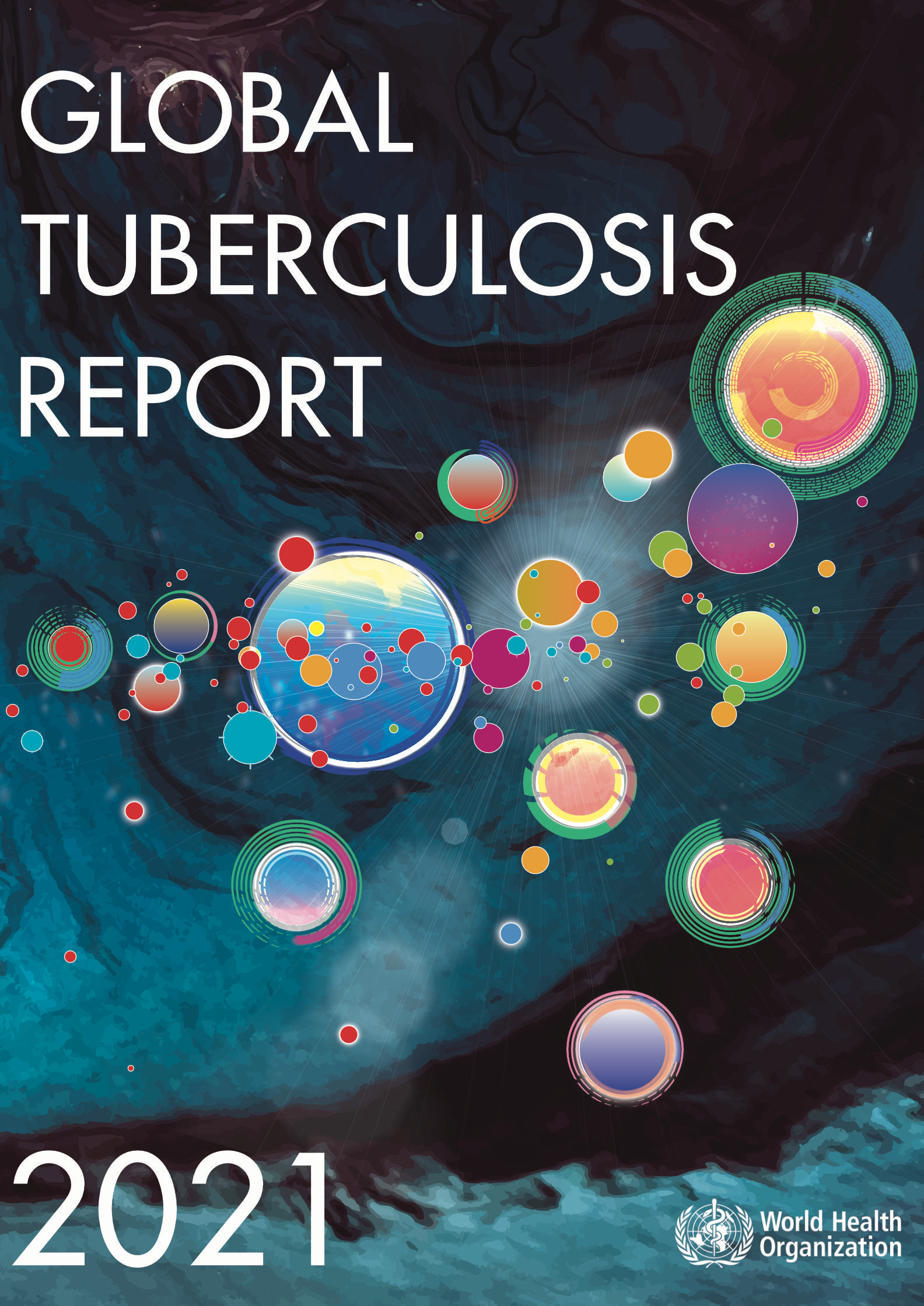
GLOBAL TUBERCULOSIS REPORT



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GLOBAL TUBERCULOSIS REPORT 2021

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Global tuberculosis report 2021

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Contents

Dr Tedros Adhanom Ghebreyesus
Director-General
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Ending this debilitating disease remains a priority for WHO, and in recent years, we have made encouraging progress globally. But the COVID-19 pandemic has put these gains at risk. Not only does the virus pose an increased risk to people with TB, it has also caused severe disruption to services.

I want to remind you that the struggle to end TB is not just a struggle against a single disease. It's also the struggle to end poverty, inequity, unsafe housing, discrimination and stigma, and to extend social protection and universal health coverage. If the pandemic has taught us anything, it's that health is a human right, not a luxury for those who can afford it.

With solidarity, determination and the equitable use of tools, we will defeat COVID-19. And with the same solidarity, determination and equitable use of tools, we can end TB.

Foreword

Dr Tereza Kasaeva
Director, WHO Global TB Programme

The 2021 global tuberculosis report highlights that we stand at a crossroads. We have just 1 year left to reach the historic 2022 tuberculosis (TB) targets committed to by heads of state and government at the first United Nations (UN) high-level meeting on TB in 2018, yet the coronavirus disease (COVID-19) pandemic has reversed gains and set back the fight against TB by several years. We need to move forward with hope, redoubling efforts and investments to urgently close widening gaps in access to much-needed prevention and care for the millions affected by this ancient disease. For the first time in over a decade, TB deaths have increased because of reduced access to TB diagnosis and treatment in the face of the COVID-19 pandemic. Close to half of the people ill with TB missed out on access to care in 2020 and were not reported; also, the number of people provided with treatment for drug-resistant TB and TB preventive treatment dropped significantly. An overview of universal health coverage (UHC), social determinants, and multisectoral action and accountability presented in this report emphasizes the need to address the core drivers and social determinants of the disease.

This year's report is in an innovative digital format, with the main findings and messages presented in a single document, which is accompanied by expanded, more comprehensive content on the World Health Organization (WHO) website. This online content is organized under seven major topics: the COVID-19 pandemic and TB; TB disease burden; TB diagnosis and treatment; TB prevention; financing for TB diagnostic, treatment and prevention services; UHC and TB determinants; and TB research and innovation. The data come from 197 countries and territories, with notification data having been reported close to real-time on a monthly basis since the start of 2021. This transformation of the report aims to make it easier to access the core report data and information, and complements content available in the Global TB Report app.

The report provides important information at a crucial time, as preparations begin for the second UN high-level meeting on TB, which was mandated for 2023 as part of the political declaration of the 2018 UN high-level meeting and the 2020 progress report of the UN Secretary-General. This will be an important landmark to bolster political leadership to help us fast-track our efforts in an integrated and sustainable way. WHO has been tasked with supporting the Office of the UN Secretary-General to prepare a comprehensive review by heads of state and government at the 2023 high-level meeting on TB, informed by the upcoming global TB reports and the global, regional and national high-level reviews. We must stay focused until the job is done.

We have before us the opportunity to save the lives of millions, to preserve resources and to demonstrate the success of efforts to end TB, despite crises that come our way. We must keep the momentum going to stop the spread of this preventable and curable disease and reach those affected with the care they need. We are running out of time – the clock is ticking.

It's time for urgent action to End TB.

Acknowledgements

The *Global tuberculosis report 2021* and accompanying online materials and products were produced by a core team of 17 people: Annabel Baddeley, Marie-Christine Bartens, Saskia den Boon, Hannah Monica Dias, Dennis Falzon, Katherine Floyd, Inés Garcia Baena, Nebiat Gebreselassie, Philippe Glaziou, Marek Lalli, Irwin Law, Peter Nguhiu, Nobuyuki Nishikiori, Cicilia Gita Parwati, Charalambos Sismanidis, Olga Tosas Auguet and Hazim Timimi. The team was led by Katherine Floyd. Overall oversight was provided by the Director of the Global TB Programme, Tereza Kasaeva.

The data collection forms were developed by Philippe Glaziou and Hazim Timimi, with input from staff throughout the WHO Global TB Programme. Hazim Timimi led and organized all aspects of data management.

Data were reviewed by the following people at WHO headquarters: Annabel Baddeley, Marie-Christine Bartens, Saskia den Boon, Dennis Falzon, Inés Garcia Baena, Nebiat Gebreselassie, Medea Gegia, Licé Gonzalez Angulo, Nazir Ismail, Avinash Kanchar, Alexei Korobitsyn, Marek Lalli, Cecily Miller, Linh Nguyen, Elizaveta Safronova, Lana Syed, Hazim Timimi, Olga Tosas Auguet and Eloise Valli. Data from countries, territories and areas in the Americas were also reviewed by the following people at the WHO regional office for the Americas: Pedro Avedillo, Oscar Bernal, Ernesto Montoro and Rafael Lopez Olarte. Andrea Pantoja (WHO consultant) contributed to the review of data on TB financing. Data for the European Region were collected and validated jointly by the WHO Regional Office for Europe and the European Centre for Disease Prevention and Control (ECDC); we thank in particular Marlena Kaczmarek and Csaba Ködmön from ECDC for providing validated data files.

UNAIDS managed the process of data collection from national AIDS programmes and provided access to their TB/HIV dataset. Review and validation of TB/HIV data were both undertaken in collaboration with UNAIDS staff.

Many people contributed to the analyses, preparation of figures and tables, and writing required for both the main report document and the expanded web-based content and products which accompany it. Unless otherwise specified, those named work in the WHO Global TB Programme.

The main text of the report was written by Katherine Floyd and the figures and tables were prepared by Inés Garcia Baena, Philippe Glaziou, Irwin Law, Peter Nguhiu, Nobuyuki Nishikiori and Hazim Timimi. Both draw from expanded web-based content that covers the main topics of the report in more detail.

The accompanying web content is organized into seven major topics and associated sections: 1) the COVID-19 pandemic and TB, which was prepared by Katherine Floyd, Philippe Glaziou and Irwin Law, with contributions from Nimalan Arinaminpathy (Imperial College, London, United Kingdom of Great Britain and Northern Ireland), Peter Dodd (Sheffield University, United Kingdom) and Carel Pretorius (Avenir Health, United States of America); 2) TB disease burden, which was prepared by Katherine Floyd, Philippe Glaziou, Irwin Law and Olga Tosas Auguet, with contributions from Nimalan Arinaminpathy (Imperial College, London, United Kingdom) and Peter Dodd (Sheffield University, United Kingdom); 3) TB diagnosis and treatment, which was prepared by Katherine Floyd and Hazim Timimi, with contributions from Annabel Baddeley, Nazir Ismail, Irwin Law and Fuad Mirzayev; 4) TB prevention, which was prepared by Annabel Baddeley, Saskia den Boon, Dennis Falzon and Hazim Timimi, with contributions to the writing of text from Katherine Floyd; 5) Financing for TB prevention, diagnostic and treatment services, which was prepared by Inés Garcia Baena and Peter Nguhiu (Kenya Medical Research Institute), with contributions from Katherine Floyd and Irwin Law; 6) Universal health coverage (UHC) and TB determinants, which was prepared by Nobuyuki Nishikiori and Inés Garcia Baena, with contributions to the writing of text from Katherine Floyd; and 7) TB research and innovation, which was prepared by Nebiat Gebreselassie, Dennis Falzon, Nazir Ismail, Alexei Korobitsyn and Irwin Law, with contributions to the writing of text from Katherine Floyd. All web-based content was reviewed by other members of the core report team.

