Stop TB Partnership hosted by UNOPS

THE GLOBAL PLAN TO END TB

2023–2030

The Global Plan to End TB 2023-2030

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OVERVIEW

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ACRONYMS

ACH air changes per hour

ACTG AIDS Clinical Trials Group

ADVANCE Accelerating the Development of Vaccines and New Technologies to Combat the AIDS Epidemic

AI artificial intelligence

AIGHD Amsterdam Institute for Global Health and Development

AIPC airborne infection prevention and control

AMR antimicrobial resistance

ART antiretroviral therapy

AVAREF African Vaccine Regulatory Forum

BCG Bacille Calmette-Guérin

BRICS Brazil, Russian Federation, India, China, South Africa

CAB community advisory board

CAD computer-aided detection

CBPR community-based participatory research

CEPI Coalition for Epidemic Preparedness Innovations

CFCS Challenge Facility for Civil Society

CI confidence interval

CLM community-led monitoring

COE challenging operating environment

CoP correlate of protection

COPD chronic obstructive pulmonary disease

COVID-19 coronavirus disease 2019

CRG community, rights and gender

CSO civil society organisation

CSR corporate social responsibility

DALY disability-adjusted life year

DAT digital adherence technology

DNO diagnostic network optimization

DR-TB drug-resistant tuberculosis

DSD differentiated service delivery

DST drug susceptibility testing

EDCTP European and Developing Countries Clinical Trials Partnership

EHR electronic health records

EPR electronic patient records

ERA4TB European Regimen Accelerator for Tuberculosis

EU-M4All EU-Medicines for all

FAO Food and Agriculture Organization of the United Nations

FDA United States Food and Drug Administration

FFP2 filtering face piece level 2

FIND Foundation for Innovative New Diagnostics

G20 Group of 20

G7 Group of Seven

GCP Good Clinical Practice

GCTA Global Coalition of TB Activists

GDF Global Drug Facility

GERD gross domestic expenditure on research and development

GFATM Global Fund to Fight AIDS, Tuberculosis and Malaria

GLP Good Laboratory Practice

GNI gross national income

HRH human resources for health

HVAC heating, ventilation and air conditioning

IAVI International AIDS Vaccine Initiative

IGRA interferon-gamma release assay

IND investigational new drug

ISD integrated service delivery

IT information technology

LAM lipoarabinomannan

LIC low-income country

LMIC lower middle income countries

MAF multisectoral accountability framework

MDR-TB multidrug-resistant tuberculosis

MIC middle-income country

Mtb *Mycobacterium tuberculosis*

NCD non-communicable disease

NGO nongovernmental organisation

NGS next-generation sequencing

NITAG National Immunization Technical Advisory Group

NSP national strategic plan

NTP national tuberculosis programme

ODA official development assistance

OECD Organisation for Economic Co-operation and Development

OIE World Organization for Animal Health

PanACEA Pan-African Consortium for the Evaluation of Antituberculosis Antibiotics

PDP product-development partnership

PDVAC Product Development for Vaccines Advisory Committee

PLHIV people living with HIV

POC point of care

PoD prevention of disease

PoI prevention of infection

PoR prevention of recurrence

PPM public–private mix

PPR pandemic preparedness and response

PR pulmonary rehabilitation

PTLD post-tuberculosis lung disease

R&D research and development

ROI return on investment

RR-TB rifampicin-resistant tuberculosis

SADC Southern African Development Community

SAGE Strategic Advisory Group of Experts

SDG Sustainable Development Goal

SHI social health insurance

SIB social impact bond

SORT IT Structured Operational Research and Training Initiative

TB tuberculosis

TIME Tuberculosis Impact Model and Estimates

TPP target product profile

TPT tuberculosis preventive treatment

TST tuberculin skin test

UHC universal health coverage

UN United Nations

UNDP United Nations Development Programme

UNEP United Nations Environmental Programme

UNHLM United Nations High-Level Meeting

UNICEF United Nations Children's Fund

USAID United States Agency for International Development

UV-C ultraviolet-C

UVGI ultraviolet germicidal irradiation

WHO World Health Organization

WOAH World Organization for Animal Health (formerly OIE)

XDR-TB Extensively drug-resistant tuberculosis

GLOSSARY

Active case finding
proactive TB screening initiated by the health system, conducted both inside and outside health facilities. Although the term "case" is used widely in public health to refer to an instance of disease, it should be used with sensitivity in health care settings to avoid dehumanizing people. A person is not a case, but a fellow human being. Individuals seeking or receiving care for TB may find it demeaning if they overhear a health worker describing them as a "case."

Active TB disease
an illness in which TB bacteria are multiplying in different parts of the body. The symptoms of active TB disease include cough, weakness, weight loss, fever, loss of appetite and night sweats. A person with active TB disease may be infectious and spread TB to others. In the Global Plan, "people with TB" or "people ill with TB" refers to those who have active TB disease.

Ambulatory care
healthcare that is delivered in a setting where a person is not admitted to a hospital or inpatient health facility.

Antibiotic
a drug used to treat bacterial infections. Anti-TB drugs are also antibiotics. Antibiotics have no effect on viral infections.

Antimicrobial Resistance (AMR)
the state a microorganism evolves to where it achieves the ability to withstand the effects of antibiotics or other forms of antimicrobial treatment. Antibiotic resistance typically evolves when a random mutation of the microorganism develops, making it less susceptible to the effects of a particular drug.

BCG
the Bacillus Calmette–Guérin TB vaccine is named after the French scientists who developed it, Calmette and Guérin. BCG provides adolescents and adults with little protection against TB, but it is often given to infants and small children in countries where TB is common, as it can prevent some of the most severe forms of TB in children.

Biomarker
in the context of TB, a measurable substance inside the body that, when present, reliably indicates the presence of TB infection and/or TB disease and, when absent, reliably indicates the absence of TB infection and/or disease. Liparabinomannan (LAM) is an example of a TB biomarker.

Biorepository
a facility for the long-term storage and conservation of biological specimens.

Contact
a person who has spent time with a person with infectious TB.

Close contact
a person who has had prolonged, frequent, or intense contact with a person with infectious TB. This group includes people who live together or spend a great deal of time together in close proximity. Close contacts, or household contacts, are more likely to become infected with M. tuberculosis than contacts who see the person with TB less often.

Community systems
community systems are the structures, mechanisms, processes and actors through which communities act on the challenges and needs that they face. They are made up of different types of entities: community members, formal and informal community organizations and networks, and other civil society organizations. Such systems are usually less formalized and less clearly defined than health systems. Entities that make up community systems have close links with communities; therefore, they are in a position to better understand the issues faced by those who are most affected and to find smart solutions.

Community systems strengthening
refers to initiatives that contribute to the development and/or strengthening of community-based organizations in order to increase knowledge of and access to improved health service delivery. It usually includes capacity-building of infrastructure and systems, partnership building, and the development of sustainable financing solutions.

Culture
a test to see whether there are TB bacteria in an individual's sputum/phlegm or other body fluids. This test can take two to four weeks in most laboratories.

Differentiated service delivery
an approach used to provide people-centred HIV care. UNAIDS defines DSD as "a client-centred approach that simplifies and adapts HIV services across the cascade, in ways that both serve the needs of people living with HIV better and reduce unnecessary burdens on the health system."

Drug-resistant tuberculosis
disease caused by a strain of TB bacteria that is resistant to the most commonly used anti-tuberculosis drugs.

Extensively drug-resistant tuberculosis
disease caused by a strain of TB bacteria that is resistant to isoniazid and rifampicin (the two most commonly used anti-TB drugs), as well as fluoroquinolone and at least one of the three injectable second-line drugs (amikacin, kanamycin, capreomycin).

Extrapulmonary TB
TB disease in any part of the body other than the lungs (for example, the kidney, spine, brain or lymph nodes).

Gender-sensitive
a recognition that males, females and people of other genders are equal actors within a society, that they are constrained in different and often unequal ways, and that consequently they may have divergent and sometimes conflicting perceptions, needs, interests, and priorities.

Innovative financing
For purposes of the Global Plan, innovative financing includes the growing variety of avenues for mobilizing resources for TB aside from the traditional ways that TB interventions have been funded, i.e., through domestic government budgets, official development assistance, development loans and grant support.

Market-shaping interventions
in the context of TB tools, activities that typically aim to reduce costs of developing new tools, distribute risk more widely in order to incentivize investment in R&D, or provide new information into the market that makes conditions more favorable for investing in R&D.

Multidrug-resistant tuberculosis
disease caused by a strain of TB bacteria that is resistant to at least isoniazid and rifampicin (the two most commonly used anti-TB drugs).

Mycobacterium tuberculosis
bacteria that cause TB infection and TB disease.

Mycobacterium bovis
bacteria that cause bovine TB, a zoonotic form of TB disease.

Nutritional support
aims at ensuring adequate nutrition and includes assessment of the dietary intake, nutritional status, and food security of the individual or household; offering nutrition education and counselling on how to ensure a balanced diet, mitigate side-effects of treatment and infections, and ensure access to clean water; and providing food supplements or micronutrient supplementation where necessary.

People-centred approach to TB care
a people-centred approach considers the needs, perspectives, and individual experiences of people affected by TB, while respecting their right to be informed and receive the best quality care based on individual needs. It requires the establishment of mutual trust and partnership between the person affected and the care provider, and creates opportunities for people to provide input into and participate in the planning and management of their own care. A people-centred approach improves treatment outcomes, while respecting human dignity.

People affected by TB
this term encompasses people ill with TB and their family members, dependents, communities, and health care workers who may be involved in caregiving or are otherwise affected by the illness.

People with TB (PWTB)
this term encompasses people who are ill with active TB. The term "people (or person) with TB" recognizes that people with TB should not be defined solely by their condition. The term may be preferable to the word "patient" in certain contexts (e.g. nonmedical and community settings).

Post-TB lung disease (PTLD)
an overlapping spectrum of disorders that affect the lungs and broader pulmonary system and that continue to affect a person with TB after treatment is completed. PTLD arises from a complex interplay between the person, the TB bacilli, and environmental factors.

Preventive therapy
medicines that prevent TB infection from progressing to active TB disease.

Public-private mix (PPM)
A strategy for scaling up TB prevention, care and support by engaging all public, voluntary, corporate, and private providers in TB care and control in coordination with national TB programmes.

Subclinical TB
TB disease that is confirmed by presence of TB bacilli where the person with TB has no observable symptoms

Sputum
phlegm coughed up from deep inside the lungs. Sputum is examined for TB bacteria using smear microscopy, culture or molecular tests.

Stigma
is derived from the Greek meaning "a mark or a stain." Stigma can be described as a dynamic process of devaluation that significantly discredits an individual in the eyes of others. Within particular cultures or settings, certain attributes are seized upon and defined by others as discreditable or unworthy. When stigma is acted upon, the result is discrimination that may take the form of actions or omissions.

TB disease
an illness in which TB bacteria multiply and attack a part of the body, usually the lungs. The symptoms of active TB disease include weakness, weight loss, fever, loss of appetite and night sweats. Other symptoms of TB disease depend on where in the body the bacteria are growing. If TB disease is in the lungs (pulmonary TB), the symptoms may include a bad cough, pain in the chest and coughing up blood. A person with pulmonary TB disease may be infectious and spread TB bacteria to others.

TB infection
also called latent tuberculosis infection. It is a condition in which TB bacteria are alive but inactive in the body. People with latent TB infection have no symptoms; they do not feel sick, cannot spread TB bacteria to others, and usually test positive for infection – positive to a tuberculin skin test or a special test called IGRA test. In the Global Plan, people referred to as "infected with TB" are people having such latent TB infection

UHC
means that all people have access to the health services they need, when and where they need them, without financial hardship.

TB infection
a condition in which TB bacteria are alive, but inactive in the body. People with latent TB infection have no symptoms, don't feel sick, and can't spread TB to others.

Zoonotic TB
TB that is transmitted from non-human animals (often domestic cattle) to people

For more information on suggested language and usage for tuberculosis communications, please access the **Stop TB Partnership WORDS MATTER Language Guide**

FOREWORD

In 2020, deaths from tuberculosis (TB) increased for the first time in over a decade. More than a third of people with TB went undiagnosed and untreated. Years of incremental progress against this deadly infectious and airborne disease were lost. But, the COVID-19 pandemic was only partly to blame. Years of dismally low levels of funding have led to an unbearable situation in which TB kills more than 4,100 people a day. TB was the leading infectious disease killer in 2019 and will very likely return to this infamous position, once the COVID-19 pandemic is brought under control.

With drug-resistant variants of TB and each untreated TB infection leading to up to 15 more infections per year, we cannot let this airborne, preventable and treatable disease continue to threaten the world. Yet, despite commitments made regularly by governments and key stakeholders to increase the resources available to fight this disease (including in September 2018 as part of the United Nations High-Level Meeting [UNHLM] on TB), efforts to reduce the burden of TB around the world are impeded by dramatic funding shortfalls.

The scale of the TB pandemic—with nearly 10 million people estimated to have the disease per year at last count—is just as hard to comprehend as that of the COVID-19 pandemic, or perhaps it is even harder. TB has primarily been a disease of poverty, almost erased from the wealthier parts of the world, yet ignored where the least wealthy live. Our global society still does not focus its attention on people living in these places.

However, as we look to the future, we refuse to let ourselves be weighed down by pessimism and despair. Instead, we choose to believe that if we mobilize our collective energy, our knowledge, technologies and resources—in short, if we finally decide to make TB a global priority—we can achieve our goals. The TB community does not demand anything out of the ordinary; we simply demand sufficient funds and appropriate local interventions so that proper prevention, diagnosis and treatment services are available to all people everywhere. It is, after all, a fundamental human right.

The Global Plan to End TB 2023–2030 is an inclusive document developed in collaboration with numerous partners, stakeholders and experts. It provides a clear roadmap and the most detailed budget estimates to date for ending TB as a public health challenge by 2030, in line with the UN Sustainable Development Goals. This Global Plan includes a comprehensive set of policy interventions for making people-centred care available to all and provides guidance to address the scarcity of resources for research and development (R&D), implementation and infrastructure—which contributes to the millions, of TB infections in high-burden countries.

This Global Plan also re-imagines TB care to be focused on people and responsive to gender needs, taking into account the many facets of the TB pandemic, such as mental health challenges and the interplay with different diseases like HIV/AIDS. The plan offers robust guidance on the R&D investments needed to develop the new tools for diagnosis, prevention and treatment to end TB. It is the first Global Plan for TB to anticipate the approval and widespread availability of at least one new TB vaccine.

With the additional funding required by this Global Plan, TB programmes worldwide will be able to treat 50 million people with TB, including 2.2 million people with drug-resistant TB. It would eliminate catastrophic underfunding of TB programmes and accelerate the development of new TB vaccines, diagnostics and medicines.

Ending TB is feasible if countries step up their funding allocations. In 2022, we saw a major effort to focus on the fight against TB by the G20 and its Member States. At the same time, TB must become an integral part of conversations around global health security, pandemic preparedness and response, and universal health coverage. We cannot accept such blind spots any longer.

The investment case presented in the Global Plan 2023–2030 shows impressive returns on investment and points out the huge costs of inaction. These facts should inspire finance ministries, donors, development banks, the private sector, and others to step up and deliver on their financial commitments. We will use this Global Plan as an advocacy tool to shape political discussions around TB, including at the UNHLM on TB taking place in 2023.

Beyond everything else, the Global Plan is about people.

With respect, we dedicate this Global Plan to the millions of people who make daily efforts to help those affected by TB—TB survivors, activists, advocates, researchers, pharmacists, community health care workers, volunteers, doctors, nurses, epidemiologists—and we promise that we will end TB together.

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EXECUTIVE SUMMARY

The Global Plan to End TB, 2023–2030 (Global Plan) is a plan for ending tuberculosis (TB) as a public health challenge by 2030—the year by which governments around the world have committed to achieving the United Nations (UN) Sustainable Development Goals. This document provides the most detailed costing estimates of any Global Plan to date and builds on the previous edition, *Paradigm Shift*, which laid out priority actions for 2018–2022 informed by global commitments endorsed by Member States at the 2018 UN High-Level Meeting (UNHLM) on TB.

This Global Plan anticipates the priority actions that will be necessary in the wake of the COVID-19 pandemic and informs follow-up commitments to be made at a second UNHLM on TB in 2023.

The numbers of people diagnosed with TB plummeted during the COVID-19 pandemic, reversing progress against TB by several years and injecting greater urgency into global TB efforts. Although the pandemic severely disrupted these efforts, it also created a new sense of what can be achieved through mobilization of political will and financial and human resources. The discovery and roll-out of the first COVID-19 vaccines in less than a year was unprecedented; however, global distribution has been woefully inequitable—an experience that provides critical lessons for TB vaccine development and access.

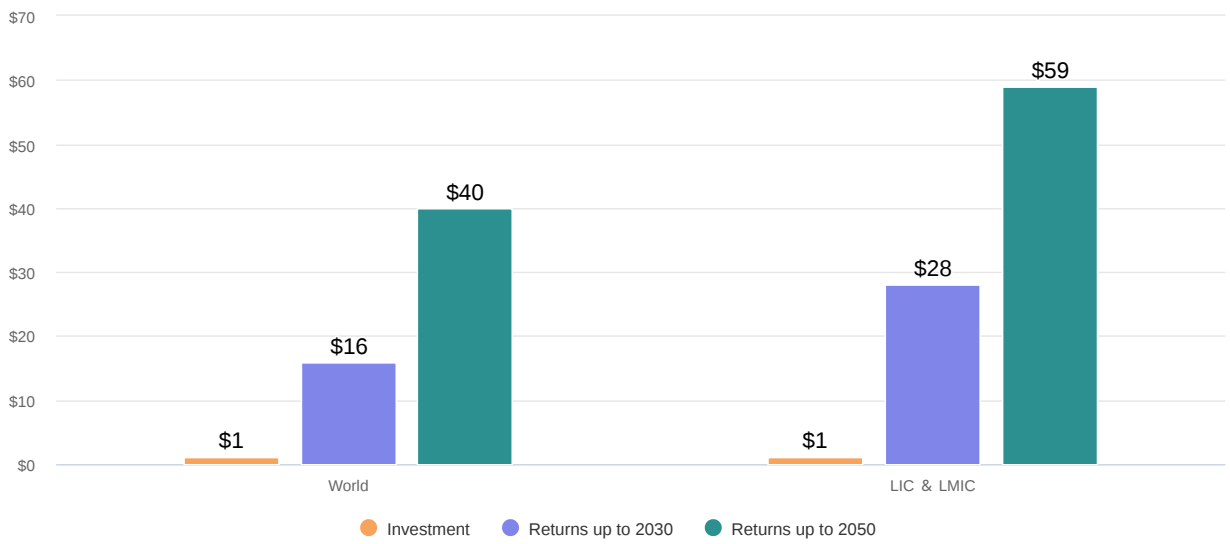
Like previous editions, this Global Plan emphasizes the need for a rights-based, people-centred approach to ending TB. It increases the focus on prevention as a public health priority alongside universal access to TB care and support, an accelerated approach to TB research and development (R&D), and the introduction and scale-up of new TB tools. For the first time, this edition anticipates that comprehensive interventions will include the development and use of a new TB vaccine. Implementing the Global Plan will require a stronger, more sustained commitment to partnerships involving participation from a variety of sectors, as well as TB survivors and members of affected communities.

To aid country-level decision-making, this edition of the Global Plan provides guidance for investing in a comprehensive package of interventions. These "investment packages" are based on new impact modelling and financial estimates, which project that ending TB by 2030 is feasible with significant new inputs that support implementation at scale. This modelling also contributed to the investment case for the seventh replenishment of the Global Fund to Fight AIDS, Tuberculosis and Malaria in 2022.

Return on investment

The Global Plan is an investment in both human life and economic productivity. Implementing the priority actions recommended by the Global Plan would deliver a return of US$ 40 for every dollar invested (see Figure A).

Figure A. Return on investment in TB prevention and care

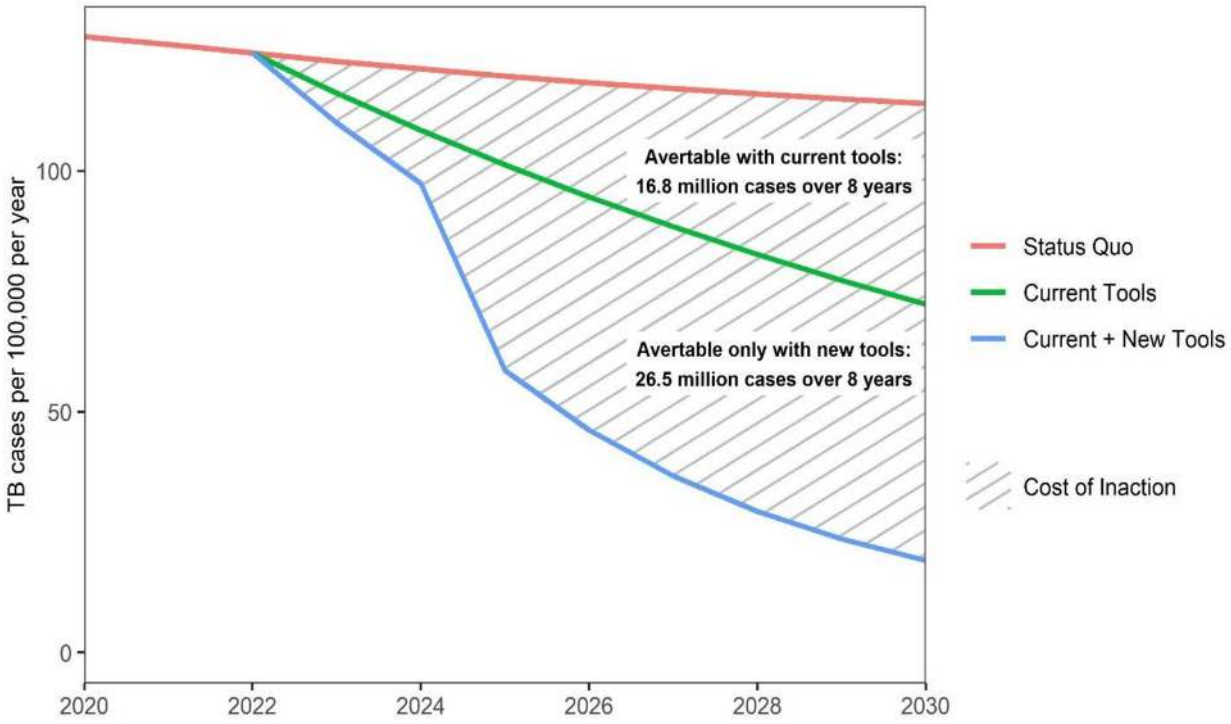


The cost of inaction

Delaying or failing to implement the Global Plan would result in immense human and economic loss. If the status quo were to continue from 2023 through 2030, an additional 43 million people would develop TB, leading to 6.6 million additional TB deaths and a global economic cost of US$ 1 trillion (see Figure B). Humanity would lose a projected 234 million disability-adjusted life years (DALYs).

Averting this scenario will require a substantial and rapid scale-up of public health interventions using currently available tools (i.e., treatment regimens, diagnostics) and an increase in investment in TB R&D for new tools.

Figure B. The potential human cost of failing to implement the Global Plan 2023–2030



Resource needs

This edition of the Global Plan projects that between 2023 and 2030, US$ 249.98 billion will need to be mobilized from all sources—governments, philanthropy, the private sector, and innovative sources of financing. This includes US$ 157.2 billion for TB prevention and care, averaging US$ 19.65 billion per year, plus US$ 52.6 billion for vaccination once new vaccines are available (see Table A). This increase is driven by the need to make up for lost progress due to COVID-19, to accelerate the development and introduction of new TB tools—including at least one new vaccine—and to make up for financing gaps in previous years.

US$ 40.18 billion is needed to accelerate the development of new TB medicines and treatment regimens, diagnostics, and vaccines, which includes US$ 800 million annually to support basic science research (see Table B).

Table A. Resources needed for TB prevention, care and support (US$ billion)

	2023	2024	2025	2026	2027	2028	2029	2030	Total
Diagnosis	4.8	5.7	7.1	8.0	7.4	7.0	7.0	7.2	54.1
Treatment	0.9	1.0	1.1	1.1	0.8	0.6	0.5	0.5	6.5
Prevention	0.7	0.8	1.0	1.1	1.2	1.4	1.5	1.7	9.3
Vaccination	0.0	0.0	0.0	0.0	12.4	12.8	13.4	14.0	52.6
Health Systems	1.9	2.2	2.8	3.1	2.7	2.4	2.4	2.5	20.0
Enablers	2.3	2.5	3.0	3.2	3.0	2.9	3.0	3.1	22.9
Programme Costs	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	44.4
Total	**15.7**	**17.6**	**20.3**	**21.9**	**33.1**	**32.8**	**33.6**	**34.9**	**209.8**

Table B. Resources needed to accelerate R&D of new TB tools, 2023–2030

New Tool	Investment Needed (US$ billion)
Medicines	16.06
Diagnostics	7.72
Vaccines	10.00
Basic science	6.40
Total	**40.18**

Projected impact

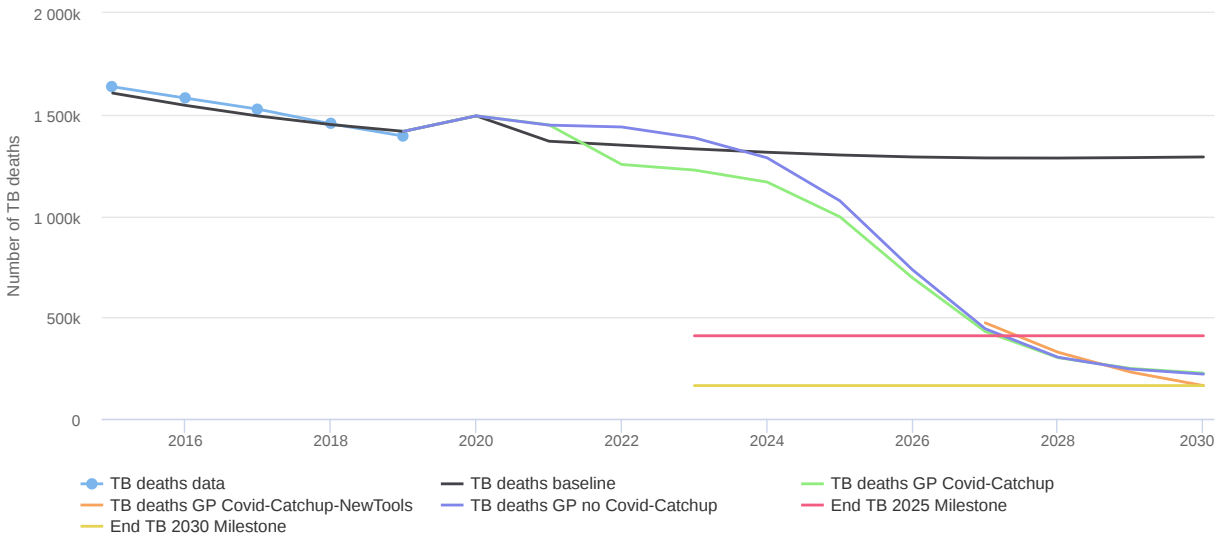
Modelling projects that the following impact objectives and targets will be met if the Global Plan 2023–2030 is fully funded and implemented.

- At least 95% of people with TB will receive a diagnosis.
- All high-risk and key and vulnerable populations will be able to access periodic screening.
- 50 million people will access appropriate TB treatment, including 4.7 million children and 3.32 million people with drug-resistant (DR-) TB.
- 35 million people will access TB preventive treatment (TPT).
- At least one new TB vaccine will be introduced for widespread use by 2026.

These and other interventions would lead to:

- an 80% decline in the number of people who develop TB annually per 100,000 population by 2030, compared to 2015;
- a 90% decline in the number of people who die from TB annually by 2030, compared to 2015 (see Figure C).

Figure C. Projected TB deaths in various Global Plan implementation scenarios



The Global Plan Chapters

This edition of the Global Plan was developed by a writing team working in collaboration with the Global Plan Task Force and a team of epidemiological and financial modellers, with inputs gathered from the international community through a series of public regional and global consultations. There are nine chapters.

Chapter 1 provides the international context that informs the Global Plan. Chapters 2 through 9 describe priorities for action.

CHAPTER 2.
Ending TB through comprehensive investment packages implemented at scale

Priority actions:

- Invest in a comprehensive investment package.
- Scale up interventions to achieve key objectives and targets.

CHAPTER 3.
Scaling up TB diagnosis and care

Priority actions:

- Re-imagine TB care, delivering services through a people-centred approach.
- Scale up the use of modern diagnostics.
- Find the missing people with TB.
- Expand early diagnosis, including at subclinical stages.
- Develop and implement public communications strategies to raise TB awareness and promote early health seeking.
- Integrate TB screening and testing into other health services, with a focus on services that address common comorbidities or risk groups, depending on local epidemiological context.
- Provide support that enables people receiving TB care to complete a full course of treatment without an undue burden on them and their families, while avoiding catastrophic costs.
- Strengthen procurement systems and supply chains.

CHAPTER 4.
Scaling up TB prevention

Priority actions:

- Implement airborne infection prevention and control measures in health care settings and high-risk indoor places where people congregate.
- Provide TPT for those living with TB infection and who are at higher risk of progression to active TB disease.
- Deploy effective vaccines once such vaccines are officially recommended and available.
- Address TB risk factors and social determinants.

CHAPTER 5.
Partnering with key stakeholders: communities and the private sector

Priority actions:

- Increase funding support for engaging TB-affected communities in the TB response at least fourfold.
- Support community-based and home-based models for delivering TB prevention and care.
- Scale up public–private mix approaches to improve the quality of TB care, reduce out-of-pocket expenses and improve data reporting in the private health sector.
- Support a multisectoral TB response through stronger partnerships.

CHAPTER 6.
Ending TB through universal health coverage, pandemic preparedness and response, and socioeconomic actions

Priority actions:

- Expand access to TB services through universal health coverage initiatives.
- Position the TB response at the centre of pandemic preparedness and response efforts.
- Invest in poverty alleviation and sustainable development.

CHAPTER 7.
Human rights, stigma, gender, and key and vulnerable populations

Priority actions:

- Position universal human rights as the foundation of the TB response.
- Eliminate TB-related stigma and discrimination.
- Ensure that TB interventions are gender-sensitive and gender-transformative.
- Prioritize, reach and involve key and vulnerable populations.

CHAPTER 8.
Accelerating development of new TB tools

Priority actions:

- Invest, at minimum, US$ 4 billion annually to accelerate the R&D of new TB diagnostics, medicines and vaccines. Resources need to be mobilized from governments and philanthropies, increased engagement with the private sector, and new approaches to innovative and sustainable financing.
- Develop a new TB vaccine by 2025.
- Accelerate the development of new tools to prevent, diagnose and treat TB by identifying innovative product-development pathways and improving collaboration among actors in product development.
- Invest at least US$ 800 million annually in basic science research.
- Expand the use of operational research.
- Develop and implement digital tools.
- Create an enabling environment for TB R&D.
- Apply best practices in community engagement throughout the R&D process.
- Apply access principles in rolling out and optimizing the use of new tools.
- Strengthen advocacy for TB innovation.

CHAPTER 9.
Resource needs, return on investment, and cost of inaction

Priority actions:

- Mobilize US$ 209.8 billion in funding between 2023 and 2030 for TB care and prevention, of which US$ 52.6 billion is for vaccination once a new vaccine is available. The resources needed for care and prevention excluding vaccination total US$ 157.2 billion, which averages to US$ 19.65 billion per year.
- Mobilize US$ 40.18 billion in funding between 2023 and 2030 for TB R&D and basic science research through a more diversified funding base.

Modelling projects a strong return on investing in the Global Plan. In line with previous analyses of the economic benefits of TB care and prevention, every US dollar invested in implementing the Global Plan will deliver US$ 40 in economic return, accounting for benefits projected to accrue through 2050. Low-income countries and lower middle-income countries will see an even greater return, with US$ 59 in economic benefits for every dollar invested.

1

INTRODUCTION

INTRODUCTION

COVID-19 changed the world. The tuberculosis (TB) response must adapt to a new reality, but also embrace new possibilities.

The pandemic started to impact high TB burden countries by early 2020. TB services in most countries experienced significant disruptions due to:

- COVID-19-related lockdowns and restrictions, which decreased people's mobility and access to TB diagnosis, treatment and care;
- TB services at all levels of the health system being curtailed or stopped completely, as the sudden increase in the demand for COVID-19 testing and care overwhelmed health systems;
- human and financial resources, technical expertise, laboratory and treatment equipment that were previously used for TB programmes being shifted to the COVID-19 response;
- people becoming reluctant to go to health facilities out of fear of being exposed to COVID-19;
- new and/or exacerbated human rights- and gender-related barriers to services.

TB diagnoses and notifications plummeted. The first observations came from India. Other countries followed.

Throughout the COVID-19 pandemic, **multiple** **modelling** **studies** predicted that the impacts of COVID-19 would cause increases in the numbers of people developing and dying from TB—enough to reverse years of declines in TB incidence and mortality. Data from countries and reported by the World Health Organization (WHO) in 2021 confirmed that COVID-19 had indeed reversed global TB progress by several years.

Because of the devastation caused by the pandemic, most political leaders suddenly saw public health as a top priority. World leaders spent an enormous amount of time and effort to protect lives and livelihoods. This resulted in a massive public health response.

- Screening and testing were made available at an unprecedented scale, using modern technology developed in a few weeks or months, with access points both within and outside the health system, and rapid notification of results.
- Countries quickly scaled up their genome sequencing capacity—even those countries not known for having a strong laboratory infrastructure.
- Real-time COVID-19 data were made available—even in countries that had struggled to provide timely reporting for other health programmes.
- Vaccines were developed and administered in less than a year.
- Digital technology was adopted at a large scale and provided a host of solutions.

Some of the things deemed impossible in the TB response now seem increasingly possible in the wake of the COVID-19 experience.

GLOBAL TB GOALS AND COMMITMENTS

Sustainable Development Goals (SDGs)

Despite the pandemic, the global commitment to end TB by 2030 has remained unchanged. This commitment is enshrined in the SDGs, which the United Nations (UN) adopted in 2015. SDG Goal 3, Target 3.3 calls for an end to the TB epidemic, measured by a decline in the rate of people who develop the disease each year.

While SDG Target 3.3 directly commits to ending TB, several other SDGs contribute to achieving this goal. These include targets to achieve universal health coverage (UHC; Target 3.8), end hunger and malnutrition (Targets 2.1 & 2.2), eradicate extreme poverty and reduce poverty in all forms (Targets 1.1 & 1.2), and strengthen social protection systems (Target 1.3), as well as a number of targets under the goal of reducing inequalities and making cities and settlements safe.

WHO End TB Strategy

In 2014, the 67th World Health Assembly endorsed the WHO End TB Strategy. This Strategy established objectives that are necessary to end TB by 2030. Using 2015 as a baseline, the Strategy aims to reach the following two targets by 2030:

- Reduce the global TB incidence rate by 80%.
- Reduce the number of TB deaths by 90% worldwide.

UN High-Level Meeting (UNHLM) and other commitments

Recognizing the world's slow progress towards ending TB, in 2018, the UN General Assembly held its first-ever High-Level Meeting on TB. The outcome was a Political Declaration on TB, in which commitments to the SDGs and End TB Strategy were reaffirmed. The Political Declaration also established specific commitments for expanding TB prevention, care, research and funding, while placing human rights at the foundation of the global TB response. The Political Declaration set global targets to be achieved by 2022. The purpose was to put the world on track to achieve the goal of ending TB by 2030. At the beginning of 2022, however, the world was largely off-track to meet the ambitious UNHLM targets and commitments. Another UNHLM is planned for 2023.

In addition to global targets and commitments, TB-related commitments have been made from time to time by groups of countries that together share a substantial burden of TB and have an ambition to act against TB jointly and decisively. Such groups of countries include BRICS (Brazil, Russian Federation, India, China and South Africa), the G20, and countries in the WHO South-East Asia Region. Such political declarations serve the purpose of keeping the fight against TB high on the political agenda at national and international levels.

The goal to end TB by 2030 is ambitious. However, the COVID-19 pandemic has demonstrated that countries—governments, civil society and the private sector together—are capable of mobilizing robust responses to public health crises. The Global Plan's modelling projects that countries can end TB by 2030 if they mobilize responses that are proportionate to the need, with investments in interventions that will create impact in their various settings. Now more than ever, investment and action are critical.

2

ENDING TB THROUGH COMPREHENSIVE INVESTMENT PACKAGES IMPLEMENTED AT SCALE

PRIORITY ACTIONS

- Invest in comprehensive investment packages of TB interventions.
- Scale up interventions to achieve key objectives and targets.

Globally, TB incidence and mortality has been only slowly declining over the last decade, with COVID-19 leading to an increase in TB deaths.

There are proven approaches and tools to diagnose, treat and prevent TB; these must be optimized and scaled up. At the same time, thanks to research and development (R&D) efforts, new tools—and improved versions of existing tools—are expected to become available in the next few years.

Some parts of the world have shown that TB can be reduced substantially if all tools and approaches are applied comprehensively and at scale. Unfortunately, in many high TB burden countries, these tools have been applied inconsistently or without a systematic approach, mainly due to a lack of resources and coordination. This has led to limited gains and missed opportunities to halt transmission.

INVEST IN COMPREHENSIVE INVESTMENT PACKAGES OF TB INTERVENTIONS

The Global Plan calls for countries to invest in a comprehensive package of interventions that can end TB. A comprehensive investment package is a set of high-level interventions strategically needed to end TB. While not an exhaustive list of detailed interventions and activities, this package is comprehensive because it covers the categories of interventions needed to end TB:

- early diagnosis
- treatment and care
- prevention
- systems and enablers
- R&D
- resource mobilization.

Depending on specific local needs, different settings should focus more on some interventions than on others, while still maintaining a comprehensive approach to investment. It is essential to not neglect investment in any category. Types of interventions must be prioritized depending on the epidemiological context (see Table 1).

Table 1. Comprehensive investment package for ending TB by 2030

Early diagnosis (Chapter 3)
Scale up modern point-of-care (POC) diagnostics and universal drug susceptibility testing (DST), aided and supported by: - robust diagnostic networks; - integration of TB screening and testing within other health and nutritional services; - X-ray for TB screening, enhanced by artificial intelligence (AI)-powered computer-aided detection (CAD); - electronic connectivity systems for timely reporting and linkage to treatment.
Detect TB as early as possible, in subclinical stages, by implementing active case finding. Prioritize outreach to: - close contacts of people with TB; - people living with underlying risk factors; - key and vulnerable populations; - health workers; - people exposed to silica dust; - populations with poor access to health services.
Care and support (Chapter 3)
Provide people-centred care for all adults, children and adolescents with TB and drug-resistant (DR-) TB, using the latest approved treatment regimens, with comprehensive clinical monitoring and management of comorbidities and underlying conditions.
Provide mental health evaluation, care and support during and post-treatment.

Provide evaluation and care for post-TB disease, preventing TB recurrence.
Integrate TB care and support into other relevant health and nutrition programmes, with a focus on underlying conditions such as nutrition, HIV, diabetes, tobacco cessation and alcohol use disorder.
Expand and maintain support systems that include: - psychosocial support; - incentives and enablers; - digital adherence support technologies.
Provide care that is human rights-affirming, free of stigma and discrimination, and gender-responsive.
Prevention (Chapter 4)
Scale up TB infection testing in line with a "test and treat" strategy, prioritizing key and vulnerable populations and communities that will benefit the most from TB preventive treatment (TPT).
Provide universal access to TPT to: - child, adolescent and adult contacts of people with TB; - people living with HIV (PLHIV); - key and vulnerable populations depending on epidemiological context.
Implement airborne infection prevention and control (AIPC) measures across the health system, and ensure that laws, policies and regulations for congregate settings and confined public spaces implement standards and best practices for airborne infection prevention.
Apply a One Health approach, collaborating with food safety authorities to prevent transmission of zoonotic TB in populations at risk of acquiring bovine TB.
Develop a vaccine implementation readiness plan.
When new vaccines become available, introduce and scale up vaccination to reach target population coverage.
Systems and enablers (Chapters 5–7)
Ensure that the TB response is equitable, human rights-based, gender-responsive, and free of stigma and discrimination, addressing the needs of key and vulnerable populations.
Engage affected communities in planning, implementation, monitoring and governance bodies involved in the TB response, providing fair compensation for their service where appropriate.
Invest in community health systems, including human resources, capacity-building, and necessary tools and approaches to bring people-centred care to the community level.
Address the needs of key and vulnerable populations.
Strengthen policies, engagement, support and supply chains to private health providers, ensuring that all people with TB who seek care in the private health sector receive affordable, quality-assured care.
Transition TB information systems from paper-based to digital, enabling real-time notification and efficient surveillance systems that aid more effective decision-making.
Strengthen human resources for TB, including formalizing the roles of community health workers.
TB R&D (Chapter 8)
Invest in identifying innovative product-development pathways and increasing collaboration among key stakeholders in product development.
Nurture and support growth in the field of TB research.

Build clinical trial capacity, including in low-income and middle-income countries (LICs and MICs).
Apply access principles and best practices in community engagement.
Invest in advocacy that improves science literacy among advocates and affected communities, builds advocacy skills among the TB scientific community, and promotes regular communication and collaboration between advocates, scientists and affected communities.
Resource mobilization (Chapter 9)
Intensify outreach to diversify the base of funding sources and enrol new partners in the TB response.
Invest in advocacy and strategic communications to mobilize resources and political will for full implementation of the Global Plan.

SCALE UP INTERVENTIONS TO ACHIEVE KEY OBJECTIVES AND TARGETS

To carry out the WHO End TB Strategy and achieve the SDG of ending TB by 2030, this updated Global Plan sets the following targets based on impact modelling (see below). The priority actions presented by this Global Plan need to be implemented to achieve these objectives and targets.

Deliver early diagnosis and TB treatment and care (Chapter 3)

Each year, millions of people with TB go without a diagnosis, denying them access to life-saving TB care. When people are diagnosed, they commonly receive a late diagnosis and/or a diagnosis with old tools that provide too little information to select an appropriate treatment regimen.

At the same time, prevalence surveys have shown that about half of people with laboratory-confirmed active TB disease may not have symptoms or might not report symptoms. This is known as "subclinical TB". This suggests that many people with active TB disease are not seeking diagnosis and care.

Thanks to recent investments in innovation, TB treatment is becoming shorter and safer. Yet, many people are denied access to appropriate treatment using the best regimens available. Delays are also common between the time people are diagnosed with TB and the time they start treatment.

Objectives:

- Reduce TB transmission by actively searching out and proactively bringing timely TB services to those in need, including those who have not yet come in contact with the health care system.
- Ensure universal access to appropriate treatment that is initiated immediately following accurate diagnosis.

Targets to achieve by 2030:

- Find and diagnose at least 95% of people with TB, including drug-susceptible (DS-) and DR-TB in adults and children.
- More than 90% of pulmonary TB should be diagnosed by rapid molecular tests, and more than 90% of bacteriologically identified TB strains should have DST before initiating treatment.
- Deliver treatment to 50 million people from 2023 to 2030, including 4.7 million children and 3.32 million people with rifampicin-resistant (RR-) or multidrug-resistant (MDR-) TB.
- Initiate appropriate treatment for all people diagnosed with TB.
- Achieve at least 90% treatment success for all forms of TB.

Prevent TB transmission, infection and disease (Chapter 4)

Prevention, detection and treatment are all linked, as early diagnosis and effective treatment prevent the spread of infection. A comprehensive approach to prevention requires protecting people from TB exposure and preventing TB infection from progressing to active disease. It also requires expanding understanding and support to prevent the recurrence of TB and other long-term adverse health effects after TB treatment is completed.

Objectives:

- Prevent exposure to TB.

- For people who have been exposed, prevent TB infection from progressing to active TB disease, and prevent recurrence of TB and post-TB disease (i.e., TB-related sequelae).

Targets to achieve by 2030:
- Provide TPT to 100% of eligible contacts of people with TB.
- Provide TPT to 100% of PLHIV.
- Provide TPT to 35 million people at risk of TB.
- Develop at least one new TB vaccine to be recommended for use in 2025 and rolled out in 2026.
- Achieve at least 60% target population coverage with a new vaccine by 2030.

Implement enablers and strengthen systems (Chapters 5–7)

The tools needed to detect, treat and prevent TB will only reach all people in need when health systems function well and are underpinned by a human rights approach that values all people equally. TB programmes need to provide care and support that enables people with TB to complete a full course of treatment without an undue burden on them and their families, while avoiding catastrophic costs. At the same time, a people-centred approach to ending TB recognizes that medical interventions are necessary but not sufficient, and that other interventions are needed that extend beyond the health sector.

Objective:
- Invest in interventions that enable and make detection, treatment and prevention impactful and equitable.

Targets to achieve by 2030:
- At least 90% of countries have a communities, rights and gender (CRG) action plan, budget line and monitoring mechanism.
- At least 90% of countries have identified key and vulnerable populations in their national TB plans, have proposed specific actions, and have a budget line and monitoring mechanism in place.
- At least 90% of countries that anticipate implementing a new TB vaccine have a vaccine readiness plan.

Accelerate R&D of new TB tools (Chapter 8)

The Global Plan's modelling shows that new diagnostics, medicines and vaccines are essential to ending TB by 2030. The R&D pipelines for new TB tools are more promising than at any point in recent history, but a lack of funding for R&D is a critical barrier to advancing research and bringing new tools to market. Funding for TB R&D has consistently fallen far short of the need. The COVID-19 response, however, shows what kind of innovation is possible with funding backed by political will and facilitated by efficient regulatory approval processes.

Objective:
- Accelerate the R&D of new TB tools needed to end TB.

Target to achieve by 2030:
- Achieve the goals and objectives set in the Global Plan's strategic frameworks for vaccines, diagnostics and medicines (see Chapter 8 for new tools strategic frameworks).

Mobilize resources to implement the Global Plan (Chapter 9)

The Global Plan presents priority actions representing contributions from all sectors involved in the global TB response. The single biggest barrier to implementing the Global Plan and ending TB is a shortfall in resources. The Global Plan's projected funding needs are in line with what modelling shows is needed to compensate for progress lost during the COVID-19 pandemic and to accelerate a decline in incidence and death in order to reach the global goal of ending TB by 2030.

Objective:
- Mobilize resources from a diversified base of domestic, international and innovative financing sources, using advocacy and strategic communications to enrol new partners in fully implementing the Global Plan.

Targets to achieve by 2030:
- Mobilize US$ 209.8 billion for TB programmes and enabling interventions from 2023 to 2030.
- Mobilize US$ 33.8 billion for R&D for new TB medicines, diagnostics and vaccines from 2023 to 2030.
- Mobilize at least US$ 6.4 billion for TB basic science research.

MILESTONES[1] :

- 2023–2027: Deliver TB treatment to 38.6 million people, including 3.3 million children and 1.7 million people with RR-TB or MDR-TB.
- 2028–2030: Deliver TB treatment to 11.4 million people, including 1.4 million children and 0.5 million people with RR-TB or MDR-TB.
- 2023–2027: Deliver TPT to 16 million people.
- 2028–2030: Deliver TPT to 19 million people.

1. Targets for 2027–2030 will have to be revised if 2023–2027 targets are not met.

MODELING THE GLOBAL PLAN'S IMPACT

Epidemiological modelling has been conducted to determine the impact of interventions needed to end TB by 2030. This chapter presents key findings from this modelling (see Figures 1 & 2, Table 2). It provides guidance on how countries can take actions that reduce TB incidence, mortality and notifications, and create greater impact as determined by key indicators.

The full modelling report is available in Annex 1.

Key findings:

- A comprehensive approach to diagnosis, treatment and prevention is needed at scale.
- Diagnosing people earlier—even at the subclinical stage—is critical. This requires using active case finding and screening all household contacts of people diagnosed with TB.
- Improvements in diagnosis and treatment of TB are needed through a variety of interventions, but these measures alone are not enough to end TB.
- TPT needs to be massively scaled up.
- We can achieve important progress with currently available tools, but new tools are essential for making the necessary strides.
- Ultimately, to end TB, a new vaccine is necessary to extend the benefits of prevention much more widely and more durably than is currently possible with preventive therapy.

Changes in modelling from the previous approach

For the previous Global Plans (2016–2020 and 2018–2022), the modelling methodologies relied heavily on national TB budget and expenditure reports submitted by countries to WHO to derive unit costs and estimate resource needs. This Global Plan uses a "normative approach", wherein the projected implementation of tools (e.g., diagnostics, medicines) and services (e.g., patient support) are consistent with WHO guidelines. This approach has allowed for more detailed projections of resource needs[1] .

Figure 1. Global TB cases, impact by 2030, with or without a catch-up effort in 2022, and with or without new tools rolled out in 2026

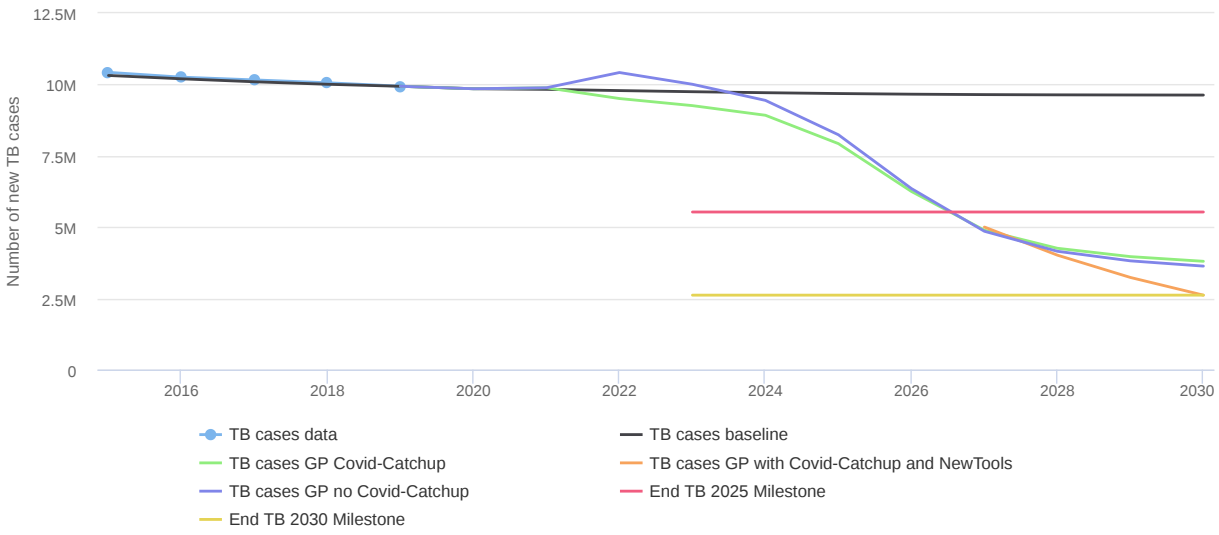


Figure 2. Global TB deaths, impact by 2030, with or without a catch-up effort in 2022, and with or without new tools rolled out in 2026

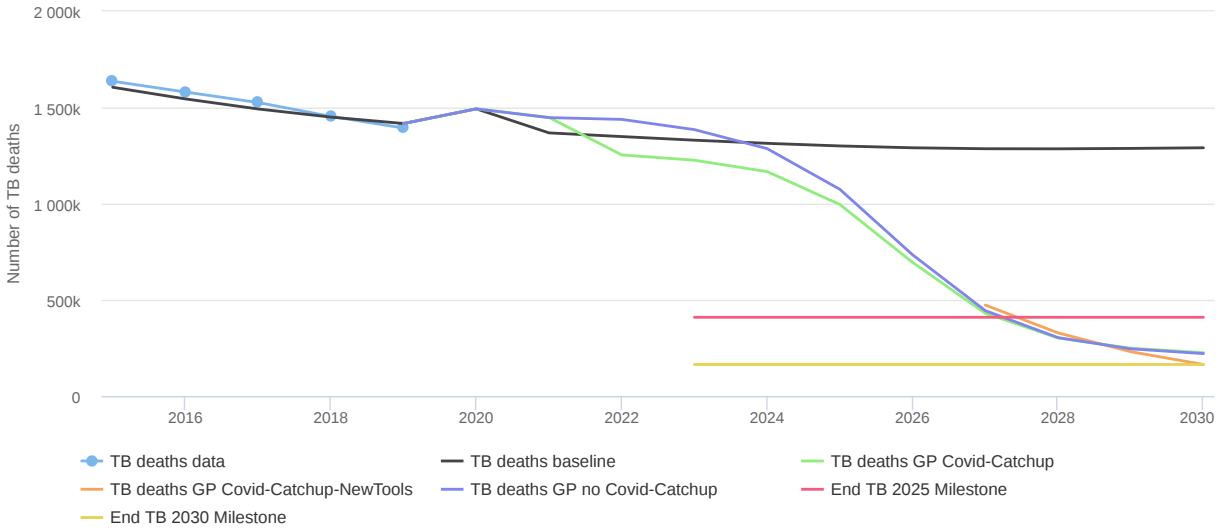


Table 2. Model projections for TB incidence rates and deaths, 2023–2030

New TB Cases (per 100,000 population)									
Country category	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2023–2030**
GLOBAL TOTAL									
Total (Global, including OECD countries	116.4	111.1	97.8	76.4	60.2	47.6	37.8	30.0	75.0
Total (Global, excluding OECD countries)	137.5	131.2	115.3	90.0	70.8	55.9	44.3	35.2	88.2
BY INCOME STATUS									
Low income	169.3	157.1	132.5	98.4	79.7	64.7	52.7	43.0	97.9
Lower middle income	193.0	184.8	163.4	127.9	99.4	77.4	60.4	47.2	124.3
Upper middle income	57.4	54.5	47.9	37.9	30.3	24.4	19.8	16.2	37.9
High income	8.8	7.8	6.9	5.6	4.5	3.6	2.9	2.3	5.6
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	1.8	2.1	2.3	2.5	3.5	3.6	3.7	3.9	23.4
Lower middle income	8.5	9.7	11.4	12.5	16.7	16.4	16.6	17.2	109.0
Upper middle income	1.5	1.6	1.8	1.8	2.4	2.4	2.4	2.5	16.4
All GFATM-eligible countries	11.8	13.3	15.5	16.8	22.6	22.3	22.7	23.6	148.7
WHO REGION									
Eastern Mediterranean	107.6	103.7	91.5	70.8	54.6	42.2	32.6	25.3	69.1
Africa	182.4	166.3	141.9	109.4	90.5	75.2	62.7	52.5	109.4
Americas	26.9	26.0	22.2	17.2	13.0	9.8	7.4	5.7	16.5
Europe	23.0	21.8	19.5	16.0	12.8	10.2	8.2	6.6	15.9
Western Pacific	87.7	84.5	74.4	57.5	44.7	34.7	27.0	21.0	57.4
South-East Asia	195.3	188.7	168.1	132.0	102.2	79.2	61.4	47.6	127.5
BRICS (BRA,CHN,IND,RUS,ZAF)	108.5	105.0	94.7	75.6	59.5	47.0	37.2	29.6	73.0

TB Deaths (per 100,000 population)									
Country category	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2023-2030**
GLOBAL TOTAL									
Total (Global, including OECD countries	15.4	14.5	12.3	8.5	5.7	3.9	2.7	1.9	8.0
Total (Global, excluding OECD countries)	18.3	17.2	14.6	10.1	6.8	4.7	3.2	2.3	9.5
BY INCOME STATUS									
Low income	24.8	22.2	17.7	11.4	7.9	5.9	4.5	3.4	11.3
Lower middle income	27.1	25.7	21.9	15.3	10.2	6.9	4.7	3.2	14.3
Upper middle income	5.3	5.0	4.2	2.8	1.9	1.3	0.9	0.6	2.7
High income	0.9	0.8	0.7	0.5	0.3	0.2	0.1	0.1	0.5
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS									

TB Deaths (per 100,000 population)									
Low income	24.8	22.2	17.7	11.4	7.9	5.9	4.5	3.4	11.3
Lower middle income	27.1	25.7	21.9	15.3	10.2	6.9	4.7	3.2	14.3
Upper middle income	26.1	25.1	21.5	14.7	9.5	6.2	4.0	2.7	14.0
All GFATM-eligible countries	26.6	25.0	21.1	14.5	9.7	6.6	4.6	3.2	13.7
WHO REGION									
Eastern Mediterranean	9.1	8.7	7.3	4.9	3.3	2.3	1.5	1.1	4.6
Africa	37.6	34.5	28.2	18.5	12.9	9.1	6.5	4.7	18.1
Americas	2.0	1.7	1.3	0.8	0.6	0.4	0.3	0.2	0.9
Europe	2.2	2.1	1.7	1.2	0.9	0.7	0.5	0.4	1.2
Western Pacific	4.1	3.8	3.2	2.1	1.5	1.1	0.8	0.5	2.1
South-East Asia	28.1	26.9	23.2	16.6	10.8	7.2	4.8	3.2	15.3
BRICS (BRA,CHN,IND,RUS,ZAF)	15.5	15.2	13.4	9.9	6.4	4.1	2.7	1.8	8.9

1. Unit costs in previous Global Plans could only be estimated in broad categories. For example, costs could be estimated in relation to diagnosis or treatment or collaborative TB-HIV activities, without a clear relationship between guidelines and costs in different programme areas (e.g., screening, diagnosis, monitoring, prevention) or types of people receiving care, depending on age, pulmonary vs extrapulmonary TB, MDR/RR status, HIV status or other variables. Following the recommendations of a technical working group, a "normative ingredients-based approach" was developed to cost all direct services (i.e., at the point of care) within a representative sample of nine types of algorithms for screening, treatment and prevention, which are tailored to the guidelines for different types of people receiving care. The guidelines are based on WHO recommendations, with greater detail in some elements (e.g., timing of an intervention's roll-out).

TB CASE NOTIFICATIONS

Table 3 shows the overall TB case notification targets, case notification targets for children under 15, and case notification targets for people with RR-/MDR-TB. Top-line TB case notification targets are:

- 50.0 million people with TB in the period 2023–2030 and 38.6 million in the first five years (2023–2027);
- 4.7 million children with TB in the period 2023–2030 and 3.32 million in the first five years (2023–2027);
- 2.2 million people with RR-/MDR-TB in the period 2023–2030 and 1.7 million in the first five years (2023–2027).

