and scale up of interventions  Use of GENEX  Gaps in treatment  Testing and case finding  Addressing latent TB | Modellers are good at the technical aspects but often their assumptions are way off | GF application  Report on the Ministerial Meeting towards Wnding TB in Southeast Asia  Several published articles | What started many years ago has evolved into a long-term trust relationship. Two of the modeller’s mentees are not working in India. |
| Indonesia  \*In-country input from Universitas Sebelas Maret | TIME and Optima | June 2020 Multi-country workshop  Technical working group for modelling – consultants/KNCV working adhoc | Used primarily for high-level analysis: For example:  Indonesia Elimination Roadmap and Global Fund Funding Request  Indonesia Strategic Plan | No information yet – Indonesia has maintained opacity of TB programme | Indonesia engaged outside stakeholders, local WHO office, and internal experts. Indonesia have used Tuberculosis modelling to inform the development of both their Global Fund funding concept note for 2018-2020 and for the development of their National Strategic Plan for TB control. In 2019, the TB sub-directorate of the Indonesia Ministry of Health planned to renew the TB Control Strategic Plan for 2020-2024. | NTP is prioritizing detection and notification.  Modelled interventions:  Managing latent TB  Screening of TB high-risk groups  Achieving a high level of confirmed bacteriological diagnosis  Expand use of molecular rapid tests  Increase resource investment to improve TB services | Strong research group within Indonesia to support modelling work.    Good engagement with external stakeholders    Limited time available to conduct comprehensive modelling work for NSP development.    Limited capacity within the NTP to engage and coordinate modelling work. | GF funding application    Indonesia NSP 2020-2024    The Republic of Indonesia Joint External Monitoring Mission for Tuberculosis |  |
| Kenya | Imperial – not really a single model. Models are developed for specific use | One-time only collaboration. The government requested modelling to support the strategic planning process. Used a collaborative process:   * Plan * Develop * Validate * Reform | Made a core contribution to Kenya’s 2018 Health Strategy | Imperial responds to requests  While planning occurs with those who will use the information, sustainability and ongoing use of a model is not a consideration | No response from NTP | | | Strategic plan  GF funding application | It was a robust plan with three possible funding scenarios  Used in application to Global Fund |
| Malawi | Optima – Gets levels of impacts of programs informed by country-based evidence  Also have used TIME | NTP led the process Bring together partners in the process  Process of generating input is the most time-consuming – records may not have been adequately kept  Three people were involved in the process – not clear who the lead was  Scoping trip to understand current & future uses of Optima  Developed concept  Provided training for government staff in South Africa for Mozambique and Malawi  Consulted government  Supported the collection of data  Modellers presented to NTP and other MoH departments  Used to assess trends. Did a pilot with three regions. North (low burden) Middle (medium burden) South (high burden) Used to extrapolate to other regions  Used modelling to help make decisions regarding resource allocation – targeting specific geographical areas based on modelling  Used in the GF application  Used in the strategic plan  Optimizing investments | Assisting with target-setting and determining efficiency of programs (cost per unit of treatment)  Making programming decisions  Looking at the impact of COVID-19 on TB treatment | It is difficult for this government to run models. The process is highly dependent on the modellers  Depend on notification to determine burden – this does not give full picture of TB incidence | World Bank provided the opportunity for OPTIMA to help refine information at the sub-national level. GF funded TIME through the London School of Hygiene. NTP sees modelling as a tool to help make decisions, particularly at the sub-national level  TIME provided sub-national estimates of burden level. Used Optima to determine trends if spending remained the same or if it increased by 20%, 60%, 100%  NTP worked with team doing the modelling. Helped them validate the output  Assessed current status and trend of TB in three districts and extrapolated from these three districts | Helped make decisions at the sub-national level.  To justify GF application in 2020 by introducing active case findings. to justify the expansion of the mobile diagnostic unit service  To optimize investment  To determine effect of COVID on TB treatment  Did not use in strategic plan because that was completed prior to modelling work. | Although modelling is math, at its core the validity of the assumptions determine whether the results are accurate – NTP would like to do a repeat prevalence survey  Modelling depends on notification and treatment data. Notification does not give full picture of TB incidence  The three selected districts included low, medium and high burden. Did not factor in rural and urban  Malawi does not have anyone in country who can do the exercise  Used Time and Optima  Costing data is difficult to get at the district level  Recognize that programmatic data is more subject to bias. |  |  |