The web content that accompanies the report also features six priority topics in more depth. These are: country success stories in TB responses to the COVID-19 pandemic, which was prepared by Nebiat Gebreselassie; the COVID-19 pandemic and TB in India – impact and response, which was prepared by Philippe Glaziou, Nimalan Arinaminpathy (Imperial College, London, United Kingdom) and WHO staff from the WHO Regional Office for South-East Asia and the Country Office for India, in collaboration with the National TB Elimination Programme of India; progress in the transition to case-

based, digital TB surveillance, which was prepared by Charalambos Sismanidis; updates to WHO TB guidelines in the period November 2020–October 2021, which was prepared by Dennis Falzon; TB and diabetes, which was prepared by Annabel Baddeley; and progress in the adaptation and use of WHO's multisectoral accountability framework for TB at global, regional and country levels, which was prepared by Sayohat Hasanova, Tereza Kasaeva, Farai Mavhunga, and Liana Oganezova, with input from Yuliya Chorna (WHO Civil Society Task Force), Ernesto Jaramillo, Evaline Kibuchi (WHO Civil Society Task Force), Debora Pedrazzoli and Lana Syed.

Annexes 1, 3 and 6 of the main report were prepared by Katherine Floyd; Annex 2 was prepared by Hazim Timimi; Annex 4 was prepared by Irwin Law; and Annex 5 was prepared by Philippe Glaziou and Olga Tosas Auguet, with contributions from Marie-Christine Bartens.

The report cover was designed by Irwin Law.

The preparation of the technical appendix that explains the methods used to produce estimates of TB disease burden published as part of the report and accompanying web-based content and products was led by Philippe Glaziou, with contributions from Nimalan Arinaminpathy (Imperial College, London, United Kingdom) and Peter Dodd (University of Sheffield, United Kingdom).

The updated data and other content required for the mobile app that accompanies the report was prepared by Katherine Floyd, Irwin Law and Hazim Timimi. Inés Garcia Baena, Sayohat Hasanova, Marek Lalli, Liana Oganezova and Valérie Robert assisted with translations of new content into French, Russian and Spanish. Marek Lalli was the main focal point for communications with the developer, Adappt. The report team is very appreciative of the excellent work done by Adappt on the development, maintenance and updating of the app.

The web-based global, regional and country profiles that accompany the report were prepared by Hazim Timimi, and the simplified versions for a more general audience were prepared by Hannah Monica Dias, Irwin Law, Hazim Timimi and Yi Wang.

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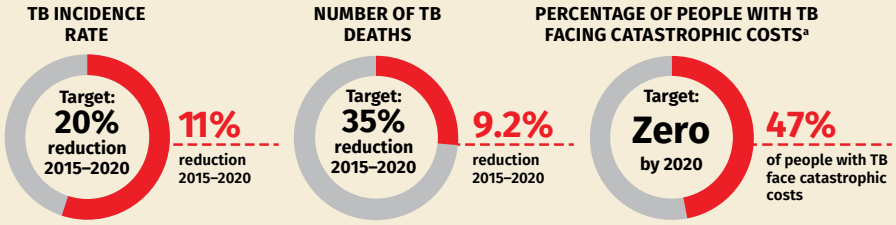
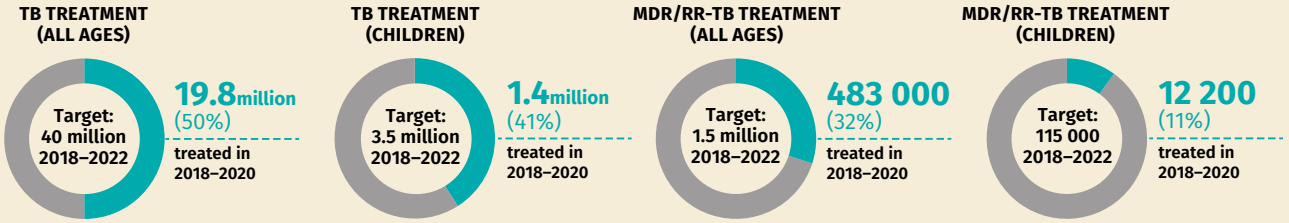
Abbreviations

AIDS	acquired immunodeficiency syndrome
ART	antiretroviral therapy
BCG	bacille Calmette-Guérin
BRICS	Brazil, Russian Federation, India, China and South Africa
CFR	case fatality ratio
CI	confidence interval
COVID-19	coronavirus disease 2019
CSV	comma-separated value
DR	drug-resistant
ECDC	European Centre for Disease Prevention and Control
GDP	gross domestic product
GHO	Global Health Observatory
Global Fund	The Global Fund to Fight AIDS, Tuberculosis and Malaria
HBC	high burden country
HIV	human immunodeficiency virus
ICD	International classification of diseases
IGRA	interferon gamma release assays
IQR	interquartile range
LF-LAM	lateral-flow lipoarabinomannan
LMICs	low and middle-income countries
MAF-TB	multisectoral accountability framework for TB
MDR/RR-TB	multidrug-resistant TB or rifampicin-resistant TB
MDR-TB	multidrug-resistant TB
NGS	next-generation sequencing
NTP	national TB programme
OECD	Organisation for Economic Co-operation and Development
RR-TB	rifampicin-resistant TB
SCI	service coverage index
SDG	Sustainable Development Goal
TAG	Treatment Action Group
TB	tuberculosis
UHC	universal health coverage
UI	uncertainty interval
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
US	United States
USAID	United States Agency for International Development
VR	vital registration
WHO	World Health Organization

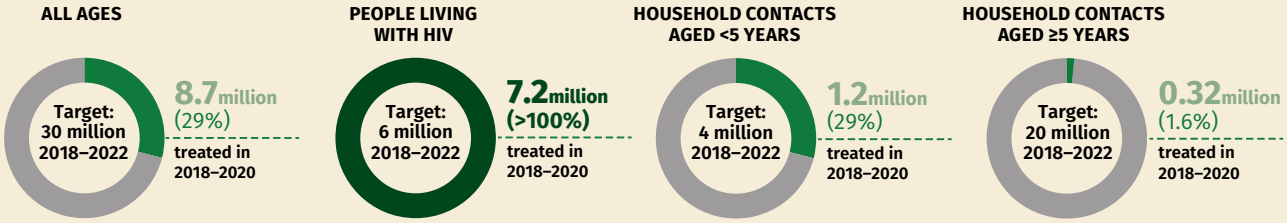
WHO End TB Strategy: 2020 milestones



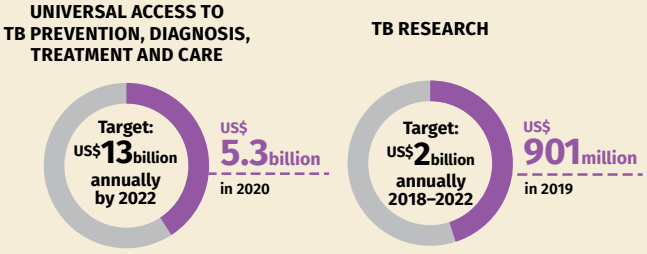
UN high-level meeting on TB: Treatment targets



UN high-level meeting on TB: TB preventive treatment targets



UN high-level meeting on TB: Funding targets



MDR/RR-TB, multidrug-resistant TB/rifampicin-resistant TB.

[a] This indicator is not the same as the SDG indicator for catastrophic health expenditures. See **Box 4** for further explanation.

1. Introduction

Tuberculosis (TB) is a communicable disease that is a major cause of ill health and one of the leading causes of death worldwide. Until the coronavirus (COVID-19) pandemic, TB was the leading cause of death from a single infectious agent, ranking above HIV/AIDS.

TB is caused by the bacillus *Mycobacterium tuberculosis*, which is spread when people who are sick with TB expel bacteria into the air (e.g. by coughing). The disease typically affects the lungs (pulmonary TB) but can affect other sites. Most people (about 90%) who develop the disease are adults, with more cases among men than women. About a quarter of the world's population is infected with *M. tuberculosis*.

TB is curable and preventable. About 85% of people who develop TB disease can be successfully treated with a 6-month drug regimen and regimens of 1–6 months can be used to treat TB infection. Universal health coverage (UHC) is necessary to ensure that all those with disease or infection can access these treatments. The number of people acquiring infection and developing disease (and thus the number of deaths caused by TB) can also be reduced through multisectoral action to address TB determinants such as poverty, undernutrition, HIV infection, smoking and diabetes. Some countries have already reduced their burden of TB disease to fewer than 10 cases and less than 1 death per 100 000 population per year. Research breakthroughs (e.g. a new vaccine) are needed to rapidly reduce the number of new cases each year (TB incidence) worldwide to the levels already achieved in these low-burden countries.

Basic facts about TB are provided in **Annex 1**.

The World Health Organization (WHO) has published a global TB report every year since 1997. The purpose of the report is to provide a comprehensive and up-to-date assessment of the status of the TB epidemic and progress in the response at global, regional and national levels, in the context of global commitments, strategies and targets.

The 2020 report included a provisional assessment of the impact of the COVID-19 pandemic on TB services, TB disease burden and progress towards targets. This 2021 edition provides updated, more definitive and more wide-ranging results. The report's most important findings and messages are highlighted in **Box 1**.

The report is, as usual, based primarily on data gathered by WHO in annual rounds of data collection. In 2021, 197 countries and territories with >99% of the world's population and TB cases reported data (**Annex 2**).

Box 1. Top findings and messages in the 2021 report

The COVID-19 pandemic has reversed years of progress in providing essential TB services and reducing TB disease burden. Global TB targets are mostly off-track, although there are some country and regional success stories.

The most obvious impact is a large global drop in the number of people newly diagnosed with TB and reported. This fell from 7.1 million in 2019 to 5.8 million in 2020, an 18% decline back to the level of 2012 and far short of the approximately 10 million people who developed TB in 2020. 16 countries accounted for 93% of this reduction, with India, Indonesia and the Philippines the worst affected. Provisional data up to June 2021 show ongoing shortfalls.

Reduced access to TB diagnosis and treatment has resulted in an increase in TB deaths. Best estimates for 2020 are 1.3 million TB deaths among HIV-negative people (up from 1.2 million in 2019) and an additional 214 000 among HIV-positive people[a] (up from 209 000 in 2019), with the combined total back to the level of 2017. Declines in TB incidence (the number of people developing TB each year) achieved in previous years have slowed almost to a halt. These impacts are forecast to be much worse in 2021 and 2022.

Other impacts include reductions between 2019 and 2020 in the number of people provided with treatment for drug-resistant TB (-15%, from 177 100 to 150 359, about 1 in 3 of those in need) and TB preventive treatment (-21%, from 3.6 million to 2.8 million), and a fall in global spending on TB diagnostic, treatment and prevention services (from US$ 5.8 billion to US$ 5.3 billion, less than half of what is needed).

Actions to mitigate and reverse these impacts are urgently required. The immediate priority is to restore access to and provision of essential TB services such that levels of TB case detection and treatment can recover to at least 2019 levels, especially in the most badly-affected countries.

[a] Officially classified as deaths from HIV/AIDS.

In addition, in February–March 2021, data on monthly or quarterly case notifications of people newly diagnosed with TB in 2020 were collected from 84 countries that together have almost 90% of global TB cases *(1)*. Since April 2021, such data have been requested from more than 100 countries on an ongoing basis, with visualizations of all reported data available in real time *(2, 3)*. These data have been crucial for timely monitoring of the impact of the COVID-19 pandemic on TB case detection, and for informing estimates of the impact of disruptions to TB services on TB disease burden in 2020 and beyond.