Table 3. TB notifications (all ages, children under 15 years and RR-/MDR-TB), 2023–2030

TB Notifications (all ages, millions)									
Country category	2023	2024	2025	2026	2027	2028	2029	2030	Total
GLOBAL TOTAL									
Total (Global, including OECD countries	7.8	8.0	8.7	8.2	6.0	4.6	3.9	3.6	50.7
Total (Global, excluding OECD countries)	7.6	7.8	8.6	8.1	6.0	4.5	3.9	3.6	50.1
BY INCOME STATUS									
Low income	1.0	1.0	1.1	1.0	0.7	0.6	0.5	0.5	6.4
Lower middle income	5.3	5.4	6.0	5.6	4.2	3.1	2.7	2.5	34.8
Upper middle income	1.4	1.4	1.6	1.5	1.1	0.8	0.7	0.7	9.1
High income	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.5
GFATM ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	1.8	2.1	2.3	2.5	3.5	3.6	3.7	3.9	23.4
Lower middle income	8.5	9.7	11.4	12.5	16.7	16.4	16.6	17.2	109.0
Upper middle income	1.5	1.6	1.8	1.8	2.4	2.4	2.4	2.5	16.4
All GFATM eligible countries	11.8	13.3	15.5	16.8	22.6	22.3	22.7	23.6	148.7
WHO REGION									
EMR	0.5	0.5	0.5	0.5	0.4	0.3	0.3	0.2	3.1
AFR	1.4	1.5	1.8	1.9	1.4	1.1	1.0	1.0	11.2
AMR	0.2	0.2	0.3	0.2	0.2	0.1	0.1	0.1	1.5
EUR	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	1.0
WPR	1.4	1.4	1.5	1.4	1.0	0.7	0.6	0.6	8.5
SEA	4.0	4.1	4.5	4.1	3.0	2.2	1.8	1.7	25.5
BRICS (BRA,CHN,IND,RUS,ZAF)									
Total	3.7	3.7	4.0	3.8	2.8	2.1	1.7	1.6	23.5

TB Notifications (U15, millions)									
Country category	2023	2024	2025	2026	2027	2028	2029	2030	Total
GLOBAL TOTAL									
Total (Global, including OECD countries	0.57	0.64	0.75	0.76	0.60	0.49	0.44	0.43	4.68
Total (Global, excluding OECD countries)	0.56	0.64	0.75	0.76	0.60	0.48	0.44	0.43	4.66

TB Notifications (U15, millions)									
BY INCOME STATUS									
Low income	0.11	0.11	0.12	0.11	0.09	0.07	0.06	0.06	0.74
Lower middle income	0.42	0.49	0.58	0.59	0.46	0.37	0.34	0.33	3.58
Upper middle income	0.03	0.04	0.05	0.06	0.05	0.04	0.04	0.04	0.34
High income	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	0.11	0.11	0.12	0.11	0.09	0.07	0.06	0.06	0.74
Lower middle income	0.42	0.49	0.58	0.59	0.46	0.37	0.34	0.33	3.58
Upper middle income	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.17
All GFATM-eligible countries	0.55	0.62	0.72	0.73	0.57	0.47	0.42	0.41	4.49
WHO REGION									
EMR	0.06	0.06	0.07	0.07	0.05	0.04	0.03	0.03	0.42
AFR	0.13	0.15	0.18	0.20	0.16	0.14	0.13	0.13	1.23
AMR	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07
EUR	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.04
WPR	0.06	0.07	0.07	0.07	0.05	0.04	0.04	0.04	0.46
SEA	0.29	0.34	0.41	0.41	0.32	0.25	0.23	0.22	2.47
BRICS (BRA,CHN,IND,RUS,ZAF)									
Total	0.19	0.21	0.26	0.28	0.23	0.19	0.17	0.16	1.69

MDR/RR TB (thousands)									
Country category	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
GLOBAL TOTAL									
Total (Global, including OECD countries	359.0	353.5	380.5	350.7	260.1	197.0	168.8	156.0	2,225.7
Total (Global, excluding OECD countries)	306.1	297.3	313.5	284.1	214.4	163.5	139.7	128.5	1,847.1
BY INCOME STATUS									
Low income	20.9	20.5	21.0	18.2	13.5	10.4	9.1	8.4	122.0
Lower middle income	205.1	207.1	226.7	216.0	161.1	120.8	101.7	92.8	1,331.4
Upper middle income	72.9	63.8	60.8	46.5	37.1	30.1	26.9	25.4	363.4
High income	60.2	62.0	72.1	70.1	48.4	35.7	31.1	29.4	409.0
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	20.9	20.5	21.0	18.2	13.5	10.4	9.1	8.4	122.0
Lower middle income	205.0	207.0	226.6	215.9	161.1	120.7	101.7	92.8	1,330.9
Upper middle income	20.3	19.8	20.3	18.2	14.8	12.5	11.5	11.0	128.6
All GFATM-eligible countries	246.2	247.4	267.9	252.3	189.4	143.7	122.3	112.2	1,581.4
WHO REGION									
EMR	25.3	23.9	25.0	22.5	17.3	13.5	11.9	11.2	150.8
AFR	37.6	39.7	45.4	48.2	37.0	29.8	26.9	25.5	290.1
AMR	55.8	59.0	70.1	68.2	46.9	34.2	29.5	27.7	391.5
EUR	62.7	52.9	48.9	36.4	29.2	23.8	21.3	20.2	295.4
WPR	18.1	16.8	16.5	13.5	10.3	8.1	7.1	6.6	97.1
SEA	159.5	161.1	174.6	161.9	119.3	87.6	72.1	64.7	1,000.9
BRICS (BRA,CHN,IND,RUS,ZAF)									
Total	183.9	172.5	179.7	160.8	122.1	90.8	75.3	68.0	1,053.1

TB PREVENTION

Table 4 shows the overall targets for providing TPT to eligible contacts of people diagnosed with TB, PLHIV, and other key and vulnerable populations. Top-line TPT targets are:

- 35 million people at risk in the period 2023–2030 and 26 million in the first five years (2023–2027);
- 21 million adult contacts in the period 2023–2030 and 16 million in the first five years (2023–2027).

Table 4. TPT (adults, children under 15 years and PLHIV in antiretroviral therapy [ART] cohorts), 2023–2030

TB Prevention, Adults (millions)									
Country category	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
GLOBAL TOTAL									
Total (Global, including OECD countries	3.0	3.1	3.5	3.4	2.6	2.0	1.7	1.6	20.8
Total (Global, excluding OECD countries)	3.0	3.1	3.5	3.4	2.5	2.0	1.7	1.6	20.7
BY INCOME STATUS									
Low income	0.4	0.5	0.5	0.5	0.4	0.3	0.3	0.2	3.0
Lower middle income	2.0	2.1	2.3	2.3	1.7	1.3	1.1	1.1	14.0
Upper middle income	0.5	0.6	0.6	0.6	0.4	0.3	0.3	0.3	3.7
High income	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	0.4	0.5	0.5	0.5	0.4	0.3	0.3	0.2	3.0
Lower middle income	2.0	2.1	2.3	2.3	1.7	1.3	1.1	1.1	14.0
Upper middle income	0.2	0.2	0.3	0.2	0.2	0.2	0.1	0.1	1.6
All GFATM-eligible countries	2.7	2.8	3.1	3.0	2.3	1.8	1.5	1.4	18.6
WHO REGION									
Eastern Mediterranean	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	1.4
Africa	0.7	0.8	0.9	1.0	0.8	0.6	0.6	0.5	5.9
Americas	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.7
Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Western Pacific	0.4	0.4	0.5	0.5	0.3	0.2	0.2	0.2	2.8
South-East Asia	1.5	1.6	1.7	1.6	1.2	0.9	0.7	0.7	9.8
BRICS (BRA,CHN,IND,RUS,ZAF)									
Total	1.4	1.4	1.5	1.5	1.1	0.8	0.7	0.6	9.1

TB Prevention, Children under 15 years (millions)									
Country category	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
GLOBAL TOTAL									
Total (Global, including OECD countries	1.12	1.15	1.28	1.26	0.94	0.72	0.62	0.57	7.65
Total (Global, excluding OECD countries)	1.11	1.15	1.28	1.26	0.94	0.71	0.61	0.57	7.63

TB Prevention, Children under 15 years (millions)									
BY INCOME STATUS									
Low income	0.27	0.27	0.29	0.28	0.21	0.16	0.14	0.13	1.73
Lower middle income	0.72	0.75	0.85	0.85	0.64	0.49	0.42	0.38	5.09
Upper middle income	0.13	0.13	0.14	0.13	0.10	0.07	0.06	0.06	0.82
High income	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	0.27	0.27	0.29	0.28	0.21	0.16	0.14	0.13	1.73
Lower middle income	0.72	0.75	0.84	0.85	0.64	0.48	0.42	0.38	5.08
Upper middle income	0.06	0.06	0.06	0.06	0.04	0.04	0.03	0.03	0.37
All GFATM-eligible countries	1.05	1.08	1.20	1.18	0.88	0.68	0.58	0.54	7.19
WHO REGION									
Eastern Mediterranean	0.10	0.10	0.11	0.10	0.08	0.06	0.05	0.05	0.66
Africa	0.39	0.42	0.50	0.56	0.42	0.33	0.30	0.28	3.20
Americas	0.03	0.03	0.03	0.03	0.02	0.02	0.01	0.01	0.18
Europe	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.06
Western Pacific	0.12	0.12	0.12	0.11	0.08	0.06	0.05	0.05	0.70
South-East Asia	0.46	0.47	0.50	0.46	0.33	0.24	0.20	0.18	2.85
BRICS (BRA,CHN,IND,RUS,ZAF)									
Total	0.39	0.38	0.41	0.39	0.29	0.21	0.17	0.16	2.40

TB Prevention, PLHIV (millions)									
Country category	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
GLOBAL TOTAL									
Total (Global, including OECD countries	0.93	1.02	1.09	0.66	0.63	0.64	0.65	0.66	6.27
Total (Global, excluding OECD countries)	0.91	1.01	1.08	0.65	0.62	0.63	0.64	0.65	6.19
BY INCOME STATUS									
Low income	0.27	0.29	0.31	0.22	0.21	0.22	0.22	0.23	1.97
Lower middle income	0.36	0.41	0.44	0.27	0.25	0.26	0.26	0.27	2.52
Upper middle income	0.29	0.31	0.33	0.17	0.16	0.16	0.16	0.16	1.72
High income	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.06
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	0.27	0.29	0.31	0.22	0.21	0.22	0.22	0.23	1.97
Lower middle income	0.36	0.41	0.44	0.27	0.25	0.26	0.26	0.27	2.52
Upper middle income	0.21	0.24	0.25	0.10	0.09	0.09	0.09	0.09	1.15
All GFATM-eligible countries	0.84	0.93	1.00	0.58	0.56	0.56	0.57	0.58	5.63
WHO REGION									
Eastern Mediterranean	0.03	0.03	0.04	0.02	0.01	0.01	0.02	0.02	0.17
Africa	0.67	0.72	0.76	0.46	0.44	0.45	0.46	0.47	4.44
Americas	0.06	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.50
Europe	0.01	0.03	0.04	0.02	0.02	0.02	0.02	0.02	0.19
Western Pacific	0.06	0.06	0.07	0.05	0.05	0.05	0.05	0.05	0.44
South-East Asia	0.09	0.10	0.11	0.05	0.04	0.04	0.04	0.04	0.53
BRICS (BRA,CHN,IND,RUS,ZAF)									
Total	0.25	0.28	0.29	0.14	0.13	0.13	0.13	0.13	1.49

SUPPLEMENTARY MODELING: INDONESIA, KENYA, UKRAINE AND UZBEKISTAN[1]

To supplement the analysis provided by the TB Impact Model and Estimates (TIME), the Global Plan presents additional modelling analyses in four focal countries: Indonesia, Kenya, Ukraine and Uzbekistan. This supplemental modelling provides some understanding of the combinations of interventions that are necessary to meet the End TB goals in these contrasting settings.

These four countries were chosen in order to capture important features of TB epidemiology today, such as:

- the strong role of a fragmented private health care sector in managing TB in many South- and South-East Asian countries (Indonesia);
- the role of HIV coinfection as a key driver of TB incidence (Kenya);
- the substantial burden of RR-TB in many countries in Central and Eastern Europe, and elsewhere (Ukraine, Uzbekistan).

Three distinct models simulate the TB epidemiology in each of these three country contexts. This tailored approach enabled modelling of different combinations of interventions, while accounting for disruptions to TB services arising from COVID-19.

Improving diagnosis and care is important in all three country contexts. At the same time, the modelling emphasizes how important it is to tailor intervention priorities to local settings.

Rolling out an effective vaccine will be necessary to meet the End TB goals in all three settings, although each country will require a different minimum level of vaccination coverage. The model assumes that a new vaccine will be licensed in 2025, with distribution starting in 2026 and scale-up over three years to achieve the vaccination coverage rate included in each model.

Until a new vaccine is available, it remains critical to bring high-quality TB services to as many people as possible. This means 1) bringing case detection and treatment outcomes in the private sector up to the same level of quality found in the public sector, and 2) scaling up active case finding. The models project that in Indonesia and Ukraine, case finding will need to be extended to finding people with subclinical TB.

Indonesia

Figure 3 shows model projections for TB incidence in Indonesia. The model projects a temporary decrease in incidence in 2020, because lockdowns against COVID-19 are likely to reduce TB incidence in the short term. In the longer term, however, the model projects that service disruptions will lead to a substantial increase in TB incidence.

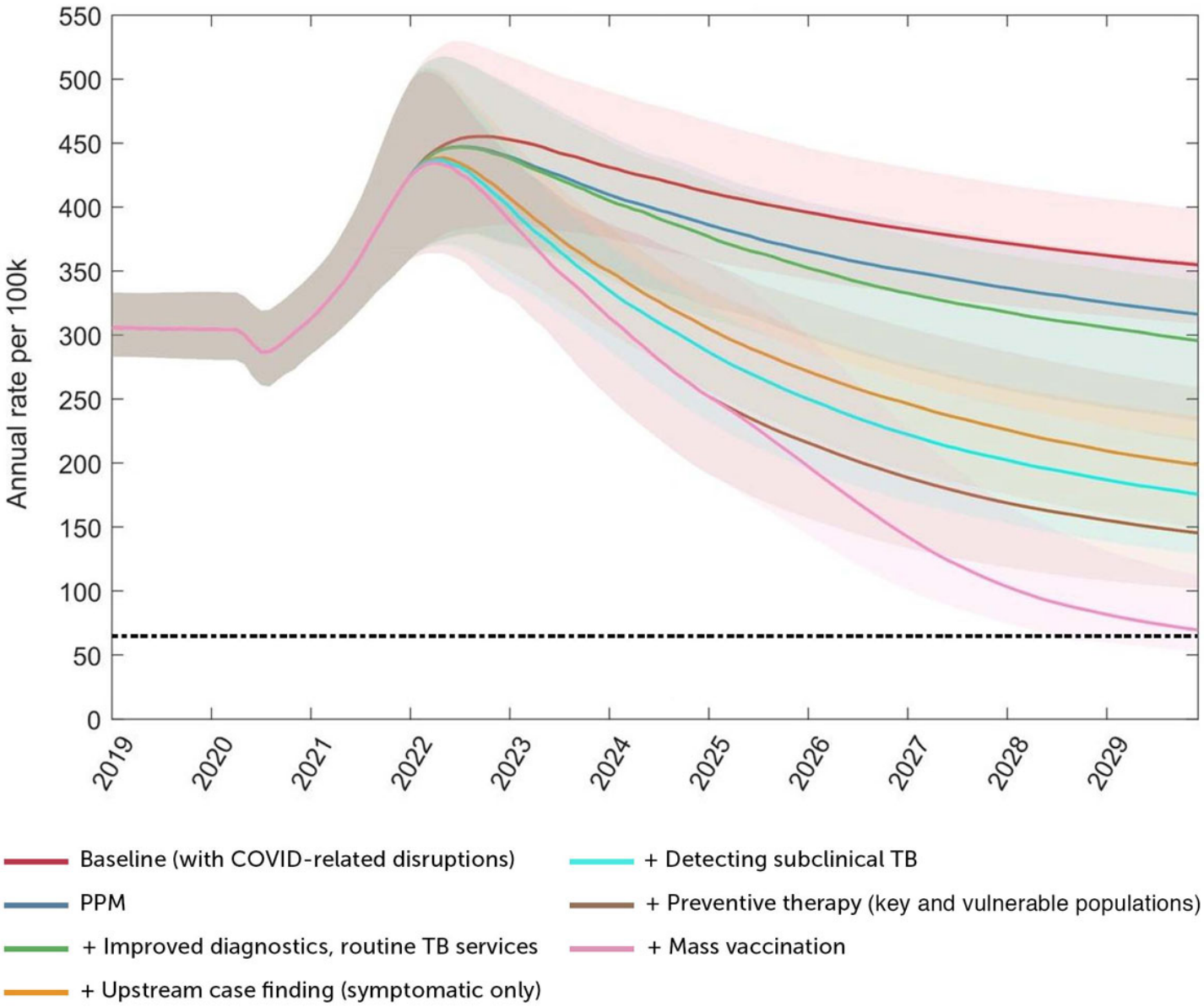
The model projects that Indonesia could end TB by 2030 if the following interventions are scaled up in a linear fashion from 2022 through 2025 and maintained thereafter:

- care delivered through a mix of public- and private-sector effort (public–private mix [PPM]);
- improved TB diagnosis;
- active finding of people living with symptomatic TB (active case finding, plus creating demand for existing TB services);
- detection of subclinical TB;
- preventive therapy focusing on key and vulnerable populations;
- mass vaccination with a new TB vaccine.

An important intervention to note is the detection of subclinical TB. Previous Global Plans have not emphasized this intervention. The model shows the important role that detecting subclinical TB can play in the TB response and in ending TB in Indonesia by 2030.

In addition to its direct impact, PPM indirectly enables other interventions. For example, PPM enhances the impact of preventive therapy by increasing the number of people with TB who are reported to the TB programme and whose contacts can benefit from preventive therapy. Overall, coordination of TB services across the health care system—whether in the public or private sector—will be critical for meeting the End TB goals.

Figure 3. Projected impact of comprehensive TB interventions in Indonesia, 2019–2030



It will not be possible to meet the End TB goals by 2030 without at least one new TB vaccine. Shown here is a coverage scenario whereby 65% of people living with TB infection receive a post-exposure vaccine with 60% efficacy from 2025 onwards.

Kenya

Figures 4 and 5 show model projections for TB incidence in Kenya. In Figure 4, the model projects that Kenya could reach the End TB goal of reducing incidence if the following interventions are scaled up in a linear fashion from 2022 through 2025 and maintained thereafter:

- improved TB diagnosis;
- active finding of people living with symptomatic TB (active case finding, plus creating demand for existing TB services);
- preventive therapy focusing on key and vulnerable populations;
- mass vaccination with a new TB vaccine.

Active case finding (plus care seeking generated by creating greater demand for TB services) has an important role in reducing TB incidence. However, the model projects that it is possible to meet the End TB goals in Kenya without extending case detection to subclinical TB. This is partly because preventive therapy has a stronger effect in Kenya than in the other countries modelled. Because HIV is a driver of TB epidemiology in Kenya, the uptake of TPT among PLHIV will play a critical role in reaching the End TB goals, as will a new TB vaccine.

Vaccine coverage does not need to be as high as in Indonesia to meet the End TB goals. The model scenario depicted in Figure 4 shows 40% coverage (versus 60% in Indonesia). Again, the strong role played by TPT among PLHIV brings the End TB goals within closer reach In Kenya than it does in other settings.

Figure 4. Projected impact of comprehensive TB interventions in Kenya, without detecting subclinical TB, 2019–2030

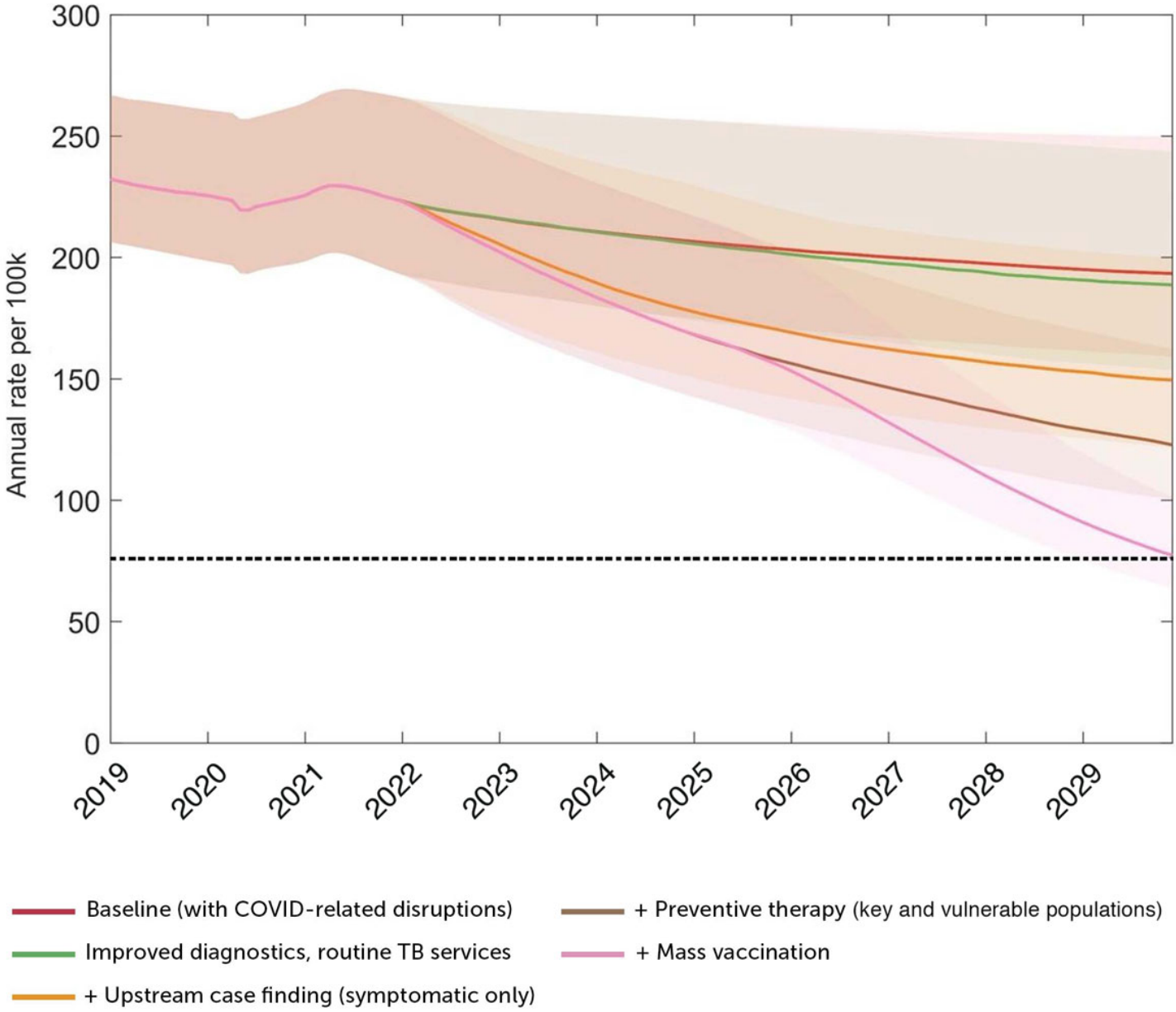
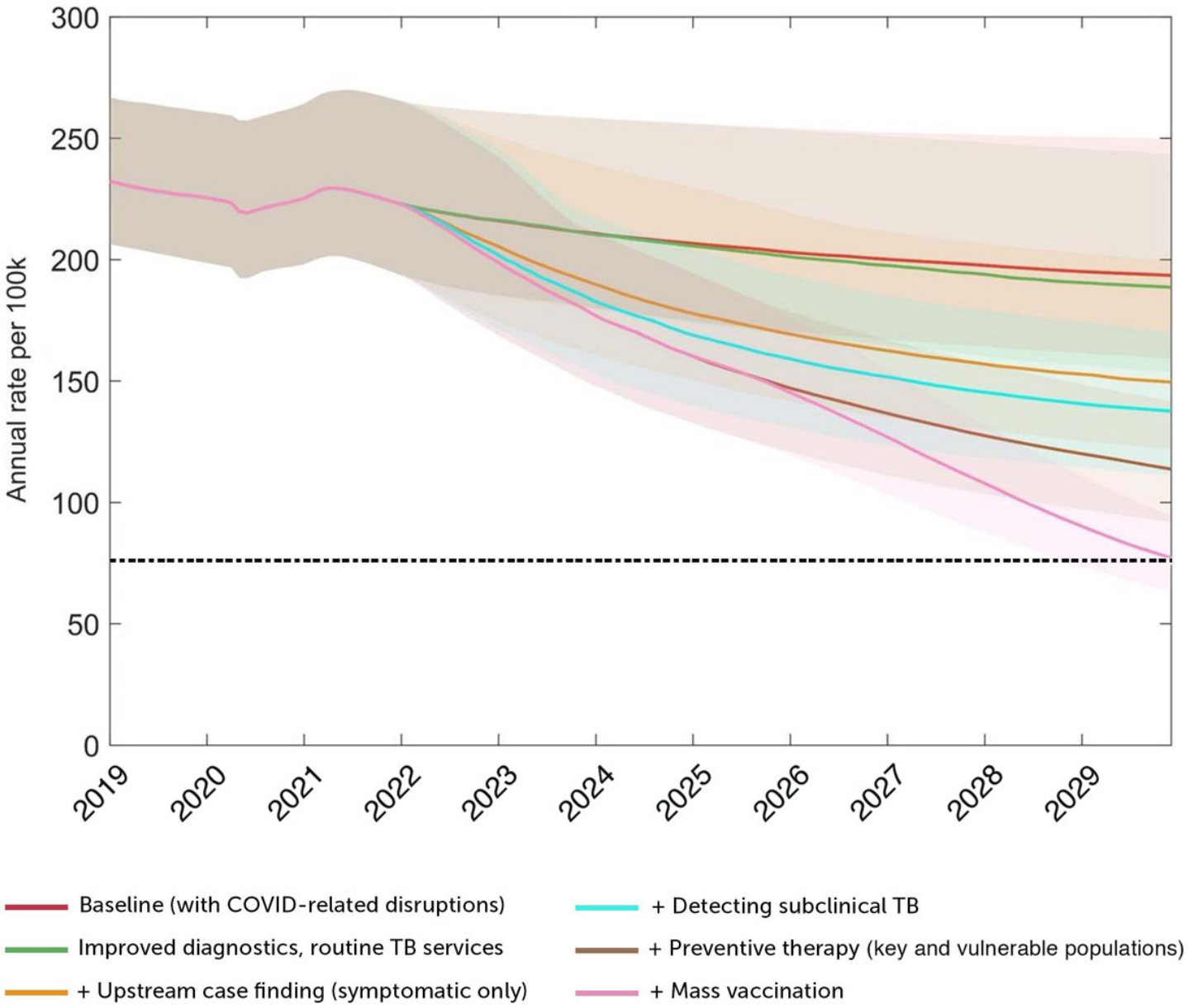


Figure 5. Projected impact of comprehensive TB interventions in Kenya, with detecting subclinical TB, 2019–2030



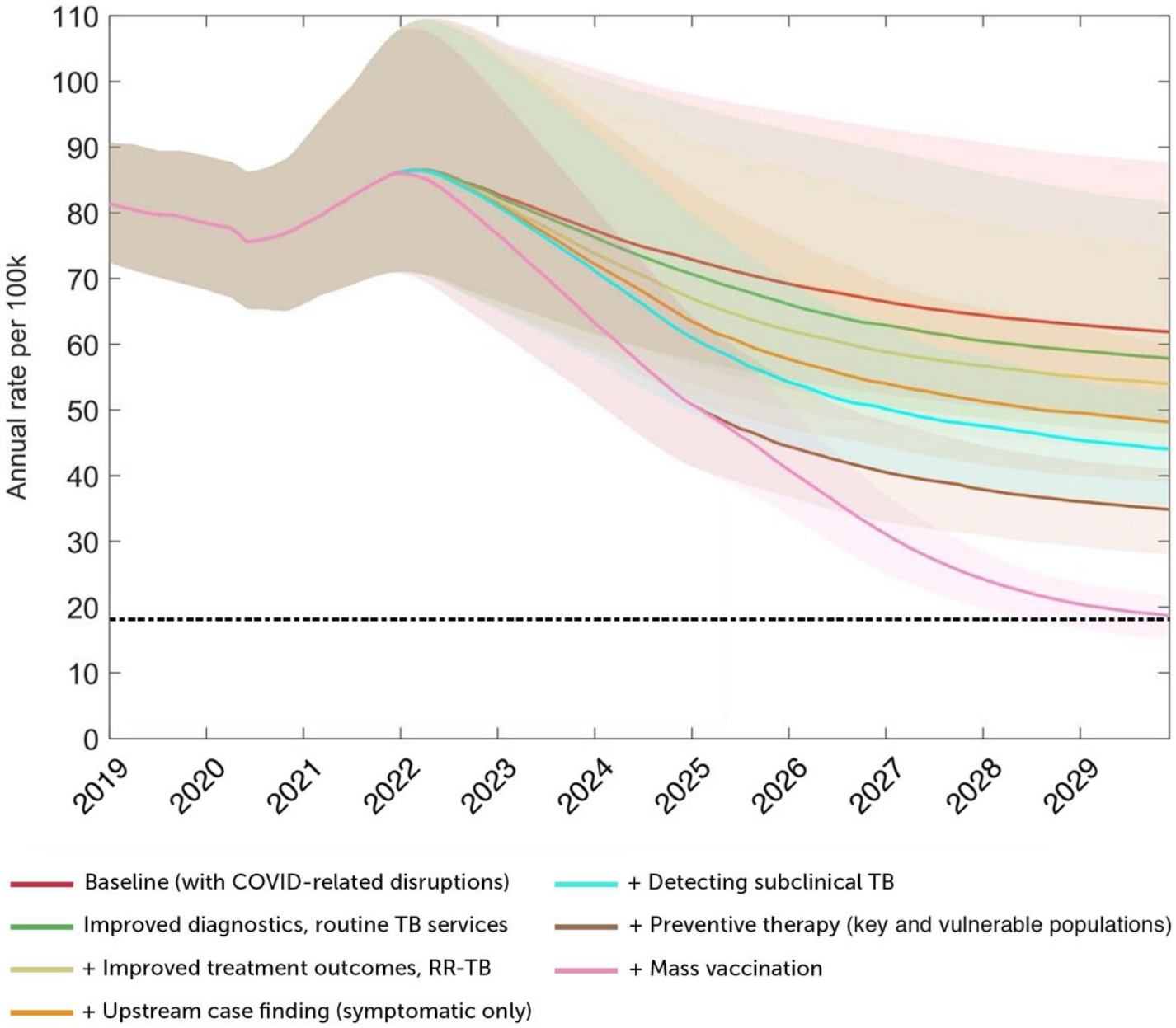
Ukraine

Figure 6 shows model projections for TB incidence in Ukraine. The model projects that Ukraine could reach the End TB goal of reducing incidence if the following interventions are scaled up in a linear fashion from 2022 through 2025 and maintained thereafter:

- improved TB diagnosis;
- improved treatment outcomes for RR-TB;
- active finding of people living with symptomatic TB (active case finding, plus creating demand for existing TB services);
- detection of subclinical TB;
- preventive therapy focusing on key and vulnerable populations;
- mass vaccination with a new TB vaccine.

Given the burden of RR-TB in Ukraine, the model projects that improving care for people with RR-TB would contribute significantly to reducing incidence and is necessary for achieving the 2030 End TB goals. This would need to involve using molecular diagnostics on a wide scale (facilitating the early recognition of RR-TB) and improving second-line treatment outcomes. Having at least one new vaccine is also critical, and the country would need to achieve 70% vaccine coverage.

Figure 6. Projected impact of comprehensive TB interventions in Ukraine, 2019–2030



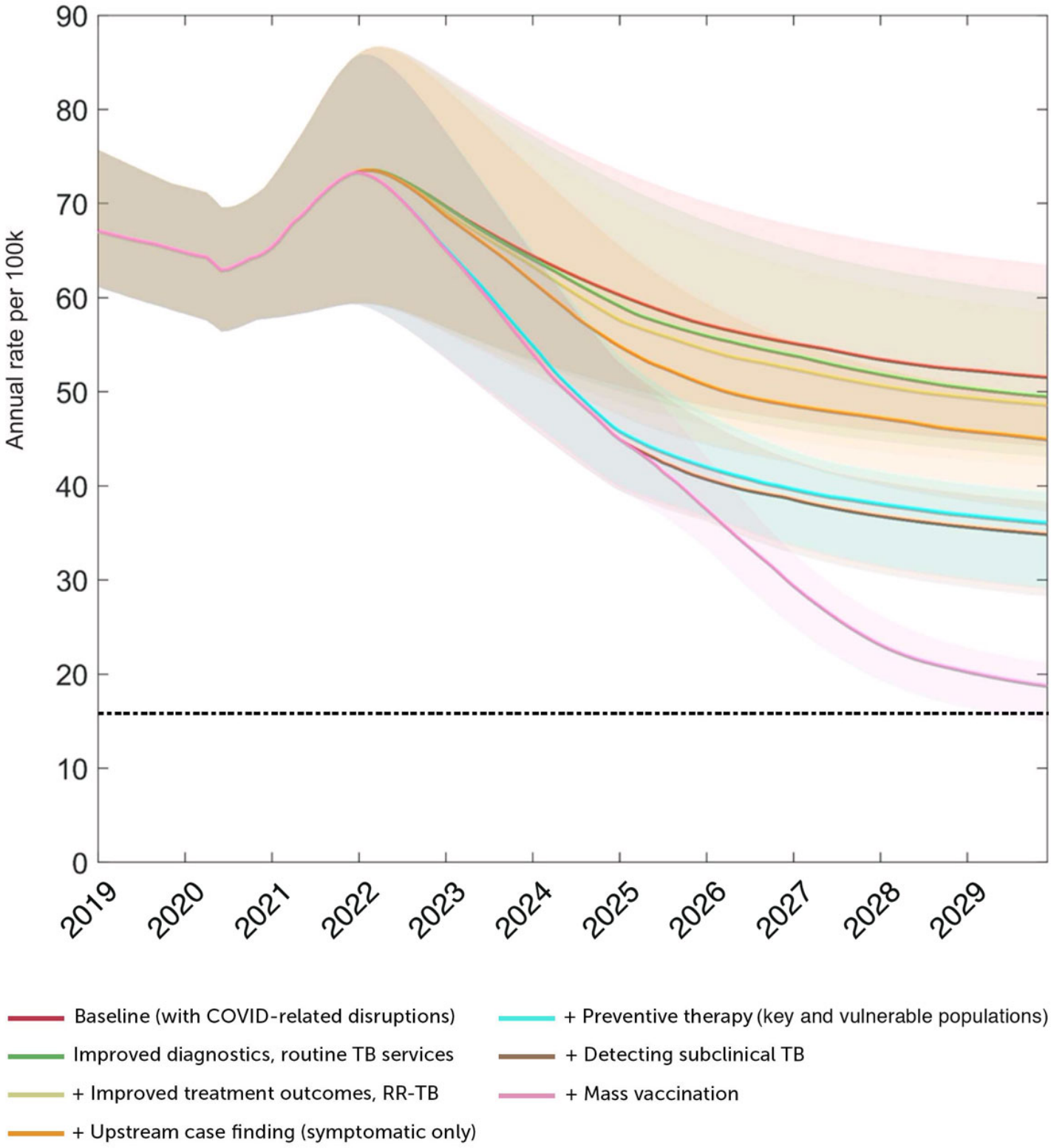
Uzbekistan

Figure 7 shows that Uzbekistan can reach the End TB goal of reducing incidence if the following interventions are scaled up in a linear fashion from 2023 through 2025 and maintained thereafter:

- use of improved diagnostics;
- improved treatment outcomes for DS- and RR-TB;
- upstream case finding of symptomatic TB;
- detection of subclinical TB.

Starting in 2026, the roll-out of a post-TB-exposure vaccine with at least 60% efficacy that reaches at least 65% of people with TB infection would decrease incidence further, in line with the End TB goal.

Figure 7. Projected impact of comprehensive TB interventions in Uzbekistan, 2019–2030



See Annex 2 for the supplementary modelling methodology and further analysis.

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1. Supplemental modelling for Ukraine was conducted prior to the invasion and the outbreak of war in February 2022. While this modelling scenario was no longer valid for Ukraine by the time the Global Plan was finalized, the modelling case study remains in the Global Plan to illustrate the impact modelled for this type of epidemiological setting. An additional country, Uzbekistan, was added to the modelling.

3

SCALING UP TB DIAGNOSIS AND CARE

PRIORITY ACTIONS

- Re-imagine TB care, delivering quality services through a people-centred approach.
- Scale up the use of modern diagnostics.
- Find the missing people with TB.
- Expand early diagnosis, including at subclinical stages.
- Develop and implement public communications strategies to raise TB awareness and promote early health seeking.
- Integrate TB screening and testing into other health services, with a focus on services that address common comorbidities or key and vulnerable populations, depending on local epidemiological context.
- Provide support that enables people receiving TB care to complete a full course of treatment without an undue burden on them and their families, while avoiding catastrophic costs.
- Strengthen procurement systems and supply chains.
- Expand the use of real-time digital TB surveillance systems.

RE-IMAGINE TB CARE, DELIVERING QUALITY SERVICES THROUGH A PEOPLE-CENTERED APPROACH

People-centred care organizes the delivery of health services around the needs and expectations of people and communities. It prioritizes meeting the needs and expectations of people at all stages of their lives, and it balances the rights of people with TB with their responsibilities and capacity as stakeholders in the health system. The delivery of people-centred care should also be guided by principles of equity, inclusion and gender-responsiveness (see Chapter 7).

Re-imagining TB care means globally embracing a people-centred approach. The TB-REP[1] Scientific Working Group **defines people-centred TB care** as *"an efficient and integrated set of affordable, accessible and acceptable health services, provided in a supportive environment to prevent, diagnose and treat TB"*. In other words, people-centred TB care not only ensures effectiveness and safety of services, but also ensures that people with TB get the right care, at the right time, by the right team, and in the right place.

Done properly, people-centred TB care closes the gaps in the care cascade, creating a seamless experience from initial care seeking, preferably at the community level, all the way through to successful treatment and appropriate care for post-TB disease. People-centred TB care is based on the most recent evidence-based clinical standards. Just as importantly, people-centred TB care delivers convenient services with high satisfaction to both the person with TB and the provider(s) of care.

When designing a people-centred approach to TB care, programmes should ensure that:

- TB survivors are meaningfully engaged and their priorities incorporated throughout the design process;
- TB services are as convenient for people to access as possible, including for the most marginalized and vulnerable populations;
- the service model meets the needs and expectations of people with TB and their families;
- underlying factors are addressed in the context of care (e.g., comorbidities, nutrition status, alcohol or tobacco use);
- services, tasks and responsibilities are defined for each setting and within different facilities, while recognizing the need for flexibility to respond to the needs of individuals with TB;
- functioning referral systems are in place across various settings and facilities;
- a robust data-reporting system is in place to monitor performance, including diagnostic delay, loss to follow-up and the quality of services from the user's perspective;
- any technology is used in ways that connect people to the health system, not alienate them from it;
- people receiving TB care and their families are protected from catastrophic financial expenses.

Deliver people-centred care in the community

Delivering people-centred TB care is only feasible by strengthening the delivery of TB care at the community level, supplementing care made available at higher levels of the health system.

Community-based and ambulatory care typically leads to better TB outcomes compared to hospital-based or inpatient care. **WHO recommends** that TB care be provided mainly in community-based and ambulatory settings, as long as certain criteria are met with regard to the person's clinical condition, the presence of infection control measures, and the availability of adequate treatment support. There also needs to be a back-up plan in cases where a person with TB does need inpatient care.

Civil society organisations (CSOs) with a direct presence in local communities play important roles in ensuring that TB care is people-centred, especially by:

- strengthening community involvement in all aspects of the TB response;

- supporting people who are receiving TB care to complete treatment;
- delivering psychosocial support to people who are receiving TB care and their families;
- creating and maintaining community awareness of TB;
- monitoring the availability, accessibility, acceptability and quality of TB services;
- eliminating TB stigma, discrimination and other human rights-related barriers to TB services.

Funded with resources from the state or other sources, social contracting is one model that helps CSOs be more sustainably involved in providing some TB services.

Use technology to deliver people-centred care

Re-imagining TB care also requires moving beyond traditional "brick-and-mortar" approaches, using all available means of delivering care that are efficient, high-quality and convenient. Convenient care means that it is available within the community and even within people's homes, including in remote areas.

Innovations in digital health make it more feasible than ever to deliver this level of convenience. (Chapter 8 discusses priorities for developing new digital solutions.) Examples include:

- digital/video-enabled health consultations and treatment support;
- real-time case notifications and disease monitoring;
- mobile app-based information sharing and communication;
- e-learning.

Out of necessity, the use of these innovations skyrocketed during the COVID-19 pandemic. Solutions were often tailored to meet local needs. As a result, the technology infrastructure, regulatory environment, and users' familiarity with digital health tools—which have applicability across disease areas—are far more advanced today than ever before.

Ensuring the widespread use of these innovations is critical to delivering care at a scale necessary to end TB. It is equally important to ensure that technology is not used in a way that creates new "digital divides", establishing technological barriers to care and worsening health inequities.

Provide care for post-TB disease

A significant number of people who are cured of TB disease **continue to experience other health challenges** as a consequence of having had TB. Medical experts have begun to recognize post-TB lung disease (PTLD) as a health condition that requires attention at both the individual and population levels. PTLD refers to a spectrum of different disorders that can affect various parts of the pulmonary system, leading to higher risks of developing TB disease again and shortened life expectancy. Relatively little research has been conducted on PTLD, and, as of 2021, no studies had been conducted on PTLD in children.

The **first clinical guidelines on providing care for PTLD** were published in 2021. They provide guidance on:

- assessing people with TB for PTLD when they reach the end of TB treatment;
- identifying people with PTLD who should receive pulmonary rehabilitation (PR);
- tailoring a PR programme to meet the needs of people and local communities;
- evaluating the effectiveness of PR;
- conducting education and counselling;
- addressing PTLD in a public health context.

The Global Plan urges TB programmes to follow these guidelines in planning and implementing programming that provides care for PTLD and addresses PTLD at a population level.

People who have been cured of TB **can also experience other health effects**. Rates of cardiovascular disease are higher in people who have had TB. Anxiety and depression are also commonly experienced by people with TB. In addition, people who have completed second-line treatment for DR-TB often face hearing loss. TB programmes should plan and implement approaches for identifying these conditions and providing appropriate care and support that continues after TB treatment has been completed.

Strengthen the TB workforce

There is an urgent need to increase the human resources available to end TB. Health workforce development includes all types of human resources for health (HRH) initiatives that have an impact on TB care and prevention, including medical education reforms, task shifting, and training primary health care providers to deliver people-centred TB care.

Wherever possible, the roles of community health workers should be formalized. Community health workers have long been a crucial part of the TB response. They are essential to delivering community-based TB care. However, the TB response continues to be stymied by unpaid labour provided by community health workers. With proper investment, community health workers can have a significant impact. **A project** funded by Stop TB Partnership's TB REACH initiative in Ethiopia found twice as many people with TB in a 15-month period than in the previous 15 months, simply by employing community health workers and professionalizing their roles within the health system. This model has been replicated throughout Ethiopia and in other countries.

Ensure a continuum of care in challenging operating environments

Conflict and natural disasters weaken health systems and displace populations, causing significant breakdowns in the provision of TB care. With a record number of refugees around the world today, **ensuring access to TB care for refugees and internally displaced people** is critical. Refugees and internally displaced people, facing urgent needs to secure the basic provisions that sustain life, have a higher risk of contracting and dying from infectious diseases. Lack of access to health care and other factors, including crowded housing, undernutrition, stress and unmanaged comorbidities, increase the risk of developing TB. Breaks in the continuum of care can lead to the emergence and spread of DR-TB. At the same time, conflict can actually contribute to the spread of TB. These challenges make TB one of the most common causes of death among refugees.

Implementing a comprehensive approach to TB care that involves cross-border collaboration, establishment and safeguarding of humanitarian corridors and supply chains, targeted funding, political solutions, and advocacy and communications is critical to creating and maintaining a continuum of care in such environments.

THE STOP TB PARTNERSHIP'S RE-IMAGINING TB CARE INITIATIVE

Given the challenges of delivering TB care, the Stop TB Partnership's Re-imagining TB Care Initiative has tested assumptions about *when*, *where* and *how* TB care and services are accessed and delivered. Its aim is to identify digital solutions for scaling up early local access to care.

To this end, the Re-Imagining TB Care Initiative has developed **a background paper** that lays out the guiding principles, goals and objectives of delivering people-centred TB care. Programmes can use this resource to help them identify which solutions are most promising for scaling up access to people-centred TB care within their local contexts.

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1. TB-REP is a multi-country, multi-partner programme funded by the GFATM and implemented by the Centre for Health Policies and Studies as the Principal Recipient, jointly with the WHO Regional Office for Europe, TB Europe Coalition (TBEC), TBpeople, and the Global TB Caucus, in partnership with national TB programmes and civil society organisations.

SCALE UP THE USE OF MODERN DIAGNOSTICS

Universally replace sputum microscopy with rapid molecular diagnostics as the initial diagnostic test

Rapid and accessible TB diagnosis is the first step in providing effective treatment and saving lives. Many countries today still rely on sputum microscopy as the initial diagnostic test for TB. Rapid molecular tests need to replace sputum microscopy as the initial diagnostic test.

Diagnostic testing also needs to move to the point of care. This will make testing more accessible and will reduce the time it takes for people to obtain their test results and start treatment. There are multiple molecular tests recommended by WHO that can be used to expand access to diagnosis through their implementation at different levels of the health system. Technologies that test for multiple diseases at one time provide even greater opportunities. They can improve system efficiencies, save costs, provide a better user experience, and ultimately help improve the quality of care.

Use complementary technologies and methods to improve rapid TB detection

Use urine-based lipoarabinomannan (LAM) tests for testing TB in PLHIV

TB is the leading cause of death among PLHIV, but it is more difficult to diagnose PLHIV using sputum. TB LAM, a urine-based, rapid POC test, offers a simple way to detect TB in PLHIV. **WHO recommends** the test for all PLHIV with TB symptoms, regardless of their CD4 count, in both inpatient and outpatient health care settings. TB LAM should be added to diagnostic algorithms, to be used in addition to rapid molecular tests that use sputum.

Use stool to test for TB in children

Detecting TB in children has historically been challenging because of how difficult it can be for children to produce a sputum sample. In 2020, **WHO recommended** using stool to test for TB in children, using rapid molecular tests. This is an easy and pain-free method for rapidly testing for TB in children. It should be universally implemented.

Use CAD to screen for TB disease

A chest X-ray can rapidly identify people who should receive diagnostic testing for TB. It can also reduce the number of symptomatic people requiring rapid molecular tests, along with the associated costs. CAD tools use AI to read chest X-rays for signs of TB and issue findings. These findings are then used for screening and triage.

CAD overcomes some of the main limitations of a chest X-ray, providing accurate, rapid results with no inter- or intra-reader variability. **Recommended by WHO** for use either alongside or in place of human readers, CAD can increase access to chest X-ray and thereby TB care in regions where few or no human X-ray readers are available. Coupled with lightweight portable X-ray systems, the technology makes screening for TB feasible even in remote locations.

Use more routine and comprehensive DST

Access to universal DST is essential for successfully diagnosing and treating people with DR-TB. DST needs to become more routine and comprehensive, so that no person receives medicines to which their TB organism is resistant. This is especially important in light of **WHO treatment guidelines** that emphasize the use of newer medicines and treatment regimens for treating people with RR- and isoniazid-resistant TB. DST laboratory capacity and specimen referral networks need to be built to achieve this.

Technology for identifying drug resistance is evolving. Next-generation genomic sequencing (NGS) will enable health systems to quickly detect resistance to a wide profile of medicines. Evidence continues to be collected on the use of NGS, and the catalogue of clinically relevant mutations in TB bacilli continues to grow. WHO is expected to issue recommendations on using NGS to guide clinical treatment decisions in 2023.

Build capacity for testing for TB infection

Countries must not only build capacity for active TB disease; they must also address the massive reservoir of TB infection. TB infection may eventually become TB disease, and an approach that focuses only on testing people when they have TB symptoms will result in continued spread of TB.

Because the tuberculin skin test (TST) can show a false-positive result in people who have received the Bacille Calmette-Guérin (BCG) vaccine, it has limited use in countries with high vaccination rates. Interferon-gamma release assays (IGRAs) and next-generation skin tests are more specific than TST and should replace their use. **WHO recommends** multiple IGRAs. It has also evaluated antigen-based skin tests and found them to be accurate, acceptable, feasible and cost-effective alternatives to TST and IGRAs.

Strengthen diagnostic systems to meet higher demand for testing

Scaling up modern diagnostics involves more than adopting new technologies. The effort must consider the entire diagnostic network, installing new testing sites and replacing old tests in the right places to ensure people's access. Increasing access means that testing networks need to be able to meet higher demand. This requires having robust specimen referral systems; sufficient human resources, supervision and quality assurance; appropriate infrastructure and electricity; and comprehensive service and maintenance plans for all equipment. **WHO provides guidance** for programmes on implementing diagnostics networks.

FIND THE MISSING PEOPLE WITH TB

TB can be diagnosed, treated and cured. Yet a large proportion of people developing TB are unable to access good-quality diagnosis and treatment. Such individuals are often referred to as the "missing people" with TB. During the period 2015–2020, an estimated 3 to 4 million people with TB worldwide went without a diagnosis or were treated in the private sector without being accounted for in national data. The large number of people who are missing from TB care is one of the main reasons that TB incidence and mortality have declined so slowly in recent years.

At the 2018 UNHLM on TB, UN Member States issued a Political Declaration committing to reduce the numbers of missing people with TB and scale up TB treatment to reach all people with TB by 2022. Significant progress was made by countries in 2018 and 2019, but the COVID-19 pandemic created a major setback starting in 2020.

The Global Plan recommends that, at minimum, 95% of people developing TB each year need to be diagnosed and treated, and that no one should be left behind. To find the missing people with TB, different approaches will be needed depending on the local setting. Some of the most effective approaches include:

- active TB case finding;
- eliminating barriers to health services, including barriers related to human rights, gender and stigma;
- engaging with the private health care sector to diagnose TB, provide appropriate care and notify cases to national TB programmes (NTPs).

Finding the missing people with TB also means ensuring that people everywhere have access to modern TB diagnostics. Old TB diagnostics such as sputum microscopy should not be used for diagnosing TB because they fail to detect 40% of TB and cannot detect drug resistance.

Countries are implementing a variety of interventions to find the missing people with TB. TB REACH projects are designed specifically to find and diagnose more people with TB. And a GFATM strategic initiative for finding the missing people with TB has provided a platform for implementers from different countries to learn from each other.

TB REACH

TB REACH is a funding mechanism that provides grants to partners for **testing innovative approaches** that aim to increase the number of people diagnosed and treated for TB, decrease the time it takes to receive a TB diagnose and start appropriate treatment, and improve treatment success rates in key and vulnerable populations and communities with **limited access to care**. It combines fast-track, results-based financing, and external monitoring and evaluation to produce results, so other donor agencies and national governments can scale-up successful approaches and maximize their own investments.

EXPAND EARLY DIAGNOSIS, INCLUDING AT SUB-CLINICAL STAGES

The Global Plan's modelling shows the importance of early diagnosis in reducing transmission and incidence of TB (see Chapter 2). Numerous studies have identified delays in diagnosing people who have TB symptoms. **Prevalence surveys** have consistently found that about half of people with laboratory-confirmed TB do not report symptoms or are asymptomatic, which is referred to as "subclinical TB".

Knowing this, the Global Plan recommends that high TB burden countries invest significantly more resources in TB screening and active case finding aimed at detecting TB early and initiating early treatment. Populations with high rates of TB should be periodically screened for TB, regardless of symptoms.

Subclinical TB can be diagnosed by X-ray followed by bacteriological confirmation. X-ray is an excellent tool for screening people for pulmonary TB, as it is more sensitive than symptom-based (i.e., clinical) screening. X-ray technology has improved in recent years. Modern X-rays are digital, highly portable, and produce high-resolution digital images, allowing X-rays to be deployed in mobile vans and in communities.

AI solutions are also improving and becoming more available. AI can read X-ray images faster and better than trained human radiologists. Ultra-portable digital X-rays with computer-aided reading of results should be used by countries to screen people for pulmonary TB in populations with high rates of TB.

Several initiatives have demonstrated the value of population-level TB screening followed by confirmatory molecular tests in those with abnormal X-rays. Stop TB Partnership's TB REACH initiative has supported several projects that have **demonstrated the value of such screening**. Large-scale screening of populations have been undertaken by several NTPs, such as those in Cambodia, India, Viet Nam, and other countries.

Population-level TB screening and active case finding are cost-effective interventions. Costs can be further reduced by conducting multi-disease screening, for example, screening for TB along with COVID-19, lung cancer, diabetes, use of tobacco and other conditions.

New tools could further facilitate population-level screening, testing and diagnosis of subclinical TB. The Global Plan calls for funding and fast-tracking the R&D of biomarker-based tests for diagnosing subclinical TB.

DEVELOP AND IMPLEMENT PUBLIC COMMUNICATIONS STRATEGIES TO RAISE TB AWARENESS AND PROMOTE EARLY HEALTH-SEEKING

Raising TB awareness and motivating people to seek care is essential to finding the missing people with TB and helping all people with TB receive an early diagnosis. This requires countries to develop and implement communications strategies for public education and behaviour change. The following are basic elements that should be included when developing a communications strategy.

Set goals

Communications goals should always serve and complement TB programme goals. Analysing TB response needs, gaps and opportunities within domestic and regional settings will help to determine goals. Analysing the strengths and weaknesses in communications capacity will show where goals are realistic and where capacity needs to be strengthened to achieve those goals. Each activity should be undertaken with a clear purpose and desired outcome in line with communications goals, and should have quantifiable targets for measuring impact. Examples of types of goals include:

- improving basic knowledge about TB among key and vulnerable populations or the general public in TB-affected countries;
- improving awareness about where to receive screening or testing;
- increasing the numbers of people with TB who seek testing;
- improving knowledge among health workers about what to do when people seek TB testing or care;
- educating government officials about TB and the TB response;
- building empowered and capacitated networks of people affected by TB to help reach, engage and support TB key and vulnerable populations.

Identify audiences

Identifying key audiences, and understanding their values and motivations, is a critical starting point in developing communications strategies. It is also critical to understand the literacy and languages spoken by audiences, and to produce communications that audiences can easily understand. Priority audiences might include key and vulnerable populations, health workers, government officials, news media and strategic partners.

Develop messaging

Messaging should be positive and educate audiences about solutions. It should be culturally appropriate. Messaging that motivates audiences to seek care early should emphasize that TB is preventable and curable. Ideally, messaging should be developed and tested with representatives of audiences.

Engage partners

Identify partners who share the same or complementary goals and who are willing to contribute to developing or implementing communications strategies. Partners can bring more visibility and add credibility to messaging. Partners should be engaged based on their credibility, reliability and connection with key audiences. When it will help to achieve goals, communications efforts should be coordinated with partners at subnational, national, regional and global levels. Partners can come from many places, such as:

- TB survivors and champions
- government offices
- nongovernmental organisations (NGOs)
- businesses and corporations
- faith communities
- news media
- celebrity ambassadors
- social media influencers.

Identify tactics, tools and communications channels

Tactics are categories of actions that can help to achieve communications goals. Tools are tangible assets used to implement tactics. Channels are ways through which people communicate or receive information.

Common tactics:

- educating health workers
- educating people seeking care
- community outreach
- disseminating messages through media channels
- making official announcements
- working with public-facing leaders and influencers to share messages with their audiences
- sensitizing judiciaries, law-makers and policy-makers
- public demonstrations
- webinars, live online chats
- townhall/community meetings

Common tools used for communications:

- brochures, pamphlets, signs, banners
- advertisements
- press releases, prepared statements
- websites
- social media platforms
- SMS/text messaging platforms
- webinar platforms
- television, radio and podcast programmes
- news editorials and op-eds
- by-line articles
- talking points and written speeches
- letters
- plays and skits

Common tools used for planning and project management:

- work plans
- editorial calendars
- checklists
- project management software applications

Common communications channels:

- news media (television, radio, print, digital)
- advertising (including content marketing)
- social media (including blogs)
- newsletters
- email
- telephone
- SMS/text messaging apps
- word of mouth

Develop and implement campaigns

Any one tactic on its own will have limited effect. The most effective approach to raising awareness is to implement a variety of tactics through a planned campaign. In a campaign, tactics are implemented in a coordinated way, with the effect of each tactic reinforcing the others. Tactics are used to communicate with specific audiences, through communications channels that are chosen based on the ones audiences are known to use. Thoughtful planning is key to successful campaigns.

To raise awareness and encourage early health care seeking among key and vulnerable populations, a campaign might involve:

- educating health workers about TB and incentivizing them to educate people seeking care about common symptoms and where to access testing;
- displaying educational signs at health facilities;
- conducting community outreach that includes a skit;
- publishing an op-ed by a TB survivor in local or national news media, which is used to earn interviews with local or national media;
- coordinating partners to share TB messages through social media and SMS;
- getting local radio stations to run public service announcements;
- working with local faith leaders to share messages with fellow adherents;
- using social media to amplify all the above activities.

Measure and evaluate impact

The success of any campaign depends on achieving goals to increase the numbers of the right people seeking care. In areas where campaigns are implemented, measurable outcomes should be increased numbers of people:

- screened for TB
- diagnosed with TB
- diagnosed with subclinical TB
- initiating TB treatment.

INTEGRATE TB SCREENING AND TESTING INTO OTHER HEALTH SERVICES, WITH A FOCUS ON SERVICES THAT ADDRESS COMMON COMORBIDITIES OR RISK GROUPS, DEPENDING ON LOCAL EPIDEMIOLOGICAL CONTEXT

Innovative approaches are needed to find the missing people with TB and ensure that they receive diagnosis and care. At the population level, these approaches need to be linked with comorbid conditions to regain momentum towards ending TB.

A **systematic review looking at integrated TB and non-communicable disease (NCD) services** found that higher levels of integration conferred more benefits to people receiving care in terms of managing TB and NCDs. **A systematic review looking at the integration of HIV with other health services** found that, overall, the strategy led to improved health and health-system outcomes. **Integrating TB care with tobacco cessation services** has also been recognized as a critical service for people with TB and HIV who use tobacco.

Integrated service delivery (ISD) combines multiple interrelated health services in one interaction. By addressing multiple health issues simultaneously, ISD promotes convenience in ways that align with the goal of delivering people-centred care. If used widely, this approach has the potential to accelerate the finding of missing persons with TB, while addressing other health conditions that contribute to TB morbidity and mortality (i.e., HIV, diabetes, undernutrition, tobacco use, and COVID-19).

ISD can also contribute to progress towards UHC, and aligns with the global move towards One Health—a multidisciplinary approach that links the health of humans, other animals and the environment through collaborative, multisectoral and transdisciplinary initiatives to combat diseases. The One Health approach aims to improve global health security and strengthen health systems (see Chapter 6).

ISD can be initiated from TB services by incorporating screening for other diseases. For example, chest X-rays taken to diagnose TB can be used to screen for lung cancer, chronic obstructive pulmonary disease (COPD) and other conditions. Similarly, TB screening can be added to vaccination campaigns.

There are different ways to coordinate services using an ISD approach, including:
- diagnosis and referral to other health facilities/providers;
- active follow-up;
- providing care for multiple health conditions at the same facility on the same day.

Several initiatives have integrated other health conditions into their TB screening platforms, including:
- joint TB and COVID-19 screening;
- TB screening conducted through COVID-19 vaccination campaigns;
- joint screening of TB and other diseases such as diabetes, silicosis, other airborne infections, lung malignancy and mental health conditions;
- TB screening integrated with tobacco-use counselling and cessation support;
- integrated sample transportation systems;
- community health workers trained to provide services for multiple health priorities.

ISD can also be combined with other initiatives, such as active case finding campaigns, immunization campaigns, and reproductive, newborn and child health services. Interventions focused on engaging private providers for ISD can also help more people with TB receive early diagnosis and access care.

Mobile vans with digital portable or handheld X-ray machines and portable laboratory equipment can be more widely used where appropriate to access communities and key and vulnerable populations. To mobilize communities to participate in these campaigns, interventions should use various media for outreach and awareness.

ACHIEVE UNIVERSAL ACCESS TO THE MOST EFFECTIVE TB TREATMENT REGIMENS

TB has a high rate of mortality without treatment. Studies of the natural history of TB disease in the absence of treatment with anti-TB medicines (conducted before drug treatments became available) found that about 70% of individuals with sputum smear-positive pulmonary TB died within 10 years of being diagnosed, as did about 20% of people with culture-positive (but smear-negative) pulmonary TB.

Improve treatment effectiveness through development of new regimens

Efforts are needed to improve TB treatment effectiveness. Effective TB treatment, including for DR-TB, relies on the use of several antibiotics administered in combination without interruption for several months. With research funding needs only partially met, some progress has been made in recent years to identify more efficacious, safer medicines and shorter treatment regimens. The development of new regimens using repurposed medicines such as linezolid, clofazimine and rifapentine is on a more positive course than in years past.

That said, continued new drug development is needed to make TB treatment regimens more people-centred by making them shorter, safer, more effective and less costly—especially regimens for treating DR-TB.

See Chapter 8 for a discussion of TB R&D priorities.

Achieve universal access to all-oral regimens for treating DR-TB

DR-TB is a global public health crisis. DR-TB is harder to treat than DS-TB and presents major challenges for people receiving care for DR-TB, health care workers and health care services. Globally, almost 15% of people with MDR-/RR-TB die from the disease, and 26% of those deaths are in people with extensively drug-resistant (XDR-) TB. Continued community transmission in many parts of the world, combined with resistance that is becoming more enhanced, is weakening global health security and undermining progress against TB.

Shorter, all-oral (i.e., no injections) DR-TB treatment regimens are urgently needed. Current regimens used to treat DR-TB are far from satisfactory. Compared to treatments for DS-TB forms, these regimens require a longer course of treatment, the use of more toxic medicines, and an exponential increase in the ingestion of pills. Many people receiving care for DR-TB experience significant adverse events and have poorer treatment outcomes.

Continue to develop evidence-based recommendations for improving the effectiveness of treatment for DR-TB

Especially as new medicines are developed, there is a critical need for the continuous development of evidence-based policy recommendations to guide the treatment and care of people with DR-TB. These recommendations need to better outline a comprehensive care path that people should take after being identified by the health system and referred for DR-TB treatment.

PROVIDE SUPPORT THAT ENABLES PEOPLE RECEIVING TB CARE TO COMPLETE A FULL COURSE OF TREATMENT WITHOUT AN UNDUE BURDEN ON THEM AND THEIR FAMILIES, WHILE AVOIDING CATASTROPHIC COSTS

In addition to better treatment regimens, people-centred TB care should include:

- psychosocial support that helps people with TB complete a full course of treatment;
- humane forms of treatment support;
- monitoring and management of adverse events/drug reactions;
- clinical monitoring and management of comorbidities (e.g., HIV, hepatitis and NCDs);
- support that fulfills the various non-medical needs of people with TB, including respect for human rights, privacy/confidentiality, and a stigma- and discrimination-free environment.