| Mongolia | AuTuMN  Australian TB Monitoring Network | Worked with the National Centre for Communicable Diseases (no NTP)  GF discussed the interest in modelling. Reps from Mongolia attended a workshop in Geneva where they met representative from AutuMN. Mongolia expressed interest in following up  Mongolia discussed with country stakeholders and approached GF and AuTuMN. | Support application to GF by developing different scenarios, looking at effectiveness and costs.  Determine what interventions will have the most impact  Used to argue for electrical heating  No idea of how else they used modelling because of COVID | Have a population that is nomadic that are highly affected by TB. Found TB is less likely to be detected by they are less likely to visit a doctor and living in close quarters in small gherts means the undetected TB spreads  At meeting where findings were to be presented around provision of electrical heating not many from the Ministry of Health attended  The TB modelling works closely together, using open approaches where other TB modellers review models | No response from NTP because of COVID | | | GF application | Not there during development process. There was a development team approved by MoH including program officers, NGOs, doctors, GF office. Discussed three-year plan. AuTuMN provides projections. Helped determine effectiveness of TB short regimen. Grant for 2021 is based on AuTuMN projections. Used to determine the need for GenXperts, need for active case finding for those in gherts. Helped determine priorities for preventive treatment |
| Mozambique | Optima – Gets levels of impacts of programs informed by country-based evidence | Head of NTP very involved in the process  Scoping trip to understand current & future uses of Optima  Developed concept  Provided training for government staff in South Africa for Mozambique and Malawi  Consulted government  Supported the collection of data  Modellers presented to NTP and other MoH departments | First used modelling to determine the efficiency of investment in TB interventions Contributed to Global Fund concept note  Then used modelling to determine targets related to TB monitoring indicators  Contributed to the TB Strategic Plan | The World Bank provided the funding and encouraged use of modelling in 2020  Work closely with government in model development  Modelling is one factor in a complex decision-making process that looks at the scientific evidence, resources available. Modelling provides the scientific evidence. | World Bank suggested using this model. Saw how it worked in Malawi and Malaysia and decided to move forward.  Had a workshop on Optima | First used modelling to determine the efficiency of investment in TB interventions Contributed to Global Fund concept note\*  Then used modelling to determine targets related to TB monitoring indicators  Contributed to the TB Strategic Plan\*  Used to establish targets  \*will send | Support was good  One week training on how results are generated and how to use results  Modelling needed data from 10 years ago, which was challenging | Cannot send strategic plan because it has not been finalized |  |
| Nigeria  \* In-country input from Nigeria Institute of Human Virology | TIME | Started in 2016-2017, following training at LSHTM. Working with LSHTM, KNCV  Nigeria TB modelling activities are different in that they have not been used for the development of NSP  Results have been fed directly into Global Fund funding requests  Working with Institute of Human Virology  KNCV working to develop National Strategic Plan template | Modelling has been used to understand impact of several possible interventions over time.  Active vs. Passive case finding measures.  Intensified case findings for secondary and tertiary facilities.  Model impact and cost effectiveness in all outpatient departments.  Understand intervention impact on notification rates.  Establish a rational baseline for TB programs.  Evaluate the value of changing passive surveillance and symptom screening | Challenges with utilization of model results for decision making, political challenges.  Main challenges have been beyond the scope of modelling, i.e. developing buy-in, irrational decision-making  May be more effective to model at the sub-national level  Process of modelling is extremely valuable to develop better understanding of TB burden and promote discussion | In 2016, the Nigeria NTP was looking for a method to estimate TB burden in the country. This led to the development of a relationship with LSHTM, and an ongoing engagement to use the TIME model to inform TB estimates and intervention impact. | TB modelling has not been used to inform the development of the National Strategic Plan for Nigeria; however, it was used to develop an epidemiological analysis and the 2017 Global Fund concept note.  Modelled interventions include: rollout of a new diagnostic algorithm, expanded contact tracing, improved drug susceptibility testing coverage, and outpatient department screening. | The primary success factor is the buy-in of the NTP to support modelling activities.  Robust technical support from external organizations and consultants  Results of modelling don’t always align with existing perceptions of TB situation  Challenges in accepting results of the model, may show burden as lower than expected  Data availability | GF funding application    TIME Modelling Application: Final Report, Nigeria    Nigeria NSP for TB Control, 2015-2020    A Report of Modelling to Inform Tuberculosis Case Finding Interventions in Nigeria |  |