The 2021 report and accompanying materials have been produced in a new and more web-centric format (**Box 2**). The aim is to make the content more digestible (by breaking it down into smaller, more "bite-sized" chunks) and easier to navigate, especially for the vast majority (>90%) of people who access the report online rather than via a printed copy.

Box 2. The *Global tuberculosis report 2021* and accompanying materials – a new and more web-centric format

From the first edition in 1997 until 2020, WHO's global TB report was made available as a single document. A few thousand copies were printed and then either distributed to an established list of users or made available to order from WHO Press. A file (PDF) was posted on the WHO website to enable anyone to download the full report. In September 2021, the 2020 report was WHO's most popular publication,[a] with the number of report downloads far exceeding the annual print run. For many years, the report included profiles for high TB burden countries (**Annex 3**), with similar profiles for all countries provided online. Since 2019, all global, regional and country profiles have been made available via a mobile app rather than through the main report (**Annex 4**); they are also available on the web. The app allows users to look up data for many indicators, either for individual countries or for user-defined country groups.

The *Global tuberculosis report 2021* and accompanying materials have been produced in a new and more web-centric format. The new format allows content to be made available in smaller (more "bite-sized") chunks, with the aim of making it more digestible for users and easier to navigate.

The main report (this document) is considerably shorter and slimmer than in previous years. It focuses on key findings and messages, which are illustrated with a selection of figures and tables. A small print run is planned and the report is available online as a single PDF.

The 2021 report is accompanied by expanded and more detailed web-based content, organized under seven major topics (similar to the main report). The topics are 1) the COVID-19 pandemic and TB; 2) TB disease burden; 3) TB diagnosis and treatment; 4) TB prevention; 5) financing for TB diagnostic, treatment and prevention services; 6) UHC and TB determinants; and 7) TB research and innovation. The content is presented across a total of 14 webpages (one each for topics 1, 4, 5 and 7; four for topic 3; and three for topics 2 and 6). Each webpage is organized in a standardized format, with text commentary (~1000–1500 words) followed by a set of about 10 figures and tables and a reference list. A compilation of this content in a single document is also available as a separate WHO publication *(4)* and is currently in press. In the coming months, the 14 web pages may be further developed to enhance their functionality and associated presentation of content. An example is the addition of interactive features to graphics, which will allow people to view data values by hovering over content such as maps and graphs.

The report website also provides links to content that discusses a selection of priority topics in more depth. The six topics featured this year are as follows: country success stories in TB responses to the COVID-19 pandemic; the COVID-19 pandemic and TB in India – impact and response; progress in the transition to case-based, digital TB surveillance; updates to WHO TB guidelines in the period November 2020–October 2021; TB and diabetes; and progress in the adaptation and use of WHO's multisectoral accountability framework for TB (MAF-TB) at global, regional and country levels.

Online profiles, the online WHO global TB database and an online technical annex can be accessed via links on the main report website. The annex provides a detailed description and explanation of methods used by WHO to produce estimates of TB disease burden (**Annex 5** summarizes the main updates in 2021).

The report is accompanied by an updated mobile app (2021 edition) that can be downloaded via Google Play (for Android devices) or the Apple Store (for iOS devices, such as iPhones and iPads). It is available in English, French, Russian and Spanish. Once installed, the app works offline, meaning that data can be accessed without an ongoing Internet connection.

[a] WHO Institutional Repository for Information Sharing (https://apps.who.int/iris/most-popular/item#, accessed 23 September 2021).

2. Global TB commitments, strategy and targets

In 2014 and 2015, all Member States of WHO and the United Nations (UN) committed to ending the TB epidemic, through their adoption of WHO's End TB Strategy (**Box 3**) and the UN Sustainable Development Goals (SDGs) *(5, 6)*. The strategy and SDGs include milestones and targets for large reductions in the TB incidence rate (new cases per 100 000 population per year), the absolute number of TB deaths and costs faced by TB patients and their households (**Table 1**).

Efforts to step up political commitment to the fight against TB intensified in 2017 and 2018.

A WHO global ministerial conference on TB was organized in November 2017. The outcome was the Moscow Declaration to End TB *(7)*, which was welcomed by

Box 3. The End TB Strategy at a glance

VISION	**A WORLD FREE OF TB** — zero deaths, disease and suffering due to TB			
GOAL	END THE GLOBAL TB EPIDEMIC			
INDICATORS	MILESTONES		TARGETS	
	2020	2025	2030	2035
Percentage reduction in the absolute number of TB deaths (compared with 2015 baseline)	35%	75%	90%	95%
Percentage reduction in the TB incidence rate (compared with 2015 baseline)	20%	50%	80%	90%
Percentage of TB-affected households facing catastrophic costs due to TB[a] (level in 2015 unknown)	0%	0%	0%	0%

PRINCIPLES

1. Government stewardship and accountability, with monitoring and evaluation
2. Strong coalition with civil society organizations and communities
3. Protection and promotion of human rights, ethics and equity
4. Adaptation of the strategy and targets at country level, with global collaboration

PILLARS AND COMPONENTS

1. INTEGRATED, PATIENT-CENTRED CARE AND PREVENTION

- A. Early diagnosis of TB including universal drug-susceptibility testing, and systematic screening of contacts and high-risk groups
- B. Treatment of all people with TB including drug-resistant TB, and patient support
- C. Collaborative TB/HIV activities, and management of comorbidities
- D. Preventive treatment of persons at high risk, and vaccination against TB

2. BOLD POLICIES AND SUPPORTIVE SYSTEMS

- A. Political commitment with adequate resources for TB care and prevention
- B. Engagement of communities, civil society organizations, and public and private care providers
- C. Universal health coverage policy, and regulatory frameworks for case notification, vital registration, quality and rational use of medicines, and infection control
- D. Social protection, poverty alleviation and actions on other determinants of TB

3. INTENSIFIED RESEARCH AND INNOVATION

- A. Discovery, development and rapid uptake of new tools, interventions and strategies
- B. Research to optimize implementation and impact, and promote innovations

[a] This indicator is not the same as the SDG indicator for catastrophic health expenditures. See **Box 4** for further explanation.

all Member States at the World Health Assembly in May 2018.

In September 2018, the UN General Assembly held its first-ever high-level meeting on TB, attended by heads of state and government as well as other leaders. The outcome was a political declaration in which commitments to the SDGs and End TB Strategy were reaffirmed and new ones added *(8)*. Global targets for the funding to be mobilized for TB prevention, care and research, and for the number of people to be treated for TB infection and disease, were set for the first time (**Table 1**).

As requested in the political declaration, a 2020 progress report was prepared by the UN Secretary-General, with support from WHO *(9)*. The report included 10 priority recommendations. A high-level review of progress achieved by the end of 2022 will take place at the UN General Assembly in 2023. Preparations for this review will be supported by WHO.

TABLE 1

Global TB targets set in the SDGs, the End TB Strategy and the political declaration of the UN high-level meeting on TB, for the period up to the SDG deadline of 2030

SDG Target 3.3	By 2030, end the epidemics of AIDS, TB, malaria and neglected tropical diseases, and combat hepatitis, water-borne diseases and other communicable diseases
WHO End TB Strategy	80% reduction in the TB incidence rate (new and relapse cases per 100 000 population per year) by 2030, compared with 2015 2020 milestone: 20% reduction; 2025 milestone: 50% reduction
	90% reduction in the annual number of TB deaths by 2030, compared with 2015 2020 milestone: 35% reduction; 2025 milestone: 75% reduction
	No households affected by TB face catastrophic costs by 2020[a]
UN high-level meeting on TB, 2018	40 million people treated for TB from 2018 to 2022, including: • 3.5 million children • 1.5 million people with drug-resistant TB, including 115 000 children
	At least 30 million people provided with TB preventive treatment from 2018 to 2022, including: • 6 million people living with HIV • 4 million children aged under 5 years and 20 million people in other age groups, who are household contacts of people affected by TB
	Funding of at least US$ 13 billion per year for universal access to TB prevention, diagnosis, treatment and care by 2022
	Funding of at least US$ 2 billion per year for TB research from 2018 to 2022

AIDS: acquired immunodeficiency syndrome; HIV: human immunodeficiency virus; SDG: Sustainable Development Goal; TB: tuberculosis; UN: United Nations.

[a] This indicator is not the same as the SDG indicator for catastrophic health expenditures. See **Box 4** for further explanation.

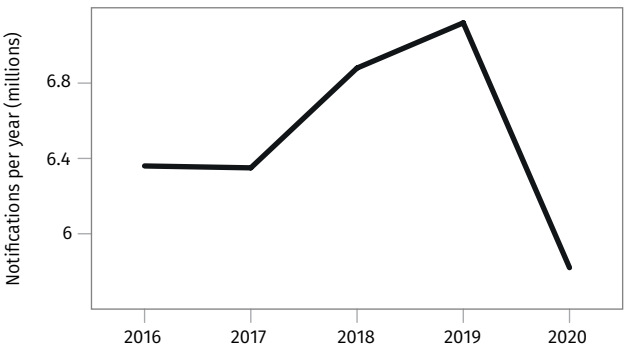
3. Main findings and messages

Big drops in TB case notifications

The most obvious impact on TB of disruptions caused by the COVID-19 pandemic is a large global drop in the number of people newly diagnosed with TB and reported in 2020, compared with 2019 (**Fig. 1**). Following large increases between 2017 and 2019, there was a fall of 18% between 2019 and 2020, from 7.1 million to 5.8 million.

FIG. 1

Global trend in case notifications of people newly diagnosed with TB, 2016–2020



A similar pattern of increases in TB case notifications up to 2019, followed by a sharp fall in 2020, is also evident in five of the six WHO regions (**Fig. 2**), with particularly large absolute and relative reductions in the regions of South-East Asia and the Western Pacific. In combination, these two regions accounted for most (84%) of the global reduction in notifications of people newly diagnosed with TB between 2019 and 2020. The decline in the WHO African Region was much more modest (2.5%). In the WHO European Region, there was clear discontinuity in an existing downward trend in notifications (reflecting an underlying decline in TB incidence), suggesting that detection and reporting of TB cases in this region was also affected by the COVID-19 pandemic.

The countries that contributed most to the global drop between 2019 and 2020 were India (41%), Indonesia

FIG. 2

Trends in case notifications of people newly diagnosed with TB by WHO region, 2016–2020

(14%), the Philippines (12%) and China (8%); these and 12 other countries accounted for 93% of the total global drop of 1.3 million (**Fig. 3**).

Monthly and quarterly notifications of people newly diagnosed with TB in 2020 and in the first half of 2021 were substantially below the average for 2019 in most of the high TB burden countries (**Fig. 4**). The largest relative reductions in annual notifications between 2019 and 2020 were seen in Gabon (80%), the Philippines (37%), Lesotho (35%), Indonesia (31%) and India (25%). Exceptions to this general pattern included the Democratic Republic of the Congo, Nigeria, the United Republic of Tanzania and Zambia (**Fig. 4**).

The substantial reduction in TB case detection and reporting between 2019 and 2020 probably reflects both supply- and demand-side disruptions to TB diagnostic and treatment services. Examples of such disruptions include reduced health system capacity to continue to provide services, less willingness and ability to seek care in the context of lockdowns and associated restrictions on movement, concerns about the risks of going to health care facilities during a pandemic, and stigma associated with similarities in the symptoms related to TB and COVID-19.