Psychosocial support is often essential for people to complete TB treatment without experiencing hardship or even trauma. Psychosocial support is a critical part of people-centred care. It improves TB treatment outcomes, as it makes it easier to receive care for the whole duration of treatment. Family members, CSOs, NGOs and community members are key facilitators of psychosocial support.

For years, this kind of support has more or less been a standard part of TB care in high-income countries. It includes:

- psychological support, including patient and family education, counselling sessions or peer-group support;
- material support, which minimizes or eliminates indirect costs incurred by people with TB that create a barrier to accessing and continuing care. Material support often comes in the form of:
  - financial assistance, such as bonuses, transport subsidies, housing incentives or living allowances;
  - food assistance, such as meals, food baskets, food supplements or food vouchers.

People receiving TB care should receive regular treatment assistance and support, whether at home or in another adequate ambulatory facility. This should be accompanied by appropriate infection control measures, including TPT for other household members.

Treatment support can be delivered in line with people's circumstances (such as at the workplace, school, health post, primary care centre, drug/alcohol dependence treatment centre or outreach programme). After care is established and infectiousness is no longer a risk, it is critical that whenever possible, people in care remain fully integrated in their community and their routine lives, enabling them to engage normally with the environment they are accustomed to.

STRENGTHEN PROCUREMENT SYSTEMS AND SUPPLY CHAINS

Reliable and efficient systems for procurement, supply chain and distribution of TB health products are essential. Procurement and supply systems in countries must be nimble enough to support the introduction of new medicines, treatment regimens and diagnostics.

The number of TB diagnostics and medicines—including new formulations of existing medicines—has grown in recent years. Thanks to investments in innovation, WHO recommends new medicines and new diagnostics at regular intervals. More new diagnostics, medicines, vaccines and other technologies are expected before 2030. These new products will need efficient regulatory approval and systems for procurement and distribution.

During the COVID-19 pandemic, countries gained considerable experience in rapidly procuring new diagnostics, vaccines and therapeutics. TB programmes must learn from this experience and prepare for the introduction of new TB medicines and diagnostics as soon as they become available.

During the pandemic, there were also significant shifts in the way medicines were distributed to people for screening or care at home. Pandemic-induced "stay-home" services led to important shifts towards strengthening home-based and community-based services, which are likely to last and develop further. Such services will need health products to be distributed to people's communities and homes.

In several high TB burden countries, the private health care sector provides TB care to a substantial proportion of people with TB. NTPs in such countries must ensure that the private health care sector has access to the latest TB diagnostics and medicines, and that people get these services at affordable prices. Where quality can be assured, NTPs also have the option to outsource certain services (e.g., laboratory services) to the private sector, using smart contracting mechanisms.

THE GLOBAL DRUG FACILITY

The 2018 UN Political Declaration on TB encouraged all countries to utilize the Stop TB Partnership's Global Drug Facility (GDF) for procuring TB medicines, diagnostics and related services, recognizing its advantages. GDF offers countries a platform for procuring quality-assured medicines and diagnostics at reduced prices. GDF is a one-stop bundled procurement and supply mechanism providing a unique package of services that combines strategic procurement of TB products and coordination of market activities with technical assistance and capacity-building for TB programmes.

EXPAND THE USE OF REAL-TIME DIGITAL TB SURVEILLANCE SYSTEMS

TB surveillance involves the continuous and systematic collection, analysis and reporting of data related to TB infection and TB disease in a population. Digital surveillance should capture data on the complete cascade of TB screening, diagnosis, treatment and care of both TB infection and active disease.

Real-time digital TB surveillance systems make data available in a more timely fashion, compared to traditional surveillance approaches, and provide more granular views of TB trends from local to national levels. They also facilitate regular data analysis, which supports adaptive responses to TB trends, enabling programmes to target resources towards specific geographical areas or towards population groups in need of services. LICs, in particular, stand to benefit from transitioning from paper-based to digital TB surveillance systems. Programmes must adhere to high standards of digital privacy and data security when implementing digital surveillance systems.

New digital tools are making digital TB surveillance more feasible than ever before, and improving the use of real-time digital TB surveillance is a key priority for operational research (see Chapter 8).

WHO is **expected to publish new guidance** on the implementation of digital TB surveillance systems in 2022.

4

SCALING UP TB PREVENTION

As described in Chapter 2, prevention is a critical part of a comprehensive package of interventions to end TB and needs significant new investment to scale up.

PRIORITY ACTIONS

- Address TB risk factors and social determinants.
- Provide TPT to those living with TB infection and who are at higher risk of progression to active TB disease.
- Implement AIPC measures in health care settings and high-risk indoor places where people congregate.
- Prepare for a successful global roll-out of effective vaccines once such vaccines are officially recommended and available.

ADDRESS TB RISK FACTORS AND SOCIAL DETERMINANTS

The most common underlying, health-related risk factors for TB are:

- undernutrition
- HIV/AIDS
- smoking tobacco
- alcohol use disorders
- diabetes mellitus.

These five risk factors can each be prevented or managed in line with the relevant Sustainable Development Goals (SDGs). Progress against these five risk factors will contribute immensely to ending TB. To prevent TB among people who live with common underlying risk factors, TB programmes should coordinate or integrate services with those for nutrition, HIV, smoking tobacco, alcohol misuse, diabetes and COVID-19.

TB is also driven by social determinants, chiefly poverty, poor living conditions, stigma and discrimination, and conditions that fail to protect and promote human and gender rights. Closely related to poverty, undernutrition is the biggest risk factor for TB globally. It is the primary contributor to TB incidence in all regions, except for Europe (where the leading risk factor is alcohol misuse).

Prevent TB through a multisectoral approach

Addressing TB risk factors requires a multisectoral approach that extends beyond the health sector and encompasses the broader development agenda. Most countries have created programmes and initiatives to address at least some TB risk factors and social determinants, including poverty and substandard housing, as well as workplace health initiatives (e.g., for mine workers).

High rates of TB or TB risk factors within communities are often indicators that should lead governments to include such populations under existing programmes or create new programmes as needed. To address underlying risk factors and social determinants of TB, governments should pursue an all-of-government approach that aligns, coordinates or integrates TB programme activities with those of other government programmes and initiatives.

NTPs should address the interplay between TB and undernutrition as a priority. Nutritional support must be provided with the dual objective of improving treatment outcomes and decreasing mortality in people with TB, as well as reducing incidence of TB among contacts and undernourished communities. Countries should follow international guidelines and best practices on TB and nutrition, and be aware of new evidence emerging through research. India, for example, has begun to provide nutritional support packages as part of TB care.

While HIV is the leading driver of TB in certain regions, particularly in sub-Saharan Africa, HIV is a significant underlying risk factor in all countries affected by TB. Collaborative programmes between TB and HIV activities have been implemented in most countries. Countries must build on this progress by addressing their remaining gaps and challenges.

Chapter 7 presents an agenda for addressing stigma and discrimination, implementing a gender-sensitive TB response, eliminating TB stigma, and reaching key and vulnerable populations.

Strengthen collaboration among health and social programmes

Preventing or addressing TB risk factors will require collaboration among TB programmes, other health programmes, development initiatives and communities. TB programmes must reach out to these programmes and initiatives to ensure that communities are no longer exposed to the same risk factors they have been exposed to in the past, disrupting the cycle of TB and reducing the risk of TB relapse. For example, TB programmes can do this by:

- including people with TB, their families and immediate communities in relevant programmes and initiatives, including poverty alleviation policies, cash transfers, nutritional support programmes, social security benefits, urban housing initiatives, and compensation schemes;
- partnering with programmes for other health-related risk factors to form a bidirectional partnership that benefits all programmes. This can include bidirectional screening and testing for TB and diabetes, TB and HIV, TB and nutritional status, TB and smoking tobacco, or TB and other respiratory conditions such as, but not limited to, COVID-19. TB should also be made part of relevant multi-disease screening and testing initiatives;
- including populations and communities experiencing high rates of TB in national and international development programmes;
- putting in place policies for airborne infection prevention and TB prevention and care in settings known for congregation and crowding, such as prisons or urban dwellings;
- encouraging or incentivizing the addition or enlargement of windows in housing design practices;
- preventing food-borne TB transmission from animals infected with *Mycobacterium bovis*, which also causes TB disease and is transmitted by infected dairy products; this requires coordination with food safety programmes in areas where raw milk, cheese and/or blood are commonly consumed (see below);
- incorporating TB screening and prevention practices within workplace health and safety policies and programmes;
- including TB anti-stigma content within diversity, equity and inclusion programmes.

TB programmes and their national and international partners must advocate for and invest in this multisectoral approach. A strong commitment to partnerships will ensure that programme goals are acted upon through a whole-of-government and whole-of-society approach, monitored through the SDG framework.

Prevent transmission of zoonotic TB using a One Health approach

A historically neglected area of the TB response, zoonotic TB refers to strains of TB that are transmitted from non-human animals to humans. Most zoonotic TB in humans is caused by *M. bovis*, transmitted from cattle. Bovine TB primarily affects key and vulnerable communities that are at risk of TB from eating meat, drinking milk, or drinking blood sourced from cattle with TB. These food products can be made safe through cooking, or pasteurization or boiling.

At the population level, zoonotic TB can be addressed through a One Health approach. One Health recognizes and implements interventions informed by the interconnection between humans, other animals (in the case of TB, mostly cattle) and the environment[1] .

WHO, the Food and Agriculture Organization of the UN (FAO), World Organization for Animal Health (WOAH) and the UN Environmental Programme (UNEP) have joined together to create a "Quadripartite" tasked with advancing One Health priorities. A One Health joint plan of action is expected in 2022, which will provide strategic guidance that countries can use to address zoonotic TB.

Key to addressing zoonotic TB in humans is preventing transmission from cattle, the main reservoir of infection with relevance for people. TB programmes in countries with communities that are at risk of bovine TB should develop policies and interventions for preventing transmission in line with a One Health approach. TB programmes should work with food safety authorities to develop and implement interventions that support communities to eliminate risks of food-borne TB transmission. Relevant TB programmes should consult the **Roadmap for Zoonotic Tuberculosis** to learn more about challenges and solutions.

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1. Coronaviruses, which cause COVID-19, are another example of a zoonotic pathogen that requires a One Health approach to protect human populations from future pandemics.

PROVIDE TPT TO THOSE LIVING WITH TB INFECTION AND WHO ARE AT HIGHER RISK OF PROGRESSION TO ACTIVE TB DISEASE

An estimated **one in four people worldwide** are living with TB infection (i.e., *M. tuberculosis* [Mtb] bacteria are contained in a dormant state within the body, and the person is not currently sick). People infected with Mtb have a 5–10% lifetime risk of developing active TB disease. People are at greater risk of progressing to active TB disease most recently after infection. For people with comorbidities and/or weakened immunity caused by diabetes, undernutrition or other conditions, the risk of TB infection developing into TB disease is substantially higher.

Expand access to TB infection testing and TPT

TPT reduces the risk of developing active TB disease by as much as 60%, making it a key intervention for stopping TB transmission.

Expanding access to TPT requires:

- making TPT available to all who test positive for TB infection;
- implementing contact-tracing followed by routine screening of close contact persons and contact persons who are considered part of key and vulnerable populations;
- ensuring access to accurate diagnosis of TB disease and TB infection;
- ensuring sufficient TPT medicines and ancillary supplies;
- ensuring that supply chains are reliable.

Governments should have a policy that clearly identifies the groups eligible for TPT; TB infection testing options; TPT regimen options; and a system for monitoring results.

At minimum, TPT should be available to those who are at highest risk of developing active TB disease (i.e., contact persons, people with underlying conditions, key and vulnerable populations).

R&D can play a vital role in harnessing the full potential of TPT. New technologies, such as IGRA blood tests and IGRA-based skin tests, are already expected to expand the number of people recommended to receive TPT and accurately select those who will benefit from TPT. Countries should scale up a "test-and-treat" approach for TPT as infection testing technology advances and allows for more decentralized testing.

Having a vaccine that prevents TB infection from progressing to active TB disease would be a paradigm-shifting tool. When a new vaccine is shown to provide protection from TB disease that is similar to or better than TPT, vaccination should become the primary prevention tool, and TPT should be reserved as a preventive therapy for people who are ineligible for vaccination. The Global Plan anticipates having at least one TB vaccine available for use by 2025.

Strengthen contact-tracing and TB disease-monitoring capabilities using digital technologies

Improved capabilities for contact tracing and disease monitoring are needed to expand access to quality care. To best improve these capabilities, countries should invest in digital-technology-based contact-tracing systems for TB at the community level. Where possible, countries can build on the capabilities that were further developed in response to COVID-19.

This investment would help:

- expand access to TB screening, early TB diagnosis and treatment—including both TPT and treatment for active TB disease;

- improve countries' pandemic preparedness and response (PPR) capabilities, making them more resilient to future airborne pandemics;
- enable countries to more easily share data with key stakeholders, including civil society and technical agencies that assist TB efforts and ensure accountability—a function made difficult by current data systems.

To build capabilities for TB monitoring and contact tracing, countries need to:

- enact a standard-of-care policy indicating that all household contacts and other close contacts of people with TB should be traced, screened for TB disease and infection, and made eligible for TPT as appropriate;
- deploy digital tools to assist health workers in health facilities and community-based programmes;
- invest in accurate, high-quality data systems;
- hire and retain sufficient human resources to carry out TB monitoring and contact tracing.

IMPLEMENT AIPC MEASURES IN HEALTH CARE SETTINGS AND HIGH-RISK INDOOR PLACES WHERE PEOPLE CONGREGATE

TB spreads through airborne aerosols, which makes AIPC measures critical to preventing transmission. AIPC has always been part of the TB response framework, but implementation has mostly been confined to laboratory and clinical settings. Even in these settings, AIPC principles have not been applied consistently, with implementation prioritizing hospital- or health facility-acquired infection.

The COVID-19 pandemic has focused the world on the threat posed by airborne pathogens. All health facilities should apply best practices for AIPC. Beyond the health system, places where people congregate also need to take all possible AIPC measures. Countries and NTPs should pursue TB infection prevention and control as part of a comprehensive AIPC approach, rather than as a TB-specific initiative. Scaling up AIPC is especially important for LICs and MICs, **where progress in implementing measures has lagged**.

Taking these steps would aid the response to TB and all other airborne infections. They would also 1) increase the likelihood that health facilities could continue functioning during outbreaks of airborne infections and 2) help prevent the community transmission that fuels pandemics.

Scaling up AIPC measures requires action in three areas:

- administrative measures
- environmental measures
- personal respiratory protection.

Administrative measures

- Revise standards for recirculation of treated/disinfected air in HVAC for health care and public buildings.
- Develop high, medium and low airborne transmission risk zoning, signage and precaution strategies in health care and congregate settings.
- Decongest health facilities by building systems for specimen transport and supply of medicines to people at their residence, especially for TB and other diseases requiring chronic care.
- Ensure reliable supply chains for AIPC supplies, equipment and services.
- Triage for prompt diagnosis and treatment of people attending health facilities, based on signs and symptoms of diseases spread through the airborne route.
- Develop affordable, easy-to-use and sensitive rapid POC testing for TB and other respiratory and/or airborne pathogens, including identification and DST for all (primary) health care facilities.
- Provide education for health care workers and the general public on masking and personal respiratory protection use.
- Where needed, institute systems for certifying the filtering masks/respirators that are now available on the market.

National AIPC standards for health facilities and other buildings should be developed or updated in order to help advance these measures. Priority changes include:

- updating architecture design parameters to include:
  - risk-based zoning
  - analysis of existing ventilation (natural, mechanical or mixed) and its maintenance
  - maximized natural ventilation
  - airborne isolation (for people confirmed or presumed to have TB or other airborne infections);
- updating ventilation standards for various public places (e.g., schools, places of worship, cinemas, restaurants) to include:
  - allowance for recirculation of treated/disinfected air
  - minimum requirements for air changes per hour (ACH)

    - consideration of whether and how the building could be used for airborne pandemic response needs;
- promoting upper-room ultraviolet germicidal irradiation (UVGI) system minimum requirements (e.g., total UV-C output, beam parameters, certification etc.);
- investing in structural changes to health facilities as needed to meet AIPC standards.

Environmental measures

- Maximize natural ventilation wherever and whenever possible.
- Build airborne isolation capabilities in health care facilities.
- Promote single-pass mechanical ventilation (HVAC) for health care facilities with at least 12 ACH for high airborne transmission risk areas.
- Use professionally designed and maintained upper-room UVGI systems as an alternative, supplement and/or backup for ventilation in health care and indoor congregate settings.
- Limit recirculating air-conditioning use in crowded and high-risk settings, unless it is used for air-mixing where upper-room UVGI is used.
- Use room air purifiers/cleaners.
- Using filtering masks as appropriate.

Personal respiratory protection

- Provide for personal masking in high-risk indoor settings.
- Provide for personal masking for people being diagnosed or treated for TB and other respiratory infections while infectious. [PF1]
- Provide certified face respirators (i.e., FFP2, N95 or equivalent certification) for health care workers and other persons in high-risk settings.

Global partners with capacity, including the Stop TB Partnership Working Group on AIPC, should provide technical assistance to countries to help guide implementation of AIPC measures. Countries have an opportunity to build on COVID-19-related public awareness and adaptations in people's behaviour in ways that can reduce the risk of TB transmission in the community. Countries should use communications campaigns to promote evidence-based behaviours, including:

- social-distancing
- self-isolation when infectious
- masking
- cough etiquette.

Implementing these measures will require investments from the health system, urban development agencies and authorities in charge of congregate settings. The Global Plan resource needs estimates (see Chapter 9) include costing for implementing AIPC in health care facilities managed by TB programmes, but do not include costing for implementing AIPC in the general health system or in congregate settings that do not receive resources from TB programmes. For more detailed guidance, TB programmes should consult **WHO guidance** on implementing infection prevention and control programmes.

PREPARE FOR SUCCESSFUL GLOBAL ROLL-OUT OF NEW EFFECTIVE VACCINES ONCE THEY ARE OFFICIALLY RECOMMENDED AND AVAILABLE

The Global Plan's modelling projects that new effective vaccines are needed to end TB (see Chapter 2). Vaccines are an essential part of the **WHO End TB Strategy** for the post-2025 period.

Among the scientific community, the aim is to develop vaccines that:

- **are at least 50% efficacious** in preventing pulmonary TB disease in adolescents and adults, and at least 80% efficacious in infants; for the purpose of this Global Plan, modelling is based on a post-infection vaccine that is 60% efficacious in adolescents and adults;
- confer long-term immunity;
- achieve high coverage in adolescents and adults (see Chapter 8).

TB advocates have called for a new effective TB vaccine for use by 2025. This is possible if funding for new TB vaccine R&D is made available immediately, and if the scientific R&D process is fast-tracked using the same approaches as for COVID-19 vaccine development.

LIMITATIONS OF THE BCG VACCINE

The BCG vaccine was first deployed in 1921 and has been the only TB vaccine available ever since. In most high TB burden countries, BCG is given to children in the first days or weeks of life as part of the country's childhood immunization programme. Coverage is relatively high in most countries where the vaccine is used.

BCG protects against severe forms of childhood TB that are associated with high mortality, but the vaccine in its current form and dosage has little to no effect on protecting adolescents and adults from developing TB disease.

Several TB vaccine candidates are in development that have the potential to provide pre- and post-infection protection for all age groups, particularly adults and adolescents (see Chapter 8 for details).

A novel TB vaccine is likely to come to market within the timeframe of this Global Plan. Assuming the vaccine is effective, to deliver impact it must also be:

- affordable
- widely available
- integrated into health systems in high TB burden settings
- accepted by key and vulnerable populations.

Delivering new TB vaccines to adults and adolescents

Adults and adolescents will be prioritized for a new TB vaccine, because **modelling projects** that vaccination of these populations would achieve the most impact on reducing TB transmission and would prevent TB in infants and children by reducing their risk of exposure. Unique challenges must be overcome to ensure broad and timely vaccination of adult and adolescent populations, who fall outside of the standard immunization infrastructure.

Lessons learned from introducing the human papillomavirus (HPV) vaccine point to difficulties in delivering vaccines to older populations. Almost a decade after launch, HPV immunization programmes had reached only **3.5% of females globally**. Moreover, a **World Bank analysis** showed that having well-functioning child immunization systems was not a strong predictor of countries' readiness to deliver COVID-19 vaccines to adults. Despite the historically slow roll-out of vaccines to adolescents and adults in LICs and MICs, COVID-19 has shown that where political will and sufficient resources exist, it is possible to introduce and scale up access to a new vaccine in adolescents and adults much faster.

Administering a new TB vaccine will require countries to identify the pathways for overcoming historical challenges and delivering the vaccine to the adult and adolescent populations at highest risk. As part of this work, it will be critical to:

- prepare adequately for new TB vaccines;
- mobilize communities and advocate for vaccines;
- invest adequate resources in vaccine roll-out and scale-up;
- promptly make vaccines available;
- work with partners to maximize vaccine access and uptake;
- ensure equitable access to vaccines;
- apply learnings from COVID-19 vaccination campaigns.

Prepare adequately for new TB vaccines

Countries should begin preparing now to introduce TB vaccines in order to achieve high vaccine coverage. Preparation will require:

- early engagement with stakeholders: Early engagement with key stakeholders involved in vaccine financing and policy development—including the WHO **Product Development for Vaccines Advisory Committee** (PDVAC), the **Strategic Advisory Group of Experts** (SAGE) on Immunization, **Gavi**, national programme heads, and end-users from affected communities—will help facilitate vaccine policy adoption, procurement and introduction;
- country-specific data and projections: Data will be important to inform introduction planning, including:
  - in-depth country-specific value proposition analyses
  - epidemiological data at country and subnational levels
  - modelling to define the vaccine development investment case and country-specific vaccine use cases;
- assessments of programme costs, benefits and budget impacts to help decision-makers:
  - formulate national TB vaccine policies
  - determine screening algorithms;
- development of vaccine implementation plans: Preparatory work is needed to develop vaccine implementation plans that prioritize high-risk groups, are people-centred, and define the generic public health system requirements to deliver a new TB vaccine, based on a thorough assessment. Plans must be sure to include:
  - vaccine use cases that clarify when TB vaccines should be used versus other existing biomedical prevention options (e.g., TPT)
  - financial and procurement processes
  - development of training materials and implementation aids
  - delivery strategies
  - positioning of ancillary supplies
  - awareness raising and demand generation
  - vaccine safety and impact monitoring

Mobilize communities and advocate for vaccines

Maximizing high coverage of new TB vaccines will require a clear understanding of the behavioural factors and perceptions that influence vaccine uptake. TB programmes have faced hesitancy surrounding TPT, arising from concerns over its benefits versus side effects in healthy individuals. Moreover, anti-vaccination sentiment during the COVID-19 pandemic heightened vaccine hesitancy in some settings.

Health education and communication campaigns that provide accurate, evidence-based information will be needed to generate demand and acceptance of vaccines. As part of these efforts, vaccine hesitancy needs to be proactively addressed. Mass-media campaigns, engagement of locally trusted leaders, civil society mobilization, and robust community engagement efforts are needed to address misinformation and mobilize demand. Community engagement efforts must reach key and vulnerable populations. (See Chapter 7 for details on reaching key and vulnerable populations and Chapter 8 for details on advocacy for vaccines and other new tools.)

Resources needed for bringing new TB vaccines to market simply will not materialize without effective advocacy. As a priority, advocacy is needed to mobilize resources for TB vaccine R&D and implementation. More advocates are needed who are trained to understand the science underlying TB vaccines. Related to that, scientific progress in TB vaccine development needs to become more visible and used to build policy champions for TB prevention. Advocates are critical to ensuring that TB prevention interventions reflect the best available scientific evidence.

Invest adequate resources in vaccine roll-out and scale-up

Adequate funding must be mobilized to support the manufacturing, procurement and distribution of vaccines, especially in high-burden settings.

This is the first Global Plan to estimate the costs for rolling out new TB vaccines[1] . Global costs to implement a new vaccine are projected to average US$ 13.15 billion annually from 2027 through 2030, totalling US$ 52.6 billion. Modelled cost estimates include costs to scale up the use of a two-dose TB vaccine, reaching at least 60% of adults and adolescents by 2028, and to maintain 60% coverage or more after that. The cost of vaccine dose units and the operational cost for vaccine delivery have been informed by the experience of rolling out COVID-19 vaccines. (See Chapter 2 for vaccine impact modelling and Chapter 9 for costing details.)

In order for governments and multilateral initiatives (e.g., Gavi) to mobilize resources for implementing new TB vaccines, those vaccines need to be affordable and demonstrate value for money. Determining the incremental costs and cost-effectiveness of new TB vaccines within various implementation scenarios will be important for securing sustainable financing. Government financing will be critical: while 80% of TB incidence is in low- and lower middle-income countries, many TB-affected countries are not eligible or will be transitioning from Gavi support in the coming years.

Private-sector companies **provided only 2% of available financing** for vaccine research in 2020, highlighting the lack of commercial interest in this neglected market. While there is a potentially large market for new TB vaccines in high-burden countries, the lack of a market in high-income countries—and therefore the prospect of lower profits—could disincentivize commercial actors from entering the TB vaccine market.

This means that market-shaping interventions will be critical to securing early investments in production capacity, helping to ensure that once a new vaccine is licensed, supply is adequate to meet demand[2] . Such market-shaping interventions could include:

- advance market commitments, where governments, in advance of regulatory approval, contract with manufacturers to bulk purchase vaccines once they are approved for use;
- direct provision of public funding to scale up manufacturing capacity;
- technological transfer, whereby the knowledge and technology needed to manufacture vaccines are shared with other manufacturing partners.

Any public financial support that is provided to private-sector partners must require those partners to adhere to principles of equitable allocation and timely availability in high-burden settings.

Promptly make vaccines available

Innovation in the ways that research is conducted and vaccine candidates are approved could speed up the time it takes for new vaccines to reach the market.

Conducting clinical trials and demonstration studies in the communities or regions where new TB vaccines will be implemented, using best practices for community engagement, can build confidence and support among communities and governments for eventual vaccine licensure and roll-out.

While having broad geographical representation in clinical trials is important, different countries have different requirements for conducting trials. Product developers spend significant amounts of time complying with varying national requirements in order to conduct clinical trials in different countries.

Agreeing on uniform clinical trial requirements across countries could help expedite clinical development and licensure pathways for new vaccines (and other tools).

Regulatory authorities should explore the suitability of applying existing expedited approval pathways to new TB vaccines in ways that accelerate access, while maintaining evidentiary rigour. Uniform expectations and formats required for review submissions would help product developers more efficiently generate the necessary data and more rapidly file for licensure in multiple countries. Joint review and mutual recognition platforms, such as EU-Medicines for all (EU-M4All), WHO's collaborative procedure for accelerated registration, and the forthcoming African Medicines Agency, can enable trusted regulatory partners to share the burden of regulatory review, which could further expedite critical decision-making and speed up access to new TB vaccines.

Ensuring timely vaccine availability will require prompt filing for registration of new vaccines in high-burden countries. Manufacturers should engage with regulators from priority countries early in the product development lifecycle, including with platforms such as the African Vaccine Regulatory Forum (AVAREF) and the WHO Prequalification Team.

Work with partners to maximize vaccine access and uptake

Countries can find different avenues for making new vaccines accessible and acceptable by collaborating with a wide range of stakeholders. Governments should focus on:

- strengthening linkages among TB programmes, public health authorities responsible for vaccination, routine childhood immunization programmes, and private-sector health providers;
- integrating TB vaccination with complementary health and social programmes, including:
  - HIV treatment and prevention services
  - sexual and reproductive health care services
  - provision of chronic care for comorbidities, such as diabetes, smoking and undernutrition
  - COVID-19 vaccination programmes;
- exploring opportunities to use non-traditional and decentralized approaches for delivering vaccines—including those deployed for COVID-19 vaccine roll-out, such as:
  - mobile units
  - schools
  - sporting events
  - other community-based sites.

Ensure equitable access to vaccines

Global commitment to equitable, affordable and sustainable access to new TB vaccines is essential. Given the likelihood that a Phase III trial will involve unprecedented levels of public funding from many governments, as well as philanthropic dollars, the final product of research must be treated as a global public good and made equitably available to all who may benefit from it, in keeping with the commitment by UN Member States in the **Political Declaration** on TB to advance equitable access to new TB tools.

Apply learnings from COVID-19 vaccination campaigns

After new vaccines are introduced in high-income countries, LICs and MICs have typically had to **wait a decade** before receiving access to them. This has been the case even with financing and market-shaping.

The COVID-19 pandemic highlighted global challenges in deploying adult or adolescent vaccines, including:

- lack of country preparedness
- lack of vaccination access points
- weak diagnostic capacity
- lack of purchase financing in many countries
- weak demand in the face of misinformation and vaccine hesitancy
- inequity in vaccine implementation.

However, a tremendous surge of resources and political will contributed to the development and authorization of COVID-19 vaccines in the unprecedented time of less than a year.

Governments collectively mobilized US$ 104 billion to fund the R&D of COVID-19 vaccines and therapeutics in the first 11 months of the pandemic. This included funds mobilized through advanced market commitments, which helped to incentivize and de-risk commercial investments in R&D. (See Chapter 9 for discussion of advanced market commitments and other forms of innovative financing.) This amount is 113 times more than the US$ 915 million invested by all funders in TB research in 2020[3] . Lessons learned from this historic achievement should be used to accelerate the development and implementation of TB vaccines. These lessons include the following:

- Mobilizing political will is critical.
- R&D can be accelerated through innovative clinical trial designs, including the use of adaptive study designs; advancing vaccine candidates in late-stage trials; and conducting different phases of clinical trials in parallel.
- Manufacturing capacity must be built in parallel with clinical development, including in high TB-burden countries.
- Data sharing, technology transfer, and public-health-oriented approaches to intellectual property management should be built into advanced market purchase commitments and other funding agreements.
- Expedited regulatory pathways for TB vaccines should be pursued, while maintaining evidentiary rigour.
- Use of non-traditional, decentralized and people-centred pathways can expand the accessibility of vaccines.

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1. Previous Global Plans included only the costs of vaccine R&D.
2. For key concepts related to market-shaping interventions, see USAID's primer.
3. 2021 Report on TB research funding trends. New York: Treatment Action Group; 2021 **https://www.treatmentactiongroup.org/resources/tbrd-report/tbrd-report-2021/**

5

PARTNERING WITH KEY STAKEHOLDERS: COMMUNITIES AND THE PRIVATE SECTOR

PRIORITY ACTIONS

- Increase funding support for engaging TB-affected communities in the TB response at least fourfold.
- Support community-based and home-based models for delivering TB prevention and care.
- Scale up PPM approaches to improve the quality of TB care and data reporting in the private health sector.
- Support a multisectoral TB response through stronger partnerships.

INCREASE FUNDING SUPPORT FOR ENGAGING TB-AFFECTED COMMUNITIES

Ending TB requires that governments engage with communities and the private sector as partners in the TB response.

Civil society and community-based organisations must play a key role in the planning and delivery of TB care. They are ideally positioned to contribute to the TB response in numerous ways, including:

- improving TB awareness
- providing support to people receiving care
- reducing stigma
- informing the design of people-centred TB services
- facilitating community engagement in the R&D of new TB tools
- advocating for TB resources, policies and interventions
- promoting government accountability for reaching targets and fulfilling commitments.

In addition to providing supplemental funding for TB efforts, partnering with the private health sector is especially critical for:

- expanding access to people-centred care
- improving quality of care
- finding people with TB
- improving TB reporting and surveillanceimplementing new TB tools.

A community is shaped by the shared experiences through which its members are connected to one another. TB-affected communities include people who have lived with TB, as well as their families, friends, social supports, and members of key and vulnerable populations. Like communities, workforces in certain industries or geographic areas can also be affected by TB. (See Chapter 7 for a discussion of key and vulnerable populations.)

In recent decades, the TB response has focused on maximizing TB case detection, notification and treatment. The social aspects of the disease have been overlooked, and so CRG initiatives have suffered from insufficient attention and chronic underinvestment.

The 2018 UN Political Declaration on TB and the 2020 UN Secretary General's Progress Update Report both acknowledge a long overdue need to engage affected communities in the TB response. This is an ethical and programmatic priority. The overall funding needed to implement the Global Plan represents a fourfold increase over currently available funding. Given the historically low levels of investment in community engagement, governments should quadruple their baseline budgets for community-led activities.

At minimum, countries should follow **WHO operational guidance** on integrating community-based activities into TB prevention and care. But, to fully acknowledge and respond to the socioeconomic and psychosocial implications of TB, support for communities must extend beyond health systems. Community-led responses, such as human rights and gender programmes and community-led social accountability, are vital to ensure that everyone affected by TB can access quality TB services, no matter who and where they are. These people-centred initiatives led by TB-affected communities often fall outside of the formal health sector, go largely unsupported, and must be scaled up.

A person who has lived with a disease is a distinct kind of expert. Yet, TB survivors and members of affected communities often lack status as partners in the TB response. Engaging TB survivors and affected communities is not merely a matter of providing a seat at the table within decision-making forums. Community organisations must be engaged in the design, implementation, monitoring, review and governance of TB programmes. Ensuring this level of participation requires resources to empower community organisations to:

- engage in formal processes involved in the TB response

- coordinate with other partners
- ensure good governance
- engage in advocacy and communications
- compensate community members and partner organisations to engage in south-to-south learning.

MEANINGFULLY ENGAGING COMMUNITIES IN NATIONAL TB PLANNING

A **study conducted by TBpeople in 2021**, with support from the GFATM, assessed the meaningful engagement of TB-affected communities in the development of national TB strategic plans (NSPs). The study identified "a huge gap in access to information and lack of capacity, which prevent communities from being meaningfully engaged in the development, implementation and monitoring of national strategies". Many survey participants indicated that, while they were invited by their health ministries and other partners to participate in discussions around NSP development, community participation often felt tokenistic. While the report noted significant progress in community engagement over the previous five years, that progress was most evident in countries that received funding from the GFATM or other international donors for their NTP.

SUPPORT COMMUNITY-BASED AND HOME-BASED MODELS FOR DELIVERING TB PREVENTION AND CARE

Community-based health care includes any type of care provided to people in community facilities and in home-based settings. It is delivered by a workforce at the community level comprising health workers, both lay and professional, formal and informal, paid and volunteer. It also includes support and supervisory staff. Because it provides people with flexible options for receiving care and support, home-based care is people-centred. In line with a people-centred approach, countries should explore how best to implement home-based TB care, telemedicine, and a differentiated service delivery (DSD) approach as options for people in addition to facility-based care.

Common services that can be provided through community health systems:

- promoting awareness, behaviour change, and community mobilization
- reducing stigma and discrimination around disease
- screening for TB and TB-related illness (e.g., HIV counselling and testing; diabetes screening) through home visits
- facilitating access to diagnostic services (e.g., sputum or specimen collection and transport)
- providing TB prevention measures (e.g., TPT, TB infection control, and BCG vaccination)
- referring community members for diagnosis of TB and related diseases
- initiating treatment and monitoring for TB and comorbidities
- providing peer support and individual follow-up for people receiving care
- supporting socioeconomic interventions (e.g., food supplementation and income generation)
- providing home-based care for TB and related diseases
- leading community advocacy

Pursue community-based active TB case finding

Active case finding helps eliminate barriers to health services. This results in earlier diagnosis, earlier initiation of care and reduced transmission. Active case finding has proven to have a positive impact on TB incidence, prevalence and mortality, and lead to cost-saving for countries. It also helps raise community awareness and reduce TB stigma. Community-based programmes are ideally positioned to carry out active case finding because of how close they are to where people live, work and socialize. Programmes can use the guide **Finding missing people with TB in communities** as a resource for expanding community-based active case finding.

By contrast, the old approach of passively diagnosing people with TB—with those with TB symptoms self-presenting at health facilities for testing and diagnosis—is inexpensive and requires less effort from the health system. But, putting the burden of seeking care on people who may or may not be aware of TB signs and symptoms, rather than on the health system, has led to delayed diagnosis, delayed care, worse health outcomes and continued TB transmission. Multiple TB prevalence surveys have shown that large numbers of people with TB are often not aware that they have TB. Many do not have symptoms or do not consider minor symptoms to require professional care. In recent years, the evidence has become clear that passive testing alone will not reduce TB incidence enough to end the disease.

Budget adequately for community-based health systems

Adequate resources are required for effective community health systems. Although some level of volunteerism can be expected, for sustained actions, resources including human resources, capacity-building, management costs, procurement and logistics should be included in NTP budgets. Funding for community organisations should be appropriately reflected in TB programme budgets, and where they do not already exist, TB programmes should develop financial systems for funding or compensating community organisations.

SCALE UP PPM APPROACHES TO IMPROVE THE QUALITY OF TB CARE AND DATA REPORTING IN THE PRIVATE HEALTH SECTOR

Of the approximately 3 million "missing people" with TB (i.e., the difference between the number of reported TB diagnoses and the total number of people estimated to develop TB in a given year), more than half are believed to be in seven countries with robust private health sectors: Bangladesh, India, Indonesia, Myanmar, Nigeria, Philippines and Pakistan. These are countries where PPM approaches are a priority.

In recent years, TB programmes have pioneered a variety of PPM approaches for engaging private health care providers. PPM approaches should improve capacity for initiating contact with people with TB at the community level, creating a continuum of care that starts in communities and ensures strong links between the community, private providers and TB programmes. Some countries have begun gradually taking PPM approaches to scale, despite persistent challenges in moving from donor to domestic funding for TB activities. Success in these and other countries can serve as an example for other countries to craft effective engagement strategies. Table 5 provides examples of these approaches.

Table 5. Examples of PPM approaches in high-burden countries

Country	Approach
Bangladesh, India, Myanmar, Pakistan	Engagement led by highly effective NGOs that act as intermediaries between private health care providers and NTPs
India	Has ambitious targets, allocates substantial budgets, strong political support for engaging private health care providers
Indonesia, Philippines	Expanded focus from engaging small numbers of high-volume private hospitals to increasing engagement of primary care providers and increasing efforts to leverage social health insurance (SHI) schemes
Indonesia	Public health system directly engages private health care providers with the support of professional associations

WHO has produced a detailed landscape analysis of approaches for engaging private health care providers in the TB response, which can serve as a useful resource for countries.

A variety of digital applications are becoming more available and can help countries improve data reporting and quality of TB care in the private health sector, including:

- digital registration systems
- digital vouchers for medicines and diagnostics
- digital treatment support technologies
- digital X-rays
- digitally delivered incentive payments provided to people with TB and to health providers
- AI-based tools.

See Chapter 8 for a discussion of the development and implementation of digital tools.

SHI funds health services through pooled contributions from individuals. SHI is one of the main ways of financing health services, and some countries are using SHI schemes as a strategy for reaching UHC. Where they exist, SHI schemes provide an opportunity to improve the quality of TB care in the private sector.

To be successful, TB programmes must be adequately funded to support PPM approaches. To support and scale up PPM approaches, governments should:

- budget for private-sector engagement implemented at scale;
- reduce costs for private-sector facilities that provide TB services in order to prevent catastrophic out-of-pocket costs from being passed on to people with TB. One way to reduce such costs is by removing taxes on all TB-related essential products;
- provide TB tools and supplies, including software and digital connectivity, to assist private sector facilities;
- establish transparent and reliable funding mechanisms for supporting private health sector engagement.

ENGAGE PRIVATE INDUSTRY IN EFFORTS TO END TB

Private industry outside of the health sector should play a bigger role in ending TB. In fact, industry has an interest in leading certain areas of the TB effort. TB predominantly affects people in their most economically productive years, and certain industries in particular—such as mining, where workers are in poorly ventilated spaces and exposed to silica dust—have high rates of their workforce affected by TB. Other companies can be impacted by TB when they have operations located in countries or communities affected by TB.

Industries should contribute to ending TB by:

- ensuring their workplaces follow best practices for preventing TB transmission and providing TB care and support to staff and their families;
- supporting TB prevention and care through corporate social responsibility (CSR) or environment, social and governance (ESG) activities;
- adopting non-discriminatory recruitment and retention policies;
- promoting infection-free and safe workplaces;
- participating in public TB campaigns.

TB programmes and TB advocates can partner with businesses to provide staff training and to assist in the development of workplace TB programmes, establishing links between those programmes and the health system.

SUPPORT A MULTISECTORAL TB RESPONSE THROUGH STRONGER PARTNERSHIPS

A country-level partnership platform is a voluntary alliance among governments and stakeholders across civil society—often including private-sector health facilities, academia, professional associations and affected communities—committed to working together to achieve the objectives necessary for ending TB. Partners understand that TB impacts them all on some level and that they share responsibilities—and experience the benefits—of helping to end the disease. They contribute their core competencies to the effort, understanding that they benefit when TB declines in their country. In addition to strategic planners and implementers, partnerships should include TB champions, celebrities and/or opinion leaders who raise the public profile of TB and influence decision-making.

Partnerships can be used to design and implement virtually any part of the TB response, in line with the aims of TB programmes. Because partnerships involve stakeholders from outside of government, they are especially important for designing and implementing national **multisectoral accountability frameworks** (MAFs). This includes stakeholders directly responsible for carrying out interventions.

A partnership's aims are decided by its members and should be determined by the country context. Examples include:

- providing technical assistance;
- mobilizing resources;
- driving advocacy and communications;
- integrating human and gender rights into national TB policies and programmes;
- improving access to comprehensive TB services;
- promoting innovation and new approaches in the national TB response.

The benefits of establishing a country-level platform include:

- innovation and strategic alliance;
- multisectoral participation;
- increased resources;
- proactive leadership;
- social change;
- technical support.

6

ENDING TB THROUGH UNIVERSAL HEALTH COVERAGE, PANDEMIC PREPAREDNESS AND RESPONSE, AND SOCIOECONOMIC ACTIONS

PRIORITY ACTIONS

- Expand access to TB services through UHC initiatives.
- Position the TB response at the centre of PPR efforts.
- Invest in poverty alleviation and sustainable development.

EXPAND ACCESS TO TB SERVICES THROUGH UHC INITIATIVES

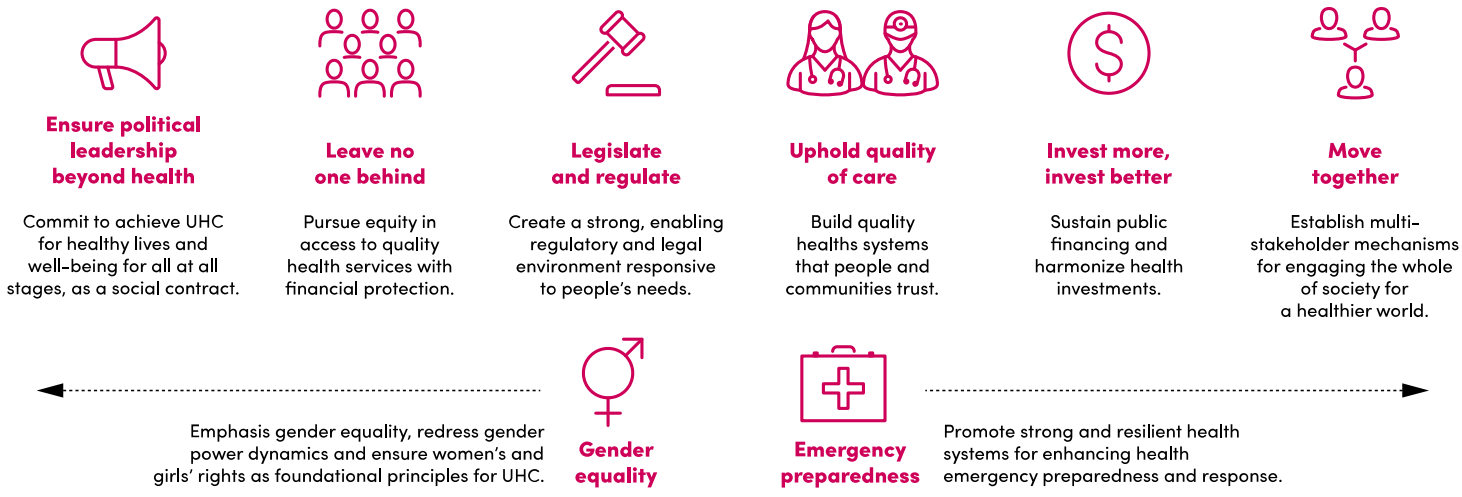
UHC is essential for ensuring access to TB care and prevention. Where people lack health coverage, they face a far more difficult challenge in accessing TB diagnosis and care. Where social safety nets are weak or absent, people with TB often face the additional challenge of losing income or economic opportunities. Achieving UHC is so critical to ending TB that the WHO End TB Strategy requires countries to "move with urgency" towards UHC and ensure that no affected people or families face catastrophic costs.

In adopting the SDGs, all countries committed to achieving UHC by 2030 (Figure 8). The COVID-19 pandemic pushed millions of people into poverty, adding urgency to the goal of reaching UHC and further exposing the need for resilient health systems that meet the needs of all people.

UHC means:

- all people can use the promotive, preventive, curative, rehabilitative and palliative health services they need;
- those services are of high enough quality to be effective;
- use of those services does not expose people to financial hardship.

Figure 8. Key areas of commitment to UHC[1]



Click on the picture to enlarge

Countries must expand access to the full range of high-quality TB services in line with the End TB Strategy. There are steps that countries can take that will have a significant impact on people's ability to conveniently access TB services.

Expand delivery of TB services through primary care

Expanding primary health care is the most important step that countries can take towards achieving UHC. Primary health care is the cornerstone of a sustainable, people-centred, community-based, and integrated TB service delivery system. Expanding primary health care requires strengthening referral systems between primary and other levels of care, and strengthening PPM approaches. (See Chapter 3 for a discussion of community-based care and Chapter 5 for a discussion of PPM approaches.)

Integrate and coordinate delivery of TB services within services for other comorbidities and underlying health conditions

Large numbers of people who develop TB have one or more common underlying conditions. Countries can expand access to TB services and help identify people with TB early by integrating TB services within care for its five most important risk factors—HIV/AIDS, diabetes, undernutrition, tobacco use and alcohol use disorder—as well as other health services as appropriate, such as hepatitis or COVID-19. Coordination should take place at both the strategic and programmatic levels. See, for example, frameworks for **coordinating TB-HIV activities**, **TB-diabetes activities**, and **TB and tobacco cessation**. (See Chapter 3 for a discussion of coordinating and integrating TB care with other health programmes and services.)

Scale up active case finding and outreach to key and vulnerable populations

These efforts are foundational to finding the missing people with TB, ensuring that people are diagnosed as early as possible, and preventing further TB transmission. Reaching key and vulnerable populations is critical to a TB response that is human rights-based and equitable.

Integrate mental health services into TB care

There is a bidirectional link between TB and mental health. Having TB can lead to mental health challenges that stem from causes such as stigma, social rejection, and an inability to work. The main mental health conditions that affect people with TB are depression, anxiety and alcohol use disorder. TB can also potentially be exacerbated when mental health conditions lead to inflammation or suppression of the immune system, which can heighten one's risk of developing TB. The adverse effects of some medicines used to treat TB can also lead to or worsen mental health conditions. Given the links between TB and mental health conditions, people with TB should receive mental health screening as a routine and early part of care, using established and validated screening methods, and be provided with appropriate support. To **integrate mental health services into TB care** at scale will require education and training for health workers, advocacy from the TB community, and operational research to understand how mental health services can be most effectively integrated into TB care in various settings.

Improve resource allocation through better TB information systems

TB data collection should be integrated within public health surveillance and data systems. They should support real-time, reliable and accurate data collection. Data should be disaggregated by income, sex, age, race, ethnicity, migratory status, disability, geographical location and other characteristics required to identify gaps in access to essential TB services and to enable real-time intervention. Many countries set up advanced data collection capabilities for monitoring COVID-19. These capabilities should be adapted to use for TB.

Improve the quality of TB services

Having access to services only matters if those services are of sufficient quality to be effective. All health care providers need to follow authoritative clinical standards for TB care. Health provider non-compliance with clinical standards prevents people with TB from receiving the quality services they need.

The Global Plan recommends the following ways to efficiently improve the quality of TB services:

Strengthen health worker recruitment, education and training.

All health workers responsible for delivering TB services—including primary health care providers, health care providers in the private sector, community health workers, and laboratory personnel—need to know how to properly diagnose, treat and care for people with TB.

Ensure access to quality-assured TB tools.

Quality care begins with affordable, safe and effective TB tools. Diagnostic networks in many countries need to be upgraded with modern diagnostic tools. Countries can ensure the quality of TB medicines by procuring from GDF, as recommended in the UN Political Declaration on TB. Countries can also increase access to quality-assured TB tools by strengthening procurement and supply management systems in order to mitigate the risk of product stockouts.

Expand access to support services to all people in need.

Providing routine holistic support as a part of TB care (e.g., nutritional support, psychosocial support, cash benefits, etc.) is a part of providing quality people-centred TB care. When expanding support services, countries should prioritize vulnerable groups who face the biggest barriers to accessing and completing care, and who have experienced the worst health outcomes.

Invest in digital tools.

Digital tools can empower both people affected by TB and TB service providers, making the delivery of TB care more people-centred and cost-effective. (See Chapter 8 for a discussion of the development and implementation of digital tools in the TB response.)

Eliminate catastrophic costs associated with accessing TB services

Countries can eliminate catastrophic costs associated with accessing TB services by taking complementary steps at two levels: ensuring adequate financing for the TB response and reducing costs associated with accessing TB services.

Ensure adequate financing for the TB response.

Progress in reducing the burden of TB disease requires adequate and sustained funding for TB diagnostic, treatment and prevention services. Countries should pursue funding for UHC through increased domestic resources plus external resources where necessary. Taxation and innovative financing should be used to improve the sustainability of financing wherever possible.

Reduce costs associated with accessing TB services.

One way to reduce costs of TB services is to include TB services in national essential health service packages. Most countries identify a package of essential health services that people can access at no or minimal cost. TB services should be included, given TB's significance as a disease of public health concern. Similarly, TB services should be included in SHI schemes. (See Chapter 5 for a discussion of SHI.) Another way is to include coverage for TB services in risk-protection schemes. People seeking TB care should qualify for national or subnational risk protection schemes, such as those that provide cash transfers or in-kind support, income replacement, food and nutritional support, and other forms of social support.

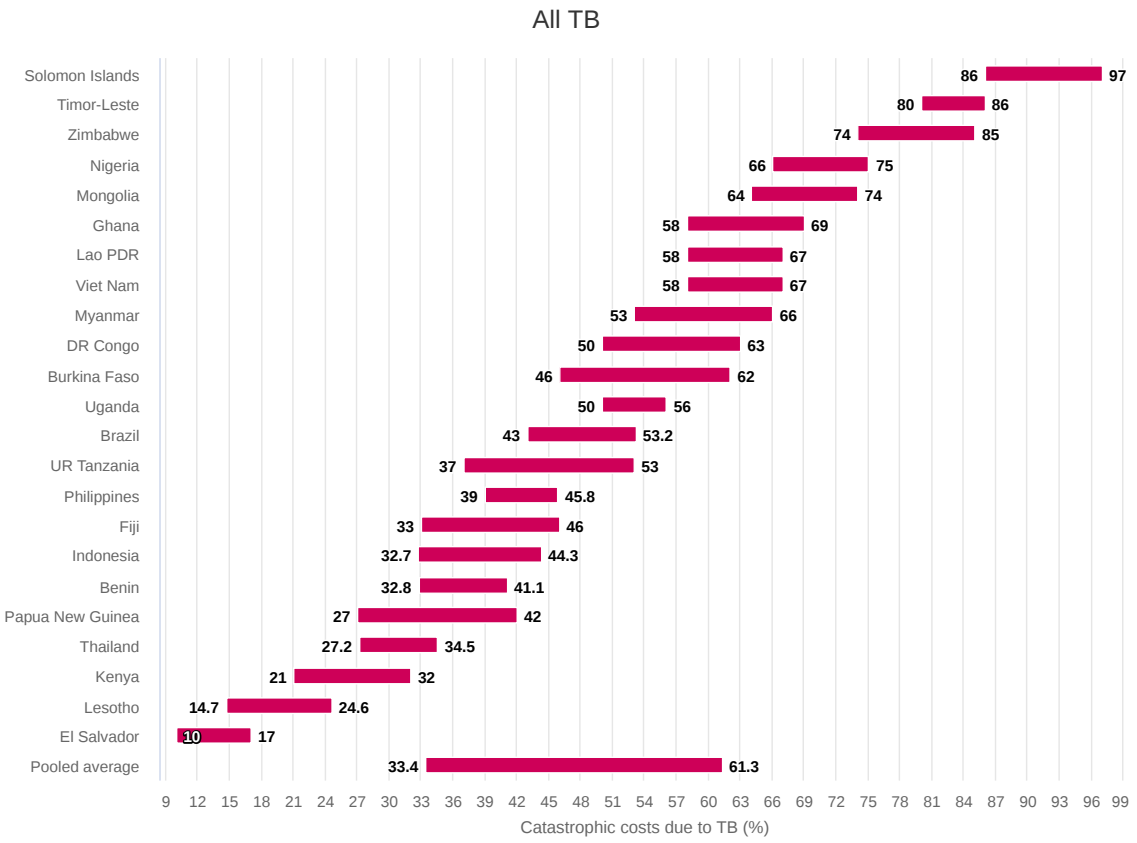
CATASTROPHIC COSTS FACED BY PEOPLE AND FAMILIES AFFECTED BY TB[2]

Given the importance of UHC to targets for reductions in TB incidence and mortality, the End TB Strategy included a third target that no persons with TB and their households should face total costs that are catastrophic. The definition of catastrophic used for this TB-specific indicator is total costs (comprising direct medical expenditures, non-medical expenditures and income losses) above 20% of household income.

Since 2015, **25 countries have completed a national survey of costs** faced by people with TB and their households, of which 23 (including 14 of the 30 high TB burden countries and one of the three global TB watchlist countries) have reported results. The percentage facing catastrophic costs ranged from 13% (95% confidence interval [CI]: 10–17%) in El Salvador to 92% (95% CI: 86–97%) in Solomon Islands; the pooled average, weighted for each country's number of notified cases, was 47% (95% CI: 33–61%) (Figures 9 and 10).

In countries that reported disaggregated data, the pooled average was considerably higher for DR-TB. Survey results are being used to inform approaches to health financing, service delivery and social protection that will reduce these costs.

Figure 9. Estimates of the percentage of people with TB and their households facing catastrophic costs, national surveys implemented 2016–2020[3]



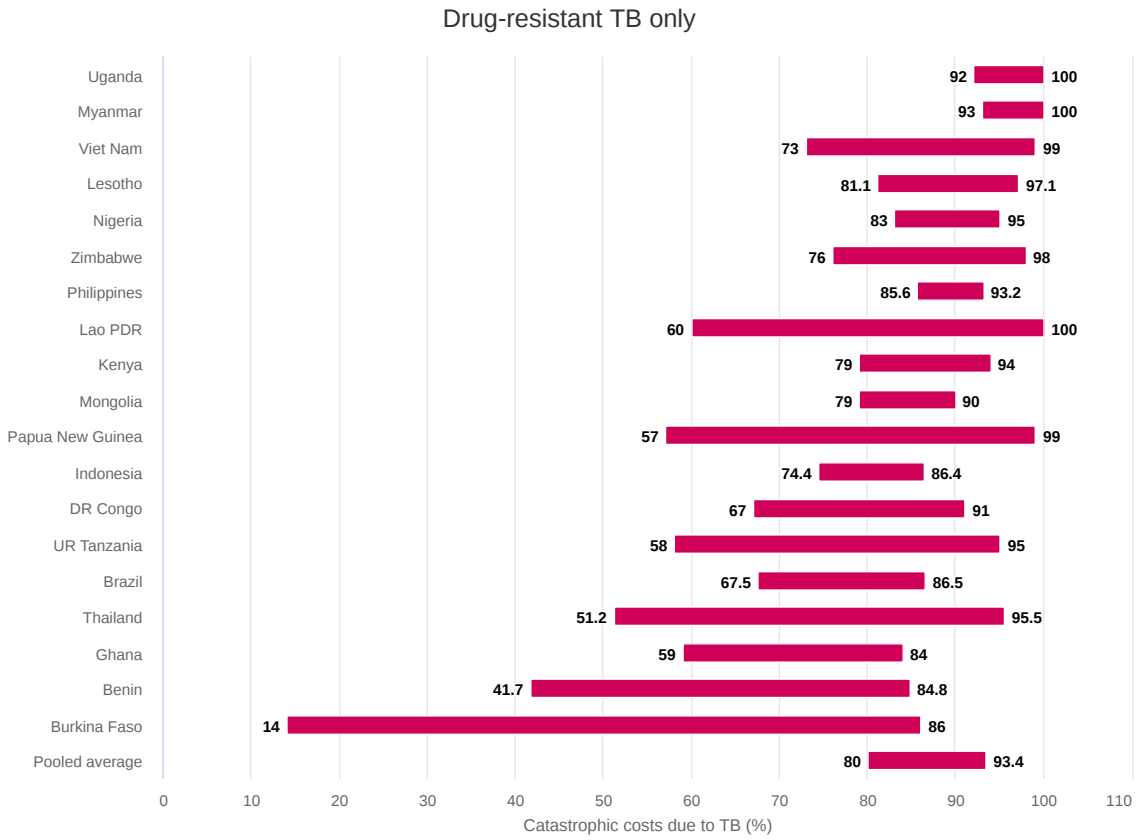
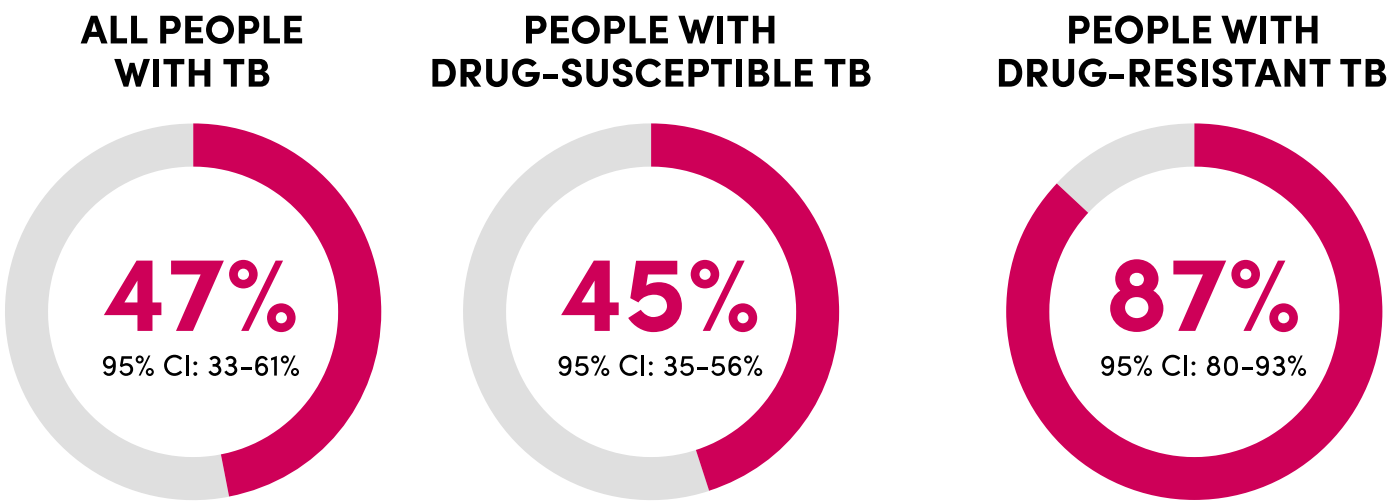


Figure 10. Average percentage of people with TB and their households facing catastrophic costs in 23 national surveys completed since 2015



Promote accountability through MAFs

Political will is critical to achieving UHC, which means that governments must be held accountable for fulfilling their commitments. Inadequate political leadership and financial constraints remain the major obstacles to equitable progress towards UHC. The Global Plan calls on national governments to provide the overall stewardship to keep TB elimination high on the development agenda through political commitment, investment and oversight. At the same time, TB stakeholders must work together to hold governments accountable for fulfilling their commitments.

Given that social and economic determinants, and not just health determinants, drive the TB epidemic, countries should institute accountability frameworks that involve multiple relevant sectors beyond the health sector. MAFs provide a structured way to engage all relevant TB stakeholders—including civil society and affected communities, the private sector and academia—in decision-making, monitoring, review and remedial actions needed to achieve objectives for UHC and TB.

1. Figure is reproduced from the UNHLM on UHC in 2019. Key targets, commitments and actions. Geneva: UHC2030; 2020 https://www.uhc2030.org/fileadmin/uploads/uhc2030/Documents/UN_HLM/UHC_key_targets_actions_commitments_15_Nov_2019__1_.pdf
2. Global tuberculosis report 2021. Geneva: World Health Organization; 2021 https://www.who.int/publications/i/item/9789240037021
3. Figures 9 and 10 have been reproduced from the Global tuberculosis report 2021. Geneva: World Health Organization; 2021. Licence: CC-By-NC-SA 3.0 IGO.