| Pakistan | TIME | Began in 2016, increased scale in 2019  Modelling engagement is mature, however due to devolved nature of Pakistan health system, modelling activities are not straightforward.  Development of NSP is effectively stitching together provincial strategic plans | Used to update national strategic plan  Global fund funding requests  Donor engagement | Devolved health system makes modeling difficult.  Data collection etc.  Limited sub-national information | Global Fund arranged modelling workshop, attended by Pakistan NTP  Global Fund suggested use of modelling to support NSP development and concept note  Modellers are not actively engaged to model interventions beyond NSP/Concept note development | Modelling used to provide a scenario analysis of interventions, which were included in concept note  Cost-effectiveness modelling used for NSP  Modelling underlined the impact of case detection, NTP is prioritizing case detection interventions.  Changed diagnostic algorithm based upon modelling results. New guidelines include GeneXpert testing.  KIT Amsterdam modelled prevalence at sub-national and district level for local prioritization where prevalence is high but case detection is low. | Very satisfied with support from external consultants, and Global Fund. Good coordination.  Primary challenge in Pakistan is the scale of the unregulated private sector health system where data availability is limited. Mandatory TB notification is a priority.  Limited funding for local modelling expertise.  Modelling is mostly done at the national level, district and sub-national level modelling is difficult. | GF funding application    National End TB Strategic Plan 2017 – 2020    National End TB Strategic Plan 2021 - 2023 |  |
| South Africa | TIME | South Africa maintains a high level of local expertise.  TB Control is integrated with the Ministry of Health  Also involved:  University of Cape Town  SACEMA Institute  South Africa is also developing their own TB model | Used to understand the scale up of interventions  Small Global Fund grant, supported through modelling  Evaluation of use and scale of GeneXpert Machines  Use of the TIME model informed the development of a TB Investment Case, as well as the South Africa Global Fund concept note. | No unit cost resources, very limited costing data  Limited global guidance/standardization on modelling, perhaps the development of a more robust framework for TB modelling would help.  Ongoing support is required | No response from NTP | | | GF funding application    The cost and cost-effectiveness of TB interventions in South Africa: Current evidence and future plans    TB Modelling in South Africa: Progress and Future Plans (SACEMA and Stellenbosch University)    Monitoring and Evaluation Plan for the NSP on HIV, TB and STI (2017 – 2022) |  |

1. <http://tb-mac.org/> [↑](#footnote-ref-1)
2. TB MAC (2017) Report on TB modelling and analysis consortium activities pp. 1-4 [↑](#footnote-ref-2)
3. World Health Organization (WHO) People-centred framework for tuberculosis programme planning and prioritization User Guide, P.IV [↑](#footnote-ref-3)
4. Ethiopia Global Fund funding request, P. 36 <https://data.theglobalfund.org/investments/documents> [↑](#footnote-ref-4)
5. National Strategic Plan for Tuberculosis: 2017 – 25 Elimination by 2025 P.17 [↑](#footnote-ref-5)
6. Report on the Ministerial Meeting Towards Ending TB in Southeast Asia, The Lancet, Vol. 389 March 25, 2017 p. 1183 [↑](#footnote-ref-6)
7. Indonesia Global Fund funding request, P. 10 <https://data.theglobalfund.org/investments/documents> [↑](#footnote-ref-7)
8. Kenya National Strategic Plan 2019 – 2023, p.xxii [↑](#footnote-ref-8)
9. IBID, P.99 [↑](#footnote-ref-9)
10. Malawi Global Fund funding request, P. 6 <https://data.theglobalfund.org/investments/documents> [↑](#footnote-ref-10)
11. IBID, P.26 [↑](#footnote-ref-11)
12. Mongolia Global Funding Request, p. 8 <https://data.theglobalfund.org/investments/documents> [↑](#footnote-ref-12)
13. IBID p. 4 [↑](#footnote-ref-13)
14. IBID, p. 13 [↑](#footnote-ref-14)
15. Mozambique Global Fund Application p. 25 <https://data.theglobalfund.org/investments/documents> [↑](#footnote-ref-15)
16. Mozambique Performance Monitoring Framework [↑](#footnote-ref-16)
17. Nigeria Global Fund Application, p.44 [↑](#footnote-ref-17)
18. South Africa Global Fund Application 2019 – 2022 [↑](#footnote-ref-18)