Reasons for regional and country variation in TB notification trends between 2019 and 2020 include dif-

FIG. 3

The 16 countries with the largest contributions to the global shortfall in TB notifications in 2020 compared with 2019

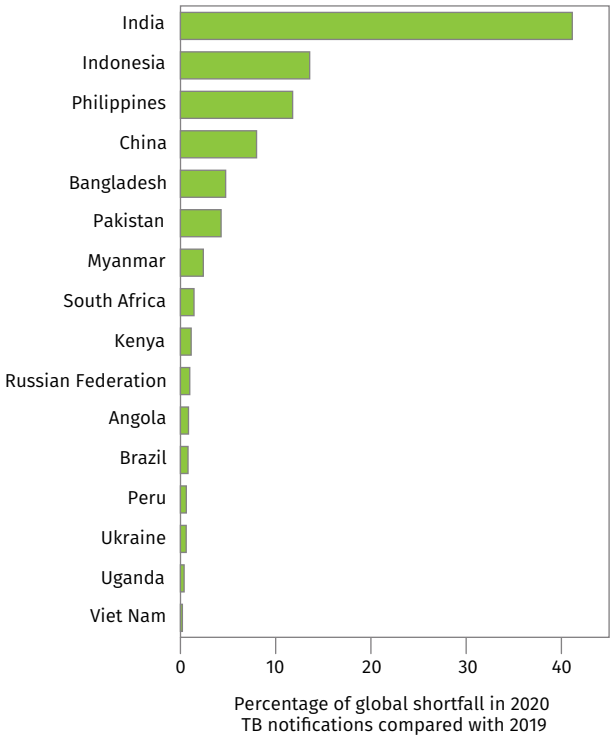
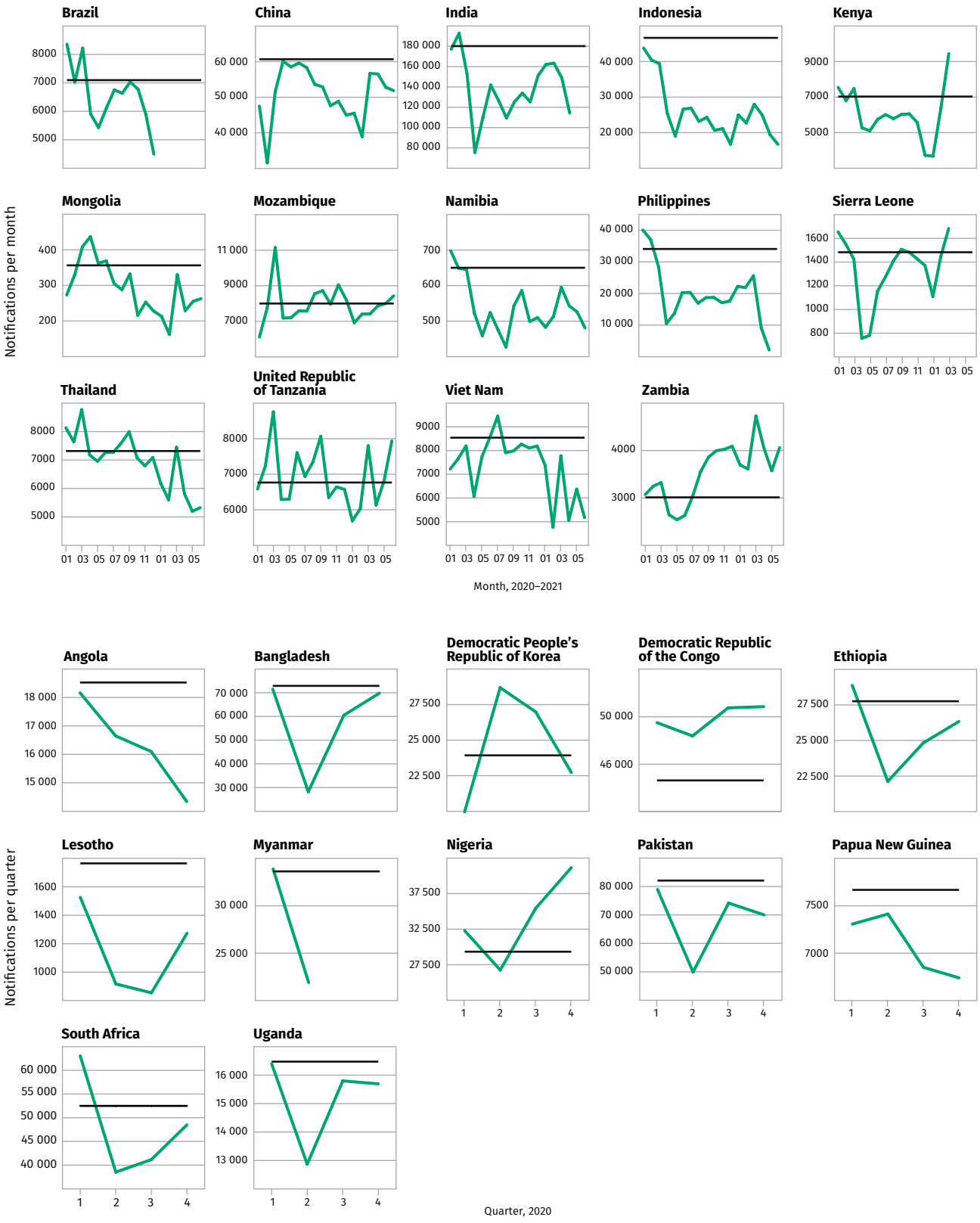


FIG. 4

Trends in monthly or quarterly case notifications of people newly diagnosed with TB from January 2020–June 2021, selected high TB burden countries[a]

The **black** line indicates the average number of monthly or quarterly case notifications in 2019.

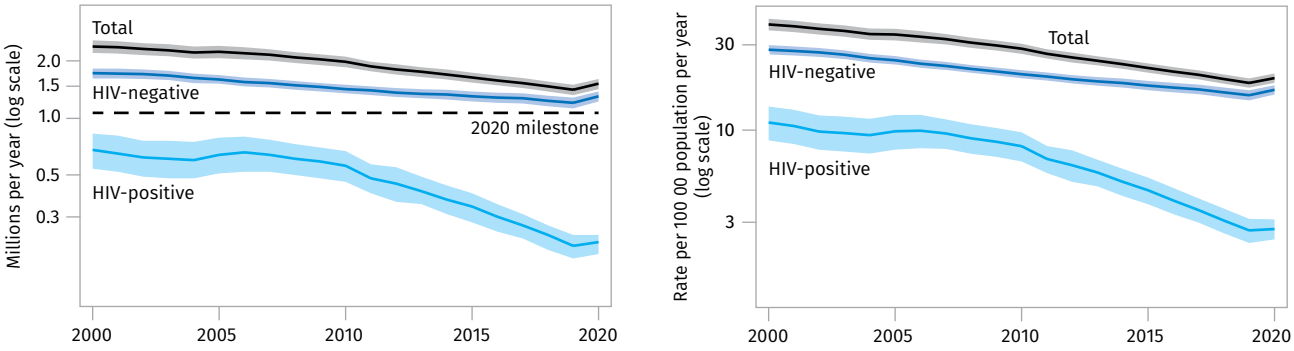


[a] Data are shown for countries that were able to report provisional national numbers for all months or quarters to WHO by July 2021.

FIG. 5

Global trends in the estimated number of TB deaths (left) and the mortality rate (right), 2000–2020

Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2020 milestone of the End TB Strategy.



ferences in when they were first affected by the COVID-19 pandemic, the severity of the impact, the extent to which restrictions were put in place and adhered to, and the capacity and resilience of health systems.

TB deaths increased in 2020

The most immediate consequence of the large drop in the number of people newly diagnosed with TB in 2020 is an increase in the number of people who died from TB in 2020, at all levels: global, regional and country.[1]

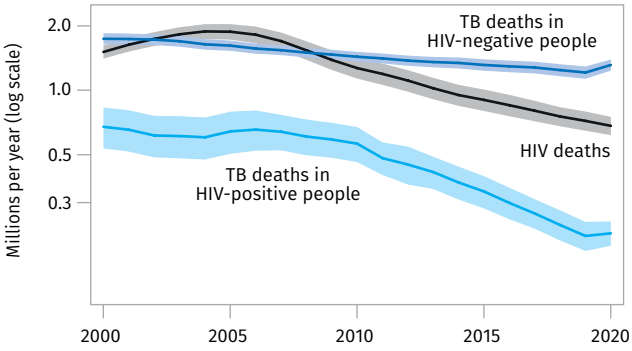
Globally in 2020, there were an estimated 1.3 million (95% uncertainty interval [UI]: 1.2–1.4 million) deaths among HIV-negative people, up from 1.2 million (UI: 1.1–1.3 million) in 2019, and an additional 214 000 (UI: 187 000–242 000) deaths among HIV-positive people, a small increase from 209 000 (UI: 178 000–243 000) in 2019 (**Fig. 5**).[2] The COVID-19 pandemic has reversed years of global progress in reducing the number of people who die from TB, with the first year-on-year increase (of 5.6%) since 2005 and the total number of deaths in 2020 returning to the level of 2017. The same trend was evident in the global TB mortality rate (deaths per 100 000 population per year, right panel of **Fig. 5**).

The global number of deaths officially classified as caused by TB (1.3 million) in 2020 was almost double the number caused by HIV/AIDS (0.68 million), and TB mortality has been more severely impacted by the COVID-19 pandemic in 2020 than HIV/AIDS (**Fig. 6**). In contrast to TB, deaths from HIV/AIDS continued to decline between 2019 and 2020.

FIG. 6

Global trends in the estimated number of deaths caused by TB and HIV, 2000–2020[a,b]

Shaded areas represent uncertainty intervals.



[a] For HIV/AIDS, the latest estimates of the number of deaths in 2020 that have been published by UNAIDS are available at http://www.unaids.org/en/. For TB, the estimates for 2020 are those published in this report.

[b] Deaths from TB among HIV-positive people are officially classified as deaths caused by HIV/AIDS in the International Classification of Diseases.

The latest year for which WHO has published estimates of global deaths by cause is 2019 (**Fig. 7**). TB was the 13th leading cause of death worldwide and the top cause from a single infectious agent. In 2020, it is anticipated that TB will rank as the second leading cause of death from a single infectious agent, after COVID-19 *(10)*.

The global pattern of a fall in the absolute number of TB deaths until 2019 followed by an increase in 2020 was evident in four of the six WHO regions; the exceptions were the WHO African and Western Pacific regions, where there was a flat trend (**Fig. 8**). The number of TB deaths increased in 2020 in most of the 30 high TB burden countries.[3]

[1] To estimate the impact of reductions in TB case detection (i.e. the number of people newly diagnosed with TB and reported) in 2020, country-specific dynamic models were developed for the 16 countries that contributed most to the global drop (**Fig. 3**) and a statistical model was used to extrapolate results to other low- and middle-income countries. The most important assumption was that reductions in notifications of people diagnosed with TB reflected real reductions in the number of people with TB who accessed treatment. Further details are provided in **Annex 5** and in an online technical annex.