POSITION THE TB RESPONSE AT THE CENTRE OF PPR EFFORTS

The world was unprepared for the COVID-19 pandemic. As a result, COVID-19 created enormous but preventable disruptions to nearly every facet of life for most of the world's people. To avoid a repeat scenario, governments have begun investing more in PPR.

TB elimination efforts should be positioned at the centre of PPR. Practically speaking, this means that TB elimination programmes should both contribute to and receive support from PPR efforts.

The reasoning is clear. Highly transmissible disease pathogens that are airborne or spread through droplets have the greatest potential to seed another global pandemic. Because TB and COVID-19 are similar in several ways—they spread through airborne transmission and require a similar set of public health interventions—many countries used their TB infrastructure and related human resources to respond to the COVID-19 emergency. Human resources were re-assigned, while hospitals, laboratories and diagnostic equipment used for TB were redesignated for the COVID-19 response. TB programmes were centres of expertise on many interventions needed for COVID-19, such as AIPC, contact tracing, appropriate use of quarantine and isolation, and respiratory care. If governments had been fully meeting their commitments to support TB elimination at the time that COVID-19 emerged, countries would have been better prepared to respond.

Instead, TB programmes were severely under-resourced when the pandemic hit. This left countries, especially high TB burden countries, with significantly less capacity to respond to COVID-19. It also meant that repurposing TB programmes to fight COVID-19 disrupted TB services, adversely impacting TB elimination efforts.

Adding investments to strengthen the infrastructure and capacity of TB programmes will help to pre-emptively develop surge capacity to fight any new respiratory infection of pandemic potential. Smart investments in PPR will help the fight against TB and at the same time prepare the world to face the next airborne-disease pandemic. The capacity to eliminate TB is so closely linked to PPR that monitoring progress in TB should be part of the monitoring of countries' state of preparedness to fight any new respiratory infection. Investments that have dual benefits for TB elimination and PPR should be considered TBE-PPR (Table 6).

Table 6. Areas of investment in TBE-PPR

Detection and care
Scaling up diagnostic capacity with a focus on multiplex molecular testing platforms for respiratory pathogens provided at point of care and unconventional access points, e.g., mobile diagnostic units
X-ray screening, including the use of AI to read images in areas facing shortages of radiologists
Digital health tools (e.g., AI-based CAD, digital adherence technology [DAT])
Systems for contact tracing, including human resources, technology and infrastructure needed to do this activity in community and at scale
Respiratory care infrastructure (e.g., human resources, hospital beds, equipment, supply, surge capacity, private-sector care)
Community systems strengthening for delivery of community care, as well as for community-led systems for monitoring of services, gaps and barriers

Prevention
AIPC implemented across the health system, congregate settings and public spaces
Surveillance
Genome sequencing
Real-time data surveillance and analysis with public-facing dashboards that report key indicators (e.g., influenza-like illness/severe acute respiratory infection [ILI/SARI], testing information, positive case numbers, variants, deaths and other outcomes)
R&D
Fast-track treatment and vaccine research

While WHO, the G20 **and other initiatives** have created political momentum for PPR at the global level, high-level recommendations need to be adapted to country contexts. To enable this adaptation, TB programmes in high TB burden countries must communicate with their counterparts in the government ministries responsible for PPR, including ministries of health, public affairs, defense and agriculture, working together to ensure that PPR plans and investments are built on the country's TB response. The targeted areas of investment in Table 6 can serve as a guide for action. Global partners working on TB must continue to advocate to WHO, G7, G20 and the donor community to position TB elimination at the centre of PPR.

Achieving UHC through global health security and antimicrobial resistance (AMR) efforts

Closely related to PPR, global health security has emerged as an important construct in public health in response to growing recognition that communicable diseases in any one part of the world can easily spread to other areas, with worldwide public health implications. The UN General Assembly, G20, G7, BRICS, Asia-Pacific Economic Cooperation bloc, and ministers from countries across South-East Asia and the African Union have identified AMR as a critical threat to global health security and economic prosperity, pledging action in response. In 2018, the UN General Assembly recognized DR-TB as a critical challenge, and noted that the grave risks to individuals and public health caused by DR-TB are cause for alarm.

Achieving universal access to TB care, while providing people with TB and their families with the social support they need to complete a full regimen of appropriate TB treatment or TPT, is essential for preventing AMR in TB. There is a risk of DR-TB emerging any time a person with TB receives inadequate, substandard or incomplete treatment. Where people with TB lack people-centred care and adequate support—such as nutritional, psychosocial or mental health support—the risks are greater that treatment will be interrupted and resistance will emerge. Preventing the emergence of drug resistance is also a priority among mobile populations such as refugees, internally displaced people and migrant workers, where breakdowns in the continuum of care can lead to treatment interruptions.

While it is critical to prevent the emergence of new instances of TB resistance, due to a lack of action, DR-TB has spread to the point where most people with resistant forms of TB acquired it through airborne transmission. The challenges posed by the global spread of DR-TB **affect all countries**. Even the wealthiest countries that are close to eliminating TB can and are impacted when even small numbers of people become sick with DR-TB. In addition to the overall burden of TB globally, the ongoing spread of DR-TB combined with shortfalls in investment to develop new TB treatment regimens makes TB a global health security risk.

Ensuring universal access to TB prevention, care and support is essential to ending TB and stopping the danger to global health security posed by TB drug resistance. Given the high-level political attention given to global health security—particularly in light of COVID-19 and the renewed understanding of the risks posed by airborne respiratory pandemics—TB programmes should work to incorporate their goals into health security agendas. Budgets allocated for health security and AMR can serve as sources of funding for TB activities, helping to bring TB budgets in line with the demonstrated need. Global health security and AMR initiatives can also provide critical sources of funding for TB R&D, helping to develop new TB treatment regimens—including a potential pan-TB regimen that can treat all forms of TB—and new vaccines that can prevent future emergence of DR-TB.

INVEST IN POVERTY ALLEVIATION AND SUSTAINABLE DEVELOPMENT

Compared to approaches to "controlling" TB followed in previous decades, the End TB Strategy has increased the focus on poverty alleviation and social protection as critical pieces of a holistic, multisectoral effort. Combined with sustainable development efforts, these interventions have the potential to enhance prevention, improve access to care and prevent TB-related catastrophic costs.

Given the number of social determinants that drive the TB epidemic (see Chapter 4), the TB response must engage a broader range of non-medical actors. Planning and investing to end TB is the task not only of health ministries, but also of other ministries and government agencies, including those responsible for social welfare, finance, labour, housing and urban planning, agriculture and other areas. Engaging finance ministries—with NTPs and advocates from across sectors participating strategically in national budget processes—is crucial to seeing more resources flow towards a multisectoral TB response.

Over the coming decades, the majority of the world's population growth is set to occur in urban areas. In many LICs, and even in many MICs, urban areas have grown rapidly, but without much planning or resources. This has left the poorest to live in slums. For an airborne disease such as TB that is fuelled by overcrowding, poor ventilation, inadequate sanitation and undernutrition, this development trend has significant implications.

Sustainable development strategies that improve living standards have the potential to **make a significant impact** in the fight to end TB. Health care facilities that are well located in relation to housing could enable better links to health services. Improving urban living conditions would also greatly benefit efforts to tackle other diseases such as diarrhoea and pneumonia that are caused by overcrowding and poor water and sanitation.

7

HUMAN RIGHTS, STIGMA, GENDER, AND KEY AND VULNERABLE POPULATIONS

PRIORITY ACTIONS

- Position universal human rights as the foundation of the TB response.
- Eliminate TB-related stigma and discrimination.
- Ensure that TB interventions are gender-sensitive and gender-transformative.
- Prioritize, reach, and involve key and vulnerable populations.

POSITION UNIVERSAL HUMAN RIGHTS AS THE FOUNDATION OF THE TB RESPONSE

Recognizing the powerful social dynamics underpinning the TB epidemic, this chapter provides guidance on implementing a TB response that is rooted in universal rights, eliminates TB stigma, is gender-sensitive, and reaches key and vulnerable populations. This approach is critical to reaching people and communities affected by TB.

Social and cultural factors heavily influence people's TB risk and vulnerability, and their ability to access TB prevention, care and support. These factors relate to a person's identity and a wide range of other determinants, including:

- stigma and discrimination
- gender
- socioeconomic status
- legal and class status
- nutritional status
- housing status
- access to education
- access to information
- language (including language spoken and use of stigmatizing language)
- surrounding cultural norms.

Because these social factors play a huge role in driving the TB epidemic, it is critical that TB responses extend beyond the health system and include broader interventions that:

- address socioeconomic factors that increase one's risk of and vulnerability to TB and/or influence health-seeking behaviour;
- remove legal, cultural, human rights- and gender-related barriers to prevention, care and support;
- create an enabling environment for TB prevention, care and support;
- **strengthen community systems**, measured by indicators.

Understanding the need for such an approach, TB-affected communities and civil society have called for a global TB response that is "**rights-based, equitable and stigma-free, with communities at the centre**."

There is also a consensus among leaders that the TB response needs to be grounded in human rights and address the epidemic's social and cultural dynamics. For example, building on the End TB Strategy, the 2018 UN Political Declaration on TB committed governments to pursuing "**an equitable, human rights-based**" TB response. The UN Secretary General also identified the need to "**promote human rights and combat stigma and discrimination**" as one of 10 priority actions needed to accelerate the TB response and reach global TB targets.

The End TB Strategy demonstrates the long-held understanding that there is a connection between TB and human rights. How to operationalize a human rights-based TB response, however, **has taken much longer to understand**.

Since the UNHLM on TB in 2018, the TB community has made significant progress in articulating exactly how human rights must inform the global TB response, most notably in the **Declaration Of the Rights Of People Affected By Tuberculosis**. This landmark document lays out how the TB response must abide by and promote universal human rights.

Grassroots communities, civil society, TB policy-makers and programme implementers can find specific guidance for **operationalizing human rights**, **building capacity** and increasing sensitization to CRG issues. The **TB CRG Country-Level Assessment Protocol Template** can be used to help document and understand how various human rights- and gender-related barriers are impeding the efforts of NTPs.

NTPs, civil society and affected communities **should continue to jointly assess** how social factors are being addressed and/or are impeding progress against TB. They should also jointly assess how human rights, gender, and key and vulnerable populations are reflected or prioritized within laws and guidelines.

Community-led monitoring (CLM)

Communities can and should play a leadership role in monitoring certain aspects of the TB response. As part of the commitment to human rights and social accountability, CLM has become a critical part of the TB response within countries. CLM is a process that promotes accountability for the success of health and social programmes. The process involves people who have the most at stake—users of services—in monitoring access to and quality of services, and working with health or social programmes to improve them.

CLM is based on routine, systematic oversight of local and national health and social systems, using consultations with community members to identify service gaps and areas for improvement. CLM can contribute to the collection and disaggregation of age, gender, and key and vulnerable population data. Insights gained through CLM can inform advocacy and policy change that benefits TB-affected communities, empowering TB-affected communities and civil society, while providing critical added value to national TB, HIV, COVID-19 and other health responses (see Table 7).

CLM tools, **including virtual tools**, must be developed and implemented in a way that promotes and protects the rights (including rights to security, privacy and confidentiality) of people affected by TB. Those rights should be enshrined as appropriate in relevant legislation, policies and guidelines (e.g., in consumer, data, and health laws and policies).

Table 7. Actions for integrating human rights into the local TB response

Planning
Conduct a TB CRG Assessment, develop a costed national TB CRG Action Plan, and fund and implement the national costed TB CRG Action Plan.
Engagement
Formalize engagement and sensitization of TB and human rights in TB policy and implementation among judges, lawyers, law enforcement, legal aid service providers and law schools.
Invest in TB survivor networks to coordinate and meaningfully engage and participate in all components of the TB response as they impact the constituencies they represent.
Capacity-building
Conduct capacity-building and sensitisation training for TB survivors and civil society on human rights-based programming, advocacy and remedies.
Sensitise health care workers in public and private sectors on the need to incorporate a human rights-based approach to TB in their work.
Develop and implement a comprehensive curriculum to advance TB-affected community and civil society literacy in TB, TB diagnosis, TB tools and technologies, TB treatment, TB care, TB data, TB financing and TB research.
Monitoring
Periodically conduct a TB legal and human rights score card analysis.
Adapt and implement real-time CLM for social accountability of human rights- and gender-related barriers to TB and social protection services.
Fund TB survivors and civil society to monitor, document and report human rights violations of abuses among people with TB and to advocate, including through litigation, for law and policy reform.
Advocacy

Review and reform social protection systems to be accessible and inclusive for people affected by TB, including support for income, nutrition, shelter, mental health and legal aid.

Utilize legal resources to uphold people's right to health

Numerous legally binding treaties, conventions and national constitutions guarantee people the right to the highest attainable standard of health. In cases where governments have not adequately safeguarded that right, people have used litigation and the courts to force governments to uphold their rights to access essential health services, their rights to be free from discrimination and other rights.

In some contexts, **litigation can be an important accountability tool** for people affected by TB. The University of Chicago School of Law in the United States and the Global Drug-Resistant TB Initiative have compiled **a valuable compendium of case law** focused on TB and human rights that includes summaries of court cases from a variety of country contexts pertaining to various TB-related issues, including inhumane and degrading treatment, compensation, compulsory isolation, employment discrimination, negligence, right to privacy and other issues.

ELIMINATE TB-RELATED STIGMA AND DISCRIMINATION

All people with TB are equal before the law and **entitled to be free from all forms of discrimination**. States have obligations to eliminate discrimination, embodied in legal conventions such as the Convention on the Elimination of All Forms of Discrimination Against Women and the International Convention on the Elimination of All Forms of Racial Discrimination.

TB CRG assessments have identified TB-related stigma and discrimination as the leading barriers to TB prevention, diagnosis and care. Assessments have also found that stigma and discrimination are most severe when multiple vulnerabilities intersect, including gender and key and vulnerable population status.

Stigma and discrimination can manifest through direct acts or omissions of actions. They can also manifest through language and body language, where people with TB are described with negative connotations or even blame (e.g., use of terms such as "defaulter" or "TB suspect"). Such language is unnecessary and inexcusable when alternative language exists that positively engages and helps to empower people affected by TB. The Stop TB Partnership's **Words Matter** resource can be used to inform all communications related to TB.

As a first step to eliminating TB-related stigma and discrimination, programmes need to understand how and why stigma and discrimination manifest, where they manifest, and the impact on people who may need access to health services. As a priority, this includes understanding how stigma and discrimination relate to gender and impact key and vulnerable populations.

Programmes must then develop and implement evidence-based interventions that bring about the end of TB-related stigma and discrimination (see Table 8). These interventions need to be monitored and reviewed to ensure that they have the intended impact. While eliminating TB stigma is a priority, **more rigorous evaluation is needed** to understand the most effective approaches.

Efforts to identify, measure and mitigate TB stigma and discrimination have been advanced by many partners, including **KNCV**, **Global Coalition of TB Activists (GCTA)**, **TB Proof**, the **GFATM** and the **Stop TB Partnership**. The **TB Stigma Assessment tool** is one example. Programmes can adapt the tool and use it to collect data on:

- anticipated stigma, self-stigma, enacted stigma (i.e., stigma directly experienced) and observed stigma among people diagnosed with TB;
- secondary TB stigma, stigma directly experienced, and stigma observed by family members and by primary caregivers of people diagnosed with TB;
- perceived TB stigma against people diagnosed with TB in communities and stigma observed by the community;
- perceived TB stigma against people diagnosed with TB in health care settings and stigma against health care workers;
- structural stigma (any existing laws/policies, the enforcement of those laws/policies and the corresponding media coverage that could harm or protect people diagnosed with TB).

This tool was used to create the first TB CRG indicators, which include:

- % of people diagnosed with TB reporting that self-stigma inhibited them from seeking and accessing TB services;
- % of people diagnosed with TB reporting that stigma in their community/neighbourhood inhibited them from seeking and accessing TB services;
- % of people diagnosed with TB reporting that stigma in a health care setting inhibited them from seeking and accessing TB services.

Table 8. Actions for eliminating TB stigma and discrimination

Planning and implementation

Conduct a TB Stigma Assessment, incorporate the findings into a costed national TB CRG Action Plan, and fund and implement the national costed TB CRG Action Plan.

Education and training

Sensitize policy-makers, health service providers and media partners regarding language that stigmatizes or disempowers people with TB, as well as the effects of using such language; train people to use language that supports and empowers people with TB.

Ensure that communication and information campaigns avoid stigmatizing language and focus on using language that empowers people with TB and TB survivors.

Policy-making

Develop legal and policy protections and remedies for people affected by TB to be free from stigma and discrimination in health care settings, law enforcement, employment and the community.

Advocacy and strategic communications

Promote legal and policy protections for health care workers to mitigate their experience of stigma and discrimination.

Develop high-level communications campaigns, supported by high-profile champions and supporters, that demystify and normalize the experience of having TB.

Monitoring and evaluation

Develop and incorporate TB stigma indicators into monitoring and evaluation frameworks and as a priority in NSPs.

Adapt and implement real-time CLM for social accountability of stigma and discrimination in health care settings, employment settings and community settings.

Increase funding available to support TB survivors, civil society, and TB key and vulnerable populations to build evidence of stigma and discrimination, and effective mitigation strategies and approaches, including advocacy, litigation, law and policy reform.

ENSURE THAT TB INTERVENTIONS ARE GENDER-SENSITIVE AND GENDER-TRANSFORMATIVE

In order to identify and overcome **gender-related barriers to TB services**, there is a need for gender-sensitive TB engagement, leadership, programming and policies. The SDGs (in particular SDG 5), which recognize that gender equality is key to development, support a gender-sensitive approach to TB elimination.

Globally, TB rates are higher in men than in women[1] . Men and boys also account for a larger share of TB mortality. Cultural and socioeconomic factors play a large role in determining TB risk and disease. Men are often more mobile and can be more affected by TB as a result of their greater tendency to use cigarettes, alcohol and drugs. Generally, though far from a universal rule, men often take longer than women to access TB care.

While certain behavioural and industrial risks are weighted towards men, there are also risks that are weighted towards women. HIV, which is more prevalent in women than in men, increases the risk of TB more than 10-fold. Yet, this does not seem to translate into proportional increases in women with TB, or treatment outcomes that are notable different from those found elsewhere in countries where this has been explored. Malnutrition, the leading underlying risk factor for TB disease, is **more common in women than in men**. While women are documented to generally have better health-seeking behaviours, they are more likely to experience cultural and socioeconomic challenges that delay or block their access to TB care.

An analysis of TB CRG assessments from 20 countries found that patriarchal norms negatively impact women's access to TB services and increase their vulnerability to infection and disease. In addition, the analysis found that women and girls affected by TB face more frequent and intense stigma and discrimination than men, sometimes leading to abuse, gender-based violence or abandonment. Based on these findings, **a gender investment package** must respond to the unique challenges faced by women and girls.

The TB response has too often **reinforced societal gender discrimination**. This can happen in several ways, such as lower wages for women in the health workforce, exclusion or stigmatization of gender-diverse people, and information, education and communication (IEC) materials that reinforce patriarchal gender roles.

A global network of women, in their diversity, who are affected by TB has been formed to champion women's empowerment and a strategic, gender-sensitive TB response. This is laid out in the **TB Women Strategic Plan 2021–2025**. It is critical for the TB response to increasingly integrate gender sensitivity and for this transition to be driven by TB-affected communities (see Table 9).

Very little is known about the TB epidemiology of gender-diverse people and communities, although the data do demonstrate that TB epidemics might be concentrated in communities that are stigmatized and marginalized because of their gender nonconformity. When India's NTP began **tracking TB among transgender people in 2018**, TB notifications among this group were 426/100,000 , compared to 134/100,000 in women and 211/100,000 in men, indicating a high TB burden in this population.

Table 9. Actions that contribute to a comprehensive gender-sensitive TB response

Education and capacity-building
Conduct capacity-building and sensitization training among TB survivors and civil society on gender-sensitive programming, advocacy and remedies, as well as women's empowerment.

Sensitize health care workers in public and private sectors on the need to incorporate a gender-sensitive approach to TB in their work.
Programme management
Implement gender-sensitive policies and programming across all aspects of TB programmes, with particular consideration for disease prevalence, leadership, women's empowerment and access to services.
Update databases to reflect diverse gender identities.
Develop a policy to advance gender equity that includes gender representation and pay equity in the TB workforce, facility-based service quality, stigma reduction and remedies, and community-based case finding.
Review and reform social protection systems to be accessible, irrespective of gender identity, including support for income, nutrition, shelter, mental health and legal aid.
Monitoring and evaluation
Adapt and implement real-time CLM for social accountability of gender-related barriers to TB services with data disaggregated by gender.
Conduct qualitative and quantitative operational research to generate an evidence base on the effectiveness of a human rights-based and gender-responsive approach to TB, especially among TB key and vulnerable populations.
Advocacy and strategic communications
Develop TB communication and information materials that are empowering and inclusive for women and gender-diverse people, and are ideally developed with input from those audiences.
Fund advocacy, monitoring and accountability through women-led TB survivor and civil society organisations.

1. The notable exception is Afghanistan, where women are consistently shown to experience higher rates of TB.

PRIORITIZE, REACH, AND INVOLVE KEY AND VULNERABLE POPULATIONS

Reaching key and vulnerable populations—people who are vulnerable, marginalized, underserved or at risk of TB infection and illness—will be essential for ending TB. It is imperative, from both an epidemiological and an equity and human rights perspective, that programmes:

- prioritize ending TB among key and vulnerable populations;
- ensure that key and vulnerable populations have convenient access to TB prevention and care, including through primary care and integrated health services (e.g., TB and nutritional support, TB-HIV, TB-diabetes, TB and tobacco cessation);
- understand the social, political, legal and economic barriers key and vulnerable populations face in accessing TB services;
- involve key and vulnerable populations as priority stakeholders and equal partners in the fight against TB;
- coordinate and collaborate with other programmes and ministries focused on gender, rights and development (see Figure 11).

Figure 11. Key and vulnerable populations

People who have **increased exposure** to TB due to where they live or work	Prisoners, sex workers, miners, hospital visitors, health care workers and community health workers **People who**: • live in urban slums • live in poorly ventilated or dusty conditions • are contacts of individuals with TB, including children • work in environments that are overcrowded • work in hospitals or are health care professionals • are in contact with or live with livestock • live or work in close proximity to cattle or ingest raw milk or blood
People who have **limited access to quality TB services**	Migrant workers, women in settings with gender disparity, children, refugees or internally displaced people, illegal miners, and undocumented migrants **People who**: • are from tribal populations or indigenous peoples • are homeless • live in hard-to-reach areas • live in homes for the elderly • have mental or physical disabilities • face legal barriers to access care • are lesbian, gay, bisexual or transgender

People at **increased risk** of TB because of biological or behavioural factors that compromise immune function

People who:

live with HIV
have diabetes or silicosis
undergo immunosuppressive therapy
are undernourished
use tobacco
suffer from alcohol-use disorders
inject drugs

If TB programmes are to understand the lived experience of TB, they must facilitate the meaningful participation of the representatives of key and vulnerable populations, on behalf of the constituencies they represent, in all TB policy, programme and governance discussions and decisions (see Table 10). A significant aspect of reaching key and vulnerable populations is investing more in capacity-building and providing avenues for their participation in a wide range of TB activities, including:

- programme design, monitoring and evaluation
- peer support
- treatment literacy
- R&D
- advocacy
- human rights interventions.

An analysis of the first 20 countries to prioritize TB key and vulnerable populations revealed a list of 26 different key and vulnerable population groups. Programs can find information on many of these specific key and vulnerable populations in a series of briefs and investment packages, which can be used as resources for prioritizing key and vulnerable populations and developing relevant interventions: **Prisoners**; **Mobile Populations**; **People who use drugs**; **Children**; **indigenous peoples**; **People living with HIV**; **health care workers**; **urban poor**; **rural populations**; **miners**. The Global Plan recommends carrying out these exercises as a part of a broader CRG assessment (see above).

In 2022, a TB key and vulnerable population size estimation tool will be available for countries to better understand and prioritize key and vulnerable populations, develop and tailor interventions, and allocate resources to the respective needs of those populations. This tool will also be integrated into the **TB CRG Assessment Protocol**.

Table 10. Actions for prioritizing and reaching key and vulnerable populations

Planning
Conduct national TB key and vulnerable population prioritization exercises and conduct size estimations of the prioritized TB key and vulnerable populations.
In partnership with TB key and vulnerable populations, develop and prioritize interventions for TB key and vulnerable populations that are culturally and linguistically appropriate, and, where possible, TB survivor and key and vulnerable population-led.
Policy-making
Review and reform social protection systems to be accessible and inclusive for TB key and vulnerable populations, including support for income, nutrition, shelter, mental health and legal aid.
Engagement
Support the participation of TB survivors and key and vulnerable populations as meaningful partners in TB R&D initiatives.
Advocacy and strategic communications
Invest in networks and organisations of TB survivors and key and vulnerable populations to build the required capacity to effectively engage in TB governance, advocacy, accountability, demand generation, law and policy reform, and service delivery.
Fund advocacy and engagement of TB key and vulnerable populations.

Facilitate the meaningful engagement and participation of TB survivors and key and vulnerable populations in all levels of policy-making and programmatic design to ensure that TB services are rights-based, gender-sensitive and people-centred, and meet the expressed needs of key and vulnerable populations.

Monitoring and operational research

Adapt and implement real-time CLM for social accountability with data disaggregated by age, gender, and key and vulnerable population status.

Conduct operational research exploring the identification, mitigation and overcoming of human rights-related barriers to accessing services for TB key and vulnerable populations, and generate nuanced findings and interventions to address gender in this context.

CHALLENGE FACILITY FOR CIVIL SOCIETY (CFCS)

The CFCS, a Stop TB Partnership initiative, exposed an immense need for more resources for CRG interventions. The CFCS provides grants to TB-affected community and civil society organisations working to ensure that the TB response is rights-based, gender-transformative, people-centred and accountable. Because of the high demand for CRG support, on average, the facility was able to meet only 15–20% of the requested funding need within its first three rounds of grant-making. Affected communities and their allies in civil society have **called for additional funding** to help meet demand.

8

ACCELERATING DEVELOPMENT OF NEW TB TOOLS

PRIORITY ACTIONS

- Invest, at minimum, US$ 4.22 billion annually to accelerate the R&D of new TB diagnostics, medicines and vaccines. Resources need to be mobilized from governments and philanthropies, increased engagement with the private sector, and new approaches to innovative and sustainable financing.
- Accelerate the development of new tools to prevent, diagnose and treat TB by identifying innovative product-development pathways and improving collaboration among actors in product development. Research goals include:
  - Vaccines:
    - Develop a new TB vaccine by 2025.
    - Diversify and broaden the pipeline of next-generation TB vaccine candidates by expanding research on Mtb immunology and basic mycobacteriology, and develop animal models that better reflect human infection and disease.
    - Provide resources and support to efficiently move a diverse range of vaccine concepts from the laboratory to the clinic.
    - Significantly accelerate clinical development of vaccine candidates and ensure sufficient financing, resources and capacity to advance multiple promising candidates through efficacy trials and licensure without delay.
    - Conduct research on correlates of vaccine-induced protection during vaccine efficacy trials to inform vaccine design and expedite clinical trials of future vaccine candidates.
    - Work with countries and affected communities to prepare for successful licensure and roll-out of new TB vaccines once licensed (see Chapter 4).
  - Diagnostics:
    - Develop rapid, affordable tests for diagnosis or triage that do not rely exclusively on sputum and are used at the point of care.
    - Develop accurate DST for critical medicines, including through sequencing-based tests and strategies for early detection of resistance to the medicines used in regimens.
    - Improve tools for detecting TB infection (i.e., latent TB) and subclinical TB, and testing for risk of progression to active disease.
    - Develop and harness AI and machine learning-based tests.
  - Medicines:
    - Increase and advance the number of novel drug candidates in the clinical pipeline.
    - Advance the development of new treatment regimens that will be superior to current regimens for drug-sensitive and drug-resistant forms of TB.
    - Focus on treatment-shortening strategies for both TB disease and TB infection.
- Invest at least US$ 800 million per year in basic science research.
- Expand the use of operational research.
- Develop and implement digital tools.
- Create an enabling environment for TB R&D.
- Apply best practices in community engagement throughout the R&D process.
- Apply access principles in rolling out and optimizing the use of new tools.
- Strengthen advocacy for TB R&D.

INVEST, AT MINIMUM, US$ 4.22 BILLION ANNUALLY TO ACCELERATE THE R&D OF NEW DIAGNOSTICS, MEDICINES AND VACCINES

Investments in science and technology are crucial to tackling any disease and are an absolute necessity to reach goals of elimination of disease. For TB, a disease that primarily affects the developing world, funding has always fallen short of meeting the basic required levels to support R&D needs.

Without new medicines, diagnostics and effective vaccines, we will not achieve the steep reductions in incidence and mortality that we need, and millions more people will get sick or die from the disease. After years of under-investment, developing these tools will require commitment and funding from governments, the private sector and philanthropic organisations that is on par with the urgent need for innovation. It will also require a radically transformed approach to accelerating promising medicine, diagnostic and vaccine candidates through the development pathway. R&D efforts should be needs-driven, evidence-based and guided by the core principles of affordability, efficiency, equity and collaboration.

In the **UN Political Declaration on TB**, UN Member States recognized the "lack of sufficient and sustainable financing" for TB research and innovation. In response, they committed to "mobilize sufficient and sustainable financing, with the aim of increasing global investments to US$ 2 billion per year in order to close the estimated US$ 1.3 billion gap in funding annually for tuberculosis research". For a few reasons, TB R&D resource needs have since increased to a minimum of US$ 4 billion annually.

First, investments in TB R&D have consistently fallen short of the need. In 2020, governments collectively invested only US$ 642 million in TB R&D (of a total US$ 915 million from all funding sources). Adjusted for inflation, total investment in TB R&D **was flat between 2018 and 2020**. The commercial pharmaceutical sector has also invested very little in TB R&D, including almost nothing for vaccines. In contrast to their support for a COVID-19 vaccine, multilateral funders such as Gavi and the Coalition for Epidemic Preparedness Innovations (CEPI), and the multilateral development banks have not yet contributed significant resources to support TB R&D. As a consequence, TB R&D continues to suffer from a lack of funding.

Second, funding needs are projected to increase as certain promising product candidates need to be tested in Phase III clinical trials, which are larger and more costly to implement than earlier phase trials. This is the first Global Plan to cost out Phase III vaccine trials.

Table 11 shows annual TB funding needs for the R&D of new TB medicines, diagnostics and vaccines from 2023 to 2030.

Table 11. Resources needed for TB R&D, 2023–2030

Tool	Investment needed (US$ billion)
Medicines	16.06
Diagnostics	7.72
Vaccines	10.00
Total	33.78

US$ 40.18 billion is needed to accelerate the R&D of new TB medicines and treatment regimens, diagnostics, and vaccines from 2023 to 2030. This includes US$ 800 million annually for basic science research.

While the figure includes R&D resource needs for new vaccines, the roll-out of a new vaccine is costed separately and expected to begin in 2026. (See Chapter 9 for a detailed discussion of TB financing. See Chapter 4 for details on vaccine implementation.) The Global Plan urges countries to increase investment in the operational research required to identify the most effective ways of implementing new tools in various national contexts.

A fuller treatment of recent TB R&D funding trends, including analysis of funding for basic research, operational research and paediatric TB research, is found in the annual **Tuberculosis research funding trends reports** produced by Treatment Action Group and the Stop TB Partnership.

The resource needs for TB R&D are greater than the US$ 2 billion funding needed in previous years. The increased need reflects the lack of investment in previous years and includes the costs of carrying out large-scale Phase III vaccine trials—a cost that reflects advances in vaccine R&D in recent years. Costed priorities are presented in the R&D strategic frameworks for diagnostics, medicines and vaccines below. (See Chapter 9 for a discussion of mobilizing resources for TB R&D.)

Apply lessons from the development and distribution of previous innovations

Investments, partnerships and global multisectoral efforts have translated into remarkable impact in creating effective therapies for HIV and, more recently, COVID-19. Advocacy, a sense of urgency, political will, and substantial public and private investments have proven critical to generating these impressive results. The TB R&D community has much to learn from these efforts.

Working together, governments, the private sector and philanthropic organisations identified new approaches and pathways to development, which enabled them to move quickly through the R&D and regulatory processes and introduce new products in record time. At the same time, the global community failed to ensure that new vaccines were distributed equitably around the world. High-income countries amassed large vaccine stocks and quickly achieved relatively high rates of vaccine coverage, while LICs faced challenges in acquiring vaccine stock and distributing vaccines efficiently, leading to relatively low rates of vaccine coverage during the same time period.

The urgency is even greater now than in the past, considering the pandemic's impact on TB R&D, which includes the diversion of resources (human, financial and infrastructural) and delays in TB research activities. With immense resources invested in COVID-19, scientists today have even less incentive to develop careers in TB research. New resources are critically needed to rebuild TB R&D capacity and safeguard TB innovation from potential future disruptions.

ACCELERATE THE DEVELOPMENT OF NEW TOOLS TO PREVENT, DIAGNOSE AND TREAT TB BY IDENTIFYING INNOVATIVE PRODUCT-DEVELOPMENT PATHWAYS AND INCREASING COLLABORATION AMONG KEY STAKEHOLDERS IN PRODUCT DEVELOPMENT

The following section lays out strategic frameworks for accelerating the R&D of new TB vaccines, diagnostics and medicines (see Tables 12a–e, Table 13).

New vaccines R&D

Vision: To develop new, more effective vaccines that will directly and safely prevent TB in all age groups and populations and are affordable and accessible to those who need them the most.

Goals:

1. Develop new TB vaccines that prevent TB infection, TB disease and/or recurrence of TB disease following successful treatment of TB, thereby interrupting TB transmission.
2. Incorporate the goal of equitable accessibility throughout the TB vaccine R&D process.
3. Strengthen community engagement in TB vaccine R&D.

Table 12a. Strategic framework adapted from the Roadmap for research and development of new TB vaccines, published by the European & Developing Countries Clinical Trials Partnership (EDCTP) and Amsterdam Institute for Global Health and Development (AIGHD), April 2021

Objective 1: Diversify the TB vaccine pipeline to increase probability of success in developing effective new TB vaccines			
Priority	**Key Actions**	**Comments**	**Funding Required (US$ million)**
Mechanisms and biomarkers of protection	Conduct observational clinical studies combining pathogenesis and immunology, making use of systems biology, epidemiology and modelling.	Identify components of the host–pathogen interaction associated with clearance, progression to disease and subclinical disease; identify biomarkers and biosignatures of natural protection.	1,000

Objective 1: Diversify the TB vaccine pipeline to increase probability of success in developing effective new TB vaccines			
	Study the role of non-conventional cellular immunity, antibody responses and trained innate immunity in natural and vaccine-induced protective responses.	Explore cellular responses through class-I restricted CD8+ T cells, Th17 cells and MAIT cells; B- cell and antibody responses including Fc-mediated antibody effector functions; and innate immune responses through unconventionally restricted T cells and epigenetic reprogramming of monocytes and natural killer cells. Investigate their role in human immune responses to Mtb	
	Identify biomarkers and biosignatures that correlate with vaccine-induced protection.	Based on data and biological samples from trials that have shown protection signals; through targeted approaches to detect cellular and/or humoral immune responses and unbiased approaches including transcriptional profiling of blood cells and mycobacterial growth inhibition assays	
Undertake novel approaches to vaccine discovery.	Develop new vaccine concepts that induce a broad diversity of potentially protective immune responses.	Explore candidates that generate non-conventional cellular immunity, protective antibody responses and trained innate immunity.	
	Study mucosal immune responses.	Understand the determinants of protective immune responses in the lung parenchyma and mucosa, and how these can be inferred by systemic responses.	
	Discover antigens that are protective in humans.	Identify Mtb expressed proteins, peptides and non-protein antigens that can be recognized by the human host immune system, applying IFN-γ and non-IFN-γ based screening approaches, including by genome-wide strategies.	
Develop and apply improved vaccine formulations and delivery platforms.	Study the effects on vaccination outcomes of adjuvants, vaccine platforms and lineage of the Mtb challenge strain.	Among other approaches, through experimental medicine studies	200
	Explore new routes of vaccine administration.	Including aerosol and intravenous approaches, among other approaches, through experimental medicine studies	
	Study how vaccines can direct immune responses to the lungs.	Evaluate the capacity of different formulations and delivery platforms to induce mucosal immune responses.	
Establish a controlled human infection model.	Develop a controlled human infection model for immunobiology studies.	To inform basic knowledge gaps, as well as for proof-of-principle studies to inform down-selection of candidates, platforms and routes of administration. Participant safety, sensitivity and ethical issues will be critical to address.	50
Advance promising vaccine candidates from early preclinical to clinical development.	Conduct the necessary studies for investigational new drug (IND) or equivalent regulatory submission.	To provide development partners, funders and regulators with sufficient evidence of safety (including necessary toxicology studies) and intended biological activity (e.g., immunogenicity; protection in preclinical challenge models) to support and enable advancement to Phase I clinical studies.	550

Table 12b. Priorities and actions to accelerate clinical development of new TB vaccines: animal models

Objective 2: Optimize and standardize animal models for understanding TB mechanisms of protection and accelerating vaccine development			
R&D Priority	**Key Actions**	**Comments**	**Funding Required (US$ million)**
Optimize animal models.	Develop fit-for-purpose animal models.	Back-translate the results/findings from adolescent/adult and paediatric trials into immunogenicity, infection and disease animal models, ideally using the same product as in humans, and from clinical studies of disease progression and subclinical disease.	735
	Develop animal models to provide insight into the relation between prevention of Mtb infection (PoI) and prevention of TB disease (PoD)	Leverage results from human trials with PoI, and ideally both PoI and PoD, end-points, as well as from clinical studies of clearance and disease progression to optimize animal models.	
	Develop immune-compromised animal models that can predict/replicate findings in specific human target populations.	Back-translate the results that emerge from clinical trials, including those in all age groups and immune-compromised humans, into disease animal models.	
Compare vaccine candidates within and across animal models.	Standardize and harmonize animal models.	Standardize and harmonize the selection of Mtb challenge strains; define protection outcomes, including the use of imaging and scoring gross pathology specimens. Identify priorities for future experimental directions, e.g., assessing aerosolized delivery of vaccines.	
	Perform head-to-head testing of candidate vaccines.	Perform these tests in independent laboratories using the standardized models that best predict protection in humans.	

Table 12c. Priorities and actions to accelerate clinical development of new TB vaccines: clinical trials

Priority 3: Advance candidates through clinical trials			
R&D Priority	**Key Actions**	**Comments**	**Funding required (US$ million**
Conduct clinical trials utilizing portfolio management and common stage-gating criteria.	Implement Phase III trials of vaccine candidates that meet criteria to advance to licensure and policy recommendations.		6500
	Continue to support vaccine candidates through the clinical pipeline and initiate new Phase I/IIa/IIb trials using PoI, PoR (prevention of relapse) and PoD end-points.	Prioritize the use of PoD end-points in adolescent/adult populations, considering the likely disproportionate effect on reducing the spread of Mtb (compared to PoI or PoR approaches or studies in infants and young children).	
	Include safety trials or safety assessments for PLHIV in clinical trial planning and implementation.		

Priority 3: Advance candidates through clinical trials			
Ensure adequate clinical trial site capacity in high TB burden regions to conduct global regulatory standard human trials of novel vaccines.	Conduct an inventory of clinical trial site capacity.	Identify additional sites; assess their quality and suitability in terms of existing technical and laboratory infrastructure.	
	Collect epidemiological data in sites considered for Phase II/III trials.	In various parts of the world, continuously collect age-stratified data on TB incidence; age-stratified incidence/prevalence of TB infection; Mtb lineage distribution; data on special populations such as PLHIV and other populations considered for vaccine trials.	
	Develop vaccine trial sites, including sustainable human resources capacity.	Develop infrastructure and human resources capacity, including mentorship and support for junior investigators, in diverse geographical locations to take account of potential variation in efficacy and safety due to heterogeneity in host and bacteriological genetic background.	
	Study potential barriers to trial acceptance.	Conduct social science research on barriers to participating in TB vaccine trials and completing follow-up, including TB-associated stigma, other stigma, and social barriers; compile best practices from successful vaccine trial sites.	
	Promote community engagement in TB vaccine trials.	Integrate community engagement into all Phase II or Phase III studies. Sponsors and developers should start developing plans for community engagement before Phase I studies start.	
Trial end-points	Define standardized PoD trial end-points that better capture the various TB disease states in diverse target populations.	Standardize the definition of laboratory-confirmed pulmonary TB; develop clinical end-points representative of subclinical TB if established as a substantial contributor to TB transmission; improve bacteriological confirmation of TB disease in neonates, infants and PLHIV; improve bacteriological confirmation of extrapulmonary TB.	8
	Define and develop better PoI trial end-points.	Define an end-point for Mtb infection for establishing PoI; this end-point should differentiate Mtb infection from vaccine-induced immune response.	
	Quantify the clinical translation of PoI into PoD.	Analyse existing and new observational data; include secondary PoI end-points in Phase III PoD trials, considering that this quantification may be different for different types of vaccines.	
Correlates of protection (CoPs)	Collect biospecimens for identifying CoPs.	In planned and ongoing Phase IIb and Phase III trials	800
	Identify CoPs for TB disease.	From Phase IIb and Phase III trials that have shown protection: analyse data and putative CoP values from individual trials and, if possible, from meta-analyses of several trials.	
	Validate CoPs for TB disease.	Validate putative CoPs identified by back-translation of trial results in terms of vaccine-induced response and clinical protection in immunogenicity studies, new trials with a clinical PoD end-point and potentially controlled human infection models. Validate identified CoPs in PLHIV to enable immuno-bridging studies.	
Trial harmonization and design	Harmonize clinical trial protocols.	Define an agnostic trial "shell" of standardized outcomes, inclusion criteria and measurements for clinical trials for different vaccine types. This would also address secondary end-points; inclusion criteria for people living with HIV infection or diabetes; and standardized measurements over time.	7

Priority 3: Advance candidates through clinical trials			
	Evaluate and develop new models for TB vaccine clinical trials with increased time- and cost-efficiency.	Phase I: explore innovative trial designs that provide information on the local human immune response. Phase IIb/III: efficacy trials within contact investigations, active case finding programmes and high-risk populations; adaptive trial designs for evaluating the safety, immunogenicity and efficacy of different vaccine types.	
Improve preclinical and clinical readouts.	Standardize reagents, harmonize assays and benchmark relevant signals by forward as well as back-translation/verification between preclinical and clinical.	Gather stakeholder input and come to a consensus on the path forward; continue to expand on programmes to provide reagents to laboratories and research facilities; develop necessary assays based on stakeholder consensus.	150

Table 12d. Priorities and actions to ensure public health impact: epidemiology and modelling

R&D Priority	Key Actions	Comments
Country-specific data and projections	Conduct in-depth country-specific value proposition analyses.	Assess value drivers for new TB vaccines across different countries and stakeholders, considering preferred delivery strategies; efficacy relative to safety; manufacturing, strain standardization and price; willingness to pay; and cost of delivery.
	Collect epidemiological data at country and subnational levels.	To inform economic and impact modelling related to country decisions on introduction of new TB vaccines and market volumes: collect data on prevalence of (sub)national TB disease and infection, including in specific risk groups; identify potential target groups for vaccination based on contribution to transmission; map *Mtb* genotypic variation.
	Conduct modelling to define vaccine development investment cases and country-specific vaccine use cases.	Model implementation scenarios, the epidemiological impact, cost-effectiveness and budget impact in consultation with countries for vaccines that are close to market introduction, using transmission and economic modelling as well as other quantitative approaches.
Post-licensure studies	Develop valid approaches for real-life vaccine scale-up studies.	Develop designs and validated tools for establishing real-world effectiveness, safety and public health impact following introduction; establish and/or support post-licensure registries making use of existing expertise from introduction of other vaccines; strengthen surveillance systems for collection of baseline epidemiological data.
	Conduct post-licensure evaluations of vaccine effectiveness, impact and safety.	Conduct real-world post-licensure studies and surveillance to establish effectiveness across various subpopulations (e.g., PLHIV) and Mtb lineages; effectiveness and safety when given concurrently with other vaccines; safety in subpopulations (e.g., pregnant women); impact on TB disease incidence; and non-specific health effects for vaccines replacing BCG.

Table 12e. Priorities and actions to ensure public health impact: research to ensure optimal implementation

R&D Priority	Key Actions	Comments

R&D Priority	Key Actions	Comments
Health system conditions for vaccine introduction	Define the generic public health system requirements to deliver a new TB vaccine.	For a vaccine for adolescents and adults: determine in different countries the feasibility of various strategies including vaccination campaigns; conditions for immunization programmes to implement these strategies; requirements for optimizing access for different population groups; integration of TB vaccination within and beyond NTPs; and approaches to measuring vaccine uptake in adolescents/adults. For a vaccine for neonates and infants: determine the fit within the Expanded Programme on Immunization and required timing with respect to other vaccinations.
	Conduct pre- and post-introduction assessments of country immunization programmes.	Assess the pre-introduction country-specific readiness of immunization programmes and health systems to handle, store and administer the new TB vaccine (considering its characteristics, particularly for delivery to adolescents and adults), to monitor vaccine coverage and adverse events, and to communicate adverse events.
Barriers and enablers of vaccine uptake	Assess drivers of acceptability and uptake of new TB vaccines in various settings.	Conduct social and behavioural research to determine across countries and settings the perceptions of decision-makers, the public and health workers on new vaccines, related to dosing, safety concerns, religious concerns, gender, use with other vaccines versus specialized programmes, and, for immunotherapeutic vaccines, integration with TB treatment.

Table 13. Priorities and actions with regard to enabling conditions for TB vaccine development

Enabling Priority	Actions
Funding	
Attract new investments in TB vaccine R&D.	Develop a comprehensive global value proposition for TB vaccines that encompasses vaccine characteristics, use case, societal value, business case, investment case, and health and micro/macro-economic impact assessment.
	Broaden the funding base with governments, charitable funders and donors. Mobilize domestic R&D funding from large countries' governments; get specific donors involved that could contribute to funding downstream aspects of TB vaccine R&D; engage with the HIV and AMR communities.
	Attract new entrants in TB vaccine R&D. Involve actors, technologies, models and knowledge from outside the TB vaccine research field; funders should promote such involvement in their funding programmes, e.g., in the specification of calls and eligibility criteria.
Innovate financing for TB vaccine R&D.	Create collaborations or partnerships for joint funding of trials with mechanisms for pooling resources between R&D funders, governments and industry; selection procedures that are product and country agnostic; and strict norms for what the funding will be used for and under what conditions.
	Customize calls to the clinical development pathway through options for flexible long-term funding (e.g., 10 years, with intermediate go/no-go decisions), enabling consortia to adopt a long-term R&D perspective for a specific candidate or approach.
Create mechanisms that attract investment in early stages of development.	Reduce commercial uncertainty by providing incentives for stronger engagement from industry and other vaccine developers through grant funding and advance market commitments with a clearly defined path to commercialization, including production of a successful candidate.
	Ensure that intellectual property can be used efficiently, openly and equitably to facilitate TB vaccine R&D in ways that promote collaboration among universities, biotech and pharmaceutical companies, and government funders.

Enabling Priority	Actions
Open science	
Promote timely and open access to data, specimens and results.	Funders and product-development partnerships (PDPs) should require registration of all animal and human studies, open access publication of both positive and negative results, data sharing and posting in open access databases as conditions for funding and/or consortium membership.
	Biospecimens collected in clinical studies should be made available based on peer review, overseen by an access committee. Access to biospecimens should not be granted on a first-come, first-served basis, but to researchers with the most innovative ideas and approaches.
	Establish publicly searchable patent databases for TB vaccine research (as exist for drug development) to promote the diffusion of knowledge by facilitating access to the information disclosed in a patent, including antigens, adjuvants, platforms and processes.
Create a mechanism for coordinating open science in TB.	Establish a platform for data sharing, starting with data from clinical studies, including generic protocols for contextual data (e.g., for what purpose the data were collected); proper use (e.g., ethical rules, privacy regulations); and acknowledgement of original collectors/contributors of the data in secondary use and publications.
	Develop and coordinate systems and procedures needed for efficient data and specimen-sharing across the field of TB research and across TB research funders.
Stakeholder engagement	
Create a supportive environment for TB vaccines.	Raise political commitment for new TB vaccines to ensure new political commitment at country level and continue high-level commitments, making sure that existing commitments and defined targets are met, based on clear communication to policy-makers about the need, efficacy and safety of new TB vaccines, including the risk–benefit and cost–benefit analyses of a new TB vaccine.
	Advocate for the development and uptake of new TB vaccines with vaccine developers and the public through positive messaging about opportunities and actions in vaccine development.
	Harmonize and fast-track regulatory review and local approval of vaccine trial protocols based on the example of AVAREF; establish National Immunization Technical Advisory Groups (NITAGs) in countries that do not have them and strengthen their capacity; fast-track regulatory approval of TB vaccines.
	Create innovative incentives by forecasting demand from countries and engaging multilateral funders, including Gavi, GFATM, Unitaid and CEPI, in offering novel financing mechanisms.
Overcome barriers to delivery and uptake.	Engage with end-user communities to address stigma, vaccine hesitancy and adherence; provide and communicate a convincing rationale for (high-risk) target groups to be vaccinated; involve end-user communities in the research process; build resilient information systems to counter vaccine-related misinformation and disinformation.
	Develop approaches to community-level delivery (e.g., through community health workers) to address gaps in access to vaccination; educate health care networks, the medical community and the general public about TB vaccine introduction through targeted, country-specific approaches.
Promote TB vaccine and research literacy.	Create a global programme for community engagement and training for new TB vaccines; develop mechanisms for engaging community representatives in TB vaccine development; engage and educate community representatives who can speak to policy-makers to invest in the development and introduction of new vaccines; support community engagement in TB vaccine clinical trials.
	Foster strategic and reciprocal partnerships between vaccine scientists/sponsors and representatives of civil society and TB-affected communities to support the involvement of all parties in advocacy for new TB vaccines.

The End TB Strategy calls for a new effective TB vaccine for use by 2025. It is likely that more than one vaccine will be necessary to meet the needs of different populations and different regions. This is possible if funding for new TB vaccine R&D is made available immediately, and if the scientific R&D process is fast-tracked using the same approaches used for COVID-19 vaccine development.

Scientific advances, particularly in the past five years, have demonstrated the feasibility of developing new vaccines to prevent TB infection and TB disease. These advances include positive results from two Phase IIb clinical trials. However, while these results were **published in 2018**, as of 2022 Phase III studies had not yet started, primarily due to chronically inadequate resources.

The successful development and licensure of at least one new TB vaccine by 2025 will require a transformation in the vaccine development pathway, including:

- accelerating clinical development pathways, including streamlining the design and reducing the duration of efficacy trials, while meeting regulatory requirements for licensure;
- developing animal models that reflect relevant human outcomes (i.e., resistance to infection) and are "fit-for-purpose" to prioritize vaccine candidates for human testing;
- evaluating novel vaccine technology platforms (e.g., mRNA) for TB and identifying human-protective antigens;
- developing innovative financing models and public–private partnerships that will enable the rapid development and deployment of vaccines once efficacy has been established;
- investing in scale-up of manufacturing and preparing the supply chain to ensure ample supply and rapid distribution of vaccines once licensed.

Roadmap for the R&D of new TB vaccines

In April 2021, the EDCTP and AIGHD launched a **Global roadmap for research and development of tuberculosis vaccines** (Global Roadmap). The Global Roadmap identifies key barriers to TB vaccine R&D and implementation, ways to overcome them, and a shared set of priorities to guide TB vaccine R&D activities. The Global Plan's strategic framework for TB vaccine R&D has been adapted to align with this Global Roadmap, and funding requirements were applied to these research priorities and activities. More details and information about these activities and priorities can be found in the Global Roadmap.

Recognizing that PLHIV are at high risk for TB infection and disease and that they tend to have a less robust immunological response to vaccination, a **Roadmap for developing TB vaccines for PLHIV** has been developed. This Roadmap seeks to accelerate development of TB vaccines for PLHIV by addressing gaps and unanswered questions regarding priority vaccine indications, clinical trial design, measures of safety, immunogenicity and efficacy considerations for PLHIV.

New diagnostics R&D

Vision: To ensure that all people with TB can access convenient, accurate and rapid TB diagnosis.

Goals:

1. Develop rapid, affordable tests for diagnosis or triage that do not rely on sputum and are used at the point of care.
2. Develop accurate DST for critical medicines, including through sequencing-based tests and strategies for early detection of resistance to the medicines used in regimens.
3. Improve tools for detecting TB infection (i.e., latent TB), subclinical TB and testing for risk of progression to active disease.
4. Develop and harness AI and machine learning-based tests.

Objectives:

1. Ensure expanded and equitable access to critical knowledge and resources that enable the development of new diagnostic tools.
2. Develop and evaluate a diverse portfolio of new tests and solutions.
3. Demonstrate patient benefit and predict impact within the entire health system.
4. Ensure that WHO-approved diagnostics are made available and appropriately used in relevant countries.

The last decade has seen a scaling up of automated diagnostic technologies that have been replacing sputum smear microscopy as the standard test in many parts of the world. The Global Plan calls for building on this progress to further develop and introduce the widespread use of diagnostics based on biomarkers such as urine, stool or blood that can work for all people (e.g., infants and children), for both pulmonary and extrapulmonary TB, and can be used wherever people seek and receive care (see Table 14).

To create a more enabling environment for implementing the new TB diagnostics strategic framework, in addition to new financing, developers need better access to biobanks, better access to data (including through open access arrangements), and stronger collaborations with academic research institutes. Public policy and regulatory environments that support the efficient approval and widespread uptake of new diagnostics would further help to create incentives for investment in new TB diagnostics R&D.

Table 14. R&D strategic framework for new TB diagnostics, 2023–2030

Objective	Milestone	Major Activities	Funding Required 2023–2030 (US$ million)

Objective	Milestone	Major Activities	Funding Required 2023–2030 (US$ million)
Objective 1			**417.15**
Ensure expanded and equitable access to critical knowledge and resources that enable the development of new diagnostic tools.	Increase access to reference materials and digital repositories that are critical for the discovery, development and validation of new TB diagnostics.	a. Facilitate sample storage and database maintenance within country of collection, reducing the need for import/export permits. b. Ensure that international biobanks and digital repositories collaborate and have centralized, open-access mechanisms and dashboards so requestors can obtain samples from anywhere. c. Promote the highest quality in biobanking and database curation to ensure global representativeness, relevance and integrity, in compliance with patient rights, data protection laws and FAIR Data Principles[1] .	62.54
	Integrate biomarker discovery and validation in well powered trials and studies collecting high-quality data.	Undertake research to identify and validate new non-sputum-based biomarkers and diagnostic concepts addressing high priority use cases, including paediatric TB, extrapulmonary TB, PLHIV, subclinical TB, preventing relapse, and to guide personalized medicine in TB.	316.40
	Support assessment of Mtb genetic variants to inform the development of molecular tests for the detection of DR-TB.	a. Expand the global knowledge base and repositories with genomic, phenotypic, and associated metadata from Mtb complex samples; review for quality and standardization. b. Support contributions of sequencing datasets by diverse groups (NTPs, academics, consortia, etc.) to expand and maintain a catalogue of mutations associated with resistance to anti-TB medicines that is updated periodically to ensure standardized and accurate interpretation of data.	16.00
	Undertake research and consultations to support the development of person-centred diagnostic tools and solutions.	a. Define patient charter/ethical criteria, and build consensus on appropriate patient data utilization and data protection protocols. b. Include end-users (people who have experienced TB, health workers, lab technicians, etc.) in the conceptualization, design, evaluation, and implementation of diagnostic tools and solutions, taking into account social and gender factors. c. Evaluate alternate, minimally invasive or non-invasive, easy-to-collect or self-collected specimen methods.	16.71
	Disseminate knowledge on diagnostic tools and solutions.	a. Develop clearer guidelines for validation studies for new diagnostics. b. Update target product profiles (TPPs). c. Develop and promote online country-specific platforms for knowledge-sharing on diagnostic development, ongoing accuracy trials, and implementation research, including massive online open courses (MOOCs) and in-country TB think tanks.	5.50

Objective	Milestone	Major Activities	Funding Required 2023–2030 (US$ million)
Objective 2			**1,6214.47**
Develop and evaluate a diverse portfolio of new tests and solutions.	Develop fit-for-purpose diagnostics for testing strategies addressing the major diagnostic gaps in TB.	Develop tests and solutions for the following: a. fast and affordable tests to determine risk of developing active TB disease in infected, at-risk populations; b. improved TB screening tools; c. simple and affordable POC diagnostics for TB detection in all people with TB, including those with extrapulmonary TB, PLHIV and children; d. new tools that are based on easy-to-obtain non-sputum samples; e. high-throughput centralized diagnostics; f. early detection of subclinical TB disease; g. detection of drug resistance, including both phenotypic DST and genotypic DST sequencing-based strategies; h. treatment monitoring and tests of cure; i. multi-disease platforms and tests to differentiate between pathogens, reduce antibiotic overuse, and improve self-isolation strategies; j. digital diagnostics for relevant use cases listed above.	848.93
	Conduct accuracy trials for new tests and evaluate their clinical performance in trials to guide global policy and country uptake.	Carry out accuracy trials and evaluation studies for tools a–j above.	612.54
	Ensure that any diagnostic is a connected diagnostic, so that surveillance, reporting and linkage to care is automated.	a. Support the development of standardized digital data collection tools suitable for multiple settings and transition away from paper-based data collection. b. Strengthen and centralize national TB surveillance systems using digital tools and applications. c. Incorporate connectivity elements such as digital readers/QR codes in the design of novel TB diagnostics to make the reporting of results digital. d. Improve the timeliness of reporting diagnostic results to patients using digital tools and applications.	160.00
Objective 3			**566.08**

Objective	Milestone	Major Activities	Funding Required 2023–2030 (US$ million)
Demonstrate patient benefit and predict impact within the entire health system.	Predict patient and health system impact from the use of new diagnostics and solutions to improve TB detection, reduce transmission and prevent mortality.	a. Demonstrate impact of new diagnostic tools on patient important outcomes, through pragmatic implementation trials in relevant countries and settings. b. Use diagnostic network optimization (DNO) and modelling to estimate the likely impact and cost-effectiveness of new technologies and innovative diagnostic strategies. c. Conduct qualitative studies on end-users' (people who have experienced TB, health workers, lab technicians, etc.) values and preferences, quality of care, and health system utilization.	549.08
	Conduct market analysis and estimate the potential of new diagnostics.	Update and expand existing market assessments.	4.00
	Work with companies and regulatory bodies to streamline the process of regulation, WHO prequalification, and national and international approval.	a. Conduct quality assurance and post-marketing surveillance. b. Support and streamline processes for WHO prequalification and national regulatory processes.	13.00
Objective 4			**5,115.12**
Ensure that WHO-approved diagnostics are made available and appropriately used in relevant countries.	Roll out tools and solutions, supporting transition away from smear microscopy for TB diagnosis.	Procure devices and consumables for the roll-out of WHO-approved molecular tools and innovative solutions (new and existing) for roll-out in high-burden countries.	4,158.00

Objective	Milestone	Major Activities	Funding Required 2023–2030 (US$ million)
	Effectively integrate diagnostic tools within the health system, including within the private sector.	a. Empower countries to develop fit-for-purpose models using DNO to optimize the placement and integration of diagnostic tools based on country contexts. b. Integrate TB diagnostic services with diagnostic services for communicable and non-communicable diseases. c. Incentivize the private sector, including pharmacies, medical clinics and hospitals, to use WHO-endorsed tools. d. Strengthen information technology (IT) capacity to implement more advanced diagnostic technologies that use AI. e. Strengthen laboratory capacity for appropriate scale-up of new tools via: i. training (coordination, development of tools, sessions, training supervisors, reference specimen transfer); ii. empowering in-country partners (e.g., supranational reference laboratories, centres of excellence) to support introduction of new tools in-country and promote operational research; iii. external quality assurance and accompanying measures for tools being used; iv. ongoing external and within-country assistance, including for supply management aspects.	526.50
	Ensure patient-centred diagnosis and decentralization of testing where appropriate.	a. Include people with TB in decision-making/policies regarding TB diagnostics. b. Develop patient-centred solutions for effective, rapid sample collection and transportation. c. Ensure that proper services are in place to link patients to care following their diagnosis.	48.00
	Support rapid policy change at the country level for implementation and facilitate in-country regulatory processes.	a. Support country-specific policy change and regulatory processes (local cost-effectiveness and validation studies). b. Harmonize regulatory processes in high-burden countries with stringent regulatory systems and with difficult markets to penetrate.	59.62
	Sensitize stakeholders on diagnostic uptake and national diagnostic algorithms.	Coordinate with advocacy groups and civil society to organize workshops with NTPs, ministries of health, technical procurement and funding agencies, medical associations (pharmacy, chest physicians etc.), and patient representatives.	35.00

Objective	Milestone	Major Activities	Funding Required 2023–2030 (US$ million)
	Scale up manufacturing and other market interventions to bring prices down.	a. Invest in commercialization and successful scale-up, including local diagnostic start-ups and companies to create lower cost, innovative diagnostic solutions. b. Support local manufacturers to improve scale-up. c. Conduct market interventions to reduce the price of diagnostic products (e.g., pool procurement mechanisms, advanced market commitment, volume guarantee, demand forecasting, demand generation, cost of goods sold [COGS], optimization, new channels, etc.).	264.00
	Expand next-generation sequencing (NGS) capacity in countries by 2030 and establish hubs for genomic drug resistance surveillance.	a. Build capacity and sustainable infrastructure, and provide training and support in genomics and bioinformatics to implement NGS approaches for genomic surveillance of DR-TB at the reference laboratory level. b. Reinforce the mechanism to use the supranational reference laboratory network and WHO collaborating centres as the main drivers to provide training, study guidance and long-term support.	24.00
TOTAL			**7,719.82**

New medicines R&D

Vision: Develop shorter, more effective, and safer medicines and regimens for all age groups and populations affected by TB.

Goals:

1. Introduce shorter treatment regimens (less than four months) for treating all forms of TB using three or four new medicines with no cross-resistance to existing medicines.
2. Introduce shorter regimens for TPT.

Objectives:

1. Sustain the pipeline through basic discovery for TB medicines.
2. Increase trial site capacity.
3. Introduce shorter regimens for DS-TB and, where appropriate, evaluate as potential universal regimens.
4. Develop a safe, higher efficacy and shorter (four-month) regimen for MDR-TB.
5. Improve TB treatment for children.
6. Develop a safer, high-efficacy regimen for TB infection.
7. Ensure adoption of new TB medicines and regimens at country level.
8. Engage community and civil society in the entire process of medicine development and access.

Currently available treatment regimens, while improved in recent years, still require several months of treatment with multiple antibiotics. Treatment regimens for active TB are long and complex both for people with TB and for health systems to administer. AMR is also a widespread challenge that is limiting the effectiveness of currently available regimens and will always be a looming risk factor for treatment regimens that are long and complex, as incomplete or inappropriate treatment accelerates the emergence of drug resistance.

To create a more enabling environment for implementing the new TB medicines strategic framework, developers need more financing mechanisms for advancing drug candidates from Phase I to Phase II trials without delays, more drug candidates brought together from diverse sources, and more consortia or collaborations that evaluate new regimens in late-stage clinical trials. Such consortia could play a key role in evaluating new regimens for their potential to serve as universal TB treatment regimens. Having better preclinical and translational models could help developers make better predictions about which early-stage drug candidates have the most potential for human benefit, reducing the time and costs of R&D by helping to better steer efforts towards the most promising candidates. Having more innovative financing mechanisms for funding distribution of new treatment regimens would help to create stronger incentives for investing in R&D for new TB medicines (see Table 15).

Table 15. New medicines R&D strategic framework

Objective	Milestone	Major Activities	Funding Required 2023–2030 (US$ million)
Sustain the pipeline through basic discovery for TB medicines.	Work towards one new clinical candidate entering Phase I each year.	Accelerate screening and optimization of new chemical entities; validate biomarkers of treatment outcomes; develop in vitro and animal models that are more predictive of clinical efficacy; identify new drug targets.	3,500
Increase trial site capacity.	Increase the number of Good Clinical Practice/Good Laboratory Practice (GCP/GLP) compliant sites available for TB drug trials.	Identify, maintain and develop new GCP/GLP compliant sites, including clinical trial sites, clinical laboratory, pharmacy, and biospecimen storage capacity.	900
Introduce shorter regimens for DS-TB and, where appropriate, evaluate as potential universal regimens.	Complete Phase III trials of a DS-TB regimen that is shorter than four months and assess regimens for all forms of active TB.	Conduct trials: pharmacokinetics studies, Phase I, Phase II (early bactericidal activity, serial sputum colony counting, drug-interaction studies), and Phase III to advance two to three new treatment-shortening regimens.	7,200
Develop a safe, higher efficacy and shorter (four-month) regimen for MDR-TB.	Complete Phase III trials of a shorter regimen for MDR-TB.	Conduct trials: pharmacokinetics studies, Phase I, Phase II, and Phase III to advance two to three new treatment-shortening regimens.	2,000
Improve TB treatment for children.	Complete formulation development and clinical testing in children.	Include children in trials as early as possible for new regimens; develop safe, reliable and user-friendly regimens for all forms of childhood TB early in the development process; conduct drug-interaction studies.	430
Develop a safer, high-efficacy regimen for TB infection.	Complete Phase III of a safer, high-efficacy regimen for TB infection.	Conduct Phase III trials of new regimens for TB infection with the aim of a shorter duration of treatment with high efficacy and safety.	330
Ensure adoption of new TB medicines and regimens at country level.	Enhance patient access to newly approved medicines and regimens, especially in high-burden countries.	Include new medicines and regimens in national policies and guidelines; implement mechanisms to expedite regulatory processes in countries; engage key stakeholders; conduct extensive training of health providers.	1,500
Engage community and civil society in the entire process of medicine development and access.	Recruit TB-affected community and civil society members to all decision-making processes and forums along the medicine discovery and development pipeline.	Include TB-affected community and civil society representatives, and specifically key and vulnerable populations, in advisory committees, protocol and study design, scientific networks and other forums related to TB drug development to ensure adequate medicine access.	200

Objective	Milestone	Major Activities	Funding Required 2023–2030 (US$ million)
TOTAL FUNDING REQUIRED			**16,060**

Meeting the unique needs of children and adolescents

Research efforts directed towards TB in children and adolescents have focused mostly on finding out how to better apply existing tools. However, children and adolescents have needs that differ from those of adults. For example, children have a hard time producing sputum, making them poor candidates for diagnosis using tests that require sputum collection (e.g., the rapid diagnostic test Xpert MTB/RIF).

Treatment Action Group and the Stop TB Partnership Child & Adolescent TB Working Group have laid out **a detailed agenda for child and adolescent TB R&D**. Priorities include the following:

Prevention: Identify new, shorter and simpler preventive regimens; develop a new vaccine for infants, children and adolescents that improves on the current BCG vaccine.

Diagnosis: Develop novel tests that are not invasive, do not rely on sputum, and can be used at the point of care.

Treatment: Evaluate the safety and efficacy of new TB medicines in children and adolescents to determine optimal dosing; identify treatment regimens that are shorter and simpler than those currently available; and ensure that TB treatment regimens are available in child-friendly formulations.

Basic science research: Research is needed to better understand how TB affects infants, children and adolescents, including the immune response to infection and associated biomarkers that can inform the development of new tools.

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1. Guiding principles that make data findable, accessible, interoperable and reusable (FAIR Data Principles)

INVEST AT LEAST US$ 800 MILLION ANNUALLY IN BASIC SCIENCE RESEARCH

Scientists still **do not fully understand** how *M. tuberculosis* causes infection.. Gaining this understanding would help drive innovation and enhance the ability to develop new tools to prevent, diagnose and treat TB.

Basic science research is typically conducted by academic institutions, industry and public–private partnerships, which rely largely on public funding. At least US$ 800 million is needed annually to advance TB basic science research. This is in addition to the US$ 4.18 billion needed annually to advance TB R&D pipelines. Investments in basic science research should be used for priorities such as:

- undertaking research to understand:
  - how TB infection progresses to disease
  - how to predict the risk and stages of disease progression based on biomarkers[1]
- how to more easily and reliably know when a person has been cured through treatment;
- R&D infrastructure, including biorepositories (i.e., facilities for collecting, storing, processing and distributing specimens used for scientific research);
- developing and sustaining a larger field of TB researchers;
- improving collaboration between researchers and research centres.

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1. LAM, discussed earlier in the chapter, is an example of a TB biomarker.

EXPAND THE USE OF OPERATIONAL RESEARCH

Operational research involves a wide range of research activities used to investigate strategies, interventions, tools and knowledge that can improve the performance of health systems and programmes. Despite improvements in recent years, large implementation gaps still exist in the delivery of TB care that is quality-assured and people-centred. Scaling up country-level capacity for operational research is essential to close those gaps and to reach universal access to TB prevention, diagnosis and treatment.

According to the WHO **Global strategy for tuberculosis research and innovation**, operational research is also necessary to understand how best to introduce and scale up new tools within various populations, and how best to combine medical care with social-service support in order to achieve the best treatment outcomes and better address the underlying factors that put people and communities at risk of TB.

Research funders should allocate specific funding for operational research, directing it as a priority towards initiatives that will build the evidence base for informing decisions that can close implementation gaps in LICs and MICs.

To be sustainable, operational research capacity needs to be more routinely embedded within NTPs, with dedicated operational research professionals and resources allocated through annual budgets.

Key priorities for operational research:

1. Understand how TB tools are used in local contexts, informing early-stage planning for the introduction of new tools in order to reduce delays between licensure and effective use.
2. Understand how to most efficiently and effectively conduct active case finding, an approach through which health systems proactively reach out to people at risk of TB and see that people receive screening, diagnosis, and appropriate care and support.
3. Improve access to treatment, care and psychosocial support, including assessing, monitoring and overcoming social, legal, political and economic barriers to access, for both DS- and DR-TB.
4. Improve access and equity for hard-to-reach populations in LICs and MICs, which is critical to achieving UHC.
5. Understand how public and private sectors can coordinate and collaborate to improve all aspects of accessing and delivering TB care and support.
6. Optimize TB infection control in order to reduce transmission.
7. Improve methods for conducting disease surveillance (including real-time digital surveillance), monitoring and evaluation of TB programmes.
8. Understand the role that TB-affected communities and TB survivors can play throughout and beyond the TB cascade of care, including in TB service delivery.
9. Improve understanding of approaches for strengthening community-level knowledge of TB and its underlying risk factors.

SORT IT

TDR—a joint effort by the United Nations Children's Fund (UNICEF), United Nations Development Programme (UNDP), the World Bank and WHO—provides a model for supporting the training of TB researchers who are working to improve TB care at the health systems level in LICs and MICs. Through the **Structured Operational Research and Training Initiative** (SORT IT)—a global operational research partnership led by TDR and implemented with over 60 partners—researchers are trained to conduct operational research according to country priorities (see, for example, impacts on operational research capacity **in Papua New Guinea and the Pacific Islands**), build sustainable operational research capacity, and make evidence-informed decisions for improving TB programme performance[1] . Participants perform classroom work, develop a research protocol and application for ethics review, receive training in data management and analysis, design a data analysis plan, write and submit a paper to a peer-reviewed journal, and acquire the skills and **tools for improved communication** of research findings (for research uptake) to policy-makers and stakeholders.

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1. SORT IT [website]. Geneva: World Health Organization **https://tdr.who.int/activities/tackling-antimicrobial-resistance/sort-it-operational-research-and-training**

DEVELOP AND IMPLEMENT DIGITAL TOOLS

Digital health refers to using a mix of digital technologies and software applications to transform health services. These tools can be applied to a wide range of health care issues, processes and functions in order to improve physical and mental well-being at the individual and population levels (see Table 16).

Scale up the use of digital health tools

Scaling up digital health has many potential benefits, including:

- making health services more efficient;
- reducing capacity constraints in the health workforce;
- reducing costs for health systems and for people;
- improving people's access to the health system;
- reducing health inequities;
- improving health outcomes and well-being.

Scaling up digital health, especially in LICs and MICs, would help to address staffing and resource constraints that have historically made it difficult both to deliver and to access TB care. Although access to the Internet, smartphones and other forms of technology is still relatively limited in LICs, mobile "feature" phones (i.e., phones that lack the advanced functionality of smartphones, but can make calls, send text messages, and access some simple Internet features through a text-based interface) are extremely common. These phones can be used for digital health.

COMMON TYPES OF DIGITAL HEALTH TOOLS

- **Electronic health records (EHR), also known as electronic patient records (EPR):** These are software solutions that replace paper records with digital records. They can also facilitate digital transactions.
- **Telecare, also known as telehealth:** This refers to the remote delivery of health care (e.g., consultation, treatment monitoring and support) using telecommunications technology.
- **Digital medical electronics:** These include a wide range of devices that can be used inside or outside of a person's body. Common applications include medical imaging (e.g., digital chest X-rays) and electronic sensors (including sensors that can be ingested or implanted to monitor bodily functions).
- **Mobile devices, services and apps:** These are solutions that monitor and share health information using mobile technology. Devices are wearable. Apps appear on mobile phones.
- **Health analytics and bioinformatics:** These use powerful computing technology to analyse large amounts of data. Health analytics tends to focus on helping health programme managers understand trends in real-time, which helps them make better decisions to improve health care delivery and better manage disease in a population. Bioinformatics uses technology to collect and analyse large quantities of biological data, such as genomic information.
- **Digital adherence tools:** These are digital tools that support people with TB to complete a full course of appropriate treatment in a people-centred way. Video chat can be used where video communication technology is available, and can be appropriately organized and operated by health care providers and people receiving care. Mobile technology can also be used, including text messages or telephone calls, to provide ongoing treatment adherence support.

If scaled up, the digital health tools that would be especially helpful for ending TB include:

- **Computer-aided detection**: CAD is an image-based diagnostic tool. CAD is powered by software that uses AI to read chest X-rays for signs of TB and provides an output that can be used for screening and triage.
- **Diagnostics connectivity solutions:** Diagnostics connectivity provides the ability for diagnostic instruments to remotely share data, enabling instant reporting of results to clinicians and databases, real-time epidemiological surveillance, and real-time monitoring of diagnostic supplies.
- **Telemedicine** connects TB specialists with people who need care for remote consultations and treatment monitoring and support.
- **Remote adherence technologies** support people with TB to complete treatment.

Table 16. Applications of digital health solutions at different levels of the health system.

<table>
<tr><th>Health system level</th><th colspan="3">Applications</th></tr>
<tr><td>Population health</td><td colspan="3">Disease surveillance and forecasting
Population health risk management
Intervention selection and targeting
Communicating health information to the public or key populations
Incentivizing people to seek health services</td></tr>
<tr><td rowspan="3">Individual health</td><td>Diagnosis</td><td>Treatment</td><td>Prevention</td></tr>
<tr><td>Image-based diagnosis
Whole genome sequencing
Screening and triage, including self-screening
Monitoring health or diagnostics data, including self-monitoring</td><td>Digital adherence support
Drug 3D printing
Personalized treatment
Telehealth</td><td>Identifying vaccine candidates
Predicting risk of disease progression</td></tr>
<tr><td colspan="3">Managing referrals between points of service
Providing health education content to people with TB and families</td></tr>
<tr><td>Health system</td><td colspan="3">Real-world, real-time data collection
Transmitting data/medical information to health care providers
Detecting drug resistance
Providing training content to health care providers
Capacity planning and management
Quality assurance Delivering supplies by drone</td></tr>
<tr><td>Pharmaceutical and insurance industries</td><td colspan="3">Drug discovery
Supply chain management
Monitoring inventories
Real-world evidence collection and analysis
Adaptive trial design
Remotely monitoring clinical trials</td></tr>
</table>

Provide guidance for scaling up implementation of digital health tools

TB programmes need to know what tools to procure and implement, where and how. They need to know how to prioritize, how to operationalize and how to optimize solutions. This is a complex undertaking that poses numerous challenges. Governments and technical agencies need to provide clear, up-to-date guidance for innovators, implementers and policy-makers to aid them in developing, operationalizing and providing an enabling environment for digital health.

As applications for digital health tools continue to expand, as access to information and communication technologies continue to grow in LICs and MICs, and as AI becomes more capable, operational research will continue to be essential in order to understand how best to apply digital tools to support people with TB and improve the quality of care. Concerns remain that digital technology has the potential to replace human contact, or even be misappropriated for uses that overstep the purposes of improving support and quality of care by violating people's rights to privacy and autonomy. Therefore, it will remain essential to seek input from people with TB and survivors in designing digital health applications. Adhering to ethical standards will also remain critical in navigating issues of privacy, oversight, accountability, public trust, data governance and management in the application of digital health tools.

Develop strategies for integrating digital health tools into NTPs

With effective guidance, NTPs would be better positioned to develop strategies for integrating digital health into their TB elimination efforts. These strategies are essential for prioritizing which tools to invest in and where, and for coordinating governments, innovators, implementers and end-users in the integration process.

Countries will have more technical resources that can be used for strategy development as WHO works to strengthen the evidence base for digital health in the fight against TB, evolves its guidance in line with advancements in digital health tools, provides technical assistance to countries, and supports digital health policy development.

CREATE A RESEARCH-ENABLING ENVIRONMENT

Accelerating TB R&D requires changes in the surrounding research environment that can enable major leaps in innovation. Enabling TB R&D requires improving:

- support and incentive structures for researchers, including in LICs and MICs;
- data-, information-, and sample/material-sharing practices;
- support for research centres and research collaborations;
- capacity to conduct clinical trials, especially in LICs and MICs;
- regulations and policies that underpin R&D and product approval;
- strengthening advocacy for TB innovation.

Develop and sustain a talented field of TB researchers

Ensuring long-term success in TB R&D will require nurturing and incentivizing researchers to focus their efforts on TB innovation, from basic science through to translational research and clinical trials.

Training the next generation of scientific investigators is a priority that has traditionally been supported by mechanisms such as Wellcome Trust fellowships, National Institutes of Health (NIH) support at the pre- and post-doctoral levels, and European Union funding. These initiatives are critical but insufficient to fill the void.

Both governmental and nongovernmental funders must recognize the urgent need to train and sustain the next generation of researchers, and special effort should be made to support and strengthen the capacity of researchers in high TB burden LICs and MICs. Support should include financial investment, proactive career support and career development activities, as well as additional opportunities for training, networking and presenting research in local, regional and global forums. These efforts should be particularly aimed at graduate, post-graduate (doctoral), and junior faculty early-career researchers. Two model initiatives are SORT IT for operational research (see Box above) and ADVANCE for HIV research (see Box below).

The COVID-19 pandemic has had multiple impacts on this collective investment in early-career TB researchers. First, resources in the form of grants and early research opportunities, which previously focused on TB and other infectious diseases, have been diverted to prioritize COVID-19 research. Many TB scientists were diverted to assist with COVID-19 solutions using TB research infrastructure, including access to human cohorts and nonhuman primates, clinical operations, supply chain for laboratory reagents, and biosafety level 3 facilities. Students considering careers in infectious disease research have also been attracted to study COVID-19 by its higher profile and the enormous resources since devoted to coronavirus research, making it even more challenging—and necessary—to recruit early trainees to study TB.

The lockdowns and travel restrictions imposed by COVID-19 and inequitable global vaccine access have also dramatically decreased access to conferences and networking opportunities for early-career investigators, impacting their ability to showcase their work to other investigators in the field, which would previously have led to collaborations and opportunities for employment and career advancement. The focus now should shift towards repurposing the expanded COVID-19 research infrastructure for other infectious diseases, particularly a high-priority respiratory disease such as TB.

ADVANCE

Supported by the United States Agency for International Development (USAID), ADVANCE (Accelerating the Development of Vaccines and New Technologies to Combat the AIDS Epidemic) is a multi-partner research initiative that increases the involvement of African and Indian researchers in all stages of HIV vaccine R&D[1] . New initiatives along the lines of SORT IT and ADVANCE, applied to TB basic science research and clinical research, would help to ensure the long-term capacity for innovation in all areas of TB research.

Support open science and information sharing

The **Global roadmap for research and development of tuberculosis vaccines** and the WHO **Global strategy for tuberculosis research and innovation** identify the importance of open science and information to the R&D process. The WHO Global Strategy notes that "Sharing high-quality data... fosters scientific progress, promotes discovery..., improves future data collection methods... and allows for the analysis of similar data from multiple sources, which can subsequently inform national and global policy-making in a cost-effective and timely manner". Key actions to promote open science identified in the Global Roadmap are outlined in Table 13.

Increase collaboration in the development of new tools

Table 17 provides examples of institutions, partnerships and collaborations that are key to accelerating the R&D of new TB tools. Each entity carries out its work through multisectoral collaboration. PDPs remain critical to advancing R&D for new TB tools. PDPs, a type of public–private partnership, are not-for-profit organisations that work through collaborations with private-sector manufacturers, governments, NGOs and academia, and typically pool resources and technical expertise to develop and commercialize new tools. PDPs are especially important for developing new TB tools because they combine the expertise and resources from multiple sectors and help to overcome weak market incentives for developing new tools.

Table 17. Key TB R&D entities

Entity	Model	Focus
TB Alliance	PDP	medicines/treatment regimens R&D
Foundation for Innovative New Diagnostics (**FIND**)	PDP	diagnostics R&D
International AIDS Vaccine Initiative (**IAVI**)	PDP	vaccines R&D
TB Vaccines Initiative (**TBVI**)	PDP	vaccines R&D
TB Trials Consortium	government consortium	clinical, laboratory, epidemiological research
AIDS Clinical Trials Group (**ACTG**)	network	TB-HIV clinical trials
Medicines Patent Pool	UN-associated organisation	licensing
BRICS TB Research Network	government network	basic research, R&D, clinical trials, operational research
EDCTP	partnership between non-profit, government and private sectors	R&D
UNITE4TB	government-sponsored consortium	treatment regimens Phase II clinical research
European Regimen Accelerator for TB (**ERA4TB**)	public–private partnership	medicines/treatment regimens R&D
Pan-African Consortium for the Evaluation of Antituberculosis Antibiotics (**PanACEA**)	government and EDCTP-sponsored consortium	treatment regimens clinical research

Entity	Model	Focus
PAN-TB	philanthropic–nonprofit–private-sector consortium	medicines/treatment regimens R&D
EU-PEARL	public–private partnership	clinical research platforms

Increase site capacity for conducting clinical trials in LICs and MICs

The most promising new tools for ending TB will be those that have been demonstrated to work well in countries and settings with the highest burden of TB. This requires the testing of new tools in the environments where they will be most widely used and will have the greatest impact. As new diagnostics, medicines and vaccines enter late-stage trials, investment in the development of trial site and laboratory capacity is becoming increasingly urgent. This includes investing in physical infrastructure to ensure that appropriate laboratory capacity is available for large-scale trials, and in human capacity and training to ensure that trials are conducted in accordance with **GCP, GLP** and **Good Participatory Practice** standards.

Clinical trial capacity must be developed and enhanced in multiple regions, as the efficacy of any new tool might vary across different populations and regions. A new tool's licensure and acceptance for use can also be affected by where it was tested.

Existing clinical trial sites should be used for TB research wherever possible. Sites should be developed with the aim of sustaining their capacity over the long term, providing continued opportunities for trained staff, and utilizing the developed infrastructure for other disease areas.

Barriers to conducting trials in LICs and MICs include:

- a lack of financial and human resources
- ethical and regulatory system obstacles
- lack of physical research infrastructure
- operational barriers
- competing demands.

Addressing these challenges requires steps to be taken together:

- LIC and MIC governments should invest in strengthening domestic research capacities.
- All partners should work together to strengthen international collaboration with the aim of improving or creating new systems for conducting clinical trials in LICs and MICs.
- Research funders should promote investigator-driven research by local researchers in LICs and MICs.
- Research organisations should strengthen their engagement of affected communities in trial design and execution as laid out in the **Good Participatory Practice: guidelines for TB drug trials** and the **Good Participatory Practice: guidelines for TB vaccine research 2017** .

Ensure an efficient and predictable regulatory and policy environment

A frequent obstacle to accessing new tools is the lack of transparency in the national registration process. When registering medicines, for example, there is often no forum for interaction between the drug sponsor applicant, regulatory authorities, and communities. The present lack of regulatory harmonization has resulted in staggered, country-by-country approval procedures for new tools, resulting in deadly delays.

Country governments should build their capacity to evaluate new tools that have already been tested in other countries, allowing those that are shown to be safe and effective to be imported for use. WHO-issued guidance can support and expedite country policy-setting and adoption of new tools, particularly in countries without rapid regulatory processes. One other potential solution is to help expedite TB research by streamlining and harmonizing regulatory processes from clinical development to regulatory submission and regional approval.

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1. Accelerating the development of vaccines and new technologies to combat the AIDS epidemic (ADVANCE). Washington, DC: USAID; 2016 **https://www.usaid.gov/sites/default/files/documents/1864/USAID-ADVANCE-Brief2-508.pdf**

APPLY ACCESS PRINCIPLES IN ROLLING OUT AND OPTIMIZING THE USE OF NEW TOOLS

Any time lost between the licensure of a new tool and people in need being able to use it leads to unnecessary suffering and loss of life. With proper planning and a strategic, evidence-based approach to access and optimization of use, people can get the most value and benefit from new tools. The following section lays out activities that national governments should undertake to scale up access and understand the most effective ways of deploying new tools within the health system.

The Universal Declaration of Human Rights, the **International Covenant on Economic, Social and Cultural Rights**, and the **Declaration of the Rights of People Affected by Tuberculosis** uphold the rights of people to enjoy the benefits of scientific progress and its applications. In keeping with these rights, the accessibility of new TB tools needs to be considered from the outset of the R&D process.

The accessibility of new tools is intimately tied to how R&D is financed and conducted, including incentive strategies, policies of research funders, governance of research institutions, and the values, norms and standards that guide R&D. As the **UN Political Declaration on TB** states, TB R&D should be "needs-driven, evidence-based, and guided by the principles of affordability, effectiveness, efficiency and equity". These principles should guide R&D from the earliest point in the process.

While there has been progress in important areas, TB R&D has long been underfunded. Given TB's public health significance as an airborne communicable disease that is responsible for more deaths than any other single infectious agent, where discrimination is both a cause and a consequence of the disease, and where large numbers of people in poor and marginalized populations are chiefly affected, states have an obligation to promote the development of new diagnostics, treatment regimens and vaccines, including through robust international cooperation, and to ensure access for all.

The **right to health** includes the **availability, accessibility, acceptability and quality** of health-related goods and services, where:

- availability requires making health goods and services available in sufficient quantity;
- accessibility involves four elements, all of which require attention to how goods and services impact key populations: non-discrimination, physical accessibility, affordability and access to information;
- acceptability requires all health facilities, goods and services to be respectful of medical ethics and culturally appropriate, sensitive to sex and lifecycle requirements, and designed to respect confidentiality, while improving the health status of people;
- quality requires goods and services to be scientifically and medically appropriate and of good quality.

It is essential that all stakeholders involved in promoting and carrying out TB R&D design and implement their activities in ways that respect, protect and ensure these rights-based principles at every stage of the R&D process, including the delivery of new tools.

APPLY BEST PRACTICES IN COMMUNITY ENGAGEMENT THROUGHOUT THE R&D PROCESS

Researchers and research institutions must embrace the involvement of communities as a standard part of the R&D process. Best practices should be followed for engaging TB-affected communities within all research activities and within decision-making bodies and forums. The **International ethical guidelines for health-related research involving humans** establishes universal principles for engaging communities in research activities, advising that:

"Researchers, sponsors, health authorities and relevant institutions should engage potential participants and communities in a meaningful participatory process that involves them in an early and sustained manner in the design, development, implementation, design of the informed consent process and monitoring of research, and in the dissemination of its results."

Specifically related to TB, research institutions should consult the **Good Participatory Practice: guidelines for TB vaccine research** and **Good Participatory Practice: guidelines for TB drug trials**, which help to facilitate effective engagement with affected communities and stakeholders at all stages of the research process.

Engaging communities in research also fulfills a key guideline in the WHO **Ethics guidance for the implementation of the End TB Strategy**: "Community members should have the opportunity to participate in research beyond their role as potential trial participants. This participation should extend throughout each stage of the research process, from the design and conduct of studies to the dissemination of results."

Community participants should be from the geographical area where the research is being conducted. They can be a subpopulation among the participants recruited and can include groups within the broader society who have a stake in the outcomes of the research. Key and vulnerable populations are discussed in Chapter 7.

These groups must be engaged and their capacity strengthened as a priority in all aspects of research activities. Community engagement must be human rights-based, gender-sensitive and people-centred.

Communities should be consulted early in the research process, before a study is even initiated, to inform the research design. Community engagement should then remain ongoing through established modes of communication between researchers and community members.

Engaging with communities in all aspects of R&D also creates new groups of informed people who can advocate for TB R&D. People affected by TB, particularly TB survivors, must be engaged as experts in this space.

TB-affected communities can play a key role in monitoring the outputs of research, helping to ensure that the benefits of scientific progress are accessible to all people, free from stigma and discrimination, irrespective of how they individually identify or where they live. TB-affected communities can also champion enhanced research on the successes and benefits of TB community-based service delivery, advocacy and monitoring for social accountability.

Community advocates play a critical role in research. They are uniquely placed to document, monitor and analyse the intersectionality between social determinants of health and effective TB responses. Their increased engagement stems from community demands for self-determination and meaningful participation in the TB response.

MODELS OF COMMUNITY ENGAGEMENT IN RESEARCH

Community advisory boards (CABs): **Research entities can establish CABs** to ensure that community voices, needs and priorities are reflected at each stage of the research process, from designing studies and conducting trials to disseminating results and working to translate results into policy change.

Community-based participatory research (CBPR): In the CBPR model, community members and researchers collaborate on all aspects of a research project, and community members work with scientists as equal partners. The CBPR model is grounded in principles of collaborative and equitable community engagement in research and shared ownership of research issues, processes and products.

STRENGTHEN ADVOCACY FOR TB R&D

Implementing the priority actions above will only be possible with powerful advocacy. Informed by the Global Plan and the WHO Global Strategy for TB Research and Innovation, TB researchers, civil society, affected communities and survivors must work together to advocate for R&D funding, for the actions that contribute to a research-enabling environment, and for equitable access to the products and benefits created through innovation.

Priorities for strengthening advocacy for TB R&D include improving research literacy among the advocacy community, deepening the research community's involvement in advocacy, and strengthening collaboration between researchers and advocates.

Improve scientific literacy among the advocacy community

Research literacy means understanding and being able to effectively communicate key concepts, processes and goals being pursued in TB R&D. Wherever research literacy is lacking, TB advocates will be limited in their capacity to effect change.

Better research literacy training opportunities and supporting tools need to be developed and made accessible for advocates across civil society. These should support advocates in three areas:

- developing an understanding of key concepts in TB R&D, so they can effectively track developments in TB R&D;
- developing skills to communicate about TB R&D issues, so they can translate R&D priorities into effective messages;
- understanding the landscape of the TB R&D community (i.e., research institutions, policy-making processes, regulatory bodies), so they can identify and pursue effective advocacy strategies.

Deepen the research community's involvement in advocacy

Likewise, advocacy funders and research institutions should support initiatives that support researchers to become more effective advocates for the TB R&D agenda. Scientists can not only speak credibly on new research findings, but also have important insights into barriers and opportunities in TB innovation. There are challenges, however, that need to be overcome to involve researchers in advocacy, particularly when it comes to communications habits and the ability to navigate the advocacy landscape. Priorities for deepening the research community's involvement in advocacy include:

- providing more advocacy and strategic communications training opportunities for TB researchers;
- strengthening relationships with TB advocates and coalitions;
- elevating the visibility of TB research among key stakeholders.

Scientific researchers are typically trained to communicate with other scientists, creating challenges when it comes to communicating with advocates, policy-makers, the news media and other stakeholders who are not scientists. This communications gap can create a significant barrier for advocacy, undermining progress in TB R&D.

Research scientists have also typically not been trained in advocacy strategy and tactics and lack familiarity with the advocacy landscape. It can be difficult for members of the research community to know where or how to become involved in advocacy, even if they want to.

However, with larger cadres of advocacy-savvy TB researchers, advocacy organisations can find more opportunities to enroll researchers in advocacy campaigns and policy-maker outreach. Research studies and key insights from the research community can be routinely shared with advocates, who can help translate findings and recommendations into advocacy messages to share important studies with decision-makers and key influencers such as the news media.

Better advocacy training opportunities and supporting tools need to be developed and made accessible for members of the R&D community. These should support researchers in four areas:

- developing knowledge of common advocacy strategies and tactics;
- building strategic communications skills, such as media training, op-ed writing and public speaking;
- translating research findings and insights into action and impact;
- building collaborative relationships with professional TB advocates and advocacy coalitions.

Strengthen collaboration between researchers and advocates

Researchers and advocates can both become more effective when they work together. When advocates build science-literacy skills and when researchers develop strong advocacy skills, it equips both to communicate with each other and work more effectively together.

Advocates are well placed to help build greater visibility around important research studies and scientific advances, because advocates maintain relationships with journalists, policy-makers and organizational leaders. Likewise, researchers can add value to advocacy efforts by providing expert scientific perspectives that complement the policy knowledge and lived experience of advocates and affected communities.

To work together effectively, researchers and advocates need to communicate early and often. When researchers communicate proactively with advocates about their work—such as by alerting advocates in advance of new studies being published—they provide advocates with new information they can use to earn media coverage, publish op-eds, engage grassroots campaign networks, or secure meetings with decision-makers—all of which are essential to advocating for resources and policies needed to accelerate the development of new TB tools. To enable regular communication, advocates and members of affected communities should be included in research decision-making structures and scientific forums.

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RESOURCE NEEDS, RETURN ON INVESTMENT, AND COST OF INACTION

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PRIORITY ACTIONS

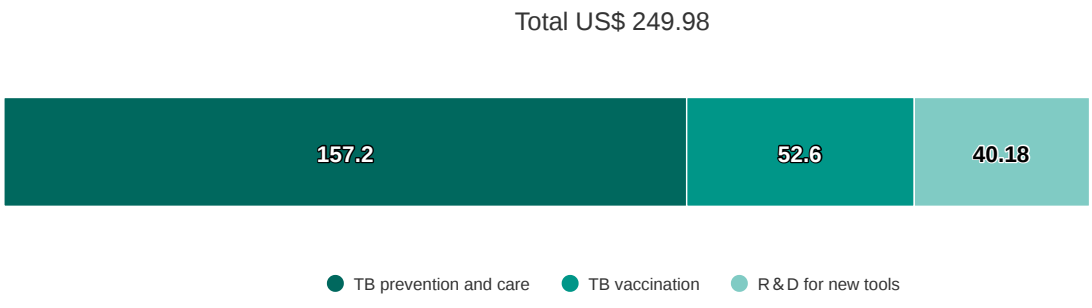
- Mobilize US$ 209.8 billion in funding between 2023 and 2030 for TB care and prevention, of which US$ 52.6 billion is for vaccination once a new vaccine is available. Resources needed for care and prevention excluding vaccination total US$ 157.2 billion, which averages to US$ 19.65 billion per year.
- Mobilize US$ 40.18 billion in funding between 2023 and 2030 for TB R&D and basic science research.
- Diversify the funding base for TB implementation and R&D.
- Mobilize resources through stronger TB advocacy and strategic communications.

New modelling has been conducted that projects the costs of implementing interventions at the scale needed to end TB by 2030. Modellers costed 54 interventions, each with an annual unit cost in US dollars. The costing model includes interventions using tools available as of 2022, plus new tools that are projected to be introduced and have a significant impact on TB trends. In a key change from previous Global Plans, the model includes the cost of diagnosing subclinical TB at scale, as well as the cost of implementing a new effective vaccine.

The costing methodology for this Global Plan improves on the methodology used in previous Global Plans. Internationally recommended normative approaches to TB prevention and care have been costed using unit costs derived from the "ValueTB" database, literature review, GDF Catalogs, and expert opinion. Using WHO data, programme-level and health systems costs have also been used. Finally, enablers have been costed by using mark-up percentages mainly derived from best-practice country budgets. (See Annex 1 for details of the costing methodology and data sources.)

The total resource needs for implementing the Global Plan are US$ 249.98 billion (Figure 12).

Figure 12. Resources needed to implement the Global Plan, 2023–2030 (in US$ billion)



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MOBILIZE US$ 209.8 BILLION IN FUNDING BETWEEN 2023 AND 2030 FOR TB CARE AND PREVENTION, OF WHICH US$ 52.6 BILLION IS FOR VACCINATION ONCE A NEW VACCINE IS AVAILABLE

The resources needed for care and prevention excluding vaccination total US$ 157.2 billion, which averages to US$ 19.65 billion per year.

The Global Plan urges TB programmes, with the support of their governments, to plan programme budgets in line with the full expression of need for TB interventions and R&D, aligned with the global goal to end TB by 2030.

An average of US$ 26.2 billion is needed per year to scale up TB care and prevention from 2023 through 2030, totalling US$ 209.8 billion from 2023 through 2030 (Table 19). This does not include the resources needed to accelerate TB R&D (see below for R&D resource needs).

Major cost categories include scaling up TB diagnosis, treatment and prevention, and the implementation of a new TB vaccine in 2026. These interventions will need to be supported by activities required to strengthen health systems and fund enablers, along with associated programme costs. Diagnosis, treatment and vaccination costs are direct costs for providing TB services at the health facility level. Programme costs are additional costs that are necessary for administering NTPs. Enabling activities include:

- direct patient support
- advocacy and communications
- CRG interventions
- PPM activities.

Global TB care and prevention costs for all cost categories excluding vaccination are projected to average US$ 19.65 billion per year, totalling US$ 157.2 billion (Figure 13). Global costs to implement a new vaccine are projected to average US$ 13.15 billion annually from 2027 through 2030, totaling US$ 52.6 billion (Figure 14). Out of the total resource needs for enablers, USD$ 6.6 billion is needed for investments in CRG interventions.

Figure 13. Resources needed for scaling up TB care and prevention interventions and enablers, excluding resources needed to roll out and scale up vaccination with new TB vaccines, 2023–2030 (in US$ billion)

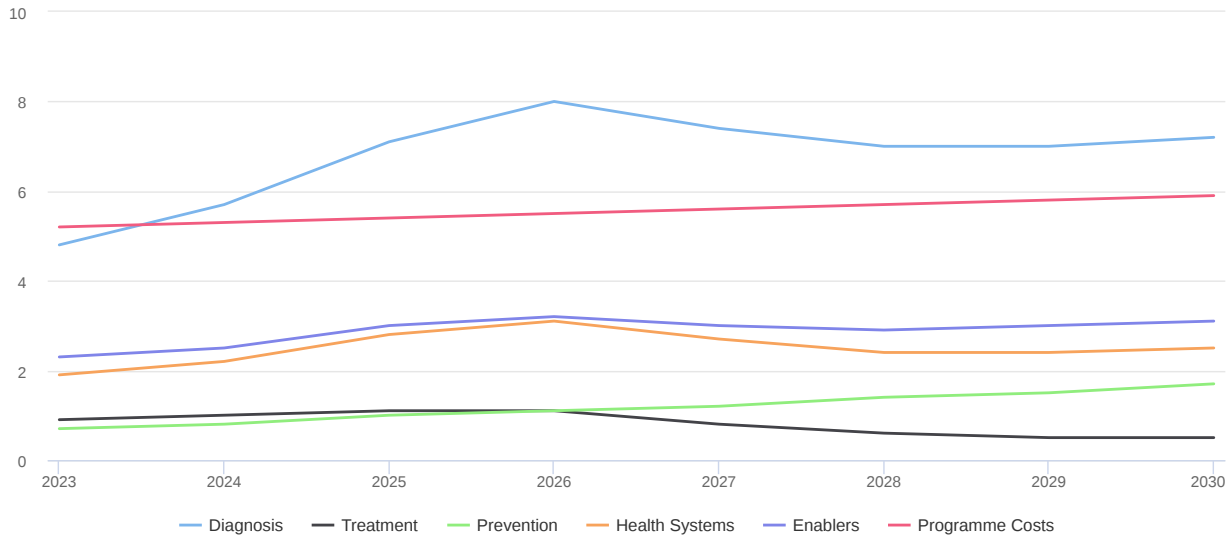


Figure 14. Cumulative resources needed for scaling up TB care and prevention, 2023–2030 (in US$ billion)

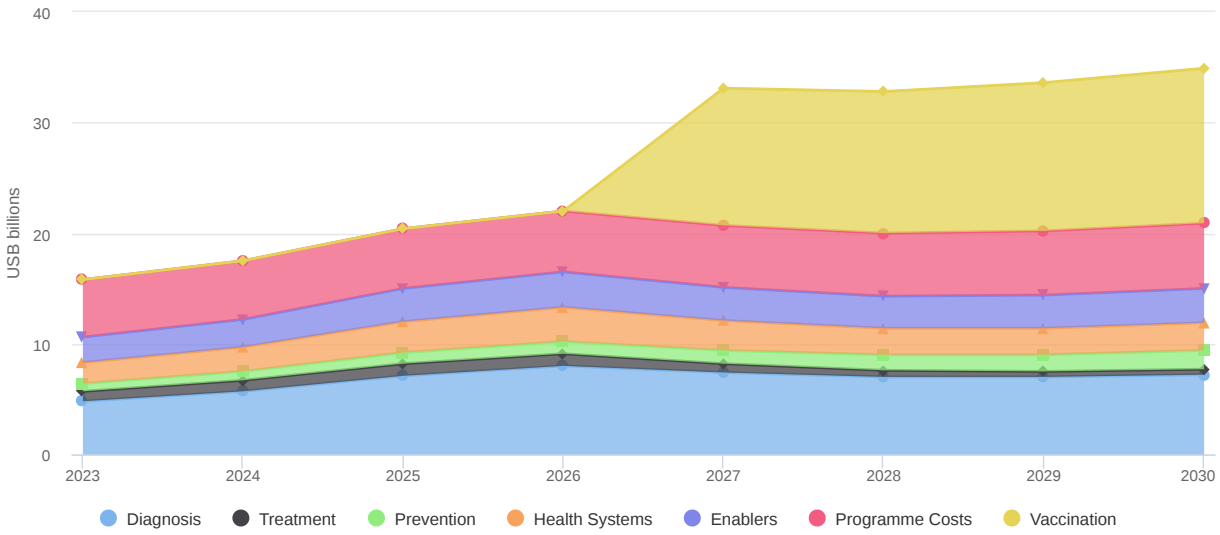


Table 19 shows the annual and total financing needs to implement the Global Plan, not including the costs of R&D. In Table 19 and Figure 15, costs are broken down based on various country categories, including income status, GFATM eligibility status, epidemiological context, WHO Region and BRICS membership. As the figures show, resource needs are required to increase from around US$ 15.7 billion per year in 2023 to US$ 34.9 billion per year. A significant increase in the funding required from 2027 onwards anticipates the need to support large-scale implementation of a new TB vaccine.

As shown in Table 18, scaling up diagnosis involves the greatest cost, followed by vaccination in later years of the Global Plan, once vaccines become available for use. Resources needed for health systems should support interventions based on country context. These resources might not be allocated through TB programme budgets, especially in settings where TB programmes are more fully integrated into the broader health system. See Annex 1 for details on what interventions are included in these cost categories.

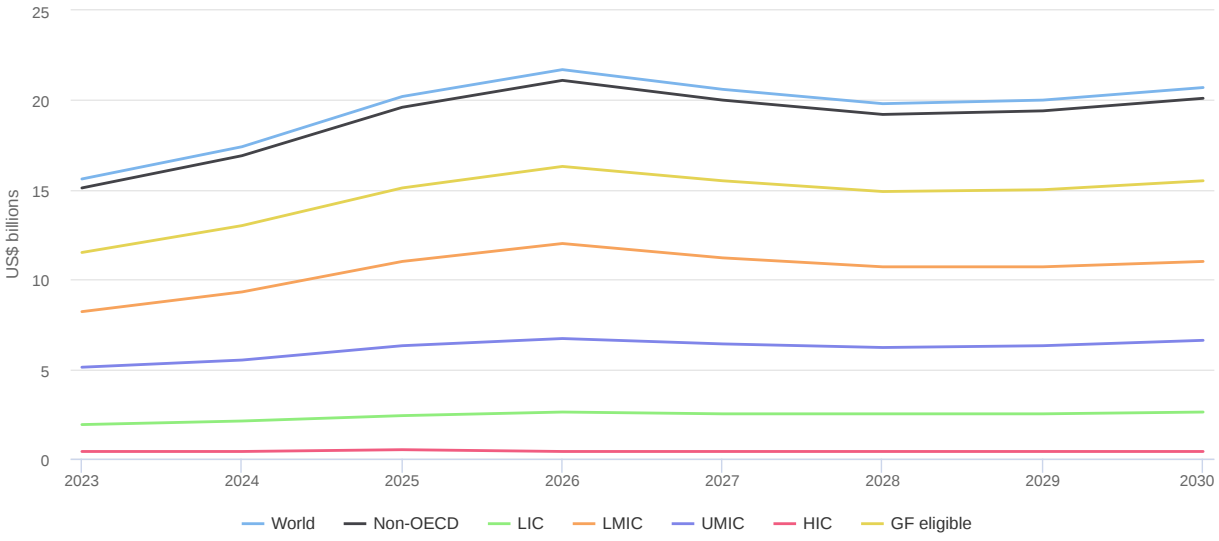
Table 18. Resource needs by cost category (US$ billions)

	2023	2024	2025	2026	2027	2028	2029	2030	Total
Diagnosis	4.8	5.7	7.1	8.0	7.4	7.0	7.0	7.2	54.1
Treatment	0.9	1.0	1.1	1.1	0.8	0.6	0.5	0.5	6.5
Prevention	0.7	0.8	1.0	1.1	1.2	1.4	1.5	1.7	9.3
Vaccination	0.0	0.0	0.0	0.0	12.4	12.8	13.4	14.0	52.6
Health Systems	1.9	2.2	2.8	3.1	2.7	2.4	2.4	2.5	20.0
Enablers	2.3	2.5	3.0	3.2	3.0	2.9	3.0	3.1	22.9
Programme Costs	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	44.4
Total	**15.7**	**17.6**	**20.3**	**21.9**	**33.1**	**32.8**	**33.6**	**34.9**	**209.8**

Table 19. Resource needs by income status, GFATM eligibility, Global Plan country group, WHO Region and BRICS membership (in US$ billions)

Country category	2023	2024	2025	2026	2027	2028	2029	2030	Total
GLOBAL TOTAL									
Total (Global, including OECD countries	15.7	17.6	20.3	21.9	33.1	32.8	33.6	34.9	209.8
Total (Global, excluding OECD countries)	15.2	17.0	19.7	21.2	30.3	30.0	30.6	31.8	195.9
BY INCOME STATUS									
Low income	1.8	2.1	2.3	2.5	3.5	3.6	3.7	3.9	23.4
Lower middle income	8.5	9.7	11.4	12.5	16.7	16.4	16.7	17.3	109.1
Upper middle income	4.9	5.3	6.0	6.4	10.4	10.4	10.7	11.1	65.2
High income	0.4	0.5	0.5	0.5	2.4	2.4	2.6	2.7	12.1
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	1.8	2.1	2.3	2.5	3.5	3.6	3.7	3.9	23.4
Lower middle income	8.5	9.7	11.4	12.5	16.7	16.4	16.6	17.2	109.0
Upper middle income	1.5	1.6	1.8	1.8	2.4	2.4	2.4	2.5	16.4
Total	11.8	13.3	15.5	16.8	22.6	22.3	22.7	23.6	148.7
WHO REGION									
Eastern Mediterranean	0.8	0.8	1.0	1.1	2.1	2.1	2.2	2.3	12.3
Africa	4.7	5.2	6.0	6.8	8.4	8.5	8.8	9.2	57.6
Americas	0.8	0.8	0.9	1.0	2.6	2.6	2.7	2.9	14.4
Europe	1.5	1.4	1.4	1.3	2.8	2.8	2.9	3.0	17.2
Western Pacific	3.1	3.5	4.1	4.4	7.3	7.2	7.4	7.7	44.6
South-East Asia	4.9	5.7	6.8	7.3	9.9	9.6	9.6	9.9	63.8
BRICS									
Total	6.8	7.5	8.6	9.3	14.0	13.7	13.9	14.3	88.1

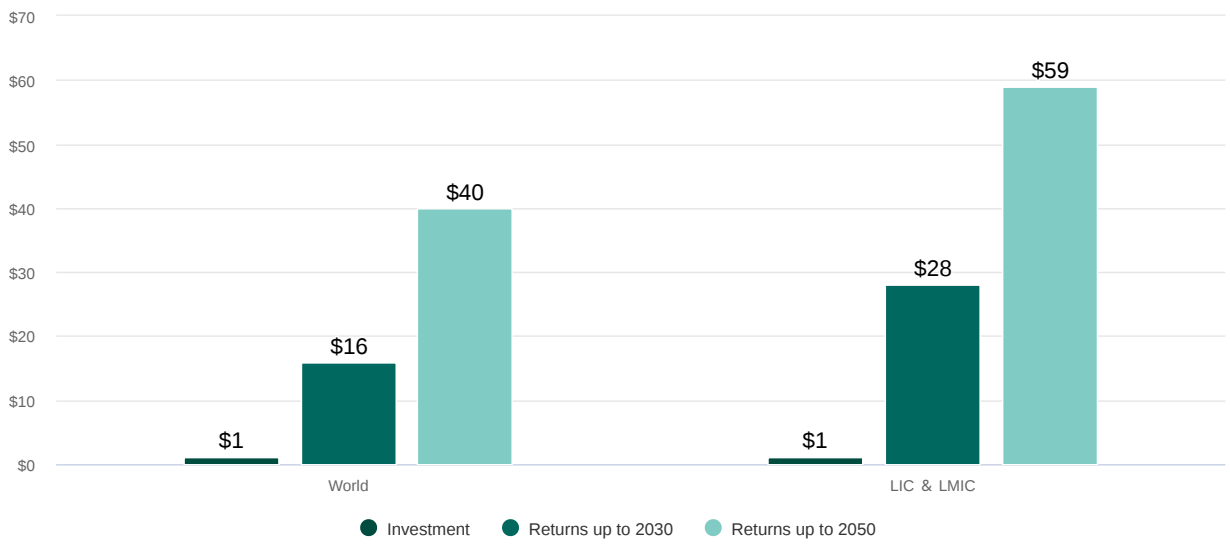
Figure 15. Resources needed for scaling up TB care and prevention by country category, 2023–2030 (US$ billions)



Return on investment (ROI)

Investing in the TB response provides a global public good. In fact, the work to end TB yields one of the best ROIs among all of the SDG targets. Fully implementing the Global Plan will yield an ROI of US$ 40 per dollar invested, accounting for economic returns projected to accrue through 2050. LICs and MICs will see an even greater return, with US$ 59 in economic benefits for every dollar invested (Figure 16). The rationale for projecting ROI through 2050 is to account for the long-term projected economic returns of the mass TB screening and vaccination campaigns that the Global Plan recommends be implemented between 2023 and 2030.

Figure 16. ROI in TB prevention and care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World
LIC & LMIC
Investment
Returns up to 2030
Returns up to 2050

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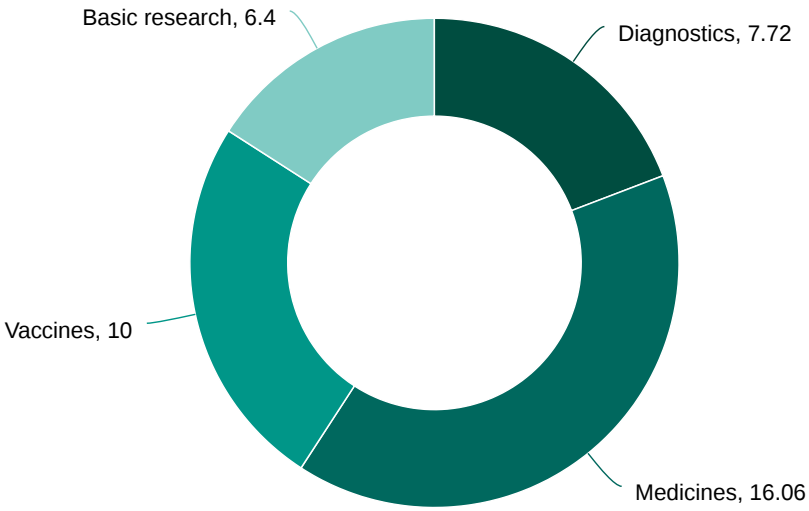
MOBILIZE US$ 40.18 BILLION IN FUNDING FOR TB BETWEEN 2023 AND 2030 FOR TB R&D AND BASIC SCIENCE RESEARCH

The Global Plan's modelling shows that innovation is essential to eliminating TB. Existing tools will have a diminishing impact after 2025 and will no longer be sufficient to bend the incidence curve steeply enough to end the epidemic by 2030.

As Chapter 8 details, R&D of new TB medicines, diagnostics and vaccines is projected to require US$ 33.78 billion from 2023 to 2030 in order to end TB. Basic science research will require at least an additional US$ 6.40 billion (Figure 17).

Figure 17. Resource needs for R&D (in US$ billion)



The human and economic costs of TB only increase every day the epidemic continues. It is crucial to immediately increase investment in new diagnostics, treatment regimens and vaccines in order to avoid these costs. Even if current interventions were fully implemented, a four-year delay in investments in R&D for new tools would still result in millions of additional TB deaths and billions of dollars in additional treatment costs alone (see "Cost of inaction" below).

The **massive gap in financing for TB R&D** puts at risk the whole effort to eliminate TB. In 2020, total TB R&D investment was less than half of the US$ 2 billion governments committed to mobilizing that year. This shortfall forced researchers to delay or even halt the advancement of promising candidates and extend research timelines, stifling the creativity, innovation and experimentation needed for the development of new diagnostics, medicines and vaccines. Crucially, the limited resources available for TB research have created disincentives for researchers to enter or stay in the field.

Governments, philanthropic donors (particularly the Bill & Melinda Gates Foundation), and some pharmaceutical industry partners have provided essential funding for TB R&D. In mobilizing new resources, the priority is to keep current TB R&D partners and funders engaged, while diversifying the funding base with new donors, investors and private-sector actors.

When it comes to allocating resources, the complexities, costs and risks of TB R&D will require multiple funding platforms and a combination of "push" and "pull" mechanisms. Push mechanisms, such as traditional grants, finance R&D activities up front, reducing the risk to researchers and developers. Pull mechanisms incentivize private-sector investment in R&D.

The BRICS countries—countries that account for nearly half of the world's TB incidence and have substantial research infrastructure and capacity—have the power to inject significant new resources into the BRICS TB Research Network. Other partners, such as the **EDCTP** and the Japan-based **Global Health Innovative Technology Fund**, should be further strengthened to increase their capacity for supporting TB R&D. There is opportunity to coordinate efforts strategically among R&D partners globally, with the aim of advancing TB R&D objectives. For example, partners should explore building on the success of pooled funds and replicating the approach for TB R&D.

Given the need to greatly increase funding for TB R&D, the potential for a TB R&D fund that brings together multiple donors or entities to pool funding, coordinate efforts and resources, and share risks must also be fully explored. An ad hoc expert group convened by Stop TB Partnership will be a valuable first step in addressing the desirability, feasibility, institutional mechanism and scope of such a fund.

A "FAIR SHARES" FRAMEWORK FOR CLOSING THE TB R&D FUNDING GAP

In the 2018 UN Political Declaration on TB, governments committed to closing the TB R&D funding gap by "ensuring that all countries contribute appropriately to R&D". One approach to ensuring that all countries contribute appropriately is to establish an expectation that countries with the greatest capacity to invest and countries with the most benefit to gain from new TB tools each devote an equal proportion or "**fair share**" of their total gross domestic expenditures on R&D (GERD) to TB R&D. The TB R&D funding gap could be closed quickly and equitably if governments followed this approach. In 2020, only one government—the United Kingdom—invested more than 0.1% of its GERD in TB R&D, meaning that governments have substantial room to increase funding for TB R&D within the context of their overall R&D expenditures.

TB R&D INNOVATIVE FINANCING PARTNERS

Unitaid

Unitaid is one of the largest sources of innovative financing for TB R&D. Unitaid funds late-stage development TB medicines and diagnostics, is an important source of funding for R&D for paediatric TB, and addresses market barriers to accelerate the introduction of new tools. Unitaid is also one of the world's largest funders of TB operational research. The main source of Unitaid's initial funding came from a small tax on airline tickets purchased in 10 countries[1] .

a4i

The Stop TB Partnership's Accelerator for Impact (a4i) is a public-sector blended finance impact investment fund to support the next generation of people-centred innovations for TB and global health. The fund focuses on:

1. pivoting the TB care model to become more digitalized, virtual and on-demand in order to make it as convenient as possible for people to access and receive quality, affordable care;
2. catalysing the rapid roll-out of new TB and global health innovations;
3. unlocking new funding and capital from both public- and private-sector investors.

The cost of inaction

One way to conceptualize the importance of upfront investment in new tools is to estimate the cost of inaction[2] . In other words, what will the negative consequences be if the world fails to fully fund implementation of the Global Plan?

Using even conservative assumptions, the estimated cost of inaction would be tremendous (Figure 18). Over eight years (2023–2030), the total cost of inaction is expected to result in an additional 43 million people developing TB, with 6.6 million additional TB deaths and a global economic cost of US$ 1 trillion. Humanity would lose a projected 234 million disability-adjusted life years (DALYs). (See Annex 3 for a discussion of the methodology and assumptions.) The global community can avoid these consequences by investing in rapidly scaling up public health interventions using currently available tools (i.e., treatment regimens, diagnostics) and accelerating the R&D of new TB tools.

These figures break down as follows:

By 2030, failure to fully scale up current interventions in line with the Global Plan would result in:

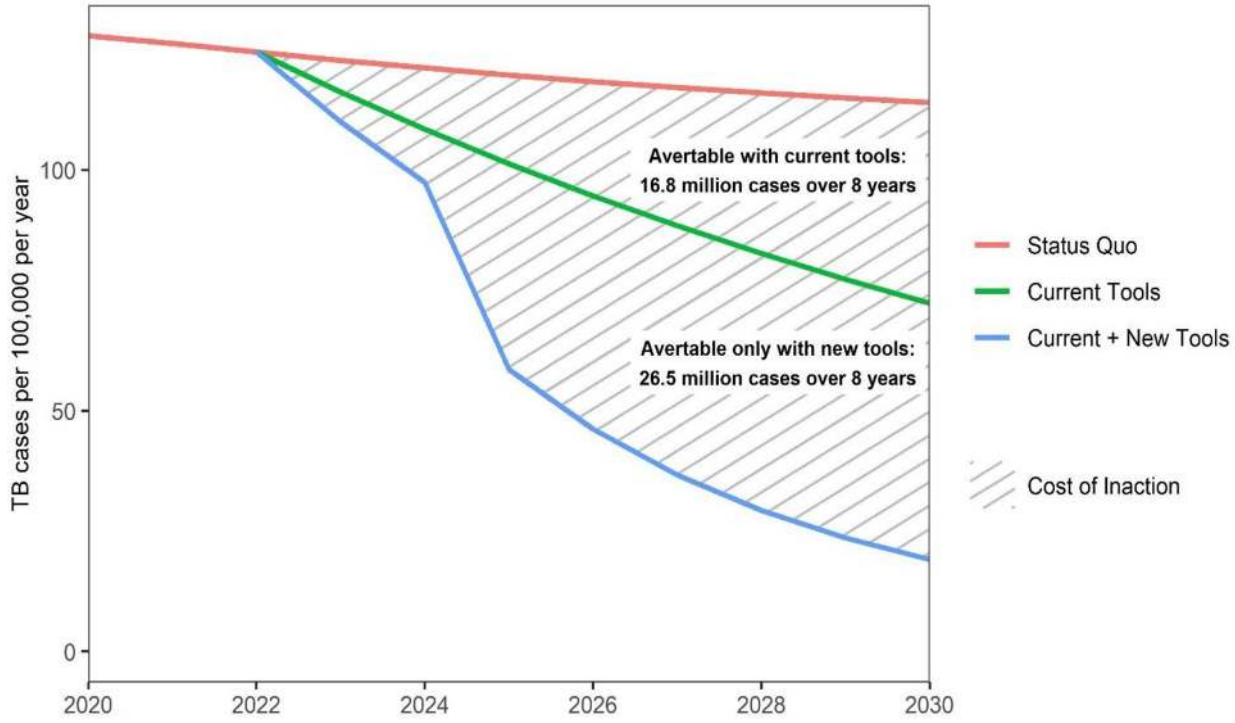
- 16.8 million additional people sick with TB
- 3.8 million additional TB deaths

- 133 million incremental TB-attributable DALYs
- US$ 20 billion in TB treatment costs
- US$ 645 billion in lost productivity.

This impact represents the ceiling of what can be achieved without new tools. Even if current interventions were fully implemented, a four-year delay in investment in R&D for new tools would still result in:

- 26.5 million additional people sick with TB
- 2.8 million additional TB deaths
- 101 million incremental TB-attributable DALYs
- US$ 31 billion in TB treatment costs US$ 487 billion in lost productivity.

Figure 18. The potential human cost of failing to implement the Global Plan 2023–2030



1. Cameroon, Chile, Congo, France, Guinea, Madagascar, Mali, Mauritius, Niger, Republic of Korea.
2. This inaction is defined as the cost of future TB treatment and lost productivity that would accrue if the world achieved the 2020 milestones of the End TB Strategy by 2022, but failed to make the necessary investments in new tools between 2020 and 2025.

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DIVERSIFY THE BASE OF FUNDING FOR TB IMPLEMENTATION AND R&D

Implementing the Global Plan is going to take increased support from current partners plus the nurturing of a range of new partners. There are three broad sources of funding for implementation and R&D—domestic funding, international funding and innovative financing—each with multiple mechanisms for mobilizing resources, representing an even larger pool of potential new partners for the TB community to nurture (see Table 20).