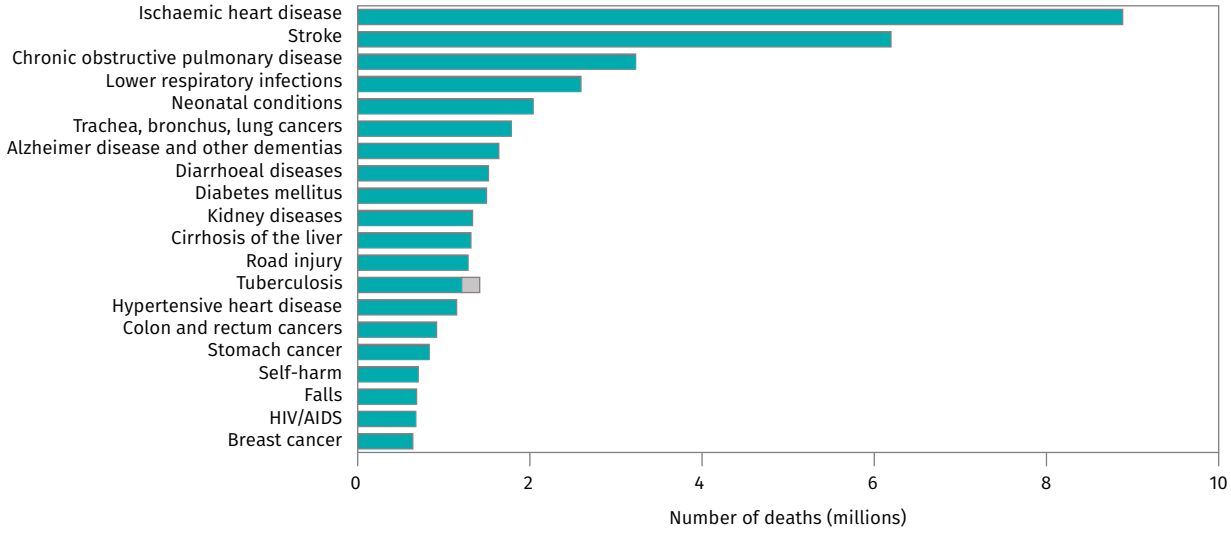
[2] When an HIV-positive person dies from TB disease, the underlying cause is coded as HIV in the International Classification of Diseases (ICD) system.

[3] In 2021, WHO updated its three lists of high burden countries for TB, drug-resistant TB and HIV-associated TB. The new lists are for 2021–2025 and replace those for 2016–2020. The updated lists are defined and explained in **Annex 3**.

FIG. 7

Top causes of death worldwide in 2019[a,b]

Deaths from TB among HIV-positive people are shown in grey.



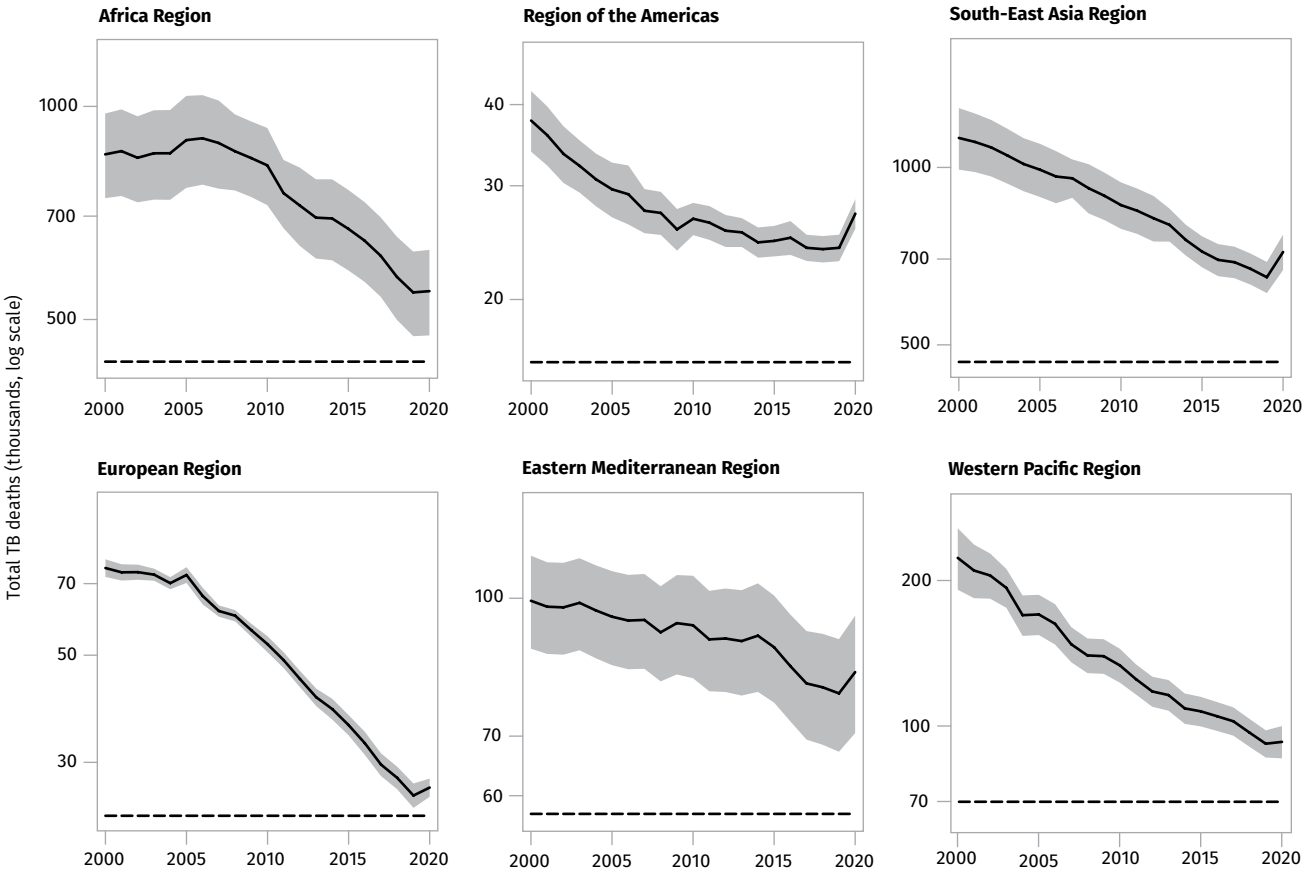
[a] This is the latest year for which estimates for all causes are currently available. See WHO estimates, available at https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death

[b] Deaths from TB among HIV-positive people are officially classified as deaths caused by HIV/AIDS in the International Classification of Diseases.

FIG. 8

Trends in the estimated absolute number of TB deaths (HIV-positive and HIV-negative) by WHO region, 2000–2020

Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2020 milestone of the End TB Strategy.



Globally in 2020, about 84% of TB deaths among HIV-negative people and 85% of the combined total of TB deaths in HIV-negative and HIV-positive people occurred in the WHO African and South-East Asia regions. India accounted for 38% of global TB deaths among HIV-negative people and for 34% of the combined total number of TB deaths in HIV-negative and HIV-positive people. Of the deaths among HIV-negative people, 53% were men, 32% were women and 16% were children (aged <15 years). Of the TB deaths among HIV-positive people, 50% were men, 40% were women and 9.8% were children.

Declines in TB incidence slowed

Worldwide, an estimated 9.9 million people (95% UI: 8.9–11 million) fell ill with TB in 2020, equivalent to 127 cases (UI: 114–140) per 100 000 population. Both figures were small declines compared with 2019 (1.9% for the incidence rate and 0.87% for the absolute number of cases[1]), continuing the slow downward trends evident since 2000 (**Fig. 9**).

There was a similar pattern of slow decline in three of the six WHO regions (the Eastern Mediterranean, South-East Asia and Western Pacific), with faster declines in the African and European regions (**Fig. 10**). Of concern is the WHO Region of the Americas, where incidence appears to be slowly increasing owing to an upward trend in Brazil since 2016.

There are two main reasons why the impact of disruptions to TB services on TB incidence in 2020 is more limited than the impact on TB mortality. One reason is that disruptions to diagnostic and treatment services affect those who already have TB disease first, resulting in an increase in the number of deaths. The other reason is that the impact on incidence of the increased pool of prevalent cases that develops as more people with TB are not diagnosed and treated is slow, because of the relatively long period of time between the acquisition of infection and the development of disease (which ranges from weeks to decades).[2]

Geographically, in 2020, most TB cases were in the WHO regions of South-East Asia (43%), Africa (25%) and the Western Pacific (18%), with smaller shares in the Eastern Mediterranean (8.3%), the Americas (3.0%) and Europe (2.3%). The 30 high TB burden countries accounted for 86% of all estimated incident cases worldwide, and eight of these countries (**Fig. 11**) accounted for two thirds of the global total: India (26%), China (8.5%), Indonesia (8.4%), the Philippines (6.0%), Pakistan (5.8%), Nigeria (4.6%), Bangladesh (3.6%) and South Africa (3.3%).

TB can affect anyone, regardless of age or sex (**Fig. 12**). The highest burden is in adult men, who accounted for 56% of all TB cases in 2020; by comparison, adult women accounted for 33% and children for 11%. The higher share of TB cases among men is consistent with evidence from national TB prevalence surveys, which show that TB disease affects men more than women, and that gaps in case detection and reporting are higher among men.

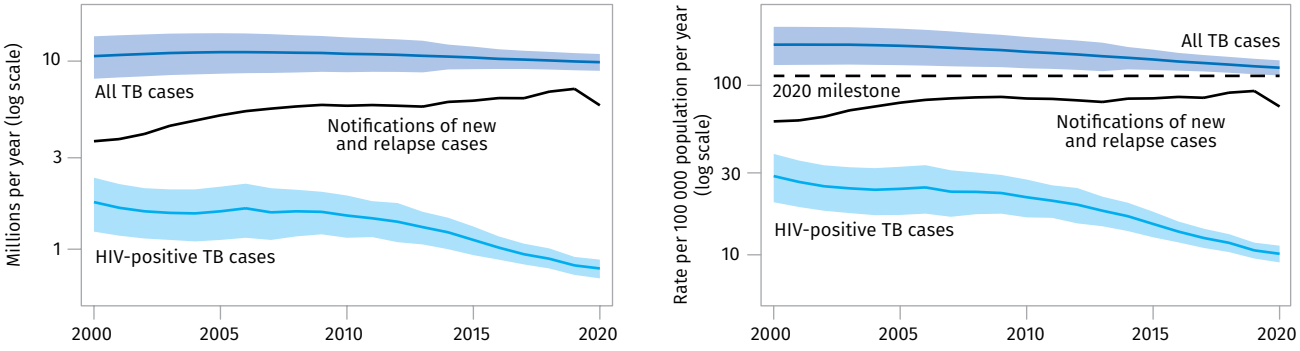
Among all incident cases of TB, 8% were people living with HIV. The proportion of TB cases coinfected with HIV was highest in countries in the WHO African Region, exceeding 50% in parts of southern Africa.

The severity of national TB epidemics, in terms of the number of incident TB cases per 100 000 population per year, varies widely among countries, from less than five to more than 500 new and relapse cases per 100 000 population per year (**Fig. 13**). In 2020, 57 countries had a low incidence of TB (<10 cases per 100 000 population per year), mostly in the WHO Region of the Americas and the WHO European Region, plus a few countries in the

FIG. 9

Global trends in the estimated number of incident TB cases (left) and the incidence rate (right), 2000–2020

Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2020 milestone of the End TB Strategy.