Table 20. Sources of TB funding and potential mechanisms

Type of funding source	Funding mechanisms	Key partners
Domestic sources	National and subnational budgets, SHI, increased TB programme efficiencies	Ministry of health, ministry of finance, national and subnational TB programmes, HIV programmes, health insurers, social protection programmes
International/Multilateral	International financing mechanisms, development banks, CSR, private philanthropy, PDPs	WHO, Stop TB Partnership, GFATM, UNICEF, BRICS TB Research Network, EDCTP, Global Health Innovative Technology Fund, World Bank, InterAmerican Development Bank, Asian Development Bank, Bill & Melinda Gates Foundation, Children's Investment Fund Foundation, TB Alliance, FIND, TBVI, IAVI, pharmaceutical companies, biotech companies, the Giving Pledge
Innovative finance	Impact bonds, blended finance, micro-levies, taxes, pooled donor trusts, CSR	Stop TB Partnership, Unitaid, HEAL fund, Wellcome Trust, Bamboo Capital Partners, UBS Optimus Foundation, Agbami Partners, India Health Fund

Mobilizing domestic funding

For high-income countries, BRICS countries and upper-middle-income countries, nearly all TB investments should flow from domestic resources.

The Russian Federation and other Eastern European countries may be able to finance a significant share of the expansion of TB services through cost savings within historical TB budgets by continuing the current trend of people-centred TB care, reducing the number of people with TB who are hospitalized and reducing hospitalization times. Other middle-income, high-burden countries could expand care cost-effectively by further integrating TB care into general health services.

However, scaling up to a comprehensive response will only be possible if countries dedicate specific budget lines to TB and increase these budget lines. South Africa, India and Indonesia are examples of countries that have done this and have the potential to do more. In recent years, India has quadrupled its domestic budget for TB and Indonesia has tripled its domestic budget, driven in both cases by high-level political commitment. Such dramatic increases are needed in several middle-income and high TB burden countries.

The economic realities are very different in LICs. TB programmes in most LICs depend on external financing. Meanwhile, large parts of TB budgets currently go unfunded. Programmes in these countries need increased funding through a variety of sources, including grants and concessionary loans from development banks.

Increasing the efficiency of TB programmes

It is not enough to increase funding. Funding also needs to be allocated and used more efficiently. The goal should be to streamline delivery of the most cost-effective interventions to target populations in the highest priority areas. As TB nears elimination, resources should support and enable shifts in strategy. The challenge is to improve efficiency without sacrificing access, quality of programmes or quality of care.

Examples of actions countries can take to make programmes more efficient include:

- investing in a comprehensive strategy for TB elimination (see Chapter 2);
- using data analytics to guide resources towards interventions that will have the most impact;
- investing in newer technologies for screening and diagnosis;
- procuring medicines and other products from GDF;
- using social contracting with local NGOs to deliver people-centred services within communities.

Covering TB service costs with SHI

SHI is **a mechanism** by which funds within countries can be raised and pooled to finance health services. In a number of country SHI programmes, employees and their employers contribute to a package of services available to the insured and their dependents. Many governments subsidize SHI programmes to ensure sustainability.

Contribution requirements are progressive in SHI programmes. Higher income people contribute more than people with low incomes, and people living with illness do not pay more than people who are healthier. Some governments have extended insurance coverage for people with little or no income by meeting or subsidizing their contributions. The SHI approach can help to mobilize significant resources for TB elimination, while promoting equity in the health system and helping people avoid catastrophic costs.

Mobilizing international funding

Official development assistance (ODA) and multilateral funding will remain critical sources of international funding for TB efforts and critical targets for advocacy. Goal 17 of the SDGs calls on developed countries to fully implement their commitment to devote 0.7% of gross national income (GNI) to ODA. Advocating for increasing ODA for TB prevention, care and R&D—either through bilateral programmes or multilateral efforts—is a vital priority in line with this goal.

The GFATM remains the single largest international source of funding for TB efforts and will remain a vital source of financing for the foreseeable future. Because the majority of funding contributions to the GFATM come from governments, advocacy is critical to ensure that the GFATM remains fully funded and able to meet country demands for support. For GFATM-eligible countries, the total resource needs for the 2024–2026 GFATM replenishment cycle is US$ 15.2 billion per year. Even in a scenario of full replenishment of the GFATM, however, eligible countries will be left with significant gaps in their national TB budgets based on actual funding needs.

TB kills more people than HIV and malaria put together, and yet the GFATM has historically provided the lowest proportion (18%) of its resources to TB. For the 2023–2025 funding cycle, the GFATM will allocate marginally more resources to TB, contingent upon an unprecedented higher level of GFATM replenishment. Advocacy efforts by TB stakeholders for more equitable distribution of funds between the three diseases in the GFATM portfolio have not met with success. The Global Plan therefore calls for new external financing instruments for TB care and prevention, without which TB cannot be ended in LICs and lower middle-income countries (LMICs).

Loans from development banks, including loan buydowns, blended loan-grant financing and converting debt into grants

The World Bank and other regional development banks provide loans that can make substantial resources available for TB elimination. Some TB programmes have used these kinds of loans for several years.

More recently, innovative approaches have been used to blend loans and grants from different sources, making borrowing more attractive and less expensive to countries. One such approach is to use grants from the GFATM, bilateral donors or the private sector to pay down interest on loans from the World Bank or regional development banks. This is called a "loan buydown." For example, the Government of India accessed **a World Bank loan** of US$ 400 million for its TB programme, and the interest, amounting to about US$ 40 million, was paid by the GFATM.

Another approach is to incentivize countries to access loans from development banks by blending loans with grants provided by other donors. For example, the Asian Development Bank and the Government of Japan have a mechanism through which countries can access blended loan and grant financing.

A "debt swap" is another approach of converting loans into grants. For example, the Government of Indonesia did this through **an agreement with the Government of Germany**.

It is critical that TB programmes communicate their resource needs to their country's health and finance ministers, so that those needs can be raised in discussions with the World Bank and regional development banks when discussing the country's broader development financing needs.

Private philanthropy

Private philanthropy is a largely untapped source of TB financing. Opportunities for pursuing private philanthropy have opened up as a result of **The Giving Pledge**. The Giving Pledge is a commitment by the world's wealthiest individuals and families to dedicate the majority of their wealth to philanthropy. As of 2019, 204 people have pledged for a total of over US$ 500 billion. This has been an untapped source of funding for TB.

Mobilizing innovative financing

Global health has a strong track record of developing innovative financing mechanisms. The GFATM and Unitaid, for example, have developed **innovative approaches** to mobilizing, pooling, channelling, allocating and implementing resources to direct large amounts of funding rapidly to LMICs and LICs. These innovative financing mechanisms have the potential to play an even bigger role in the fight against TB, including by **funding TB R&D**.

Innovative financing mechanisms already being explored in global health R&D must continue to be assessed to determine their suitability for supporting TB R&D, including matching funding schemes, public-backed bonds to raise TB R&D capital, advance market commitments (for new TB vaccines) or competitive programmes seeking to fund the most promising R&D leads. One type of pull mechanism that could be replicated is the U.S. Food and Drug Administration's (FDA) **Tropical Disease Priority Review Voucher Program**. The FDA grants these vouchers to companies that work on discovering drugs for neglected diseases. A company holding a voucher can receive expedited regulatory review for new drug candidates. Vouchers **can be sold** on the secondary market, although the value of vouchers is expected to decline as the number of vouchers available increases.

Impact bonds

Impact bonds are a financial scheme wherein investors pay in advance for interventions, with an agreement to achieve specific results. Investors then work with delivery organisations to ensure that those results are achieved. As part of the arrangement, outcome funders (i.e., governments and/or donors) agree to pay the investors if the interventions succeed.

In this sense, impact bonds are similar to other results-based approaches, but with capital provided up front. There are two main types of impact bonds: social impact bonds (SIBs), which are typically implemented on the scale of a city or district, and development impact bonds (DIBs), which are typically implemented on the scale of a country or significant region of a country.

In the context of TB programming, impact bonds could encourage investors to provide upfront capital to support the efforts of various service providers to improve TB diagnosis, treatment and prevention in high-burden communities.

Blended finance

Blended finance is an approach whereby governments help to free up investment from the commercial sector by providing guarantees that lower the risk involved in making those investments. This approach is especially suited for LMICs and emerging markets where higher risk has limited the availability of resources from commercial finance.

The Stop TB Partnership has entered into an agreement with Bamboo Capital Partners to co-launch the **HEAL fund**, a blended finance fund to deploy both public- and private-sector capital to innovators developing health technologies that can address TB and other communicable and non-communicable diseases in LICs and emerging markets, and to provide the necessary product roll-out support.

Micro-levies/taxes

The most cited example of a micro-levy for TB is a small tax on airline ticket purchases. Started in 2006 in France, the tax is now collected from airline tickets purchased in Cameroon, Chile, Congo, Madagascar, Mali, Mauritius, Niger and the Republic of Korea. The funds raised support Unitaid in purchasing treatments for HIV, TB and malaria. Supported in part through a tax of around US$ 1 for an economy-class ticket and US$ 40 for a business-class seat, Unitaid helps countries introduce and scale up the use of innovative health technologies and solutions (see Box). There are numerous other areas where micro-levies could be established, particularly in areas involving extractive industries and the financial sector.

Pooled donor trusts

Pooled donor trusts distribute grants to organisations to meet defined social outcomes. Their main feature involves a multi-donor approach, which aims to better coordinate funding for programmes, while raising awareness for issues that need national or global attention.

Trusts can help to simplify the grant-making process and maximize impact. For example, the Power of Nutrition is an independent charitable foundation founded in 2015 with US$ 150 million contributed by the UK Government (DFID) and the Children's Investment Fund Foundation, followed by additional founding contributions made by UBS Optimus Foundation, with the World Bank and UNICEF serving as implementing partners. The foundation works to increase the efficiency of funding for undernutrition and other specific health goals related to stunting and wasting. The fund requires countries to provide matching capital in order to receive support.

Corporate social responsibility (CSR)

CSR is a mechanism for businesses to be socially responsible by contributing to social, health and environmental causes in areas where they operate. Large corporations and businesses operating in high TB burden countries need to be engaged and encouraged to invest in TB. In the past, **oil companies in Nigeria** (Agbami Partners) have built, equipped and donated TB clinics to the government. **Corporations in India** (e.g., the India Health Fund established by Tata Trusts) and Indonesia have also increased their support for TB elimination through CSR initiatives.

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MOBILIZE ACTION THROUGH STRONGER TB ADVOCACY AND STRATEGIC COMMUNICATIONS

As COVID-19 has demonstrated, policy-makers will make resources available for global public health when they understand the matter is an urgent priority for their populations. Governments have likewise made historic commitments to end TB. Holding governments accountable for investing the resources necessary to fulfil those commitments is going to take a much stronger advocacy effort driven by TB survivors and affected communities; civil society coalitions of advocates; scientists and public health experts; and their allies.

Expand the presence of advocates focused on TB resource mobilization

Funders who are interested in supporting efforts to end TB can multiply the impact of their resources by funding more advocates to mobilize TB resources from governments, multilateral institutions and other sources. There are established TB advocacy coalitions devoted to mobilizing TB resources from key donor countries and from governments of high-TB-burden countries—but there is space to replicate these approaches in many other countries. Advocates focused on mobilizing TB resources closely track TB and national research budgets and funding allocations year to year. This can be a complex task that sometimes requires getting governments to establish new approaches to budgeting or to identifying and quantifying funds that are used to support TB interventions and R&D. Successful approaches show that by developing relationships with finance officials inside of governments and institutions, advocates can monitor TB resource flows, providing critical information that informs advocacy.

Engage more TB survivors and affected communities as advocacy leaders

People directly affected by TB have lived experience and are an essential kind of expert vital to TB advocacy. TB survivors can play a role in TB advocacy that no one else can: they can ground the TB narrative in human, experiential terms that others can understand and relate to on a deep emotional level.

TB survivors and affected communities have assumed a more prominent role in TB advocacy in recent years, working as partners with full-time TB advocates, public health experts and members of the scientific community. Supporting the growth and capacity of TB patient networks is especially critical to communicating more persuasively with policy-makers, building greater TB awareness among the general public, and holding governments accountable for fulfilling TB commitments.

Broaden engagement with government officials

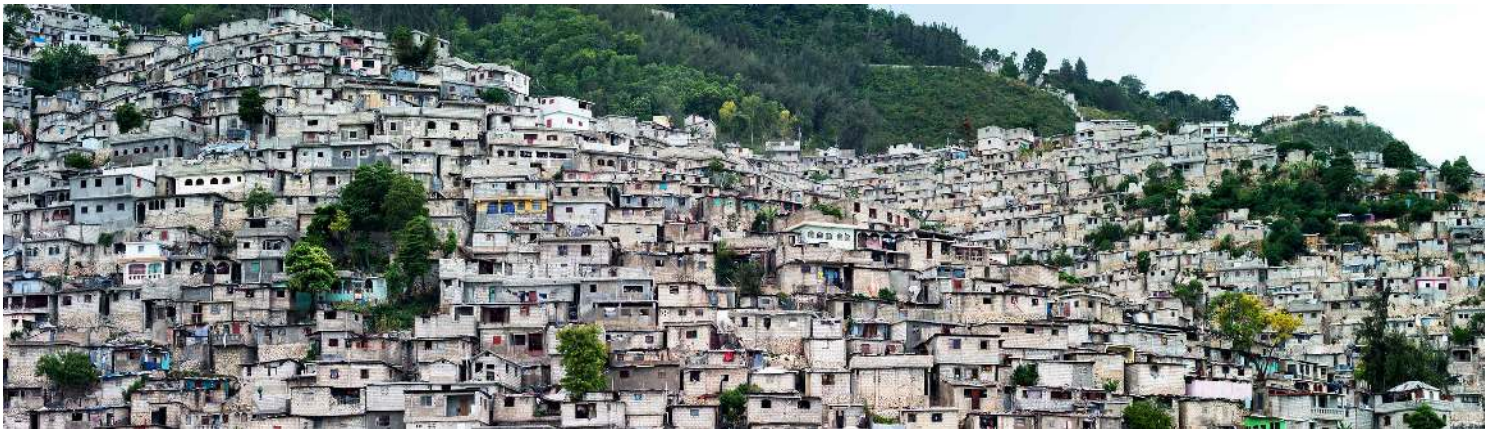
Members of parliament (especially those sitting on relevant committees responsible for budgeting, health, regulatory, science and technology research, even national defense) must be better educated about the need for new TB tools and the commitments their governments have made to support TB research through the UN Political Declaration on TB. Advocates can partner with the Global TB Caucus, which provides the TB advocacy and research communities with an entry point into parliamentary engagement in more than 130 countries.

TB advocacy has for a long time focused on advocating for ministries of health to prioritize TB. Other ministries need to be engaged with equal focus, including finance, science and technology, labour and regulatory committees, which are essential to mobilizing resources; supporting programmes and initiatives that reach communities with TB services; addressing underlying determinants; and seeing governments adopt and scale up the use of new TB tools and technologies.

Increase TB's visibility in the news media

Earning coverage of TB issues in the news media is one of the most important ways of maintaining a sense of urgency around the need to end TB. More opportunities need to be made available for TB survivors and affected communities, research scientists and public health experts to receive training on how to effectively communicate with the news media. Media engagement should be explored routinely in the lead up to the publication of important new research studies, policy reports and other key moments, such as scientific conferences and policy events where TB is on the agenda. Opinion media provides additional opportunities for communicating newsworthy insights that can inform the TB response.

Improving advanced coordination among advocates, researchers, TB survivors and affected communities can help to ensure that earned media coverage of TB is used effectively for advocacy purposes. Sharing media coverage with policy-makers at all levels is an effective way of disseminating insights and keeping them up-to-date on progress and challenges in the TB response. (See Chapter 8 for a discussion of the advocacy needed to accelerate TB R&D.)



ESTIMATING THE COST AND IMPACT OF THE TB GLOBAL PLAN 2023–2030

Overview

This document details the methodology developed for modelling the cost and impact of the Global Plan to End TB, 2023–2030. The project was conducted under a technical working group, with further expert guidance facilitated by the TB Modelling and Analysis Consortium (TBMAC).

The impact modelling methods can be summarized as a framework for adjusting trends in key TB indicators, such as TB incidence, mortality, notifications and other indicators, to reflect the epidemiological impact of the programmatic implementation of the Global Plan to End TB, 2023–2030.

Impact simulations for TB were performed with the Impact component of the TB Impact Model and Estimates (TIME) model[1] , a dynamic compartmental TB model developed using the open-source Spectrum suite of models.

For past Global Plans (2016–2020 and 2018–2022), there was strong reliance on the expenditure and budgetary reports submitted by countries to WHO to derive unit costs and estimate resource needs. In this analysis, a normative approach was adopted, where tools (e.g., diagnostics) and services (e.g., support to people with TB) are made consistent with WHO guidelines.

These principles were applied to cost the Global Plan, which proceeded in three steps. First, the screening algorithms and services for costing were listed in accordance with current WHO guidelines. Second, the target populations for those services were estimated using the TIME model. (Some of the target populations were provided directly by the TIME model, while others were estimated from the underlying demographic and HIV models.) Third, the service volumes for TB screening, diagnostic and TPT services were determined using the estimated prevalence, sensitivity and specificity values of the screening algorithms.

Finally, the country-specific unit costs for TB diagnostic, treatment and TPT services for 2023–2030 were derived using information from one of four sources: the Value TB study database, WHO Global TB Programme's (GTB) CHOICE Health service delivery costs, the Global Health Cost Consortium and the GDF Product Catalogs for diagnostics, medicines and other supplies. These data were used to estimate the direct costs of screening, diagnosis and TPT services at country level.

The Global Plan to End TB, 2023–2030: target setting

The strategy objectives resulted in targets for the following areas:

Finding and treating TB

At least 95% of estimated TB burden should be found and 90% of those initiated on treatment should be successfully treated:

- 50.0 million people with TB in the period 2023–2030, of which 38.6 million are in the first five years (2023–2027);
- 4.7 million children with TB in the period 2023–2030, of which 3.3 million are in the first five years (2023–2027);
- 2.2 million people with RR- or MDR-TB in the period 2023–2030, of which 1.7 million are in the first five years (2023–2027).

The Global Plan calls for early diagnosis and case finding, with 3.5% of a country's population screened, focusing first on key and vulnerable population settings.

More than 90% of pulmonary TB should be diagnosed by rapid molecular tests, and more than 90% of bacteriologically identified TB strains should have DST before initiating treatment.

TPT

All eligible contacts of people with TB, PLHIV and other risk groups on TPT:

- 35 million people at risk in the period 2023–2030, of which 26 million are in the first five years (2023–2027);
- 21 million contacts of people with TB in the period 2023–2030, of which 16 million are in the first five years (2023–2027).

Vaccine recommended for use in 2026 and rolled out in 2027:

- At least 60% coverage of a 60% efficacious post-exposure vaccine by 2030.

Modelling the epidemiological impact of the Global Plan to End TB, 2023–2030

Modelling the strategy targets of the Global Plan 2023–2030

Screening and treatment targets

Several modelling decisions were made to model the Global Plan strategy targets using the TIME model. The first addresses the overall notification objectives.

The period 2012–2022 greatly influenced the starting point of the Global Plan 2023–2030. WHO notification data for 2020 showed a decline of about 20%, and 2021 data are expected to show a similar relative decline. However, the UNHLM targets for 2018–2022 remain unchanged (i.e., political commitments are still in place). This means that a comprehensive "catch-up" effort is needed in 2022 to find and treat the cases that were missed in 2020 and 2021.

The Global Plan 2023–2030 assumes that the UNHLM targets will largely be met and that the decline in screening rates resulting from disruptions in 2020–2021 will largely be overcome. This catch-up effort requires the use of active case finding measures, such as screening of all household contacts of people with TB. If the catch-up strategy is unsuccessful, then the Global Plan 2023–2030 will have to address a greater burden and require more resources.

To achieve the case detection target of the Global Plan, the model parameters linked to the screening rate were increased in an S-shaped curve, starting in 2023 and ending in 2030, such that 95% of people with TB will be found by 2030. In terms of the competing risks of TB processes captured in time, this means finding about 90% of people diagnosed with TB before they die or self-cure.

The same final screening rate was applied to all countries, which means that there will be a corresponding mix of impacts[2] . There was no simple way to further specify country allocations in terms of contributing to the overall screening target of 95%, considering that countries were not involved directly in the modelling process.

Diagnostic pathways were explicitly modelled with TIME in terms of the tools comprising a pathway (including eligibility criteria, screening tools such as X-ray, and diagnostic tools such as clinical observation, smear microscopy or Xpert). The diagnostic pathways defined by the strategy (which to conform to WHO guidelines are based on the use of X-ray screening and Xpert diagnosis) lead to sensitivity and specificity of 84.8% and 99.7%, respectively, for the passive programme, household contacts and high-risk groups found as part of systematic screening. For new and established persons taking antiretroviral therapy (ART), sensitivity was set at 72% and 65% and specificity at 98% and 97%, respectively.

Treatment success was increased in the model from 2019 levels (carried to 2023) to 90% by 2030.

Unlike previous Global Plan analyses, no country had impact constrained below 10% in any year, as such a constraint would mean that End TB impact milestones for 2030 would not be reached.

TPT targets

The Global Plan 2023–2030 continues the focus of the previous Global Plan 2018–2022 on TPT. This Global Plan calls for 100% coverage of contact tracing in the household (HH) of all people with bacteriologically positive TB by 2022 and onward.

Furthermore, it is assumed that all new people taking ART and those already on ART will receive TPT.

Estimates for the distribution of active and latent TB in adults and children in HHs of index cases were based on Fox et al. 2013[3] . HH size estimates and the percentage of the HH under 5 years of age were based on demographic health surveys (DHS) where available, and a global average was used where not (HH size of five and 15% of HH under the age of 5).

New tools

The TIME model does not directly model the finding and treatment of subclinical TB or TB prevention through large-scale vaccine programmes[4] . Insights into the additional impact of these "new" tools, when added to a programme implementing existing tools at full scale, were obtained via supplementary modelling work.[5] This supplementary modelling suggests that these tools can lead to the achievement of the 2030 impact milestones. "Rolled starts" beginning in 2027 were assumed, with coverage reaching 30% for treating subclinical TB and 60% for a post-exposure TB vaccine by 2030.

TB countries and country groups/contexts

Epidemiological impact was estimated by applying the TIME modelling framework to capture the potential impact of the Global Plan 2023–2030. The model was calibrated to WHO GTB data from 18 countries. These countries represent a range of contexts and represent 70% of the global TB burden, and were chosen from a list of country models that were validated and recalibrated in recent modelling projects. The estimated impact of the Global Plan 2023–2030 strategy in these countries was then applied to GTB epidemiological trends for an additional 152 countries[6] by assigning to each country a country in the same context or group that had been explicitly modelled.

TB contexts or groups were determined using statistical analysis of a multivariate dataset. The variables represent TB burden (cases and deaths), HIV burden, TB-HIV burden and aspects of socioeconomic standing (e.g., GDP per capita, Human Development Index, Fragile State Index), TB service delivery (e.g., TB treatment success) and general health systems financing (e.g., per capita health expenditure).

The group corresponding to countries with a high degree of private-sector involvement in TB diagnosis and treatment was further used in the resource needs estimation process. For these countries, a markup was added to projected budgets to cover commitments countries have made to strengthen PPM activities.

GTB epidemiological data and trends

The TB burden analysis of the Global Plan relies strongly on incidence and notification data reported to GTB in 2019.

A cubic spline regression approach was used to project baseline trends through incidence and notification data. The trends (i.e., "baseline" trends) obtained formed the basis of the counterfactual/comparator to trends under the Global Plan 2023–2030 strategy should it be fully implemented within the 2023–2030 timeframe. The 2020 GTB burden estimates were not used as part of this statistical projections, as they would generally have caused a "kink" being the last year of data.[FS1] [CP2]

The projected TB incidence trends were used together with reported TB-HIV data to estimate a disaggregation of the total number of TB incident cases into three assumed components: HIV-negative, HIV-positive not on ART, and HIV-positive on ART, as outlined in Pretorius et al[7] . This disaggregation method was also based on cubic spline regression, combining data from the GTB and UNAIDS at country level.

CD4 information and ART status information used by the HIV disaggregation method were drawn from the UNAIDS dataset. The TB-HIV data came from three sources that countries report to GTB: nationwide representative HIV serological surveys among a sample of reported TB cases, data from HIV sentinel groups, and results from routine testing of people with TB where testing coverage of newly reported cases is high.

TB mortality is affected by a complex relationship between active TB disease and many clinical variables. These variables were approximated in a simple functional relationship between incidence and case fatality ratios (CFRs). The eight categories of CFRs (HIV-negative, HIV-positive not on ART, HIV-positive on ART for < 6 months, and HIV-positive on ART for ≥ 6 months, by notification status) were clinical states that were both clinically relevant and possible to estimate from the available data. Using this approach, TB mortality was calculated as a product of incidence and CFRs.

The UNAIDS dataset was further used to project the number of PLHIV newly initiated on ART and PLHIV currently on ART, which was needed for TPT cost estimation.

TIME model

TIME is used by TB policy-makers and NTPs to develop strategic responses and strategies for TB, and to produce projections that inform funding applications. The model has been used in many TB settings, including in countries where TB is driven by HIV and by weak health systems, countries with high MDR-TB burden, and countries where TB programmes depend on a high level of private-sector involvement. The Estimates component of TIME was used by the WHO GTB to produce estimates for TB-HIV burden for the Global TB Report.

The TIME model reflects key aspects of the natural history of TB, including primary and latent infection, re-infection and re-activation of latent to active TB. Smear positivity, negativity and smear conversion are explicitly handled in the model. TIME also accounts for the characteristics of childhood TB, treatment history and drug resistance. It has additional structure for HIV/ART that mimics the structure of the Spectrum AIDS Impact Model (AIM) module in order to directly use its HIV programmatic data. TIME includes two generic strains by MDR status: susceptible and resistant to treatment. Resistance can be acquired during treatment or upon transmission, at rates that distinguish DR-TB from DS-TB in the model.

Epidemiological impact of reaching the Global Plan 2023–2030 targets for interventions and service provision

Figure A1.1 below illustrates the modelled situation with respect to TB cases. The dots show data on the total number of cases and a baseline trend through these data. The baseline scenario was based on the assumption of no further scale-up of interventions post-2019, resulting in a gradual decrease in cases. The two horizontal lines show the End TB milestones in 2025 and 2030. These targets represent a 50% and 80% decline in TB cases (per 100,000 population, relative to 2015) by 2025 and 2030, respectively, and a 75% and 90% decline in TB deaths (absolute numbers, relative to 2015) by 2025 and 2030, respectively (see Figure A1.2).

The period 2020–2022, and the extent to which catch-up efforts in 2022 reach the UNHLM target of 40 million treated over the period 2018–2022, has an important impact on the 2023–2030 period. First, failure to find the cases missed in 2020–2021 will lead to excess burden in subsequent years. This excess shows up more in prevalence and mortality than it does in incidence, since the impact on incidence is moderated by the assumption that disruptions to TB programmes will also disrupt TB transmission (predominantly because of reduced contact rate). It should be noted that the end-points in 2030 are similar for the two scenarios (i.e., the Global Plan with or without catch-up in 2020–2022), as the high screening rate of the Global Plan would address the possible COVID-19-related excess burden. However, addressing the excess burden would require proportional additional resources in the post-2022 period.

The results show that the 2030 impact milestone for reduction of TB cases will not be met, even with the most aggressive scale-up of existing tools, as per the strategy targets. Meeting the End TB impact milestones for 2030 would require additional average declines of 8% for incidence and 6% for mortality.

Supplementary modelling work based on a "deep-dive" analysis for Indonesia, Kenya, Ukraine and Uzbekistan shows that this level of impact is possible through large-scale vaccine roll-out, combined with programmes for finding and treating subclinical TB.

Table A1.1 shows TB cases and deaths from 2023 to 2030 globally and by various country categories: WHO Region, GFATM eligibility, Global Fund country group, etc.

Figure A1.1. Global TB cases, impact by 2030, with or without a catch-up effort in 2022, and with or without new tools rolled out in 2026

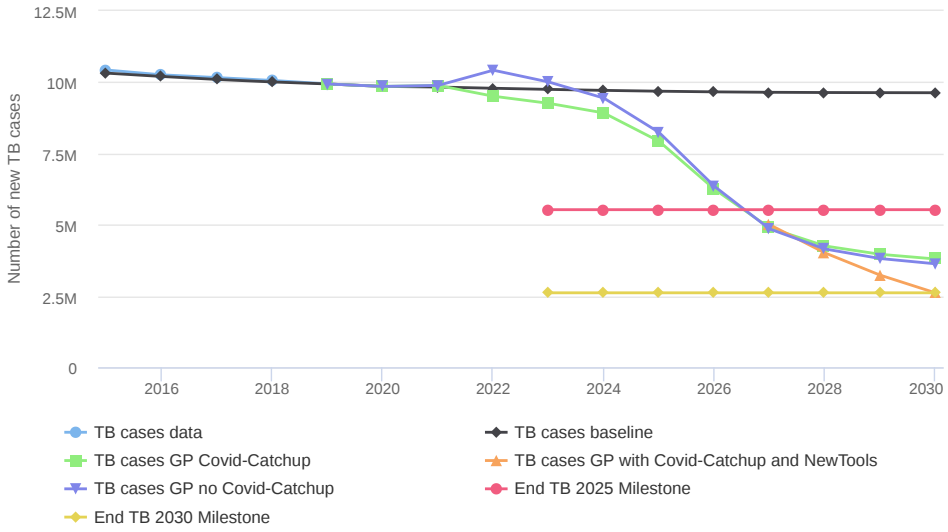


Figure A1.2. Global TB deaths, impact by 2030, with or without a catch-up effort in 2022, and with or without new tools rolled out in 2026

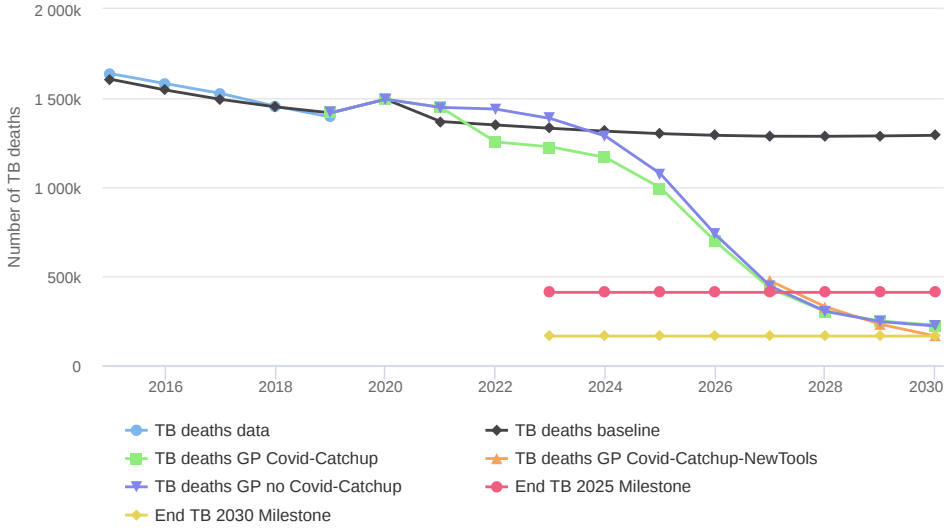


Table A1.1. TB cases and deaths by income status, GFATM eligibility, Global Plan country group, WHO Region and BRICS membership

New TB Cases (per 100,000 population)									
Country category	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2023–2030**
GLOBAL TOTAL									
Total (Global, including OECD countries	116.4	111.1	97.8	76.4	60.2	47.6	37.8	30.0	75.0
Total (Global, excluding OECD countries)	137.5	131.2	115.3	90.0	70.8	55.9	44.3	35.2	88.2

New TB Cases (per 100,000 population)									
BY INCOME STATUS									
Low income	169.3	157.1	132.5	98.4	79.7	64.7	52.7	43.0	97.9
Lower middle income	193.0	184.8	163.4	127.9	99.4	77.4	60.4	47.2	124.3
Upper middle income	57.4	54.5	47.9	37.9	30.3	24.4	19.8	16.2	37.9
High income	8.8	7.8	6.9	5.6	4.5	3.6	2.9	2.3	5.6
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	1.8	2.1	2.3	2.5	3.5	3.6	3.7	3.9	23.4
Lower middle income	8.5	9.7	11.4	12.5	16.7	16.4	16.6	17.2	109.0
Upper middle income	1.5	1.6	1.8	1.8	2.4	2.4	2.4	2.5	16.4
All GFATM-eligible countries	11.8	13.3	15.5	16.8	22.6	22.3	22.7	23.6	148.7
WHO REGION									
Eastern Mediterranean	107.6	103.7	91.5	70.8	54.6	42.2	32.6	25.3	69.1
Africa	182.4	166.3	141.9	109.4	90.5	75.2	62.7	52.5	109.4
Americas	26.9	26.0	22.2	17.2	13.0	9.8	7.4	5.7	16.5
Europe	23.0	21.8	19.5	16.0	12.8	10.2	8.2	6.6	15.9
Western Pacific	87.7	84.5	74.4	57.5	44.7	34.7	27.0	21.0	57.4
South-East Asia	195.3	188.7	168.1	132.0	102.2	79.2	61.4	47.6	127.5
BRICS (BRA,CHN,IND,RUS,ZAF)	108.5	105.0	94.7	75.6	59.5	47.0	37.2	29.6	73.0

TB Deaths (per 100,000 population)									
Country category	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2023-2030**
GLOBAL TOTAL									
Total (Global, including OECD countries	15.4	14.5	12.3	8.5	5.7	3.9	2.7	1.9	8.0
Total (Global, excluding OECD countries)	18.3	17.2	14.6	10.1	6.8	4.7	3.2	2.3	9.5
BY INCOME STATUS									
Low income	24.8	22.2	17.7	11.4	7.9	5.9	4.5	3.4	11.3
Lower middle income	27.1	25.7	21.9	15.3	10.2	6.9	4.7	3.2	14.3
Upper middle income	5.3	5.0	4.2	2.8	1.9	1.3	0.9	0.6	2.7
High income	0.9	0.8	0.7	0.5	0.3	0.2	0.1	0.1	0.5
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	24.8	22.2	17.7	11.4	7.9	5.9	4.5	3.4	11.3
Lower middle income	27.1	25.7	21.9	15.3	10.2	6.9	4.7	3.2	14.3
Upper middle income	26.1	25.1	21.5	14.7	9.5	6.2	4.0	2.7	14.0
All GFATM-eligible countries	26.6	25.0	21.1	14.5	9.7	6.6	4.6	3.2	13.7
WHO REGION									
Eastern Mediterranean	9.1	8.7	7.3	4.9	3.3	2.3	1.5	1.1	4.6
Africa	37.6	34.5	28.2	18.5	12.9	9.1	6.5	4.7	18.1
Americas	2.0	1.7	1.3	0.8	0.6	0.4	0.3	0.2	0.9
Europe	2.2	2.1	1.7	1.2	0.9	0.7	0.5	0.4	1.2
Western Pacific	4.1	3.8	3.2	2.1	1.5	1.1	0.8	0.5	2.1
South-East Asia	28.1	26.9	23.2	16.6	10.8	7.2	4.8	3.2	15.3
BRICS (BRA,CHN,IND,RUS,ZAF)	15.5	15.2	13.4	9.9	6.4	4.1	2.7	1.8	8.9

TB notifications

TB notifications form the basis of costing the passive TB programme according to age, pulmonary status, MDR status, etc.

Table A1.2 states the overall notification targets to be reached, notifications among children under 15 and the number of people with MDR-/RR-TB among all notified. The high-level notification targets are as follows:

- 50.0 million people with TB in the period 2023–2030, of which 38.6 million are notified in the first five years (2023–2027)
- 4.7 million children with TB in the period 2023–2030, of which 3.32 million are notified in the first five years (2023–2027)
- 2.2 million people with MDR-/RR-TB in the period 2023–2030, of which 1.7 million are notified in the first five years (2023–2027).

Table A1.2. TB notifications (all ages, children under 15 and MDR-/RR-TB) by income status, GFATM eligibility, Global Plan country group, WHO Region and BRICS membership

TB Notifications (all ages, millions)									
Country category	2023	2024	2025	2026	2027	2028	2029	2030	Total
GLOBAL TOTAL									
Total (Global, including OECD countries	7.8	8.0	8.7	8.2	6.0	4.6	3.9	3.6	50.7
Total (Global, excluding OECD countries)	7.6	7.8	8.6	8.1	6.0	4.5	3.9	3.6	50.1
BY INCOME STATUS									
Low income	1.0	1.0	1.1	1.0	0.7	0.6	0.5	0.5	6.4
Lower middle income	5.3	5.4	6.0	5.6	4.2	3.1	2.7	2.5	34.8
Upper middle income	1.4	1.4	1.6	1.5	1.1	0.8	0.7	0.7	9.1
High income	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.5
GFATM ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	1.8	2.1	2.3	2.5	3.5	3.6	3.7	3.9	23.4
Lower middle income	8.5	9.7	11.4	12.5	16.7	16.4	16.6	17.2	109.0
Upper middle income	1.5	1.6	1.8	1.8	2.4	2.4	2.4	2.5	16.4
All GFATM-eligible countries	11.8	13.3	15.5	16.8	22.6	22.3	22.7	23.6	148.7
WHO REGION									
EMR	0.5	0.5	0.5	0.5	0.4	0.3	0.3	0.2	3.1
AFR	1.4	1.5	1.8	1.9	1.4	1.1	1.0	1.0	11.2
AMR	0.2	0.2	0.3	0.2	0.2	0.1	0.1	0.1	1.5
EUR	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	1.0
WPR	1.4	1.4	1.5	1.4	1.0	0.7	0.6	0.6	8.5
SEA	4.0	4.1	4.5	4.1	3.0	2.2	1.8	1.7	25.5
BRICS (BRA,CHN,IND,RUS,ZAF)									
Total	3.7	3.7	4.0	3.8	2.8	2.1	1.7	1.6	23.5

TB Notifications (U15, millions)									
Country category	2023	2024	2025	2026	2027	2028	2029	2030	Total
GLOBAL TOTAL									
Total (Global, including OECD countries	0.57	0.64	0.75	0.76	0.60	0.49	0.44	0.43	4.68
Total (Global, excluding OECD countries)	0.56	0.64	0.75	0.76	0.60	0.48	0.44	0.43	4.66
BY INCOME STATUS									
Low income	0.11	0.11	0.12	0.11	0.09	0.07	0.06	0.06	0.74
Lower middle income	0.42	0.49	0.58	0.59	0.46	0.37	0.34	0.33	3.58
Upper middle income	0.03	0.04	0.05	0.06	0.05	0.04	0.04	0.04	0.34
High income	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
GFATM ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	0.11	0.11	0.12	0.11	0.09	0.07	0.06	0.06	0.74
Lower middle income	0.42	0.49	0.58	0.59	0.46	0.37	0.34	0.33	3.58
Upper middle income	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.17
All GFATM-eligible countries	0.55	0.62	0.72	0.73	0.57	0.47	0.42	0.41	4.49
WHO REGION									
EMR	0.06	0.06	0.07	0.07	0.05	0.04	0.03	0.03	0.42
AFR	0.13	0.15	0.18	0.20	0.16	0.14	0.13	0.13	1.23
AMR	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07
EUR	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.04
WPR	0.06	0.07	0.07	0.07	0.05	0.04	0.04	0.04	0.46
SEA	0.29	0.34	0.41	0.41	0.32	0.25	0.23	0.22	2.47
BRICS (BRA,CHN,IND,RUS,ZAF)									
Total	0.19	0.21	0.26	0.28	0.23	0.19	0.17	0.16	1.69

MDR/RR TB (thousands)									
Country category	2023	2024	2025	2026	2027	2028	2029	2030	Total

MDR/RR TB (thousands)									
GLOBAL TOTAL									
Total (Global, including OECD countries	359.0	353.5	380.5	350.7	260.1	197.0	168.8	156.0	2,225.7
Total (Global, excluding OECD countries)	306.1	297.3	313.5	284.1	214.4	163.5	139.7	128.5	1,847.1
BY INCOME STATUS									
Low income	20.9	20.5	21.0	18.2	13.5	10.4	9.1	8.4	122.0
Lower middle income	205.1	207.1	226.7	216.0	161.1	120.8	101.7	92.8	1,331.4
Upper middle income	72.9	63.8	60.8	46.5	37.1	30.1	26.9	25.4	363.4
High income	60.2	62.0	72.1	70.1	48.4	35.7	31.1	29.4	409.0
GFATM ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	20.9	20.5	21.0	18.2	13.5	10.4	9.1	8.4	122.0
Lower middle income	205.0	207.0	226.6	215.9	161.1	120.7	101.7	92.8	1,330.9
Upper middle income	20.3	19.8	20.3	18.2	14.8	12.5	11.5	11.0	128.6
All GFATM-eligible countries	246.2	247.4	267.9	252.3	189.4	143.7	122.3	112.2	1,581.4
WHO REGION									
EMR	25.3	23.9	25.0	22.5	17.3	13.5	11.9	11.2	150.8
AFR	37.6	39.7	45.4	48.2	37.0	29.8	26.9	25.5	290.1
AMR	55.8	59.0	70.1	68.2	46.9	34.2	29.5	27.7	391.5
EUR	62.7	52.9	48.9	36.4	29.2	23.8	21.3	20.2	295.4
WPR	18.1	16.8	16.5	13.5	10.3	8.1	7.1	6.6	97.1
SEA	159.5	161.1	174.6	161.9	119.3	87.6	72.1	64.7	1,000.9
BRICS (BRA,CHN,IND,RUS,ZAF)									
Total	183.9	172.5	179.7	160.8	122.1	90.8	75.3	68.0	1,053.1

TB prevention

Table A1.3 shows the overall TPT targets among eligible contacts of people with TB, PLHIV and other risk groups on TPT. The high-level TPT targets are as follows:

- 35 million people at risk in the period 2023–2030, of which 26 million are in the first five years (2023–2027)
- 21 million adult contacts of people with TB in the period 2023–2030, of which 16 million are in the first five years (2023–2027).

Table A1.3. TPT (adults, children under 15 and PLHIV in ART cohorts) by income status, GFATM eligibility, Global Plan country group, WHO Region and BRICS membership

TB Prevention, Adults (millions)									
Country category	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
GLOBAL TOTAL									
Total (Global, including OECD countries	3.0	3.1	3.5	3.4	2.6	2.0	1.7	1.6	20.8
Total (Global, excluding OECD countries)	3.0	3.1	3.5	3.4	2.5	2.0	1.7	1.6	20.7
BY INCOME STATUS									
Low income	0.4	0.5	0.5	0.5	0.4	0.3	0.3	0.2	3.0
Lower middle income	2.0	2.1	2.3	2.3	1.7	1.3	1.1	1.1	14.0
Upper middle income	0.5	0.6	0.6	0.6	0.4	0.3	0.3	0.3	3.7
High income	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	0.4	0.5	0.5	0.5	0.4	0.3	0.3	0.2	3.0
Lower middle income	2.0	2.1	2.3	2.3	1.7	1.3	1.1	1.1	14.0
Upper middle income	0.2	0.2	0.3	0.2	0.2	0.2	0.1	0.1	1.6
All GFATM-eligible countries	2.7	2.8	3.1	3.0	2.3	1.8	1.5	1.4	18.6
WHO REGION									
Eastern Mediterranean	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	1.4
Africa	0.7	0.8	0.9	1.0	0.8	0.6	0.6	0.5	5.9
Americas	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.7
Europe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Western Pacific	0.4	0.4	0.5	0.5	0.3	0.2	0.2	0.2	2.8
South-East Asia	1.5	1.6	1.7	1.6	1.2	0.9	0.7	0.7	9.8

TB Prevention, Adults (millions)									
BRICS (BRA,CHN,IND,RUS,ZAF)									
Total	1.4	1.4	1.5	1.5	1.1	0.8	0.7	0.6	9.1

TB Prevention, Children under 15 years (millions)									
Country category	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
GLOBAL TOTAL									
Total (Global, including OECD countries	1.12	1.15	1.28	1.26	0.94	0.72	0.62	0.57	7.65
Total (Global, excluding OECD countries)	1.11	1.15	1.28	1.26	0.94	0.71	0.61	0.57	7.63
BY INCOME STATUS									
Low income	0.27	0.27	0.29	0.28	0.21	0.16	0.14	0.13	1.73
Lower middle income	0.72	0.75	0.85	0.85	0.64	0.49	0.42	0.38	5.09
Upper middle income	0.13	0.13	0.14	0.13	0.10	0.07	0.06	0.06	0.82
High income	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	0.27	0.27	0.29	0.28	0.21	0.16	0.14	0.13	1.73
Lower middle income	0.72	0.75	0.84	0.85	0.64	0.48	0.42	0.38	5.08
Upper middle income	0.06	0.06	0.06	0.06	0.04	0.04	0.03	0.03	0.37
All GFATM-eligible countries	1.05	1.08	1.20	1.18	0.88	0.68	0.58	0.54	7.19
WHO REGION									
Eastern Mediterranean	0.10	0.10	0.11	0.10	0.08	0.06	0.05	0.05	0.66
Africa	0.39	0.42	0.50	0.56	0.42	0.33	0.30	0.28	3.20
Americas	0.03	0.03	0.03	0.03	0.02	0.02	0.01	0.01	0.18
Europe	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.06
Western Pacific	0.12	0.12	0.12	0.11	0.08	0.06	0.05	0.05	0.70
South-East Asia	0.46	0.47	0.50	0.46	0.33	0.24	0.20	0.18	2.85
BRICS (BRA,CHN,IND,RUS,ZAF)									
Total	0.39	0.38	0.41	0.39	0.29	0.21	0.17	0.16	2.40

TB Prevention, PLHIV (millions)									
Country category	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
GLOBAL TOTAL									
Total (Global, including OECD countries	0.93	1.02	1.09	0.66	0.63	0.64	0.65	0.66	6.27
Total (Global, excluding OECD countries)	0.91	1.01	1.08	0.65	0.62	0.63	0.64	0.65	6.19
BY INCOME STATUS									
Low income	0.27	0.29	0.31	0.22	0.21	0.22	0.22	0.23	1.97
Lower middle income	0.36	0.41	0.44	0.27	0.25	0.26	0.26	0.27	2.52
Upper middle income	0.29	0.31	0.33	0.17	0.16	0.16	0.16	0.16	1.72
High income	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.06
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS									
Low income	0.27	0.29	0.31	0.22	0.21	0.22	0.22	0.23	1.97
Lower middle income	0.36	0.41	0.44	0.27	0.25	0.26	0.26	0.27	2.52
Upper middle income	0.21	0.24	0.25	0.10	0.09	0.09	0.09	0.09	1.15
All GFATM-eligible countries	0.84	0.93	1.00	0.58	0.56	0.56	0.57	0.58	5.63
WHO REGION									
Eastern Mediterranean	0.03	0.03	0.04	0.02	0.01	0.01	0.02	0.02	0.17
Africa	0.67	0.72	0.76	0.46	0.44	0.45	0.46	0.47	4.44
Americas	0.06	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.50
Europe	0.01	0.03	0.04	0.02	0.02	0.02	0.02	0.02	0.19
Western Pacific	0.06	0.06	0.07	0.05	0.05	0.05	0.05	0.05	0.44
South-East Asia	0.09	0.10	0.11	0.05	0.04	0.04	0.04	0.04	0.53
BRICS (BRA,CHN,IND,RUS,ZAF)									
Total	0.25	0.28	0.29	0.14	0.13	0.13	0.13	0.13	1.49

Modelling the financial needs of the TB Global Plan 2023–2030

A bottom-up, ingredients-based approach was used to estimate resource needs. Interventions and services were organized into nine algorithms and linked to specific target populations. Coverage and other settings were made consistent with Global Plan strategy targets. A summary of the approach is presented below:

- Algorithms varied by age, pulmonary status, HIV status, MDR status, passive or active TB, etc.
- 54 interventions were costed as part of these algorithms, each with a unit cost by year (in US$).
- Patient in- and out-days were costed directly as part of these algorithms.
- Unit cost came directly from Value TB studies, were based on Value TB data, or came from GDF.
- Value TB data were collected in five countries in ~20 facilities per country, and the recommended method was applied for extrapolation (by country and by year).
- WHO financing data were used to determine markups for programme costs.
- Outliers were identified and removed from the reported WHO expenditure data. Again, 2020 introduced much uncertainty into this process, as many countries could not deliver direct services as planned, skewing the markup.
- A 6% markup was introduced for CRG, based on NSP budgets of programmes implementing CRG.

Unit costs

To estimate unit costs (in US$) for the years 2023–2030, we have used the following methods:

- Data from the Value TB project[8] that have recently been made available for five countries were used, namely, Ethiopia, Georgia, India, Kenya and Philippines. Local currency data for the base year and the inflate/convert methodology[9] were used to arrive at the unit costs for 2023. The US$ GDP deflator was used for 2019 onward, after conversion to US$ was done in 2019 for each country and exchange rate.
- Due to the long period of unit cost extrapolation to 2030, 2019 values and the US$ GDP deflator to 2030 were used, thereby avoiding the uncertainties that would have been introduced by using the provisional 2020 estimates. The programme cost markup was applied to obtain a programme cost estimate for 2023, after which the same GDP deflator used for direct costs was applied.
- For the remaining ~165 countries, unit costs were extrapolated from the five Value TB project countries:
  - Georgia was used as a reference for upper-middle-income high TB burden countries.
  - India was used as a reference for lower middle-income high TB burden countries in South Asia.
  - The Philippines was used as a reference for middle-income high TB burden countries in the Western Pacific Region.
  - Kenya was used as a reference for middle-income high TB burden countries in Africa.
  - Ethiopia was used as a reference for lower income high TB burden countries.

To extrapolate the unit costs from the reference country to the target country, an ingredients-based approach was used, as suggested by Sergio et al[10] . Each cost input in the ingredients costing was classified as a tradable good (consumables), non-tradable good (overheads + capital costs) or staff cost. To convert the tradable goods from the reference country (R) to the target country (T), the cost of the tradable good was converted into US$ in the base year. Tradable goods were inflated using US$-based inflation rates or taking the latest price from the GDF Medicines[11] or Diagnostics Catalog[12] . For extrapolating costs of non-tradable goods (NT) from the base country to the target country, the ratio of purchasing power parity[13] was used to obtain the equivalent costs in local currency for the base year, inflated in local currency using local country-specific inflation rates for the target year, and then converted back to US$ using the target year currency conversion rates. To convert staff costs (S) for a particular service from a base country to the second country, the staff time (in minutes) to conduct the activity and the estimated staff cost per minute in the base country were used. Staff time (in minutes) was extrapolated to the target country without any modifications from the base country. For converting the staff cost (per minute), the conversion rates from Serge et al. were used[14] . GDP per capita multipliers and the nominal GDP ratios were used to convert the staff wages per minute from the base country base year to the target country base year; this cost was multiplied by country-specific inflation rates, and the target year staff cost values in the local currency were obtained and then converted to US$ in the target year conversion rates. The total unit cost in the target country for the target year is the sum of T, NT and S.

For estimating the cost of outpatient visits, we used the GTB WHO CHOICE Health service delivery costs: annual update of WHO CHOICE: TB service delivery estimates.

For the cost of medicines (for TPT) and consumables, the prices in US$ from the latest GDF Diagnostics and Medicines Catalogs were also used. It was estimated that CAD would cost an additional US$ 1 per person (assuming high volumes) undergoing digital chest X-ray.

For all unit cost calculations, the latest country-specific GDP deflation[15] and US$ conversion rates published by the World Bank[16] were used to adjust the inflation and currency conversions from the base year (2019) to the target year (2030).

The list of 54 interventions is shown in Table A1.4. Each intervention is shown with its "Method", which indicates 1) if it is based on the Value TB extrapolation method directly; 2) if its consumables are given, but its non-tradable goods are based on a comparable Value TB unit cost; and 3) if it is specified as a single value or "Lump sum", such as all the treatment costs from the GDF Catalogs.

Table A1.4. Unit cost percentiles for 54 interventions

Intervention	Method	25th percentile	Median	75th percentile
Sputum smear microscopy (ZN or LED-FM)	Value TB	2.0	4.8	16.4
Chest radiography	Value TB	1.4	4.4	31.1

Intervention	Method	25th percentile	Median	75th percentile
Molecular WHO-recommended diagnostic test (mWRD; Xpert MTB/RIF)	Value TB	14.5	18.9	25.1
Clinical assessment	Value TB	0.1	7.1	85.2
Liquid culture	Value TB	24.2	83.1	303.8
LPA-FLD	Value TB	7.9	55.4	86.5
Urinary LAM	Value TB	4.1	5.8	13.1
Sputum collection and transportation	Value TB	1.5	3.4	8.3
CT-scan	Value TB	5.5	25.9	64.3
SGPT	Value TB	0.6	8.7	37.1
SGOT	Value TB	0.6	8.7	37.1
Renal function test (RFT)	Value TB	1.6	20.3	97.7
TST	Value TB	0.9	3.8	10.0
IGRA test	Value TB	8.5	17.8	61.8
Diabetes	Value TB	0.6	2.4	7.1
HIV testing	Value TB	2.4	3.9	8.6
Patient counselling	Value TB	0.4	2.1	20.3
Digital adherence technologies/DOT	Value TB	0.4	2.1	20.3
Sputum smear microscopy at end of intensive phase and end of treatment	Value TB	2.0	4.8	16.4
Liver function tests	Value TB	2.2	26.5	122.8
Post-TB treatment follow-up for TB disease every six months up to two years	Value TB	0.4	2.1	20.3
Sputum culture (monthly)	Value TB	7.4	13.2	112.7
Sputum smear microscopy (monthly)	Value TB	2.0	4.8	16.4
CAD	Lump sum	1.1	1.1	1.1
Portable digital X-Ray	From Value TB	1.1	3.5	27.7
mWRD (Xpert MTB/XDR)	From Value TB	34.5	68.1	74.1
LPA-SLD	Lump sum	63.3	63.3	63.3
Targeted genome sequencing (TGS)	Lump sum	63.3	63.3	63.3
FNAC	From Value TB	0.7	4.1	13.6
Biopsy	From Value TB	0.7	22.8	115.8
Ultrasound	From Value TB	0.7	4.1	13.6
Gastric aspiration	From Value TB	0.7	4.1	13.6
CRP	From Value TB	2.9	18.1	83.6
ECG	From Value TB	1.1	3.5	27.7
Sputum transportation	Lump sum	10.5	10.5	10.5
2HRZE/4HR (Adult)	Lump sum	45.3	45.3	45.3
2HRZE/4HR (Paediatric)	Lump sum	22.7	22.7	22.7
4 RPT-Mox (Adult)	Lump sum	245.7	245.7	245.7
4 RPT-Mox (Paediatric)	Lump sum	122.9	122.9	122.9
Short all-oral BDQ regimen (9–12 months) Adult	Lump sum	738.2	738.2	738.2
Long regimen for DR-TB (18–20 months) Adult	Lump sum	1,054.5	1,054.5	1,054.5
Long regimen for DR-TB (18–20 months), contains delamanid, Adult	Lump sum	2,003.6	2,003.6	2,003.6
BPaL regimen (nine months), Adult	Lump sum	949.1	949.1	949.1
Modified BPaL regimen, Adult	Lump sum	949.1	949.1	949.1
Delamanid-based regimen (Paediatric)	Lump sum	949.1	949.1	949.1
Digital adherence (SMC)	Lump sum	9.4	9.4	9.4
DOT	Lump sum	0.0	0.0	0.0
Patient support costs	Lump sum	0.0	0.0	0.0
Partial lung surgical resection	Lump sum	0.0	0.0	0.0
3 HP (Adult)	Lump sum	15.8	15.8	15.8
3 HR (Paediatric)	Lump sum	15.8	15.8	15.8
Hr-TB (Adult)	Lump sum	45.3	45.3	45.3
Hr-TB (Paediatric)	Lump sum	22.7	22.7	22.7
Inpatient care (for severe adverse drug reactions)	Lump sum	0.1	48.0	1,031.7

Markups

The programme expenditure data reported to WHO were used to estimate the markup of the cost of direct services (diagnosis, treatment and so on) represented by "programme costs", or costs above the patient level. Globally, this cost is more than 70%.

There continues to be a lack of investment in key enabling activities. As with the previous Global Plan, it was recommended by the Global Plan task force to uniformly increase projected budgets to include fixed percentages of specific "enabling" activities, including direct patient support (5%), advocacy & communications (1%), CRG (6%) and PPM (12%, for countries with a high degree of private-sector involvement).

Detailed budgets of a few countries, such as Democratic Republic of the Congo, Georgia, India, Philippines and Tajikistan, judged to be representative in terms of budgeting for enabling activities were used to estimate the size of enabling cost categories.

Resource needs results

Table A1.5 shows the financial needs required to implement the Global Plan 2023–2030 by income status, GFATM eligibility, Global Plan country group, WHO Region and BRICS membership, as well as globally. Resource needs are required to increase substantially from approximately US$ 13 billion per year to implement the UNHLM 2018–2022 strategy to about US$ 26.2 billion per year to implement the Global Plan 2023–2030, including a large-scale vaccine roll-out starting in 2027. Without the vaccine roll-out. Resource needs are estimated at US$ 19.6 billion per year.

An average of US$ 15.2 billion is required per year for the next GFATM replenishment, 2024–2026.

A breakdown of resource needs by cost category is shown in Table A1.6 and Figure A1.3.

Table A1.5. Resource needs by income status, GFATM eligibility, Global Plan country group, WHO Region and BRICS membership

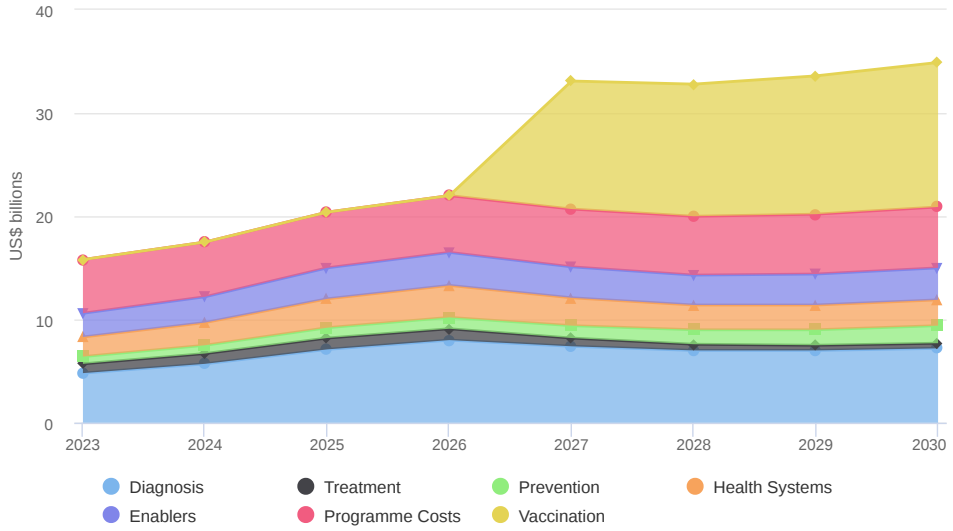
Country category	2023	2024	2025	2026	2027	2028	2029	2030	Total
GLOBAL TOTAL									
Total (Global, including OECD countries)	15.7	17.6	20.3	21.9	33.1	32.8	33.6	34.9	209.8
Total (Global, excluding OECD countries)	15.2	17.0	19.7	21.2	30.3	30.0	30.6	31.8	195.9
BY INCOME STATUS									
Low income	1.8	2.1	2.3	2.5	3.5	3.6	3.7	3.9	23.4
Lower middle income	8.5	9.7	11.4	12.5	16.7	16.4	16.7	17.3	109.1
Upper middle income	4.9	5.3	6.0	6.4	10.4	10.4	10.7	11.1	65.2
High income	0.4	0.5	0.5	0.5	2.4	2.4	2.6	2.7	12.1
GFATM-ELIGIBLE COUNTRIES, BY INCOME STATUS	11.8	13.3	15.5	16.8	22.6	22.3	22.7	23.6	148.7
Low income	1.8	2.1	2.3	2.5	3.5	3.6	3.7	3.9	23.4
Lower middle income	8.5	9.7	11.4	12.5	16.7	16.4	16.6	17.2	109.0
Upper middle income	1.5	1.6	1.8	1.8	2.4	2.4	2.4	2.5	16.4
All GFATM-eligible countries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GLOBAL PLAN COUNTRY SETTING									
Moderate Burden, COE	0.7	0.8	0.8	0.9	1.3	1.3	1.4	1.4	8.6
Low Burden, High Income	0.5	0.5	0.6	0.5	2.7	2.8	2.9	3.1	13.6
Moderate Burden, Middle Income	1.1	1.2	1.4	1.5	3.0	3.0	3.1	3.2	17.4
High Burden, Private Sector	10.4	11.9	14.0	15.2	21.1	20.7	21.1	21.8	136.2
High MDR burden, Centralized Care	1.3	1.2	1.2	1.1	1.6	1.5	1.6	1.6	11.1
High TB-HIV, SADC	0.8	0.9	0.9	0.9	1.1	1.1	1.2	1.2	8.2
High TB-HIV, outside SADC	1.0	1.2	1.4	1.7	2.3	2.3	2.4	2.5	14.8
WHO REGION									
Eastern Mediterranean	0.8	0.8	1.0	1.1	2.1	2.1	2.2	2.3	12.3
Africa	4.7	5.2	6.0	6.8	8.4	8.5	8.8	9.2	57.6
Americas	0.8	0.8	0.9	1.0	2.6	2.6	2.7	2.9	14.4
Europe	1.5	1.4	1.4	1.3	2.8	2.8	2.9	3.0	17.2
Western Pacific	3.1	3.5	4.1	4.4	7.3	7.2	7.4	7.7	44.6
South-East Asia	4.9	5.7	6.8	7.3	9.9	9.6	9.6	9.9	63.8
BRICS (BRA,CHN,IND,RUS,ZAF)									
Total	6.8	7.5	8.6	9.3	14.0	13.7	13.9	14.3	88.1

Table A1.6. Resource needs by cost category (US$ billion)

	2023	2024	2025	2026	2027	2028	2029	2030	Total
Diagnosis	4.8	5.7	7.1	8.0	7.4	7.0	7.0	7.2	54.1
Treatment	0.9	1.0	1.1	1.1	0.8	0.6	0.5	0.5	6.5
Prevention	0.7	0.8	1.0	1.1	1.2	1.4	1.5	1.7	9.3
Vaccination	0.0	0.0	0.0	0.0	12.4	12.8	13.4	14.0	52.6
Health Systems	1.9	2.2	2.8	3.1	2.7	2.4	2.4	2.5	20.0

	2023	2024	2025	2026	2027	2028	2029	2030	Total
Enablers	2.3	2.5	3.0	3.2	3.0	2.9	3.0	3.1	22.9
Programme Costs	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	44.4
Total	**15.7**	**17.6**	**20.3**	**21.9**	**33.1**	**32.8**	**33.6**	**34.9**	**209.8**

Figure A1.3. Resource needs by cost category (US$ billion)



Return on investment (ROI)

ROI, as with the 2016–2020 and 2018–2022 TB Global Plan analyses, is based on the "full income" approach to measuring a society's economic welfare. This approach monetizes life expectancy gains and combines them with consumption gains to estimate improvements in welfare.

Monetary value of averted TB deaths

The monetary value of deaths avoided follows standardized assumptions from the Copenhagen Consensus Center's project Halftime for the SDGs 2015–2030 – where to invest best for the endgame. This project identifies where additional funding from governments, international organizations and philanthropies could yield excellent social, economic and environmental returns for the poorer half of the world (defined as LICs and LMICs).

The project uses the same monetary value across all lives saved in the target population. The valuation is based on guidance on income elasticity for value of statistical life (VSL) benefit transfer provided by Robinson et al. (2019)[17] .

Each death avoided is valued using a VSL of US$ 9.4 million (2015 dollars), representing approximately 160 times income as measured by income per capita PPP, transferred to the LIC and LMIC population using an income elasticity of 1.5.

To estimate these values, we take the GDP per capita figure in 2020 Int$ for the group of LICs and LMICs and the United States of America, and estimate the VSL at time t=0, 2020.

$$VSL_t = \left(\frac{GDP\ pc_{LIC+LMCt}}{GDP\ pc_{USAt}}\right)^{0.5} * 160\ * GDP\ pc_{LIC+LMCt} \qquad \text{(Eq. 1)}$$

Following Cropper et al. (2019)[18] , we estimate each subsequent VSL in the time series according to the following formula:

$$VSL_{t+1} = VSL_t * [(1 + g_t)]^e \qquad \text{(Eq. 2)}$$

where g_t is the GDP per capita growth rate between period t and t+1 (SSP Database, IIASA GDP Model, Scenario SSP2_v9_130219) and e=1.5.

The GDP growth in this group of countries outpaces the population growth, so that the VSL grows rapidly over time. In constant 2020 dollar value, the benefit of an avoided death is $ 98,700 (2020), $ 149,800 (2025), $ 212,000 (2030), $ 276,300 (2035), $ 338,100 (2040), $ 396,800 (2045), and $ 456,000 (2050).

The average VSL approach underestimates the intrinsic value of a life in high-income countries, but 90% of the lives saved by the Global Plan are in LICs and LMICs. The VSL used is close to the average VSL of India.

ROI results

The counterfactual against which cost and benefit are measured is the continued disruption of TB programmes due to COVID-19—the same counterfactual used for the GFATM ROI estimates for the next replenishment cycle, 2024–2026.

The net present value of the yearly costs and benefits used an 8% discount rate. All TB deaths, including deaths in HIV-positive people with TB, were added, although generally part of those costs are borne by HIV programmes.

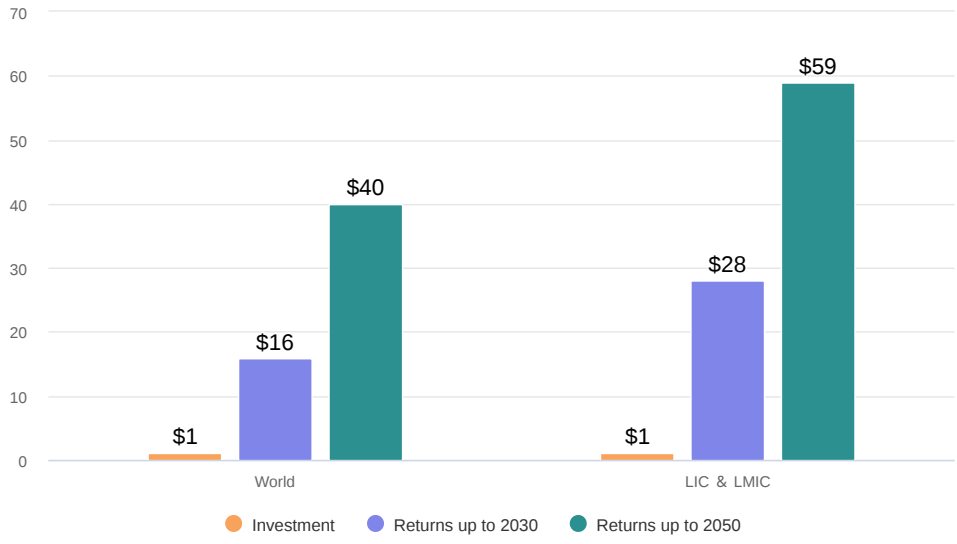
Fully implementing the Global Plan will yield an ROI of US$ 40 per dollar invested, accounting for economic returns projected to accrue through 2050. The rationale for projecting ROI through 2050 is to account for the long-term projected economic returns of mass TB screening and vaccination campaigns that the Global Plan recommends for implementation between 2023 and 2030.

The ROI is higher in LICs and LMICs, where most lives would be saved, namely US$ 59 for each dollar invested.

The ROI measured in 2023–2030 is lower (US$ 16 globally and US$ 28 in LICs and LMICs), but still very favourable. The main reason for the lower ROI measured in the short term is the large upfront investments in large-scale screening, prevention and vaccination campaigns recommended to be implemented before 2030. The benefits of these programmes will take many years to accrue.

These findings are summarized in Figure A1.4.

Figure A1.4. ROI in TB prevention and care per dollar invested, globally and in LICs and LMICs



Costed TB services

This section details the costed services used to estimate the resources needed to implement the Global Plan 2023–2030. The services are arranged broadly into seven algorithms pertaining to diagnosis, TPT and treatment. Table A1.7 states the intervention abbreviations, names and descriptions used throughout the costing section.

For each, the resource needs were determined by summing the algorithm and the underlying services, specifying the factors:

Resource needs(t) = Target population(t) x Population in need(t) x Coverage(t) x Unit cost(t), where:

- **All the variables are time-dependent, with t between 2023 and 2030:**
- **Target population:**
  - Interventions are linked to a population meant to receive the intervention or health service. For example, diagnosis with microscopy is linked to bacteriologically positive notified cases.
- **Population in need (PIN):**
  - Specification for a proportion of the population that is eligible for the intervention. For example, a proportion of all notified cases may need patient support.
  - PIN can also be used to achieve other types of adjustments. For example, a PIN for diagnosis of 40 by 2030 assumes that 40 people with signs and symptoms of TB will need to be tested to find and notify one case by 2030.
- **Coverage:**
  - Coverage targets are specified for 2023 and 2030. For example, diagnosis with Xpert may increase from 40% in the first year of the plan, costed to 100% by 2023.
- **Unit costs as determined by ingredients:**
  - This will typically comprise the following:
    - commodities (e.g., all the commodities needed for a given diagnostic test)

- staff time, e.g., staff time provided by technicians, doctors, community health workers and other types of staff
- capital costs
- overheads
- outpatient and inpatient days (optionally).

Table A1.7. Intervention terms and abbreviations used in the costing exercise

Abbreviation	Explanation
Epidemiology	
MDR	multidrug-resistant
RR	rifampicin-resistant
XDR	extensively drug-resistant
LTBI	latent TB infection
Testing for DS- and DR-TB	
Dx	diagnostics
SCT	sputum/specimen collection and transportation
ST	sputum transportation
CXR	chest X-ray
CAD	computer-aided detection
P-CXR	portable-chest X-ray
GA	gastric aspiration (for collecting specimens for diagnosis of TB in children)
LC	liquid culture
LF-LAM	lateral flow urine lipoarabinomannan assay
mWRD	molecular WHO-recommended rapid diagnostic test
mWRD RR	molecular WHO-recommended rapid diagnostic test for detection of rifampicin resistance
LPA-FLD	line probe assay for first-line drug
LPA-SLD	line probe assay for second-line drug
CRP	c-reactive protein
TGS	targeted gene sequencing
FNAC	fine needle aspiration cytology
CT-scan	computed tomography scan
SC	solid culture
Testing for LTBI	
TBI test	tuberculosis infection test
TST	tuberculin skin test
IGRA	interferon-gamma release assay
Treatment monitoring	
TM	treatment monitoring
OPD	outpatient department
SSM	sputum smear microscopy
FU-PTT	follow-up post-TB treatment
FU-TT	follow-up during TB treatment
SSM	sputum smear microscopy
Other tests and procedures	
HIV-Dx	HIV diagnostic testing
DM	diabetes mellitus
RFT	renal function test
ECG	electrocardiogram
LFT	liver function test
SGPT	serum glutamic pyruvic transaminase
SGOT	serum glutamic-oxaloacetic transaminase
Biopsy	biopsy
USG	ultrasonography
PLSR	partial lung surgical resection
Treatment-related	
DOT	directly observed treatment
DAT	digital adherence technology
PSC	patient support costs
PC	patient counselling

Abbreviation	Explanation
IP-care	inpatient care
OPD-care	outpatient department care
Children/paediatric: regimens for treating active TB	
2HRZE/4HR (paediatric)	paediatric six-month TB treatment regimen containing isoniazid, rifampin, pyrazinamide and ethambutol for two months/isoniazid plus rifampin for four months
Four-month RPT-MOX regimen (paediatric)	paediatric four-month rifapentine-moxifloxacin regimen for the treatment of DS pulmonary TB
Hr-TB regimen (paediatric)	paediatric six-month regimen for rifampicin-susceptible and isoniazid-resistant TB
Delamanid-based regimen (paediatric)	paediatric treatment regimen for MDR-TB or XDR-TB containing delamanid
Adults: regimens for treating active TB	
2HRZE/4HR	six-month TB treatment regimen containing isoniazid, rifampin, pyrazinamide and ethambutol for two months/isoniazid plus rifampin for four months
Four-month RPT-MOX regimen	four-month rifapentine-moxifloxacin regimen for the treatment of DS pulmonary TB
Hr-TB regimen	six-month paediatric regimen for rifampicin-susceptible and isoniazid-resistant TB
Short all-oral BDQ regimen	shorter all-oral bedaquiline-containing regimen for MDR-/RR-TB of 9–12 months' duration
BPaL	regimen of bedaquiline, pretomanid and linezolid for 6–9 months
Longer MDR-TB regimens	TB treatment regimen for MDR-/RR-TB, which lasts at least 18 months
aDSM	active TB drug safety monitoring and management
AE	adverse event
Shorter MDR-TB regimen	MDR-/RR-TB treatment regimen lasting less than 12 months, which is largely standardized
Long regimen for DR-TB, containing delamanid	TB treatment regimen for MDR-/RR-TB containing delamanid, which lasts at least 18 months

Diagnostic services

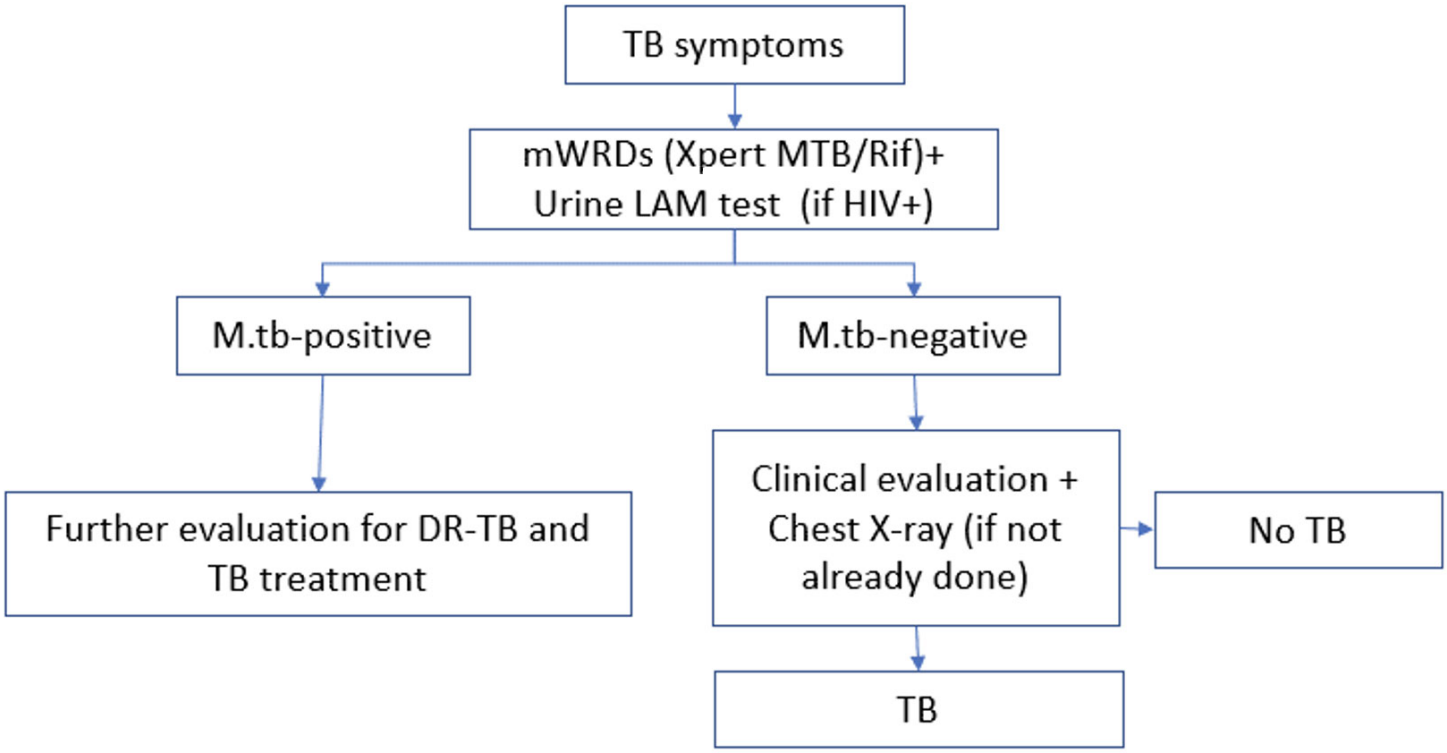
Passive case finding—pulmonary TB (adults and children)

- **Target population subgroups:** People with pulmonary TB disaggregated by
  - age (< 5 years, 5–14 years, ≥ 15 years)
  - HIV+/HIV-
  - new and re-treatment including relapse
  - Bac+/clinically diagnosed.
- Diagnostic algorithm for costing

Description: For persons attending health facilities with TB symptoms, the model assumes that all of them will be offered an mWRD. Those who test positive for Mtb will be further offered other DR-TB tests, such as Xpert MTB/XDR test or a liquid culture test with first- and second-line DST or targeted genome sequencing (TGS) (when it becomes available during the Global Plan 2023–2030) to identify the resistance pattern and assess the choice of anti-TB treatment regimen. Based on the results of the diagnostic tests, persons with TB will be classified into the following five categories: persons with TB with Mtb sensitive to isoniazid (H) and rifampicin (R); persons with TB with Mtb resistant to H (mono or poly) but sensitive to R; persons with TB with Mtb resistant to R or HR only; persons with TB with Mtb resistant to HR + fluoroquinolones (FQ); and finally, persons with TB with Mtb resistant to HR + FQ + BDQ or injectables. People will be offered the appropriate TB treatment regimen based on these categories (see Figure A1.5).

The 2019 distribution of notification types was used to obtain the notification types needed for costing, based on the argument that 2020 would introduce too much uncertainty into the distributions applied through to 2030.

Figure A1.5. Algorithm 1 for diagnosis of pulmonary TB in persons presenting with TB symptoms at health facilities (passive case finding)



The following services (shown in Table A1.8) for the diagnosis of pulmonary TB under passive case finding are included in the costing model:

Table A1.8. Services related to diagnosis of pulmonary TB (passive case finding)

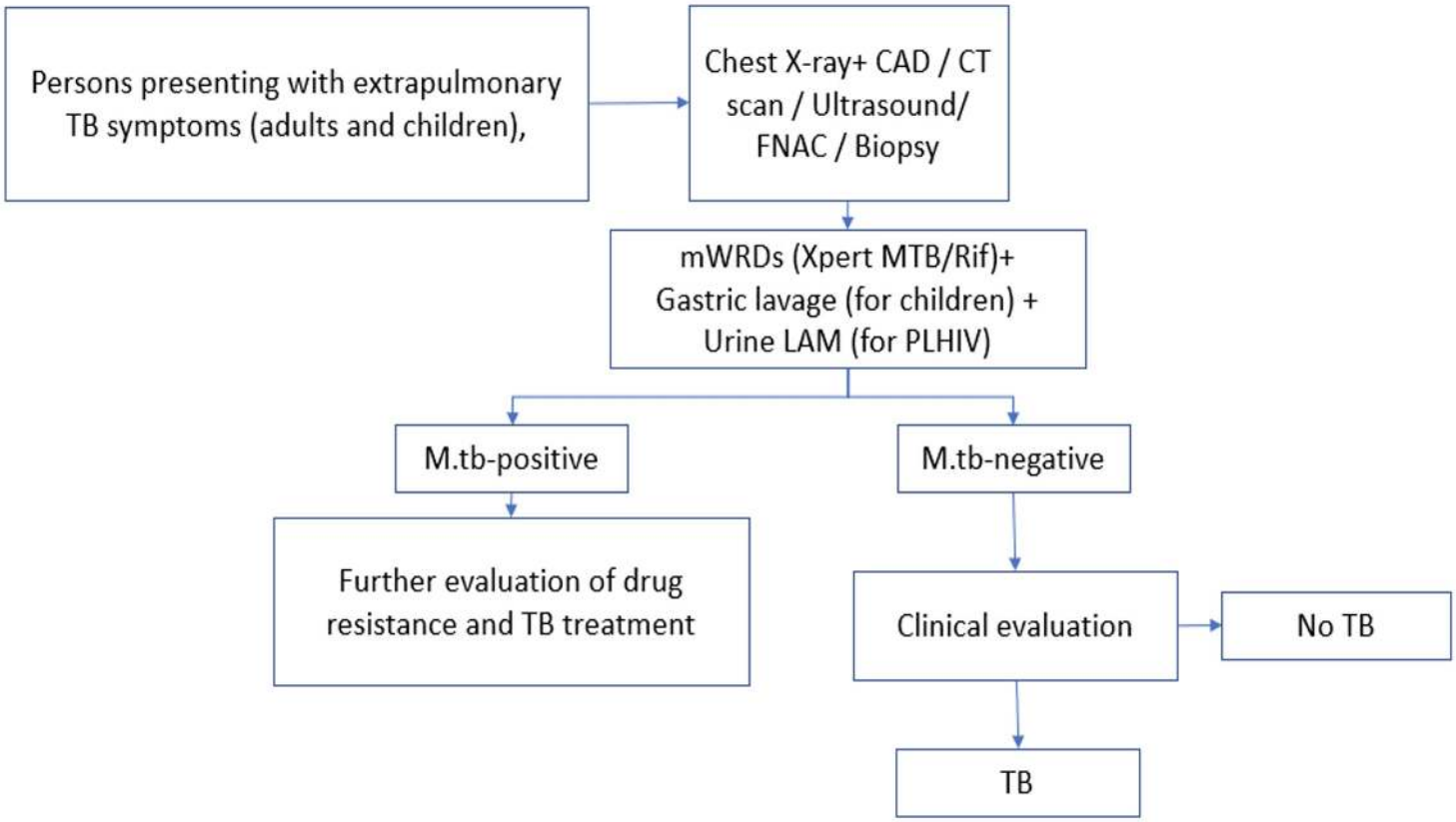
Service	Target population	Number of units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Outpatient department visits	Persons with pulmonary TB symptoms	2	10 times the number of people diagnosed with TB	40 times the number of people diagnosed with TB	100%	100%	
mWRD (Xpert MTB/RIF)	Persons with pulmonary TB symptoms	1	10 times the number of people diagnosed with TB	40 times the number of people diagnosed with TB	100%	100%	
Chest X-ray + CAD	Persons with pulmonary TB symptoms who are Xpert MTB/RIF negative	1	5 times the number of people diagnosed with TB	20 times the number of people diagnosed with TB	100%	100%	CAD only for those aged ≥ 15 years
Gastric aspiration (for children)	Children aged < 5 years with pulmonary TB symptoms	1	10 times the number of children diagnosed with TB	40 times the number of children diagnosed with TB	100%	100%	
Sputum collection and transportation	Persons with pulmonary TB symptoms	1	25% of those who are undergoing diagnostic evaluation	25% of those who are undergoing diagnostic evaluation	100%	100%	
Liquid culture	Persons with pulmonary TB	1	15% of people with TB diagnosed	15% of people with TB diagnosed	100%	100%	
Urine LAM	Persons with pulmonary TB symptoms who are HIV-positive	1	10 times the number of HIV-positive people diagnosed with TB	40 times the number of HIV-positive people diagnosed with TB	100%	100%	

Passive case finding—extrapulmonary TB (adults and children)

- **Target population subgroups:** People with extrapulmonary TB disaggregated by
  - age (< 5 years, 5–14 years, ≥ 15 years)
  - HIV+/HIV-new + re-treatment.
- **Diagnostic algorithm for costing (Figure A1.6)**

Description: For persons attending health facilities with extrapulmonary TB symptoms, the model assumes that all of them will be offered a chest X-ray + CAD along with the either FNAC, biopsy, ultrasound or CT-scan. An mWRD will be offered for all biological specimens collected from such persons. PLHIV presenting with extrapulmonary TB symptoms will also be offered a urine LF-LAM test for the detection of TB.

Figure A1.6. Algorithm 2 for the diagnosis of extrapulmonary TB in persons presenting with extrapulmonary TB symptoms at health facilities (passive case finding)



The following services (shown in Table A1.9) for the diagnosis of extrapulmonary TB under passive case finding are included in the costing model:

Table A1.9. Services related to the diagnosis of extrapulmonary TB

Service	Target population	Number of units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Outpatient department visits	Persons with extrapulmonary TB symptoms	2	10 times the number of people diagnosed with TB	40 times the number of people diagnosed with TB	100%	100%	
mWRD (Xpert MTB/RIF)	Persons with extrapulmonary TB symptoms	1	10 times the number of people diagnosed with TB	40 times the number of people diagnosed with TB	100%	100%	
Chest X-ray + CAD	Persons with extrapulmonary TB symptoms	1	10 times the number of people diagnosed with TB	40 times the number of people diagnosed with TB	100%	100%	CAD only for those aged ≥ 15 years

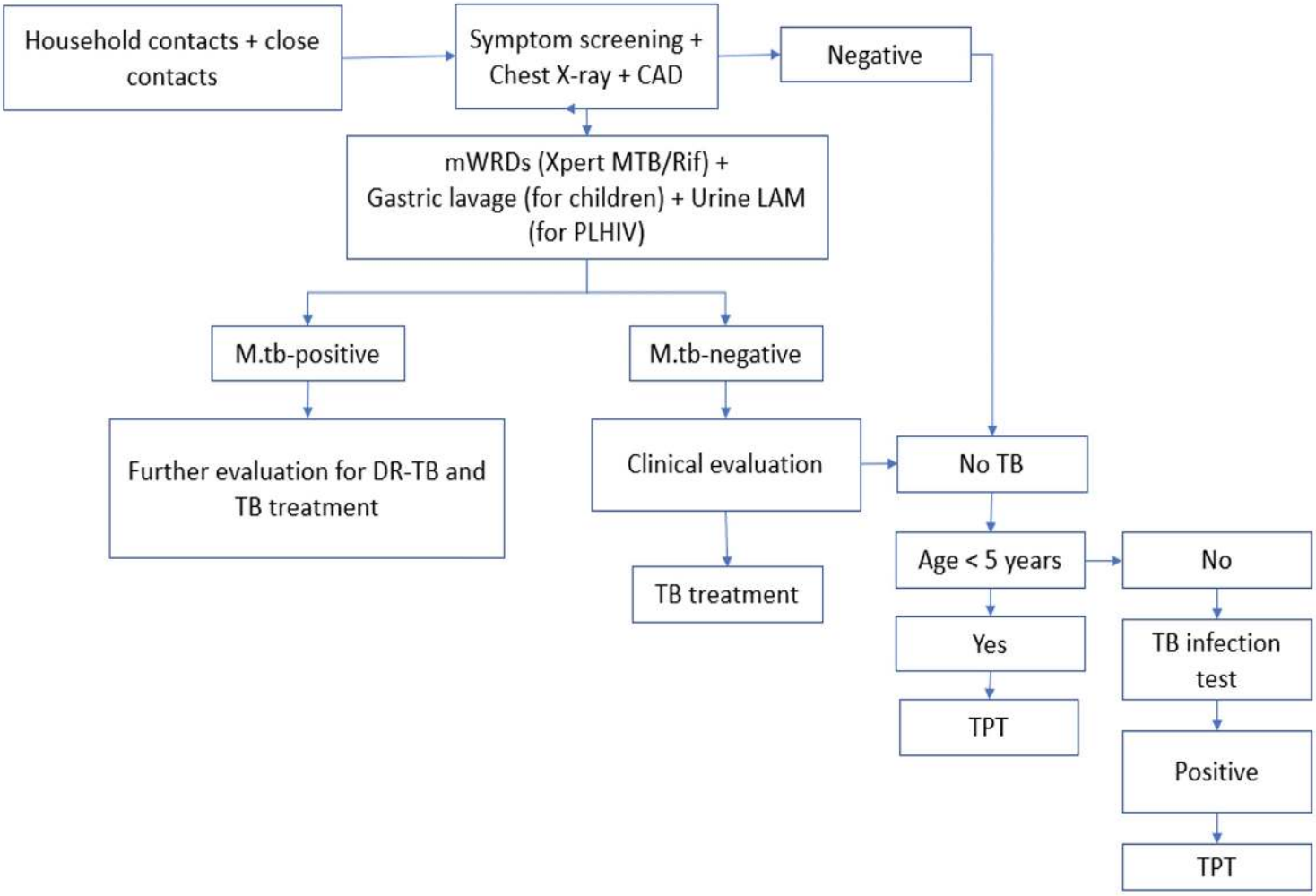
Service	Target population	Number of units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Gastric aspiration (for children)	Children aged < 5 years with extrapulmonary TB symptoms	1	10 times the number of children diagnosed with TB	40 times the number of children diagnosed with TB	100%	100%	
Sputum/specimen collection and transportation	Persons with extrapulmonary TB symptoms	1	25% of those who are undergoing diagnostic evaluation	25% of those who are undergoing diagnostic evaluation	100%	100%	
Liquid culture	People with extrapulmonary TB	1	15% of people with TB diagnosed	15% of people with TB diagnosed	100%	100%	
Urine LAM	Persons with extrapulmonary TB symptoms who are HIV-positive	1	10 times the number of HIV-positive people diagnosed with TB	40 times the number of HIV-positive people diagnosed with TB	100%	100%	
FNAC	Persons with extrapulmonary TB symptoms	1	8 times the number of people diagnosed with extrapulmonary TB	32 times the number of people diagnosed with extrapulmonary TB	100%	100%	
Biopsy	Persons with extrapulmonary TB symptoms	1	2.5 times the number of people diagnosed with extrapulmonary TB	10 times the number of people diagnosed with extrapulmonary TB	100%	100%	
Ultrasound	Persons with extrapulmonary TB symptoms	1	10% of persons with extrapulmonary TB symptoms	10% of persons with extrapulmonary TB symptoms	100%	100%	
CT-scan	Persons with extrapulmonary TB symptoms		20% of persons with extrapulmonary TB symptoms	20% of persons with extrapulmonary TB symptoms	100%	100%	

Systematic screening—household and close contacts (adults and children)

- **Population subgroups:**
  - age (< 5 years, 5–14 years, ≥ 15 years)
  - HIV+/HIV-
  - contacts of people with DS- and DR-TB
- **Algorithm for systematic screening for TB disease among household/close contacts and TPT eligibility (Figure A1.7)**

Description: For household contacts, the model assumes that all of them will be screened for TB symptoms and offered a chest X-ray with CAD (CAD for adults aged ≥ 15 years). Those who screen positive will be offered an mWRD such as Xpert MTB/RIF and will follow the evaluation process as discussed for pulmonary (algorithm 1) and extrapulmonary (algorithm 2) TB. In those without TB, TPT will be offered to everyone under the age of 5 years. For those aged ≥ 5 years, TPT will be offered to those who test positive for TB infection (IGRA test).

Figure A1.7. Algorithm 3 for TB case detection, assessing TPT eligibility and TPT provision among household/close contacts of people with TB



The services included for costing under the systematic screening of household contacts for TB disease and for assessing TPT eligibility are shown in Table A1.10.

Table A1.10. Services for systematic screening of household contacts and for assessing TPT eligibility

Service	Target population	Number of units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Clinical evaluation for TB symptoms (OPD visit)	Household/close contacts	2	All household contacts	All household contacts	100%	100%	Screening test 1
Chest X-ray + CAD	Household/close contacts	1	All household contacts	All household contacts	100%	100%	Screening test 2: CAD only for those aged ≥ 15 years
mWRD (Xpert MTB/RIF)	Household/close contacts who are positive for either of the two screening tests	1	40% of the household contacts aged < 15 years and 20% of household contacts aged ≥ 15 years	40% of the household contacts aged < 15 years and 20% of household contacts aged ≥ 15 years	100%	100%	

Service	Target population	Number of units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Gastric aspiration (for children)	Children aged < 5 years who are positive for either of the two screening tests	1	40% of the household contacts aged < 5 years	40% of the household contacts aged < 5 years	100%	100%	
Sputum/specimen collection and transportation	Household contacts requiring Xpert MTB/RIF test	1	20% of those who are undergoing diagnostic evaluation	20% of those who are undergoing diagnostic evaluation	100%	100%	
Liquid culture	Household contacts	1	2% of household contacts	2% of household contacts	100%	100%	
Urine LAM	Household contacts who are HIV-positive	1	1% of household contacts	1% of household contacts	100%	100%	
FNAC	Household contacts with extrapulmonary TB symptoms	1	1% of household contacts	1% of household contacts	100%	100%	
Biopsy	Household contacts with extrapulmonary TB symptoms	1	0.8% of household contacts	0.8% of household contacts	100%	100%	
Ultrasound	Household contacts with extrapulmonary TB symptoms	1	0.5% of household contacts	0.5% of household contacts	100%	100%	
CT-scan	Household contacts with extrapulmonary TB symptoms	1	0.1% of household contacts	0.1% of household contacts	100%	100%	
IGRA test	Household contacts aged ≥ 5 years without TB disease	1	90% of household contacts aged ≥ 5 years	90% of household contacts aged ≥ 5 years	100%	100%	TB infection tests

Systematic screening—TPT for household and close contacts (adults and children)

The following services (shown in Table A1.11) for provision of TPT to those found to be TPT-eligible are included in the costing model:

Table A1.11. Services for provision of TPT to those who are TPT-eligible

Service	Target population	Number of units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
TPT (3 HR regimen)	All household contacts of people with bac+ TB aged < 5 years without TB disease	1	90% of household contacts aged < 5 years	90% of household contacts aged < 5 years	100%	100%	

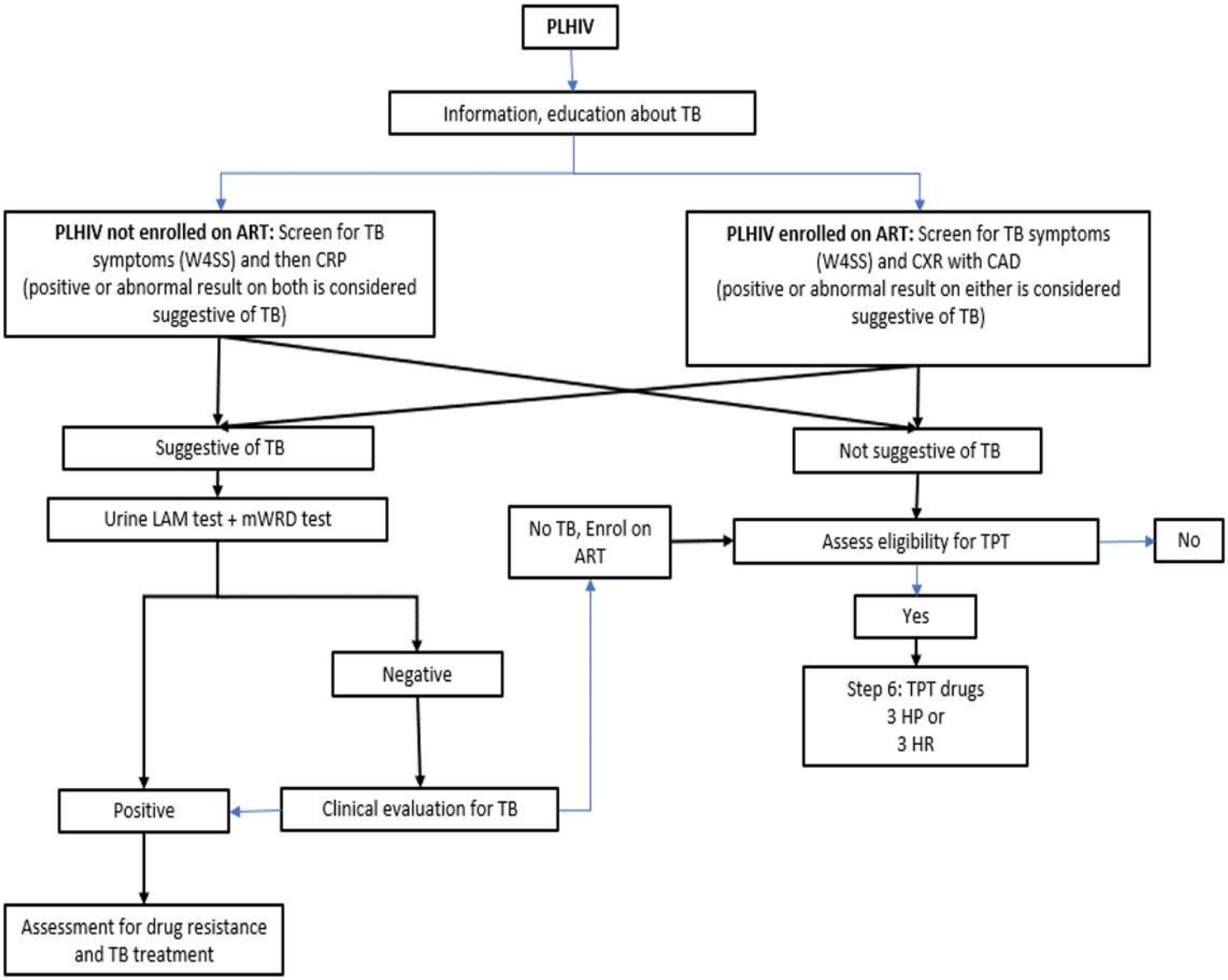
Service	Target population	Number of units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
TPT (3 HP regimen)	All household contacts of people with bac+ TB aged ≥ 5 years without TB disease and those who are IGRA-positive	1	~35% of household contacts aged ≥ 5 years	~35% of household contacts aged ≥ 5 years	100%	100%	
SGPT	Household contacts receiving TPT with adverse drug reactions	1	5% of household contacts receiving TPT	5% of household contacts receiving TPT	100%	100%	Liver function tests
SGOT	Household contacts receiving TPT with adverse drug reactions	1	5% of household contacts receiving TPT	5% of household contacts receiving TPT	100%	100%	Liver function tests
Inpatient care (for severe adverse drug reactions)	Household contacts receiving TPT with adverse drug reactions	10	1% of household contacts receiving TPT	1% of household contacts receiving TPT	100%	100%	

Systematic screening—PLHIV (adults and children)

- **Population subgroups:**
  - age < 10 years and ≥ 10 years
  - newly diagnosed and on ART for less than six months, or on ART for more than six months
  - severely ill (CD4 cell count < 200 cells/mm^3) vs not severely ill (CD4 cell count > 200 cells/mm^3)
- **Algorithm for systematic screening of PLHIV for TB disease and assessing TPT eligibility (Figure A1.8)**

Description: For people newly diagnosed with HIV, the model assumes that they would undergo screening for TB disease at the time of diagnosis. The screening methods include so-called four-symptom screening along with a test for C-reactive protein (CRP). For PLHIV who are already on ART, the model assumes that they would undergo systematic screening for TB disease once a year. The screening methods include four-symptom screening along with a chest X-ray with CAD. Those who screen positive will be evaluated for pulmonary and extrapulmonary TB disease using a combination of urine LF-LAM test and mWRD (Xpert MTB/RIF), and will be treated for TB (if diagnosed). Newly diagnosed PLHIV without TB disease will be initiated on TPT.

Figure A1.8. Algorithm 4 for systematic screening of PLHIV for TB disease



The services included for costing under the systematic screening of PLHIV for TB disease and for assessing TPT eligibility are shown in Table A1.12.

Table A1.12. Services for the systematic screening of PLHIV and assessing TPT eligibility

Service	Target population	Number of units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Clinical evaluation for TB four symptoms at the time of health facility visit (OPD visit)	All PLHIV	1	100%	100%	100%	100%	
Chest X-ray + CAD	All PLHIV who are on ART	1	100%	100%	100%	100%	CAD only for those aged ≥ 15 years
CRP	All PLHIV newly diagnosed who screen positive with four-symptom screening	1	66% of PLHIV newly diagnosed	66% of PLHIV newly diagnosed	100%	100%	

Service	Target population	Number of units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Gastric aspiration	Children living with HIV who screen positive	1	10% of children living with HIV	10% of children living with HIV	100%	100%	
Urine LF-LAM	All PLHIV newly diagnosed and those already on ART who screen positive	1	30% of all PLHIV	30% of all PLHIV	100%	100%	
mWRD (Xpert MTB/Rif)	All PLHIV newly diagnosed and those already on ART who screen positive	1	30% of all PLHIV	30% of all PLHIV	100%	100%	
mWRD (Xpert MTB/XDR)	Children living with HIV who screen positive	1	5% of PLHIV	5% of PLHIV	100%	100%	
Sputum collection and transportation	All PLHIV with Bac+ pulmonary TB	1	5% of PLHIV	5% of PLHIV	100%	100%	
Liquid culture	All PLHIV with Bac+ pulmonary TB	1	5% of PLHIV	5% of PLHIV	100%	100%	
LPA-SLD	All PLHIV with Bac+ pulmonary TB	1	5% of PLHIV	5% of PLHIV	100%	100%	
TGS	All PLHIV with Bac+ pulmonary TB	1	0%	0%	0%	0%	
FNAC	All PLHIV	1	3% of PLHIV	3% of PLHIV	100%	100%	
Biopsy	All PLHIV	1	1% of PLHIV	1% of PLHIV	100%	100%	
Ultrasound	All PLHIV	1	0.5% of PLHIV	0.5% of PLHIV	100%	100%	
CT-scan	All PLHIV	1	0.1% of PLHIV	0.1% of PLHIV	100%	100%	
SGPT	All PLHIV	1	1% of PLHIV	1% of PLHIV	100%	100%	To rule out contraindications for TPT
SGOT	All PLHIV	1	1% of PLHIV	1% of PLHIV	100%	100%	To rule out contraindications for TPT

Systematic screening—TPT for PLHIV (adults and children)

The following services (shown in Table A1.13) for the provision of TPT to PLHIV found to be TPT-eligible are included in the costing model:

Table A1.13. Services for the provision of TPT to PLHIV found to be TPT-eligible

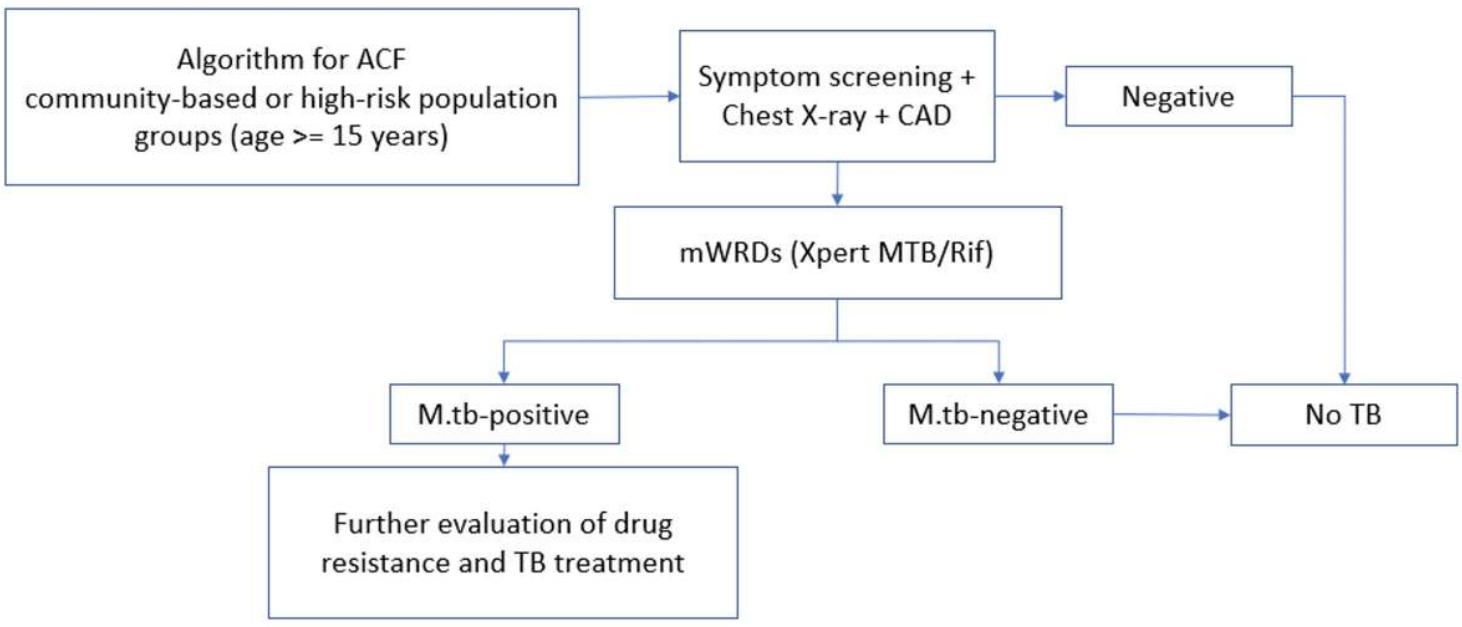
Service	Target population	Number of units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
TPT (3 HR regimen)	All PLHIV aged < 5 years newly diagnosed with HIV without TB disease	1	90% of PLHIV aged < 5 years newly diagnosed with HIV	90% of PLHIV aged < 5 years newly diagnosed with HIV	100%	100%	
TPT (3 HP regimen)	All PLHIV aged ≥ 5 years newly diagnosed with HIV without TB disease	1	90% of PLHIV aged ≥ 5 years newly diagnosed with HIV	90% of PLHIV aged ≥ 5 years newly diagnosed with HIV	100%	100%	
SGPT	PLHIV newly diagnosed with HIV and initiated on TPT	1	10% of those on TPT	10% of those on TPT	100%	100%	
SGOT	PLHIV newly diagnosed with HIV and initiated on TPT	1	10% of those on TPT	10% of those on TPT	100%	100%	
Inpatient care (for severe adverse drug reactions)	PLHIV newly diagnosed with HIV and initiated on TPT	10	2% of those on TPT	2% of those on TPT	100%	100%	10 days of inpatient care

Systematic screening—key and vulnerable population groups (at the community level)

- **Population subgroups**
  - age ≥ 15 years
  - those dwelling in urban slums
  - people deprived of their libertyother high TB burden subgroups approximated as 3.5% of the total population, based on TB vulnerability studies
- **Algorithm for systematic screening for TB in key and vulnerable populations (Figure A1.9)**

Description: All persons in key and vulnerable populations will be offered symptom screening and chest X-ray with CAD. Those who screen positive to either of the two screening methods will be offered an mWRD (Xpert MTB/RIF).

Figure A1.9. Algorithm 5 for systematic screening of key and vulnerable populations for TB



The following services (shown in Table A1.14) for the systematic screening of key and vulnerable populations for TB disease are included in the costing model:

Table A1.14. Services for the systematic TB screening of key and vulnerable populations

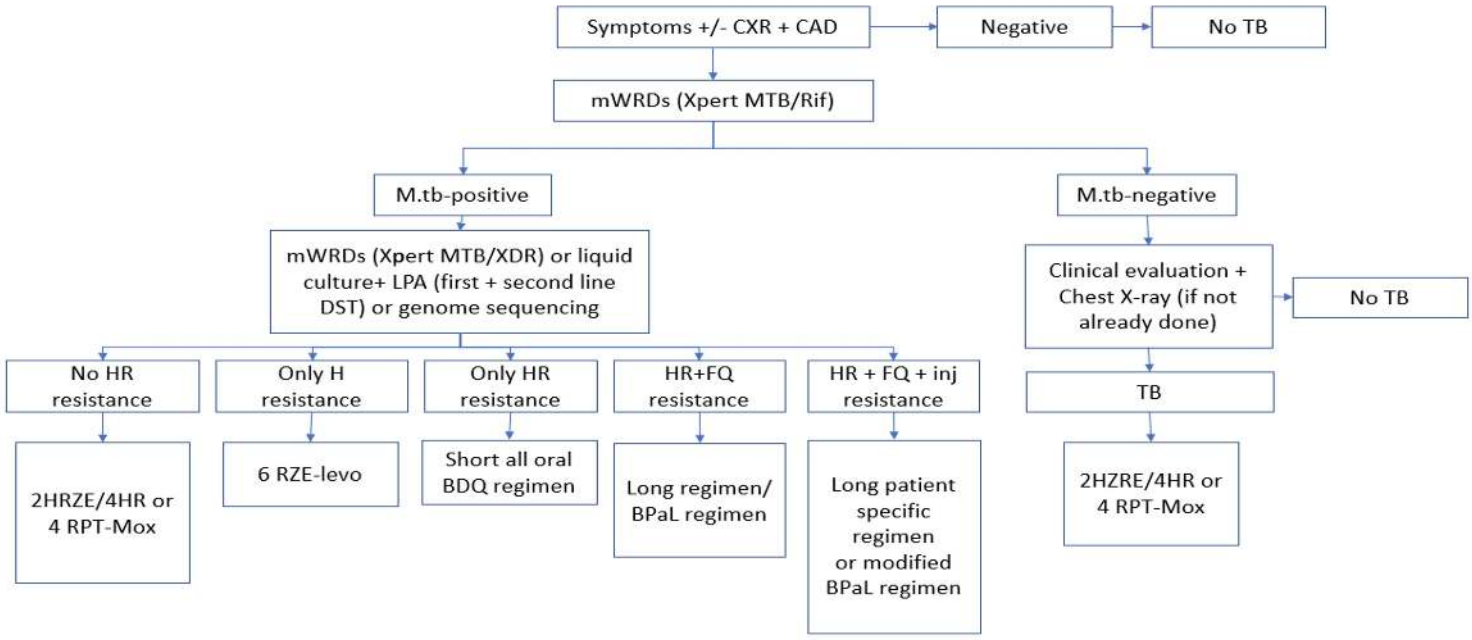
Service	Target population	Number of units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Assessment for symptoms (at the community level)	Key and vulnerable populations targeted for systematic screening	2	100%	100%	100%	100%	Screening test 1
Chest X-ray + CAD	Key and vulnerable populations targeted for systematic screening	1	100%	100%	100%	100%	Screening test 2: CAD only for those aged >= 15 years
mWRD (Xpert MTB/RIF)	Key and vulnerable populations targeted for systematic screening who screen positive for screening test 1 or 2	1	16% of the key and vulnerable population	16% of the key and vulnerable population	100%	100%	
Sputum/specimen collection and transportation	Key and vulnerable populations targeted for systematic screening who screen positive for screening test 1 or 2	1	10% of those requiring mWRD	10% of those requiring mWRD	100%	100%	At each visit, samples from multiple persons can be taken
Clinical assessment through OPD visit	Key and vulnerable populations targeted for systematic screening found to be bac+	1	0.6% of the key and vulnerable population	0.6% of the key and vulnerable population	100%	100%	
mWRD (Xpert MTB/XDR)	Key and vulnerable populations targeted for systematic screening found to be bac+	1	0.6% of the key and vulnerable population	0.6% of the key and vulnerable population	100%	100%	
HIV testing	Key and vulnerable populations targeted for systematic screening found to be bac+	1	0.6% of the key and vulnerable population	0.6% of the key and vulnerable population	100%	100%	
Liquid culture	Key and vulnerable populations targeted for systematic screening found to be bac+ who may require LPA-SLD	1	0.05% of the key and vulnerable population	0.05% of the key and vulnerable population	100%	100%	
TGS	Key and vulnerable populations targeted for systematic screening found to be bac+	1	0%	0%	0%	0%	
SGPT	Key and vulnerable populations targeted for systematic screening found to be bac+	1	0.06% of the key and vulnerable population	0.06% of the key and vulnerable population	0%	0%	10% of people with TB will need this test, due to key and vulnerable populations

Service	Target population	Number of units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
SGOT	Key and vulnerable populations targeted for systematic screening found to be bac+	1	0.06% of the key and vulnerable population	0.06% of the key and vulnerable population	0%	0%	10% of people with TB will need this test, due to key and vulnerable populations

Diagnostic services for detection of drug resistance and comorbidities (for all patients diagnosed through passive case finding and systematic screening)

All persons with bacteriologically confirmed TB will be offered additional diagnostic tests for the detection/determination of DR-TB, as described in Figure A1.10, and will be offered a TB treatment regimen according to the drug resistance profile.

Figure A1.10. Algorithm 6 for determining the drug resistance profile of people diagnosed with TB and the appropriate TB treatment regimen



**All children with Mtb resistant to rifampicin and isoniazid will receive a delamanid-based paediatric DR-TB regimen. Apart from assessment of DR-TB, all persons diagnosed with TB will also undergo systematic assessment for undernutrition, diabetes, smoking, alcohol use disorder and HIV infection as part of the diagnostic evaluation.*

The following services (shown in Table A1.15) for determining the drug resistance profile of people with TB and for assessing comorbidities are included in the costing model:

Table A1.15. Services for determining drug resistance profile and comorbidities

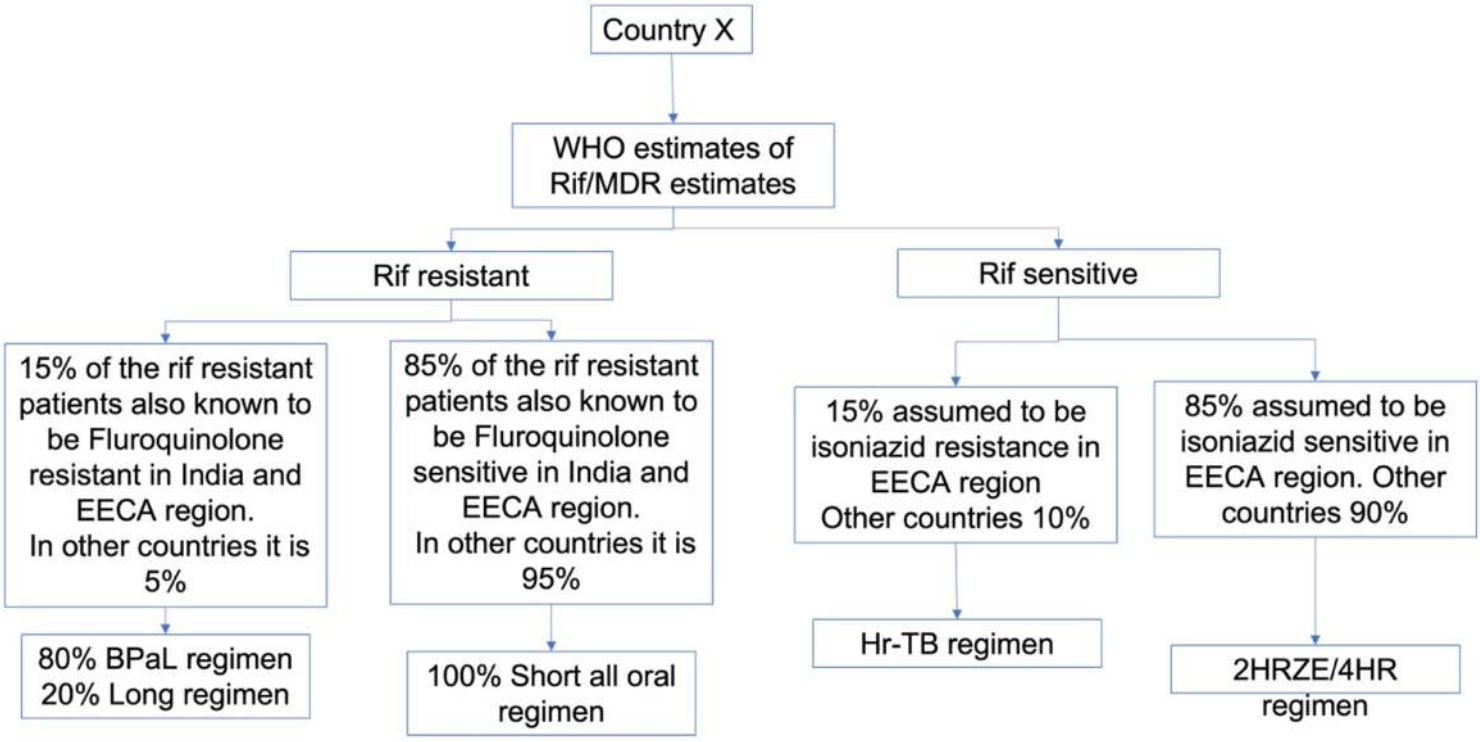
Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
mWRD (Xpert MTB/XDR)	Persons with TB symptoms who are Xpert MTB/RIF positive	1	100% of people diagnosed with TB	100% of people diagnosed with TB	100%	100%	

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Liquid culture + LPA (first-line + second-line)	Persons with TB symptoms who are Xpert MTB/RIF positive	1	2% of people with TB	2% of people with TB	2%	2%	
TGS	Persons with TB symptoms who are Xpert MTB/RIF positive	1	100% of people diagnosed with TB	100% of people diagnosed with TB	0%	0%	
Systematic screening for other risk factors: undernutrition	All persons diagnosed with TB	1	100% of people diagnosed with TB	100% of people diagnosed with TB	100%	100%	
Systematic screening for other risk factors: diabetes (rapid diagnostic test)	All persons diagnosed with TB	1	100% of people diagnosed with TB	100% of people diagnosed with TB	100%	100%	
Systematic screening for other risk factors: smoking	All persons diagnosed with TB	1	100% of people diagnosed with TB	100% of people diagnosed with TB	100%	100%	
Systematic screening for other risk factors: alcohol use disorder	All persons diagnosed with TB	1	100% of people diagnosed with TB	100% of people diagnosed with TB	100%	100%	
Systematic screening for other risk factors: HIV infection (rapid diagnostic test)	All persons diagnosed with TB	1	100% of people diagnosed with TB	100% of people diagnosed with TB	100%	100%	

TB treatment regimens and services for all TB patients diagnosed through passive case finding and systematic screening

The distribution of people with TB on various TB treatment regimens is based on the following assumptions (Figure A1.11).

Figure A1.11. Algorithm 7 for describing the methodology for estimating the proportion of people with TB eligible for various TB treatment regimens



In any given country, information about the prevalence of RR-/MDR-TB was obtained from the WHO's Global TB Report 2020/2021. All persons with H- and R-sensitive TB (irrespective of resistance to other medicines) would receive the standard 2HRZE/4HR TB treatment regimen. In persons with rifampicin-sensitive TB, 15% in the Eastern Europe and Central Asia (EECA) region and 10% in other countries were assumed to have isoniazid mono- or poly-resistance and would be given the Hr-TB regimen. In those with RR-/MDR-TB, 15% of such persons in India and EECA were assumed to have FQ-resistant Mtb, and in other countries, 5% of people with TB were assumed to have FQ-resistant Mtb. 80% of people with TB with FQ resistance would receive the BPaL regimen, and the remaining would receive a longer DR-TB treatment regimen. 100% of those with RR-TB without FQ resistance would receive a shorter all-oral DR-TB regimen.

Six-month regimen (2HRZE/4HR)

The following services (see Table A1.16) for people with TB eligible for the six-month regimen (2HRZE/4HR) are included in the costing model:

Table A1.16. Services for people with TB eligible for the six-month regimen

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Six-month regimen (2HRZE/4HR)	For all people diagnosed with TB that is sensitive to isoniazid and rifampicin	1	100%	100%	100%	100%	
Patient counselling	For all people with TB initiated on the 2HRZE/4HR regimen	6	100%	100%	100%	100%	At person's home by a health care worker
Clinical evaluation	For all people with TB initiated on the 2HRZE/4HR regimen	5	100%	100%	100%	100%	At a health facility (OPD visit) once a month
Digital adherence technologies	For all people with TB initiated on the 2HRZE/4HR regimen	1	100%	100%	100%	100%	GDF Catalog

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Liver function tests	For all people with TB initiated on the 2HRZE/4HR regimen who develop adverse drug reactions	2	20%	20%	100%	100%	Two liver function tests
Inpatient care	For all people with TB initiated on the 2HRZE/4HR regimen with severe illness and/or those who develop severe adverse drug reactions	10 days of inpatient care	20%	20%	100%	100%	Assuming such persons require 10 days of inpatient medical care
Sputum smear microscopy	For all people with TB initiated on the 2HRZE/4HR regimen	2	95%	95%	100%	100%	At the end of intensive phase and end of TB treatment
Liquid culture	For all people with TB initiated on the 2HRZE/4HR regimen with suspected treatment failure	1	5%	5%	100%	100%	

Four-month regimen (RPT-Mox) treatment regimen, including children

The following services (shown in Table A1.17) for people with TB eligible for the four-month (RPT-Mox) treatment regimen are included in the costing model:

Table A1.17. Services for people with TB eligible for the four-month regimen

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Four-month regimen (RPT-Mox)	For all people diagnosed with TB that is sensitive to isoniazid and rifampicin	1	100%	100%	100%	100%	
Patient counselling	For all people with TB initiated on the four-month regimen (RPT-Mox)	4	100%	100%	100%	100%	At person's home by a health care worker
Clinical evaluation	For all people with TB initiated on the four-month regimen (RPT-Mox)	3	100%	100%	100%	100%	At a health facility (OPD visit) once a month
Digital adherence technologies	For all people with TB initiated on the four-month regimen (RPT-Mox)	1	100%	100%	100%	100%	GDF Catalog

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Liver function tests	For all people with TB initiated on the RPT-Mox regimen who develop adverse drug reactions	2	20%	20%	20%	20%	Two liver function tests
Inpatient care	For all people with TB initiated on the RPT-Mox regimen with severe illness and/or those who develop severe adverse drug reactions	10 days of inpatient care	20%	20%	100%	100%	Assuming such persons require 10 days of inpatient medical care
Sputum smear microscopy	For all people with TB initiated on the RPT-Mox regimen	2	95%	95%	100%	100%	At the end of intensive phase and end of TB treatment
Liquid culture	For all people with TB initiated on the RPT-Mox regimen with suspected treatment failure	1	5%	5%	100%	100%	

Regimen for rifampicin-susceptible, isoniazid-resistant tuberculosis (Hr-TB)

The treatment regimen comprises the drugs rifampicin, ethambutol, pyrazinamide and levofloxacin for six months, including for children, and the services included in the costing for people with TB eligible to receive this regimen are shown in Table A1.18.