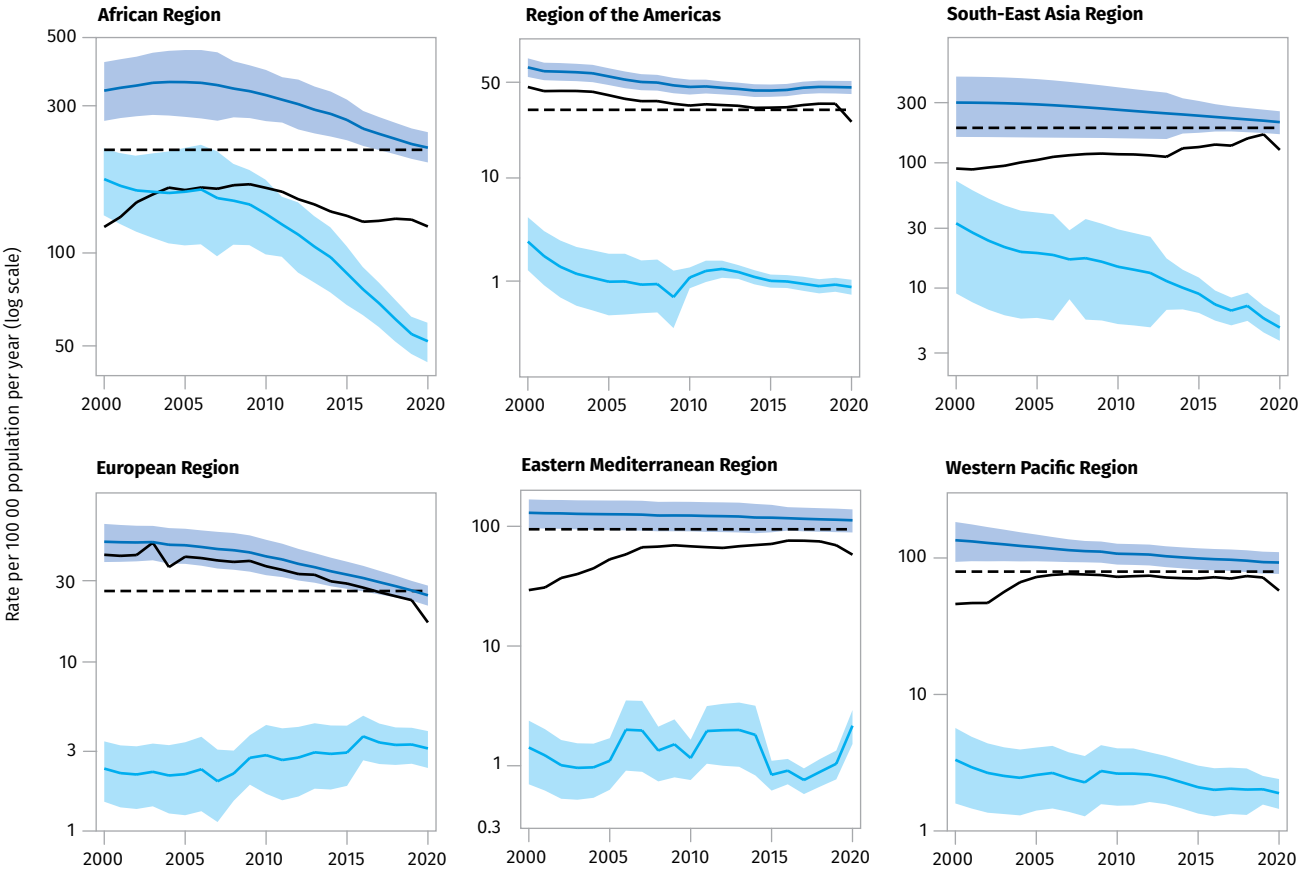
[1] The annual rate of decline between 2018 and 2019 was 2.3% for the incidence rate and 1.2% for the absolute number of incident cases.

[2] The number of people newly infected by each person with TB disease may also have been reduced by the effect of lockdowns and other policy measures (e.g. physical distancing and mask wearing). However, modelling suggests that the overall impact on TB incidence of such measures was small.

FIG. 10

Trends in estimated TB incidence rates by WHO region, 2000–2020

Total TB incidence rates are shown in **blue** and incidence rates of HIV-positive TB are shown in **light blue**. The black solid lines show notifications of new and relapse cases for comparison with estimates of the total incidence rate. Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2020 milestone of the End TB Strategy.



WHO Eastern Mediterranean and Western Pacific regions. Countries with a low incidence are well placed to target TB elimination. There were 150–400 cases per 100 000 population in most of the 30 high TB burden countries, and more than 500 cases per 100 000 population in the Central African Republic, the Democratic People's Republic of Korea, Lesotho, the Philippines and South Africa.

Drug-resistant TB continues to be a public health threat. Resistance to isoniazid and rifampicin – the two most effective first-line drugs – is of greatest concern; resistance to both drugs is defined as multidrug-resistant TB (MDR-TB). Both MDR-TB and rifampicin-resistant TB (RR-TB) require treatment with second-line drugs.

Globally, the burden of MDR-TB or RR-TB (MDR/RR-TB) is stable. For more than 10 years, the best estimate of the proportion of people diagnosed with TB for the first time who had MDR/RR-TB has remained at about 3–4% and the best estimate for those previously treated for TB has remained at about 18–21%.[1] The highest proportions (>50% in previously treated cases) are in countries of the former Soviet Union.

[1] As published by WHO in annual global TB reports.

2020 milestones for reducing TB disease burden

Mostly not achieved, some success stories

The End TB Strategy milestones for reductions in TB disease burden by 2020 were a 35% reduction in the number of TB deaths and a 20% reduction in the TB incidence rate, compared with levels in 2015 (**Table 1**). These milestones were not achieved globally or in most WHO regions and countries, although there were some success stories that showed the milestones were achievable.

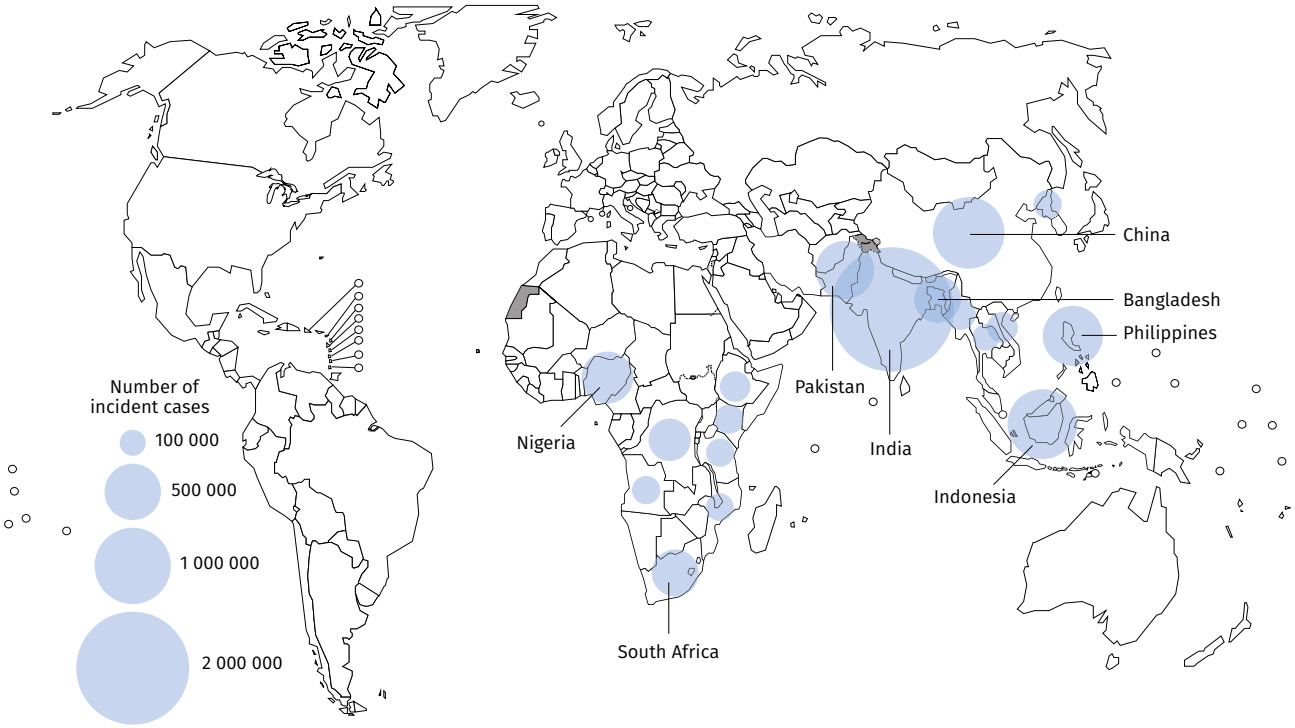
Globally, the reduction in the number of TB deaths between 2015 and 2020 was only 9.2%, about one quarter of the way to the milestone. Progress achieved up to 2019 (a 14% reduction from 2015 to 2019 and a 41% reduction from 2000 to 2019) was compromised by the increase in TB deaths in 2020 that resulted from disruptions to diagnosis and treatment caused by the COVID-19 pandemic (**Fig. 5**, left panel).

At regional level, only the WHO European Region came close to reaching the milestone, with a reduction of 26% (**Fig. 8**). This was driven mostly by progress in the

FIG. 11

Estimated TB incidence in 2020, for countries with at least 100 000 incident cases

The eight countries that rank first to eighth in terms of numbers of cases, and that accounted for two thirds of global cases in 2020, are labelled.



Russian Federation, where the number of TB deaths fell 10% per year between 2010 and 2020. The WHO African Region made relatively good progress, with a reduction of 18%. In contrast, the number of TB deaths in 2020 was higher than in 2015 in the Americas (+10%). Declines compared with 2015 in the other WHO regions were 13% in the Western Pacific, 6.2% in the Eastern Mediterranean and 0.19% in South-East Asia.

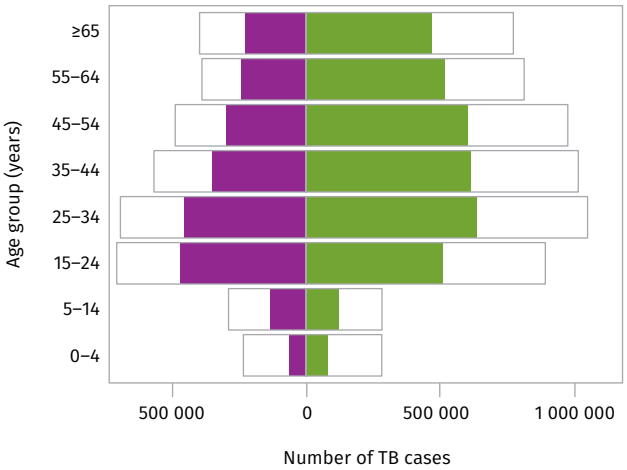
The success stories at country level included six high TB burden countries (Kenya, Mozambique, Myanmar, Sierra Leone, the United Republic of Tanzania and Viet Nam) and one of the global TB watchlist countries (Russian Federation),[1] all of which achieved the milestone (**Fig. 14**). In total, 33 countries reached the milestone.

Globally, the cumulative reduction in the TB incidence rate from 2015 to 2020 was 11%, just over half-way to the 2020 milestone (**Fig. 9**, right panel).

There were two success stories at regional level (**Fig. 10**). The WHO European Region exceeded the 2020 milestone, with a reduction of 25%. This was mostly driven by the decline in the Russian Federation, where incidence fell by 6% per year between 2010 to 2020; as a result, the Russian Federation has transitioned out of

FIG. 12

Global estimates of TB incidence (black outline) and case notifications of people newly diagnosed with TB disaggregated by age and sex (female in purple; male in green), 2020



[1] Alongside the list of 30 high TB burden countries for 2021–2025, WHO has established a global TB watchlist. The watchlist comprises the three countries that have transitioned out of the previous list for 2016–2020, which warrant continued global attention: Cambodia, the Russian Federation and Zimbabwe (**Annex 3**).