Table A1.18. Services for people with TB eligible to receive the Hr-TB regimen

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Six-month regimen containing rifampicin, ethambutol, pyrazinamide, and levofloxacin (Hr-TB regimen)	For all people diagnosed with TB that is resistant to isoniazid but sensitive to rifampicin	1	100%	100%	100%	100%	
Patient counselling	For all people with TB initiated on the Hr-TB regimen	4	100%	100%	100%	100%	At person's home by a health care worker
Clinical evaluation	For all people with TB initiated on the Hr-TB regimen	5	100%	100%	100%	100%	At a health facility (OPD visit) once a month

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Digital adherence technologies	For all people with TB initiated on the Hr-TB regimen	1	100%	100%	100%	100%	GDF Catalog
Liver function tests	For all people with TB initiated on the Hr-TB regimen who develop adverse drug reactions	2	20%	20%	100%	100%	Two liver function tests
Inpatient care	For all people with TB initiated on the Hr-TB regimen with severe illness and/or those who develop severe adverse drug reactions	10 days of inpatient care	20%	20%	100%	100%	Assuming such persons require 10 days of inpatient medical care
Sputum smear microscopy	For all people with TB initiated on the Hr-TB regimen	2	95%	95%	100%	100%	At the end of intensive phase and end of TB treatment
Liquid culture	For all people with TB initiated on the Hr-TB regimen with suspected treatment failure	1	5%	5%	100%	100%	

Nine-month all-oral shorter DR-TB regimen (for adults)

The following services (shown in Table A1.19) for people with TB eligible to receive the nine-month all-oral shorter DR-TB regimen are included in the costing model:

Table A1.19. Services for people with TB eligible for the nine-month all-oral shorter DR-TB regimen

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Nine-month all-oral shorter DR-TB regimen	For all people diagnosed with TB that is resistant to isoniazid and rifampicin	1	100%	100%	100%	100%	
Inpatient care	For all people with TB initiated on the all-oral shorter DR-TB regimen with severe illness at diagnosis	10 days of inpatient care	20%	20%	100%	100%	Assuming such persons require 10 days of inpatient medical care

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Patient counselling at person's home by a health care worker	For all people with TB initiated on the all-oral shorter DR-TB treatment regimen	9	100%	100%	100%	100%	
Clinical evaluation at a health facility (OPD visit) once a month	For all people with TB initiated on the all-oral shorter DR-TB treatment regimen	8	100%	100%	100%	100%	
Digital adherence technologies	For all people with TB initiated on the all-oral shorter DR-TB treatment regimen	1	100%	100%	100%	100%	GDF Catalog
Liver function tests	For all people with TB initiated on the all-oral shorter DR-TB treatment regimen who develop adverse drug reactions	2	20%	20%	100%	100%	Two liver function tests
ECG monitoring	For all people with TB initiated on the all-oral shorter DR-TB treatment regimen	9	100%	100%	100%	100%	At diagnosis and at every visit to health facility
Sputum smear microscopy	For all people with TB initiated on the all-oral shorter DR-TB treatment regimen	8	95%	95%	100%	100%	Every month
Liquid culture	For all people with TB initiated on the all-oral shorter DR-TB treatment regimen with suspected treatment failure	8	95%	95%	100%	100%	Every month

BPaL regimen (for adults)

The following services (shown in Table A1.20) for people with TB eligible to receive the nine-month BPaL regimen are included in the costing model:

Table A1.20. Services for people with TB eligible to receive the BPaL regimen

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Nine-month BPaL regimen	For all people diagnosed with TB that is resistant to isoniazid, rifampicin and fluoroquinolones	1	100%	100%	100%	100%	
Inpatient care	For all people with TB initiated on the BPaL regimen with severe illness and/or those who develop severe adverse drug reactions	10 days of inpatient care	20%	20%	100%	100%	Assuming such persons require 10 days of inpatient medical care

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Patient counselling at person's home by a health care worker	For all people with TB initiated on the BPaL regimen	9	100%	100%	100%	100%	
Clinical evaluation at a health facility (OPD visit) once every month	For all people with TB initiated on the BPaL regimen	8	100%	100%	100%	100%	
Digital adherence technologies	For all people with TB initiated on the BPaL regimen	1	100%	100%	100%	100%	GDF Catalog
Liver function tests	For all people with TB initiated on the BPaL regimen who develop adverse drug reactions	2	20%	20%	100%	100%	Two liver function tests
ECG monitoring	For all people with TB initiated on the BPaL regimen	9	100%	100%	100%	100%	At diagnosis and at every visit to health facility
Sputum smear microscopy	For all people with TB initiated on the BPaL regimen	8	95%	95%	100%	100%	Every month
Liquid culture	For all people with TB initiated on the BPaL regimen with suspected treatment failure	8	95%	95%	100%	100%	Every month

18–24-month longer treatment DR-TB regimen (for adults)

The following services (shown in Table A1.21) for people with TB eligible to receive the 18–24-month longer DR-TB treatment regimen are included in the costing model:

Table A1.21. Services for people with TB eligible for the 18–24-month longer DR-TB regimen

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
18–24-month longer treatment regimen	For all people diagnosed with TB that is resistant to isoniazid, rifampicin, fluoroquinolones and injectables/bedaquiline	1	100%	100%	100%	100%	
Inpatient care	For all people with TB initiated on the 18–24-month longer treatment regimen with severe illness and/or those who develop severe adverse drug reactions	10 days of inpatient care	20%	20%	100%	100%	Assuming such persons require 10 days of inpatient medical care

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Patient counselling at person's home by a health care worker	For all people with TB initiated on the 18–24-month longer treatment regimen	18	100%	100%	100%	100%	
Clinical evaluation at a health facility (OPD visit) once every month	For all people with TB initiated on the 18–24-month longer treatment regimen	18	100%	100%	100%	100%	
Digital adherence technologies	For all people with TB initiated on the 18–24-month longer treatment regimen	1	100%	100%	100%	100%	GDF Catalog
Liver function tests	For all people with TB initiated on the 18–24-month longer treatment regimen who develop adverse drug reactions	9	20%	20%	100%	100%	Once every two months
ECG monitoring	For all people with TB initiated on the 18–24-month longer treatment regimen	18	100%	100%	100%	100%	At diagnosis and at every visit to health facility
Sputum smear microscopy	For all people with TB initiated on the 18–24-month longer treatment regimen	18	95%	95%	100%	100%	Every month
Liquid culture	For all people with TB initiated on the 18–24-month longer treatment regimen with suspected treatment failure	18	95%	95%	100%	100%	Every month

Nine-month delamanid-based regimen (for children)

This regimen will be offered to all children diagnosed with resistance to rifampicin. The services included in the costing for children with TB eligible to receive this regimen are as follows (Table A1.22).

Table A1.22. Services for children with TB eligible to receive the nine-month delamanid-based regimen

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Nine-month delamanid-based regimen	For all children diagnosed with TB that is resistant to isoniazid and rifampicin	1	100%	100%	100%	100%	

Service	Target population	Number of service units per person	Population in need		Coverage		Remarks
			2023	2030	2023	2030	
Inpatient care	For all children with TB initiated on the delamanid-based regimen with severe illness and/or those who develop severe adverse drug reactions	10 days of inpatient care	20%	20%	100%	100%	Assuming such persons require 10 days of inpatient medical care
Patient counselling at person's home by a health care worker	For all children with TB initiated on the delamanid-based regimen	9	100%	100%	100%	100%	
Clinical evaluation at a health facility (OPD visit) once every month	For all children with TB initiated on the delamanid-based regimen	8	100%	100%	100%	100%	
Digital adherence technologies	For all children with TB initiated on the delamanid-based regimen	1	100%	100%	100%	100%	GDF Catalog
Liver function tests	For all children with TB initiated on the delamanid-based regimen who develop adverse drug reactions	2	20%	20%	100%	100%	Two liver function tests
ECG monitoring	For all children with TB initiated on the delamanid-based regimen	9	100%	100%	100%	100%	At diagnosis and at every visit to health facility
Sputum smear microscopy	For all children with TB initiated on the delamanid-based regimen	8	95%	95%	100%	100%	Every month

Other interventions to be included for costing

Subclinical TB

Operational definition: Persons who are asymptomatic, but have abnormalities on their chest X-ray suggestive of TB and are bacteriologically confirmed with an mWRD test as having TB.

Target population for detection of subclinical TB: Due to the various diagnostic algorithms used in the costing model, the detection of subclinical TB has been included among household/close contacts, PLHIV, and key and vulnerable populations.

Vaccination

Operational definition: A two-dose vaccine with an efficacy of 60% in people who are positive for latent TB infection (LTBI; may also have some impact on people who are LTBI-negative) will be available for roll-out in 2027. Vaccine cost is assumed to be US$ 4 per dose, or US$ 8 per person (for two doses). Vaccine delivery cost is assumed to be an additional US$ 2 per dose, or US$ 4 per person vaccinated with two doses.

Target population and coverage of TB vaccine: Coverage will be at least 60% of adolescents and adults (all above 10 years of age). Coverage will be maintained at 60% or more after 2030 by vaccinating the cohort of 10-year-olds entering the adolescent age group each year (about 140 million at the global level) and vaccinating the number of people equal to the number of those dying in the vaccinated cohorts.

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5. Nim Pathy and Sandip Mandap conducted "deep-dive" supplementary studies for Indonesia, Kenya and Ukraine.
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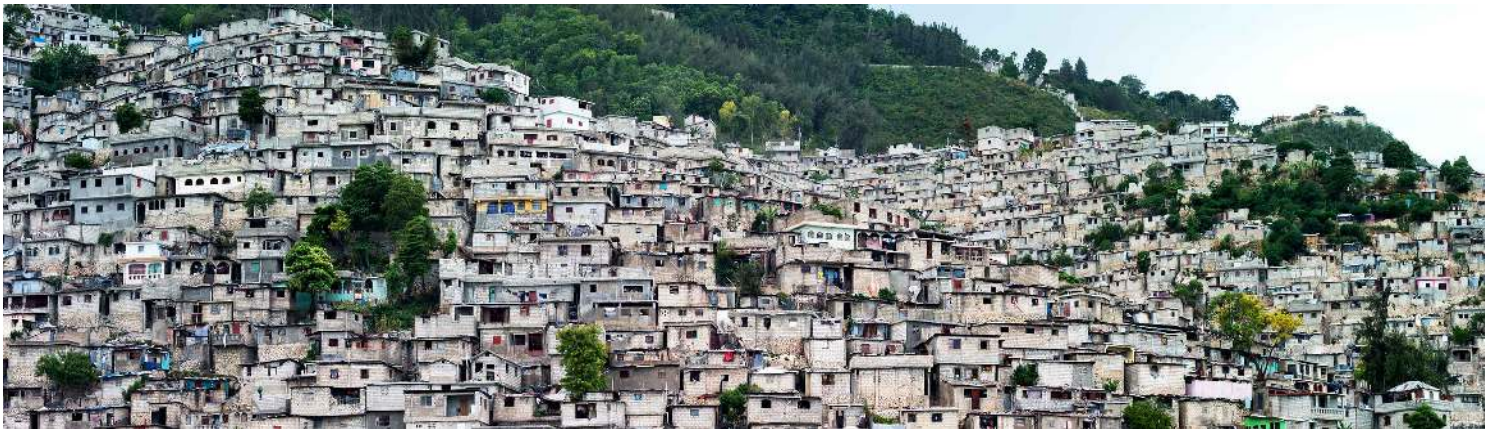
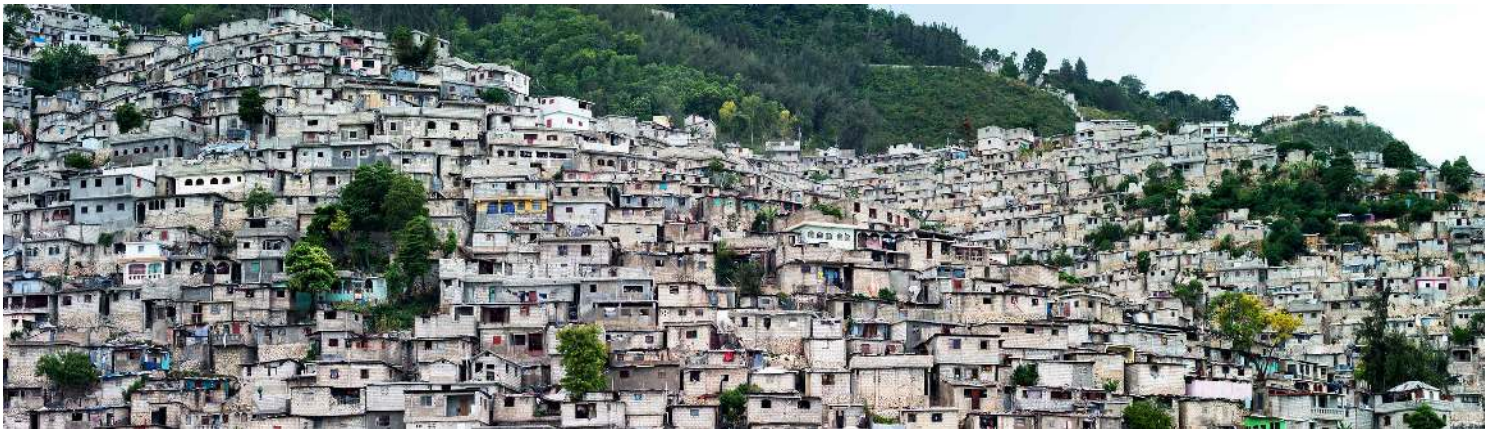


SENSITIVITY AND SPECIFICITY VALUES OF THE VARIOUS SCREENING AND DIAGNOSTIC TESTS USED IN THE COSTING MODEL

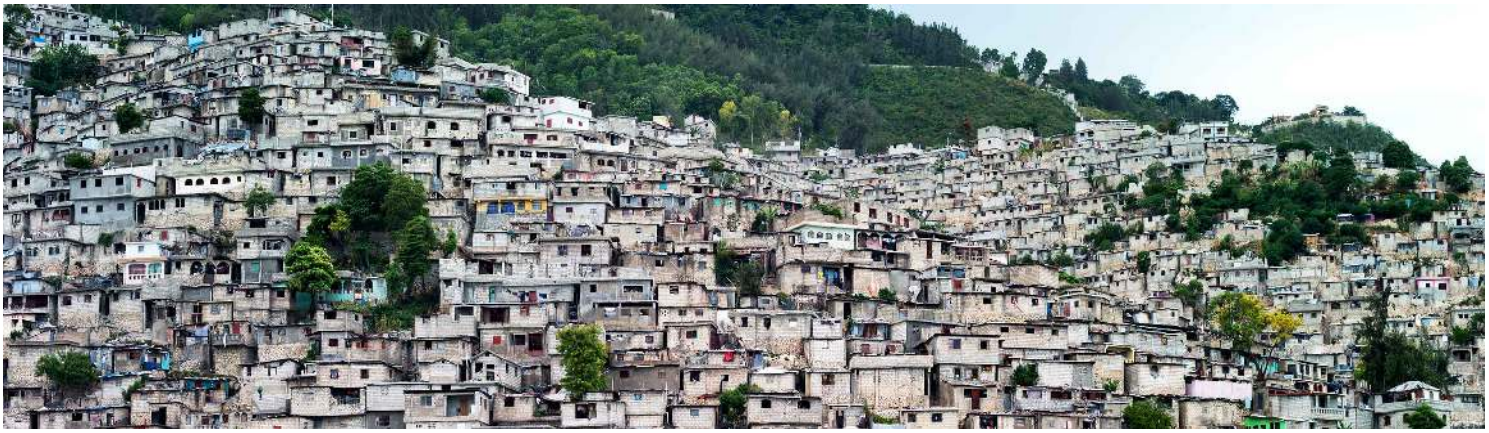
	Passive case finding		Systematic screening	
	Sensitivity	**Specificity**	**Sensitivity**	**Specificity**
(Pulmonary, children, HIV-negative)				
Symptoms			71%	64%
Chest X-ray + CAD (children)	95%	86%	95%	86%
Symptoms + CXR abnormality			98%	63%
Xpert MTB/RIF	85%	98%	85%	98%
Xpert MTB/XDR	100%	100%	100%	100%
(Any symptoms or any CXR abnormality) + Xpert-positive	85%	100%	85%	100%
Clinical evaluation with X-ray applied to Xpert-negative (option 1)	93%	86%	93%	86%
Clinical evaluation with X-ray applied to Xpert-negative (option 2)	65%	97%	65%	97%
(Pulmonary, adults, HIV-negative)				
Symptoms			96%	63%
Chest X-ray + CAD (adults)	95%	86%	95%	86%
Symptoms or CXR abnormality			100%	84%
Xpert MTB/RIF	85%	98%	85%	98%
Xpert MTB/XDR	100%	100%	100%	100%
Any symptoms or any CXR abnormality	100%	84%	100%	84%
(Any symptoms or any CXR abnormality) + Xpert-positive	85%	100%	85%	100%
Clinical evaluation with X-ray applied to Xpert-negative (option 1)	93%	86%	93%	86%
Clinical evaluation with X-ray applied to Xpert-negative (option 2)	88%	98%	88%	98%
(Pulmonary, children, HIV-positive, new)				
4S followed by CRP			96%	17%
Symptoms only			61%	94%
CRP	89%	54%	89%	54%
Urine LAM	35%	95%	35%	95%
Xpert MTB/RIF	75%	98%	75%	98%
Xpert MTB/XDR	100%	100%	100%	100%
4S+ or CRP+	96%	17%	96%	17%
(4S+ or CRP+) + Xpert-positive	72%	98%	72%	98%
(4S+ or CRP+) + (Xpert-positive or TB LAM-positive)	80%	94%	80%	94%
(Pulmonary, adults, HIV-positive, new)				
4S screening			53%	70%
Only CRP	40%	80%	40%	80%
4S followed by CRP			84%	64%
CRP (in those with symptoms)	84%	64%	84%	64%
Urine LAM	35%	95%	35%	95%
Xpert MTB/RIF	84%	93%	84%	93%
Xpert MTB/XDR	100%	100%	100%	100%

	Passive case finding		Systematic screening	
4S+ or CRP+	84%	64%	84%	64%
(4S+ or CRP+) + Xpert-positive	63%	99%	63%	99%
(4S+ or CRP+) + (Xpert-positive or TB LAM-positive)	70%	98%	70%	98%
(Pulmonary, children, HIV-positive, already on ART)				
Symptoms			53%	70%
Chest X-ray + CAD	70%	63%	70%	63%
Urine LAM	35%	95%	35%	95%
Xpert MTB/RIF	77%	96%	77%	96%
Xpert MTB/XDR	100%	100%	100%	100%
4S+ or CXR with CAD+	85%	33%	85%	33%
(4S+ or CXR+) and Xpert-positive	65%	97%	65%	97%
(4S+ or CXR with CAD+) and (Xpert-positive or LAM-positive)	72%	94%	72%	94%
(Pulmonary, adults, HIV-positive, already on ART)				
Symptoms			53%	70%
Chest X-ray + CAD	70%	63%	70%	63%
Urine LAM	35%	95%	35%	95%
Xpert MTB/RIF	85%	91%	85%	91%
Xpert MTB/XDR	100%	100%	100%	100%
4S+ or CXR with CAD+	85%	33%	85%	33%
(4S+ or CXR+) and Xpert-positive	65%	97%	65%	97%
(4S+ or CXR with CAD+) and (Xpert-positive or LAM-positive)	72%	94%	72%	94%



DIAGNOSTIC TESTS/NEWER TESTS IN THE PIPELINE CONSIDERED FOR INCLUSION IN THE COSTING MODEL

Diagnosis	Tests	Manufacturers /kit name	Key features	Turnaround time	Deployment level
	Xpert MTB/RIF & MTB/RIF Ultra	Cepheid	Detects RIF resistance	4–6 Hrs	POC
	Truenat - MTB, MTB Plus, MTB/RIF Dx assay	Molbio	Detects RIF resistance	4–6 Hrs	POC
	LPA - first-line (GenoType MTBDRplus and NTM+MDRTB Detection Kit)	Hain	Detects resistance to RIF, INH and ETO	48 hrs	Reference laboratory
	LPA - second-line (GenoType MTBDRs)	Hain	Detects resistance to FQs and AMK	48 hrs	Reference laboratory
	LPA -first-line (Genoscholar® PZA-TB II assay)	Nipro	Detects mutations within the *pncA* gene which lead to PZA resistance		Reference laboratory
	Solid culture		C & phenotypic DST resource limited settings	6–8 weeks	District level
	Liquid culture by fluorescent technology	BD	C & phenotypic DST resource limited settings	2–3 weeks	District level
	Liquid culture by microscopic observation of drug susceptibility (MODS)		C & phenotypic DST in central laboratory	2–3 weeks	Reference laboratory
	Liquid culture by nitrate reductase assay (NRA)		C & phenotypic DST in central laboratory		Reference laboratory
	Liquid culture by colorimetric redox indicator (CRI)		C & phenotypic DST in central laboratory		Reference laboratory
	Commercial real-time PCR assay	Abbott RealTime MTB and MTB RIF/INH	Detects MTB & resistance to RIF & INH	24 hrs	Reference laboratory
	Commercial real-time PCR assay	Roche cobas® MTB and MTB-RIF/INH assays	Detects MTB & resistance to RIF & INH	24 hrs	Reference laboratory
	Commercial real-time PCR assay	Hain FluoroType® MTBDR assay	Detects MTB & resistance to RIF & INH	24 hrs	Reference laboratory
	Commercial real-time PCR assay	BD MAXTM MDR-TB assay	Detects MTB & resistance to RIF & INH	24 hrs	Reference laboratory
	Targeted next generation sequencing & DST	Multiple manufacturers	Detects mutations in targeted genomic sequence	24 hrs	District level
	Whole genome sequencing	Multiple manufacturers	Detects mutations in the whole genome	24 hrs	District level
Monitoring	Solid culture		C & phenotypic DST resource limited settings	2–3 weeks	Reference laboratory
	Liquid culture by fluorescent technology	BD	C & phenotypic DST resource limited settings	2–3 weeks	Reference laboratory
	Liquid culture by microscopic observation of drug susceptibility (MODS)		C & phenotypic DST in central laboratory		Reference laboratory
	Liquid culture by nitrate reductase assay (NRA)		C & phenotypic DST in central laboratory		Reference laboratory
	Liquid culture by colorimetric redox indicator (CRI)		C & phenotypic DST in central laboratory		Reference laboratory



SUPPLEMENTARY MODELLING BACKGROUND, METHODS AND RESULTS

Background

To supplement the main analysis provided by the TIME model, we conducted additional modelling analyses in three focal countries—Indonesia, Kenya and Ukraine—in order to shed light on the combinations of interventions that would be needed to meet the End TB goals in these contrasting settings. These three countries were chosen to capture important features of TB epidemiology today:

- the strong role of a fragmented private health care sector in managing TB in many South- and South-East Asian countries (e.g., Indonesia);
- the role of HIV coinfection as a key driver of TB incidence (e.g., Kenya);
- the substantial burden of rifampicin-resistant (RR-) TB in many countries in Central and Eastern Europe, and elsewhere (e.g., Ukraine).

We developed bespoke models to capture the TB epidemiology in each of these different countries. An advantage of this tailored approach focusing on a limited set of countries is that we were able to rapidly examine different combinations of interventions and take into account the disruptions to TB services arising from the COVID-19 pandemic.

Methods

For each of the countries described above, we developed a mathematical model to capture the key features of their TB epidemics (private sector, HIV coinfection and rifampicin resistance). In a departure from previous modelling approaches, we also modelled subclinical TB and the rate at which individuals develop symptomatic TB. For each country, we adjusted model parameters to match WHO estimates of incidence and prevalence; the prevalence of subclinical TB from prevalence surveys; and other country-specific data, including the proportion of TB incidence having HIV coinfection (for Kenya) and the proportion of TB incidence that is rifampicin-resistant (for Ukraine).

To consider TB service disruptions during the COVID-19 pandemic, we drew from monthly notification data reported by countries to WHO. We adjusted the case detection in each country model on a month-to-month basis to reflect how monthly TB notifications fell during COVID-19, relative to 2019. In order to capture these declines in case detection, the model incorporates a delay to diagnosis and treatment initiation, while also capturing the resulting increases in opportunities for TB transmission.

We estimated uncertainty in a systematic way, using a Bayesian Markov Chain Monte Carlo method to propagate uncertainty from model inputs to model outputs.

We modelled the following interventions, assuming each intervention to be scaled up in a linear way from 2022 to 2025.

Public–private mix (Indonesia only)

PPM efforts are scaled up, assuming an intervention that engages effectively with 80% of private health care providers who are already involved in managing TB, improving their standards of TB diagnosis and TB treatment outcomes to the same level as in the public sector. By improving standards of diagnosis among private providers, the intervention reduces missed opportunities for diagnosis and thus reduces the diagnostic delay. By improving treatment completion, the intervention reduces rates of post-treatment relapse, which would otherwise arise from suboptimal implementation of treatment.

Improved routine TB services

TB diagnostics are modernized throughout routine services, i.e., comprehensive replacement of any microscopy-based and clinical diagnosis with rapid molecular tests for TB. In Ukraine, we assumed that comprehensive use of these diagnostic tools would facilitate recognition of RR status at the point of TB diagnosis.

Improved treatment outcomes for RR-TB (Ukraine only)

All current second-line treatments are replaced with new regimens, such that the proportion of treatment success increases to 85%.

Upstream case finding (symptomatic TB)

All activities are designed to diagnose symptomatic TB more rapidly than an individual's first attempt at care seeking. These activities could include active case finding in the community, and also measures such as demand generation, i.e., encouraging those with symptoms to come forward for care more rapidly than they do at present. We assumed that, together, these measures would reduce the delay-to-diagnosis by 30% for symptomatic individuals.

Detecting subclinical TB

Measures are in place to find and treat 20% of individuals with subclinical TB before they develop symptoms. Note that this intervention is only an example of additional intervention efforts over and above the use of existing tools, which could contribute to meeting the End TB goals. (Alternative strategies might include, for example, new regimens or therapeutic vaccines to reduce post-treatment recurrence.)

TB preventive therapy, key and vulnerable populations

There is full uptake of TPT among key and vulnerable populations identified in WHO recommendations, i.e., PLHIV and all-age, close contacts of persons diagnosed with TB.

TB vaccine

A post-exposure vaccine with 60% efficacy in reducing TB incidence among those with latent TB infection and conferring immunity for 10 years is rolled out to reach a given coverage of the population (with coverage dependent on the country setting, in order to meet the End TB goals by 2030). We assume that a vaccine would be licensed by 2025 and scaled up over the subsequent three years.

Results

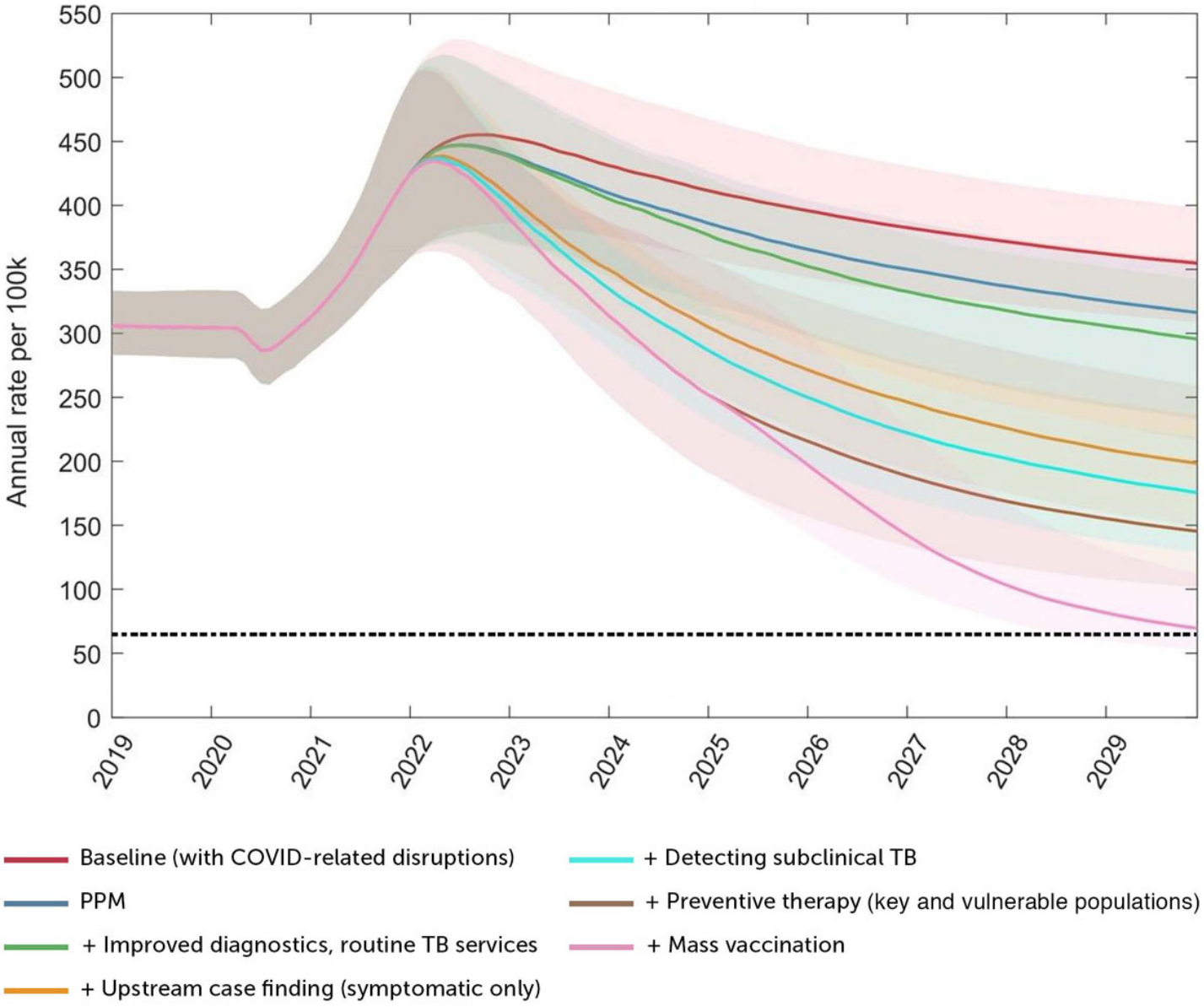
Figure A3.1 shows model projections for TB incidence in Indonesia. The figure illustrates a temporary decrease in incidence in 2020, because lockdowns against COVID-19 are likely also to have the effect of reducing TB incidence. In the longer term, however, the figure illustrates how service disruptions would give rise to a substantial increase in TB incidence.

Following the start of interventions in 2022 in Indonesia, there would be substantial reductions in TB incidence as a result of the combined interventions. Some key points in this figure are as follows:

- Case finding would make an important contribution to incidence reductions, both in terms of symptomatic TB ("upstream case finding") and subclinical TB. Indeed, without the latter, the remaining interventions would not be sufficient to meet the End TB goals by 2030.
- As well as its direct impact, PPM also has important knock-on effects for other interventions: for example, it enhances the impact of TPT by increasing the number of people with TB who are reported to the TB programme and whose contacts can benefit from preventive therapy. Overall, coordination of TB services across the health care system—whether in the public or private sectors—will be a critical foundation for meeting the End TB goals.
- Ultimately without a TB vaccine, it will not be possible to meet the End TB goals by 2030.

Figure A3.1. Incidence projections for Indonesia under different intervention scenarios

Indonesia



Note. Interventions are shown in successive combination. Therefore, for example, the bottom line in pink shows a combination of all interventions, including vaccination. The upsurge in incidence peaking in 2022 reflects COVID-related disruptions, assuming that TB services will return to pre-pandemic levels over the next six months. After 2022, we assumed that interventions would be scaled up over a period of three years until 2025. Solid lines show central model estimates, while shaded areas show 95% uncertainty intervals. The horizontal dashed line shows the 2030 goal for incidence. Here, the vaccination coverage required to meet the 2030 goals in 65%.

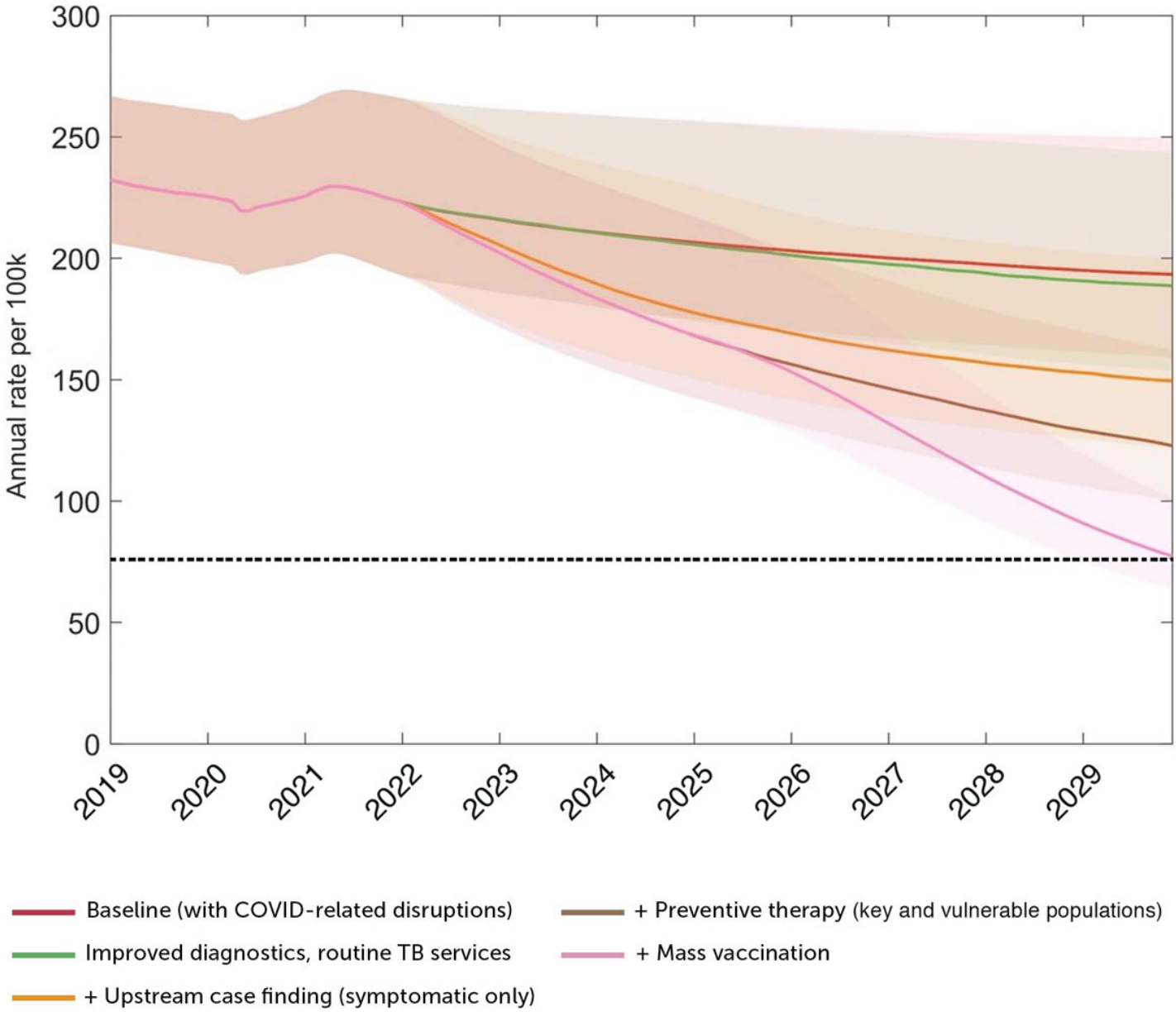
Figure A3.2 shows model projections for TB incidence in Kenya. Key points are as follows:

- As with Indonesia, upstream case finding would play an important role in incidence reductions. However, in Kenya, it may be possible to meet the End TB goals *without* having to extend case detection to subclinical TB.
- This is partly because TPT has a stronger effect in Kenya than in other countries modelled: given the importance of HIV as a driver of TB epidemiology in Kenya, the uptake of TPT among PLHIV will play a critical role in reaching the End TB goals.
- As with Indonesia, deployment of a vaccine will be necessary to meet the 2030 goals. However, the coverage of this vaccine does not need to be as high as modelled in Indonesia: shown here is a scenario with only 40% coverage. Again, the strong role played by TPT among PLHIV brings the End TB goals within closer reach than in other settings.

In practice, Kenya has begun implementing case finding for subclinical TB. In a supplementary analysis, we modelled the inclusion of these activities. Figure A3.S1 [PROVISIONAL] illustrates that detection of subclinical TB can play an important role in incidence reductions. Importantly, its inclusion means that vaccination coverage need not be as high as in Figure A3.2; shown in Figure A3.S1 is a scenario with 33% coverage.

Figure A3.2. Incidence projections for Kenya under different intervention scenarios

Kenya



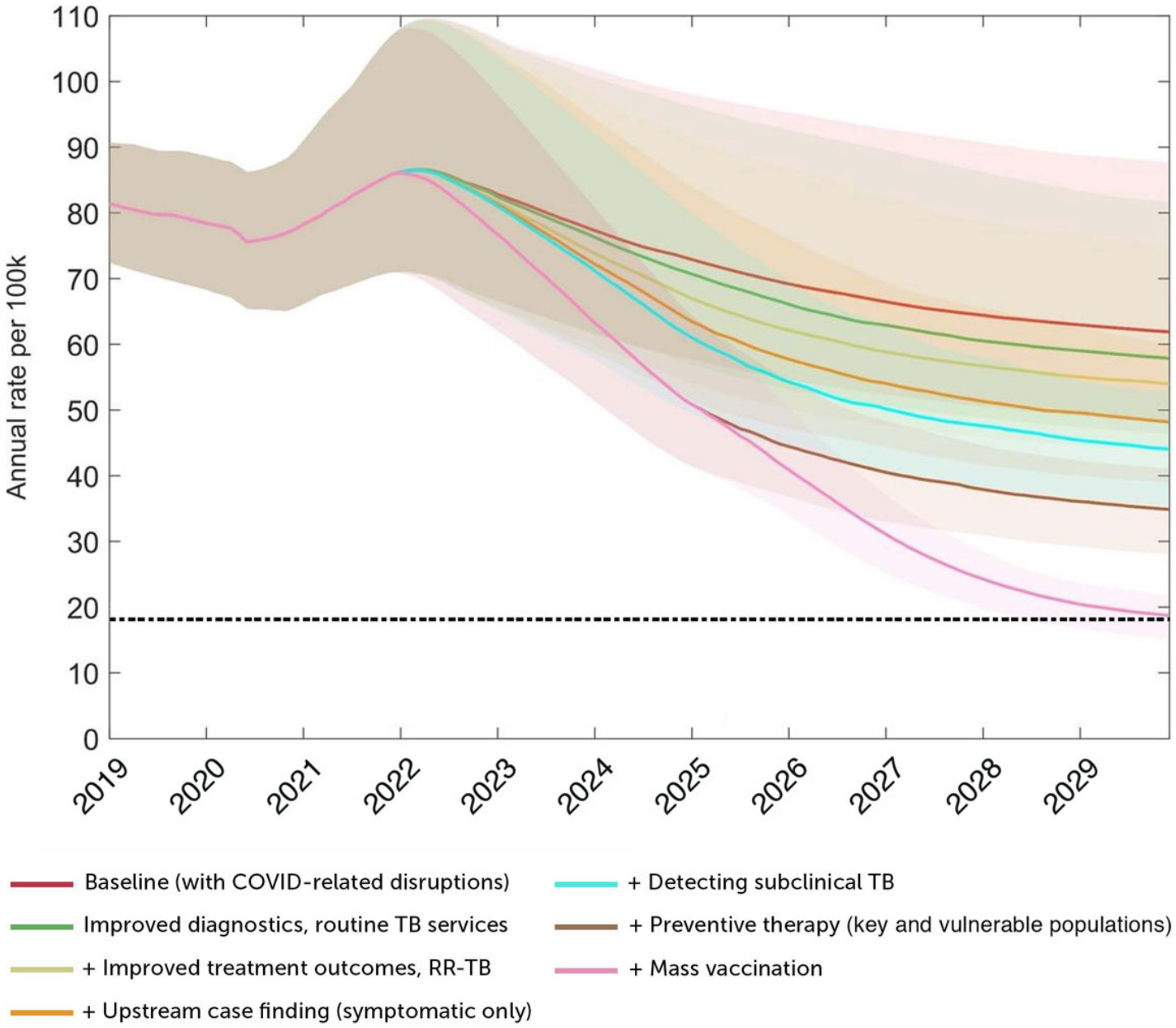
Note. Details are as in Figure A3.1. Here, the vaccination coverage required to meet the 2030 goals is 40%.

Figure A3.3 shows model projections for TB incidence in Ukraine. Key points are as follows:

- Given the burden of RR-TB in Ukraine, improved care of RR-TB could have an important contribution to reducing incidence.
- This includes both using improved diagnostics (facilitating the early recognition of RR-TB) and improving second-line treatment outcomes.
- The required vaccination coverage to meet the 2030 goals is higher than in Indonesia, at 70%.

Figure A3.3. Incidence projections for Ukraine under different intervention scenarios

Ukraine



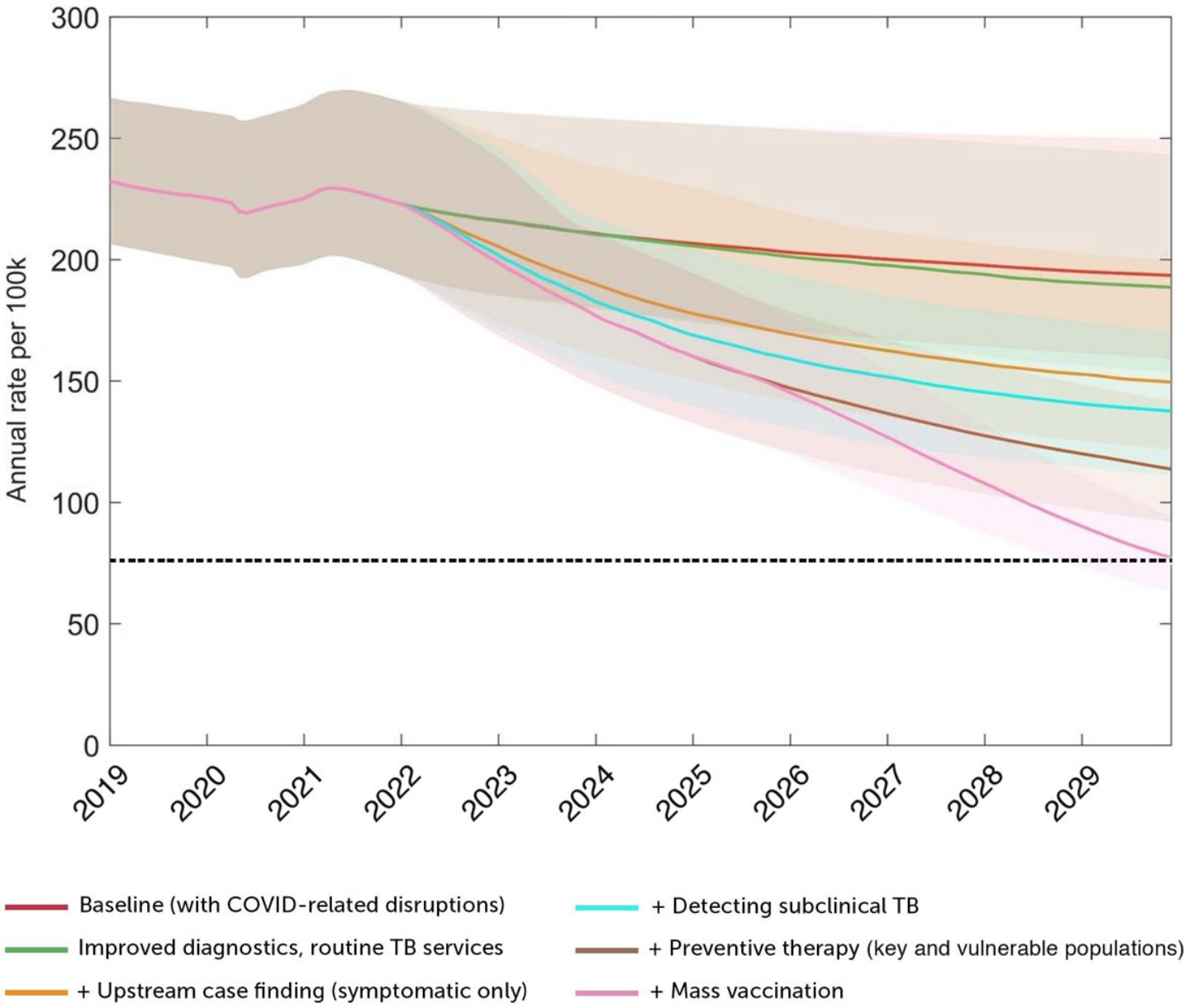
Note. Details are as in Figure A3.1. Here, the vaccination coverage required to meet the 2030 goals is 70%.

Conclusions

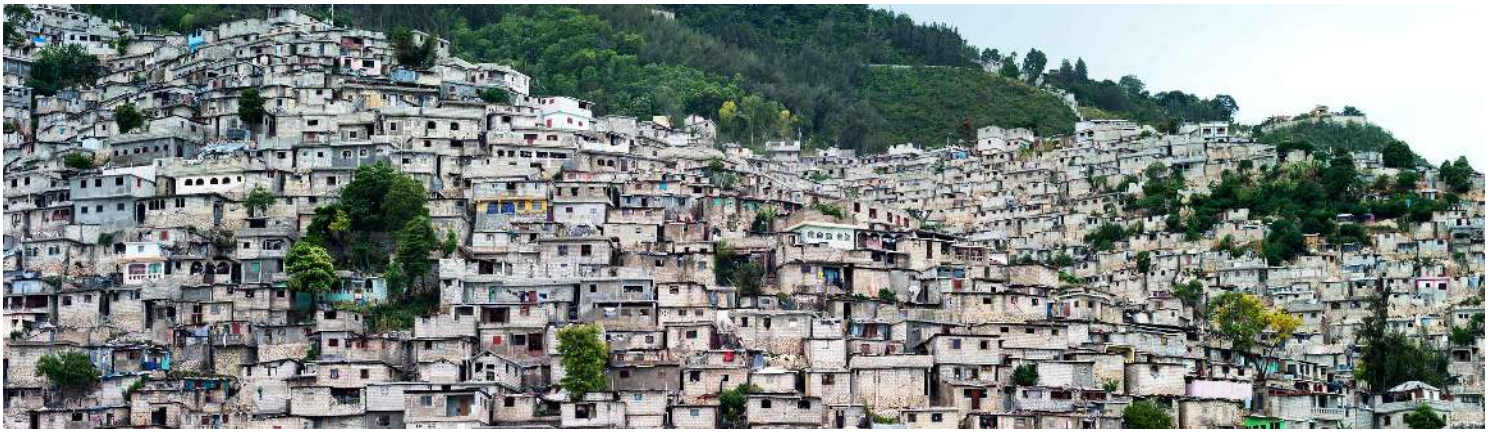
- Intervention priorities should be tailored to local settings, e.g., TPT among PLHIV in Kenya; second-line treatment outcomes in Ukraine; and coordinating TB care between public and private sectors in Indonesia.
- Roll-out of an effective vaccine will ultimately be necessary to meet the End TB goals in all three of these settings, although the percentage of the population covered will vary. Until then, it is important to bring high-quality TB services to as many people as possible, through both improved routine TB services and upstream case finding. In some settings, such as Indonesia and Ukraine, case finding may need to be extended to subclinical TB.

Additional results

Figure A3.S1 [PROVISIONAL]. Incidence projections for Kenya as in Figure A3.2, but here including detection of subclinical TB (cyan curve)



Note. Details are otherwise as in Figure A3.2. Here, the vaccination coverage required to meet the 2030 goals is 30%.



COST OF INACTION ANALYSIS

Background

Given the high global burden of TB, the failure to meet global targets to reduce TB incidence and mortality will have drastic consequences, including excess illnesses and deaths, substantial costs to health care systems, and productivity losses. This document presents a draft analysis to quantify these consequences ("cost of inaction") for the Global Plan to End TB, 2023–2030.

Methods

The cost of inaction was calculated based on the following assumptions: new TB cases, TB deaths, and DALYs attributed to TB were projected through 2030 based on the impact modelling used elsewhere in the Global Plan. The scenarios used here included a scenario in which TB programmes continue at current coverage levels (Status Quo), a scenario in which currently available TB interventions are fully implemented as outlined in the Global Plan (Current Tools), and a scenario in which additional interventions (including TB vaccination) made available through R&D efforts are brought to scale in addition to Current Tools (Current + New Tools). Under each scenario, TB treatment costs and TB-attributable productivity costs were estimated, assuming that it costs an average of US$ 1,372 to treat a person with TB[1] and that productivity losses can be quantified at US$ 4,835 per DALY[2] . Discounted costs and DALYs are also presented, based on a 3% annual discount rate.

The cost of inaction is quantified by comparing estimated costs, cases, deaths and DALYs under the Status Quo and Current + New Tools scenarios over the period 2020–2030. A new feature compared to previous estimates of the cost of inaction is that the cost can be divided into two parts: that attributable to a failure to scale up current tools in line with the Global Plan (Status Quo vs. Current Tools) and that attributable to inadequate investment that prevents new tools from becoming available in time (Current Tools vs. Current + New Tools). By contrast, in previous analyses, the cost of inaction was taken simply as the difference between baseline trends and a scenario that meets global targets (i.e., Status Quo vs. Current + New Tools).

Results

The cost of inaction is expected to be substantial (Figures A5.1 & A5.2). By 2030, failure to fully scale up current interventions in line with the Global Plan would result in:

1. 16.8 million additional people sick with TB
2. 3.8 million additional TB deaths
3. 133 million incremental TB-attributable DALYs (157 million without discounting)
4. US$ 20 billion in TB treatment costs (US$ 23 billion without discounting)
5. US$ 645 billion in lost productivity (US$ 758 billion without discounting).

This impact represents the ceiling of what can be achieved without new tools. Even if current interventions were fully implemented, a four-year delay in investment in R&D for new tools would still result in:

1. 26.5 million additional people sick with TB
2. 2.8 million additional TB deaths
3. 101 million incremental TB-attributable DALYs (117 million without discounting)
4. US$ 31 billion in TB treatment costs (US$ 36 billion without discounting)
5. US$ 487 billion in lost productivity (US$ 566 billion without discounting).

Therefore, over eight years (2023–2030), the total cost of inaction is expected to exceed US$ 1 trillion (undiscounted) and have serious health implications (43 million additional people with TB and 6.6 million additional TB deaths). Substantial and rapid progress in both (a) scaling up currently available technologies and interventions, and (b) TB R&D will be needed to avert these consequences.

Figure A5.1. Projected global TB incidence with and without broad implementation of current and new tools

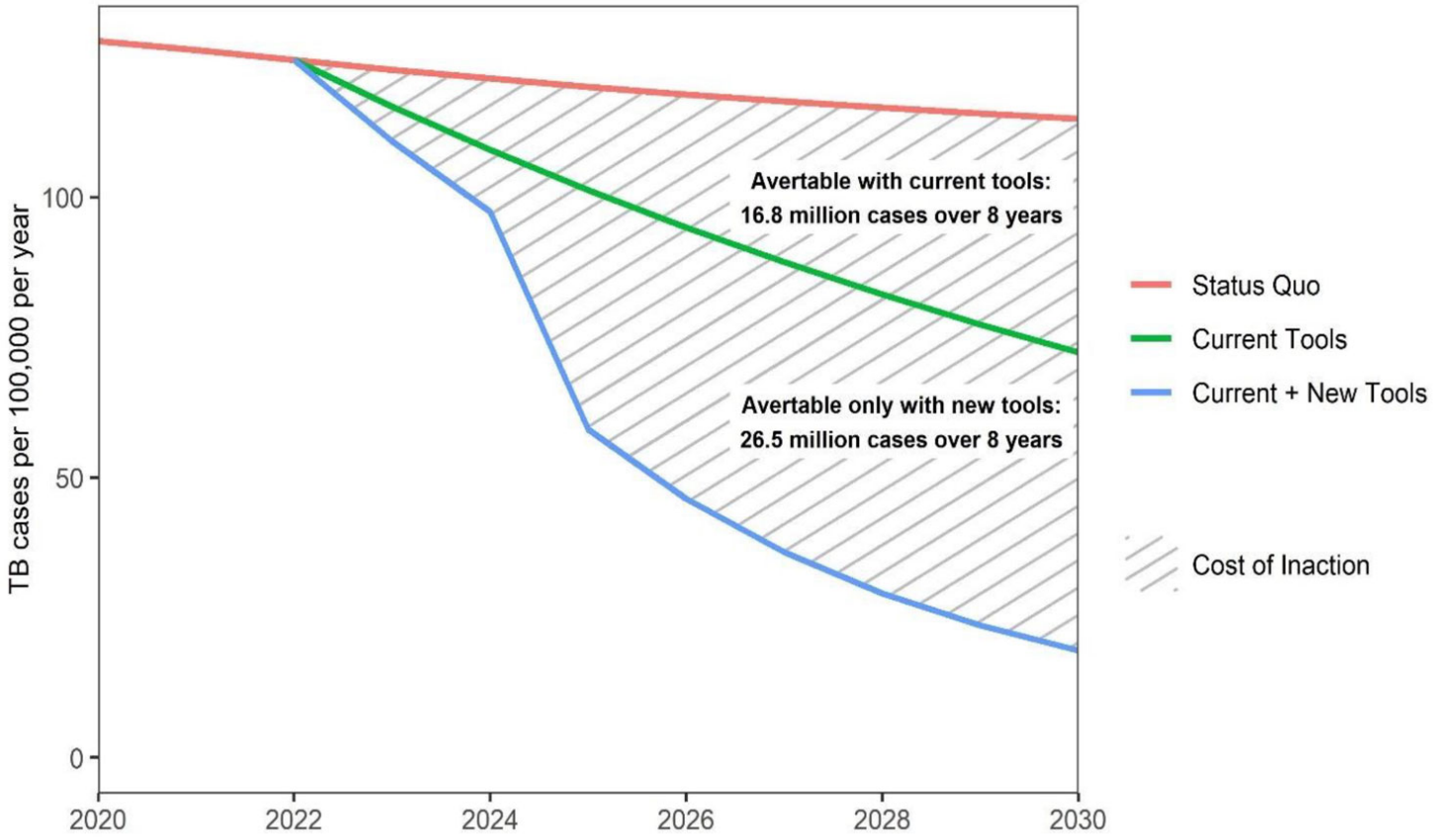
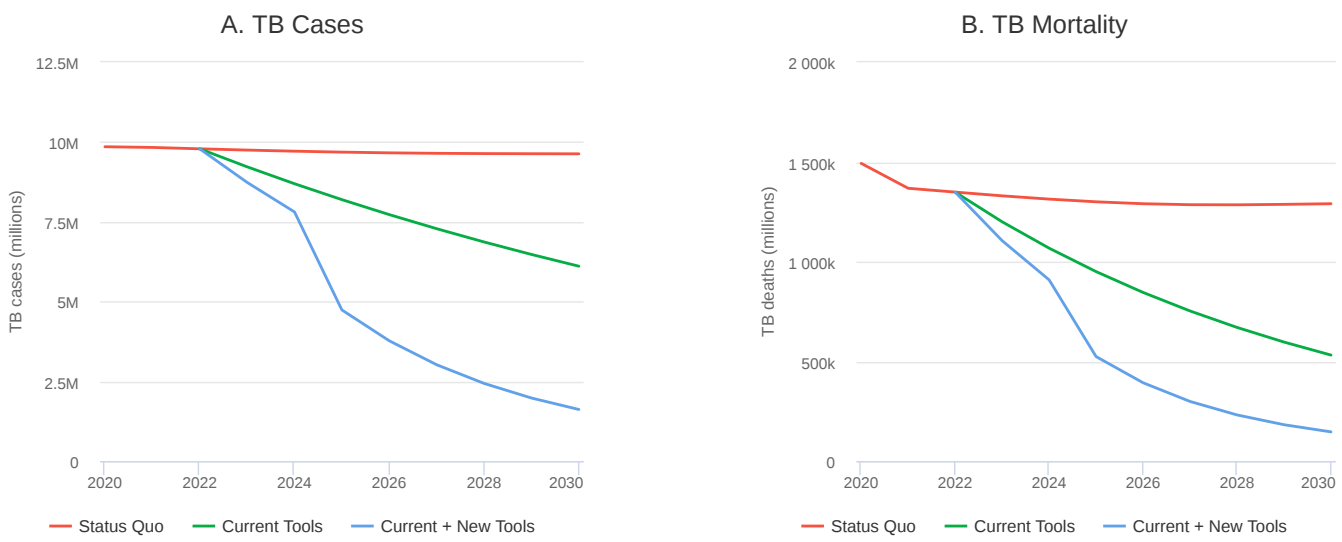
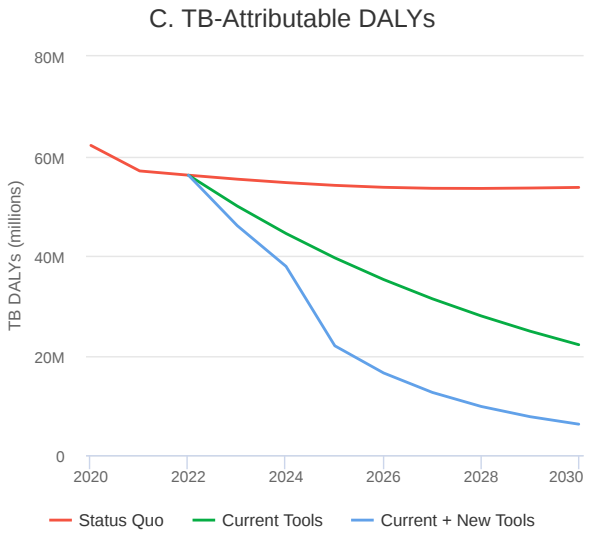
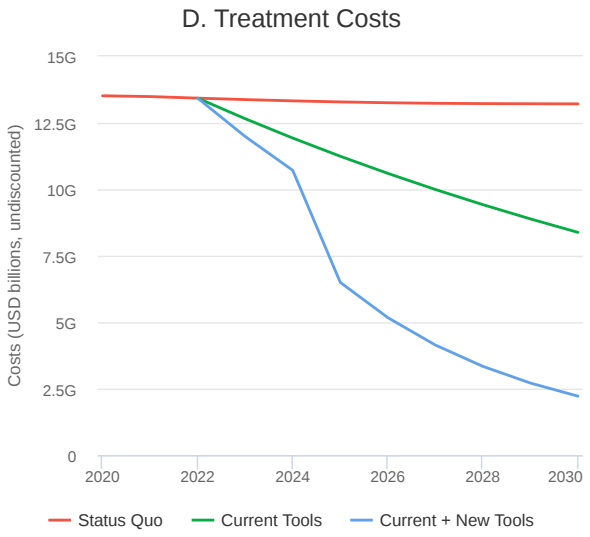
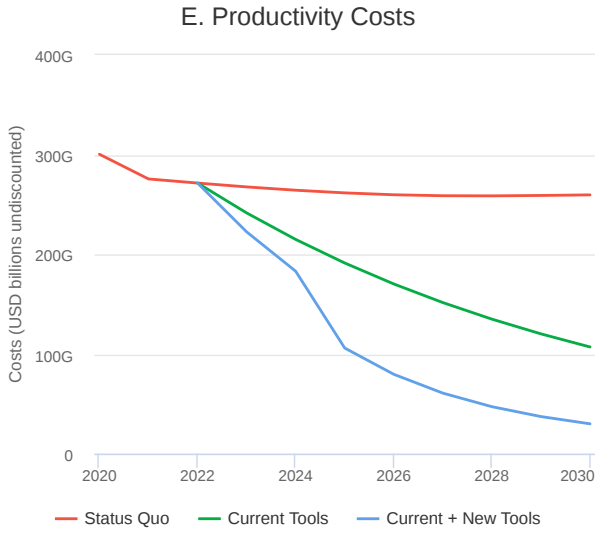


Figure A5.2. Additional projected global outcomes with and without broad implementation of current and new tools









1. US$ 1,372 is based on estimates from the 2021 Global TB Report of DS-TB and MDR-TB treatment unit costs (US$ 1,245 and US$ 3,868, respectively) and assuming 4.84% of people receiving treatment for TB have MDR-TB (based on the 2019 Global TB Report).
2. Equal to the World Bank's estimate of GNI per capita in LICs and MICs in 2020.