FIG. 13

Estimated TB incidence rates, 2020

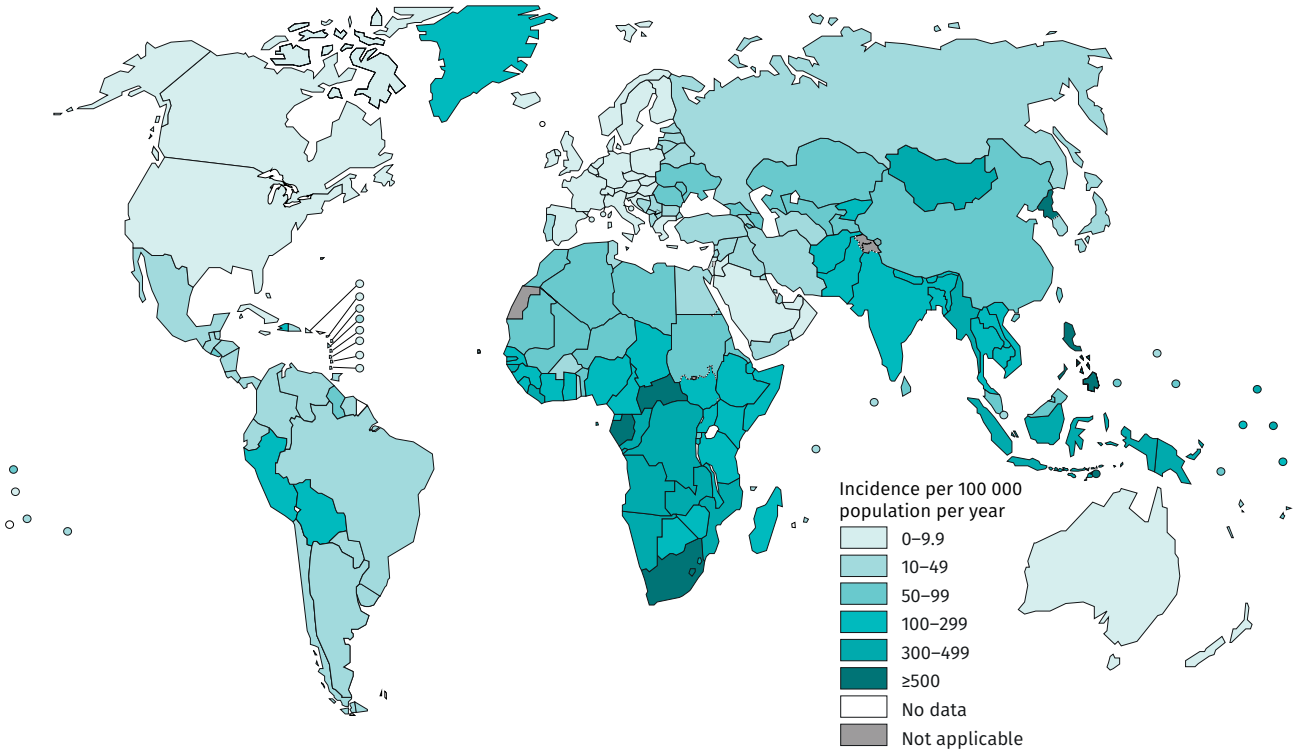


FIG. 14

High TB burden and global TB watchlist countries estimated to have achieved the End TB Strategy 2020 milestone of a 35% reduction in the absolute number of TB deaths between 2015 and 2020

Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2020 milestone of the End TB Strategy.

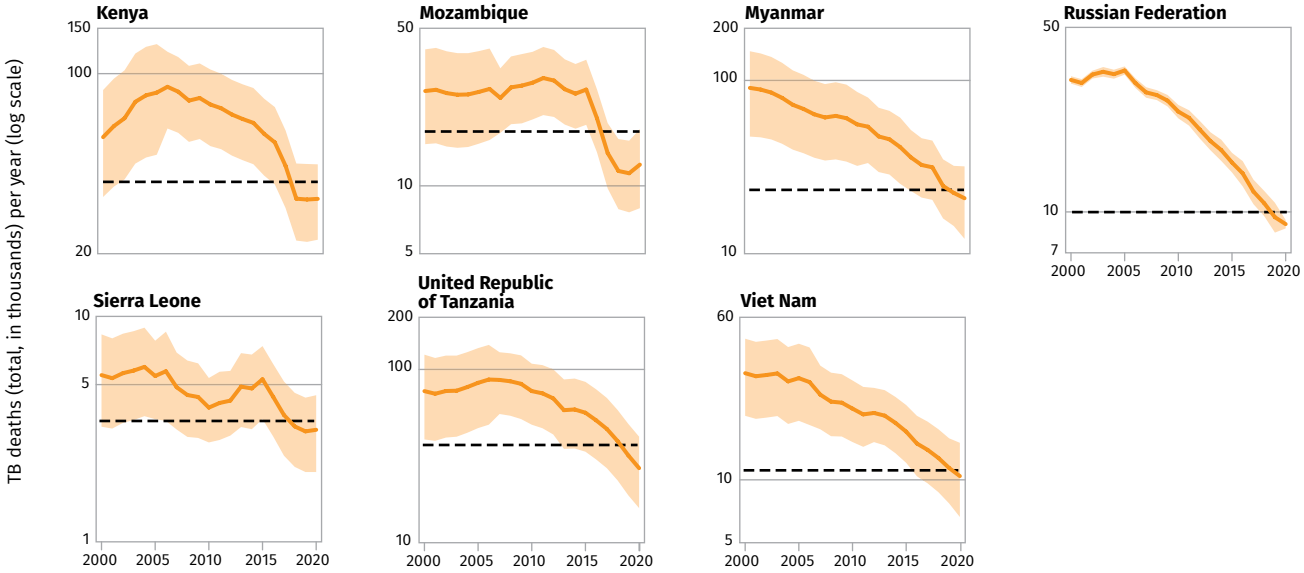
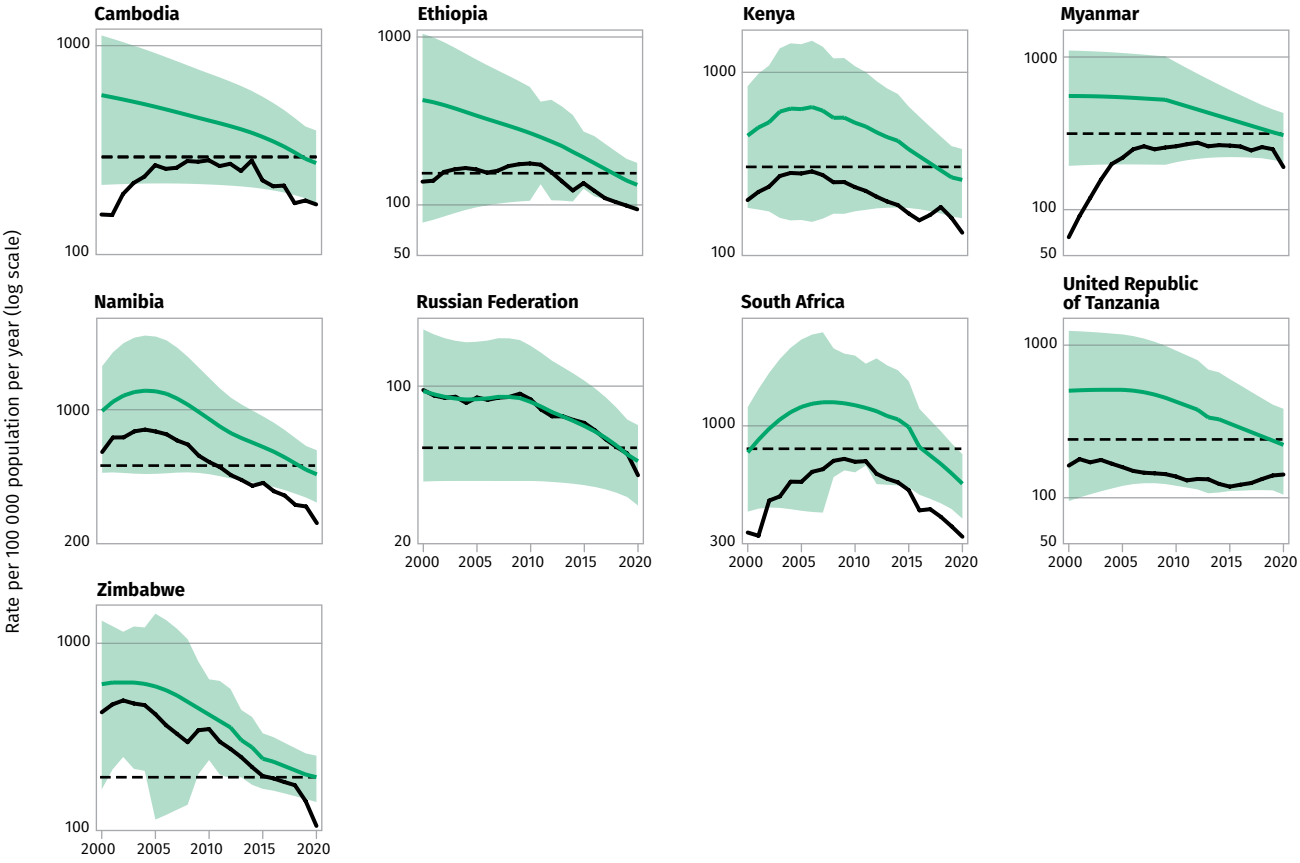


FIG. 15

High TB burden and global TB watchlist countries estimated to have achieved the End TB Strategy 2020 milestone of a 20% reduction in the TB incidence rate between 2015 and 2020

TB incidence rates are shown in **green**. The **black** solid lines show notifications of new and relapse cases for comparison with estimates of the total incidence rate. Shaded areas represent uncertainty intervals. The horizontal dashed line shows the 2020 milestone of the End TB Strategy.



WHO's list of 30 high TB burden countries. The WHO African Region came close to reaching the milestone, with a reduction of 19%. This reflects impressive reductions of 4–10% per year in several countries in southern Africa, following a peak in the HIV epidemic and the expansion of TB and HIV prevention and care. Reductions in the TB incidence rate from 2015 to 2020 in three other WHO regions were much smaller: 4.9% in the Eastern Mediterranean, 11% in South-East Asia and 6.7% in the Western Pacific. There was no progress in the WHO Region of the Americas.

The success stories at country level included six high TB burden countries (Ethiopia, Kenya, Myanmar, Namibia, South Africa and the United Republic of Tanzania) and the three global TB watchlist countries (Cambodia, Russian Federation and Zimbabwe), all of which achieved the milestone (**Fig. 15**). In total, 86 countries reached the milestone of a 20% reduction in the TB incidence rate between 2015 and 2020.

TB deaths and incidence, 2021–2022

Worsening trends projected

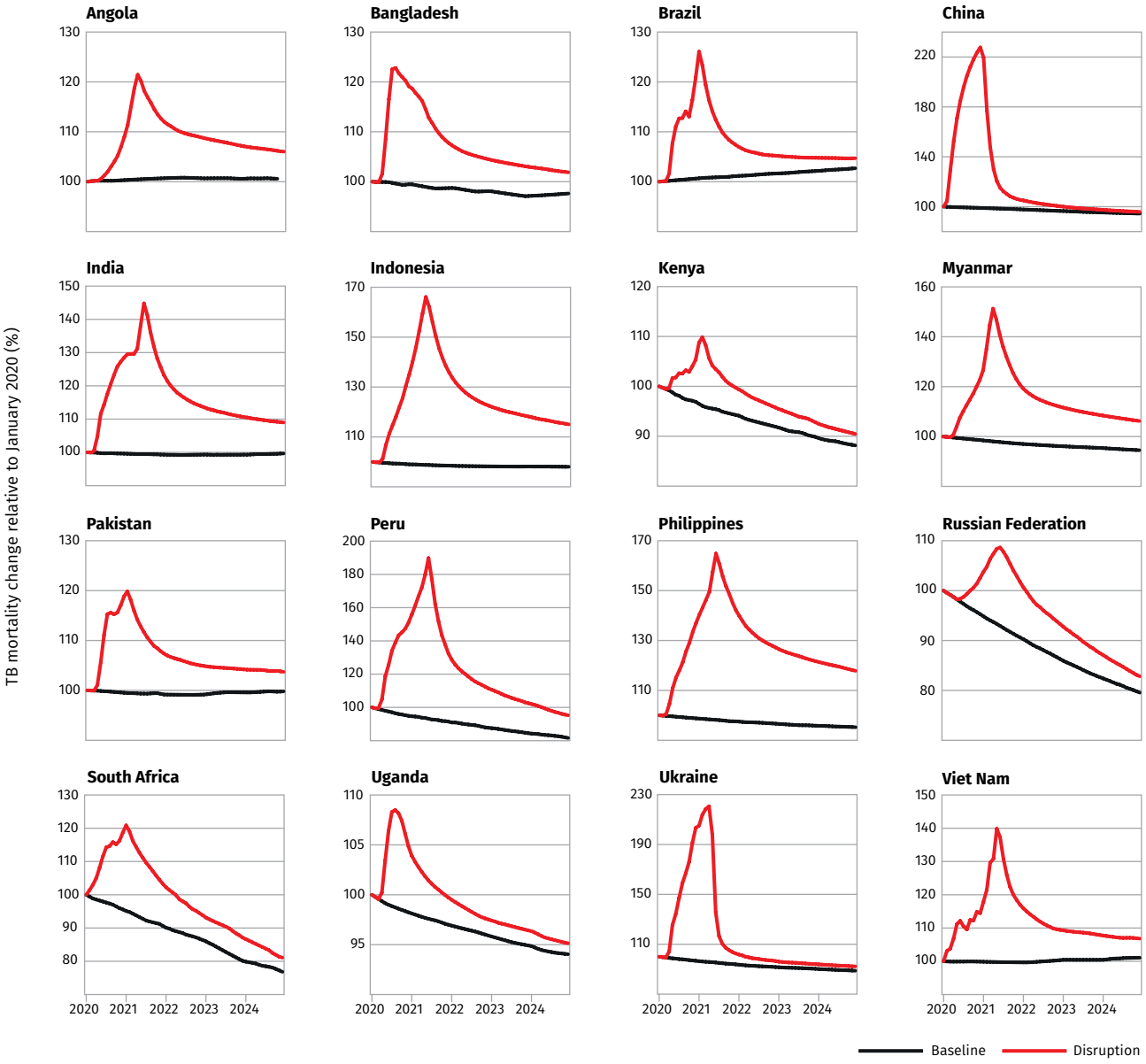
Country-specific models developed for the 16 countries that accounted for almost all of the global drop in TB notifications between 2019 and 2020 (**Fig. 3**), and for 71% of the estimated global number of incident cases in 2020, suggest that the negative impacts on TB mortality and TB incidence in 2020 will become much worse in 2021 and beyond (**Fig. 16**, **Fig. 17**). The biggest impact on TB deaths is expected in 2021 and the biggest impact on TB incidence is forecast to be in 2022. In 2021, TB mortality is projected to be much higher than in 2020 in all of the 16 modelled countries and by 2022, TB incidence is projected to be above the level of 2020 in most of them. This is consistent with earlier modelling projections published in 2020 *(11–14)*.

Moreover, the impacts suggested in **Fig. 16** and **Fig. 17** could be underestimates. The modelling does not yet account for the negative impact of the COVID-19 pandemic on broader TB determinants, such as income levels and undernutrition, which increase the probability of developing TB disease among people already infected

FIG. 16

Estimated impact of the COVID-19 pandemic on TB mortality for 16 selected countries, up to 2025

Standardized TB mortality rate (including HIV)[a]



[a] These estimates are standardized so that rates in January 2020 equal 100 and all subsequent rates are relative to January 2020. For example, a reading of 115 translates into a 15% increase relative to January 2020. Baseline is a scenario of no COVID-19 disruptions based on pre-2020 trends. The impact of COVID-19 related disruptions on estimated mortality is noticeable from 2020 onwards.

with *M. tuberculosis*. Declines in income may also affect health care seeking behaviour when people become unwell, causing delays in TB diagnosis and treatment. There is a strong association between the TB incidence rate and both average income (measured as gross domestic product [GDP] per capita) and the prevalence of undernutrition (**Fig. 18**).

TB diagnosis and treatment

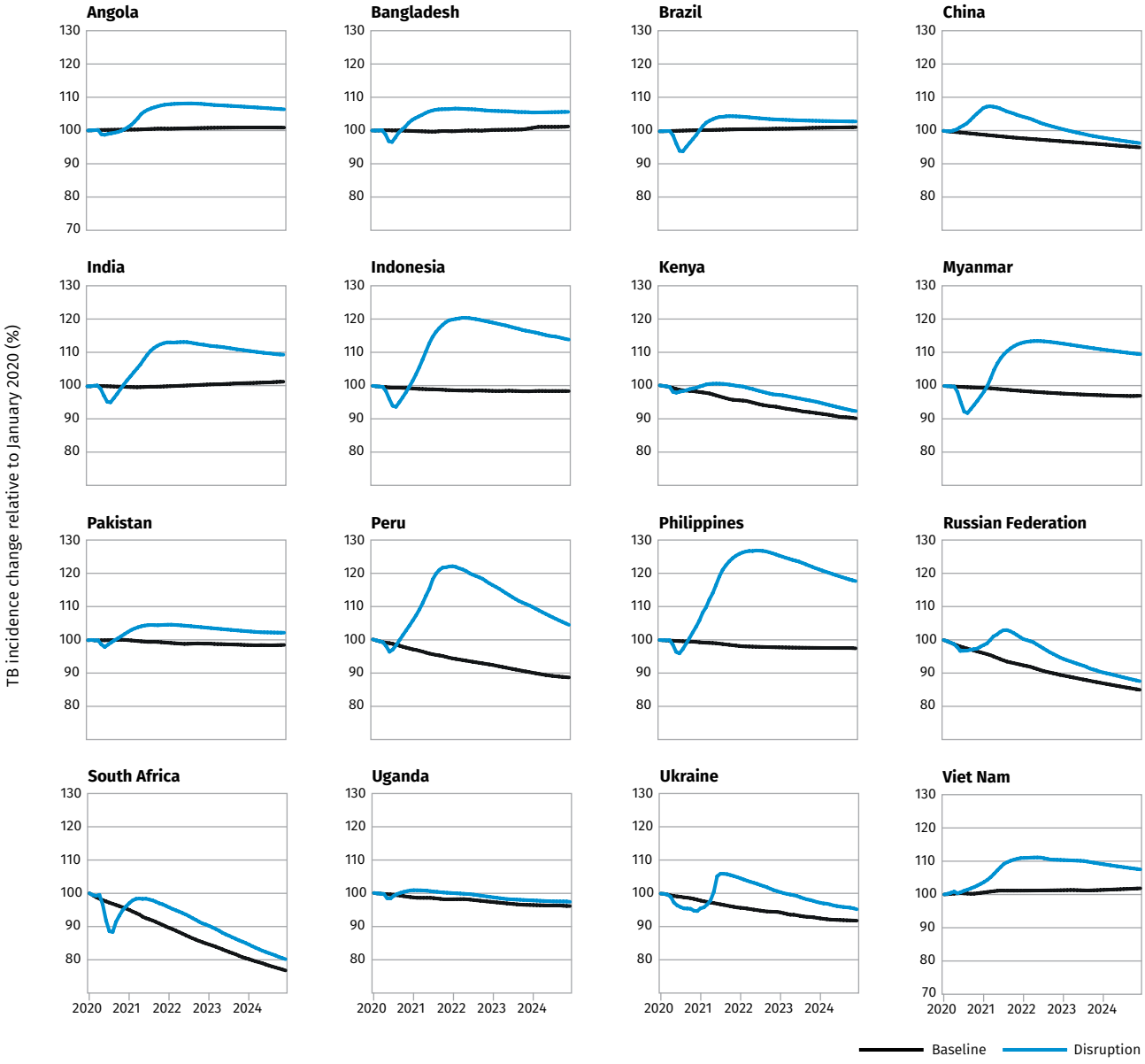
Recent gains reversed, targets off track

The big global drop in TB case notifications in 2020 compared with 2019 (**Fig. 1**, **Fig. 2**, **Fig. 3**, **Fig. 4**) means that the gap between the number of people who fell ill with TB and the number of people newly diagnosed and reported widened substantially in 2020 (**Fig. 19**), to a best estimate of 4.1 million. This was a major reversal of previous progress in closing the gap between 2012 and 2019, when the global number of people newly diagnosed with TB and reported rose from 5.7–5.8 million annually in the years 2009–2012 to 6.4 million in 2017 and 7.1 million in

FIG. 17

Estimated impact of the COVID-19 pandemic on TB incidence for 16 selected countries, up to 2025

Standardized TB incidence rate[a]



[a] These estimates are standardized so that rates in January 2020 equal 100 and all subsequent rates are relative to January 2020. For example, a reading of 115 translates into a 15% increase relative to January 2020. Baseline is a scenario of no COVID-19 disruptions based on pre-2020 trends. The impact of COVID-19 related disruptions on estimated incidence is limited in 2020 and more noticeable in subsequent years.

2019, while TB incidence was relatively stable at around 10 million cases per year. The number of new TB case notifications in 2020, at 5.8 million, takes the world back to the level of 2012.

The two countries with the largest absolute reductions in notifications between 2019 and 2020 (**Fig. 3**), India and Indonesia, had previously been the main contributors to the large global increase in TB notifications between 2013 and 2019. Their combined annual total number of notifications increased by 1.2 million in that period, but then fell by 0.7 million between 2019 and 2020.

Globally, these negative trends meant that TB treatment coverage in 2020 (approximated as notifications divided by incidence)[1] was 59% (95% UI: 53–56%), down from 72% (UI: 65–80%) in 2019. Among the six WHO regions, treatment coverage was highest in the Americas (with a best estimate of 69%) and lowest in the Eastern Mediterranean (with a best estimate of 52%). Of the 30 high TB burden countries, those with the highest levels of treatment coverage in 2020 included Brazil, China and Thailand. Eight high TB burden countries had worryingly low levels of treatment coverage in 2020, with best esti-

[1] Some people who are newly diagnosed and reported may not be started on treatment, and some people may be diagnosed and treated but not reported (and thus not included in the number of case notifications).

FIG. 18

The relationship between GDP per capita and the prevalence of undernutrition, and TB incidence per 100 000 population

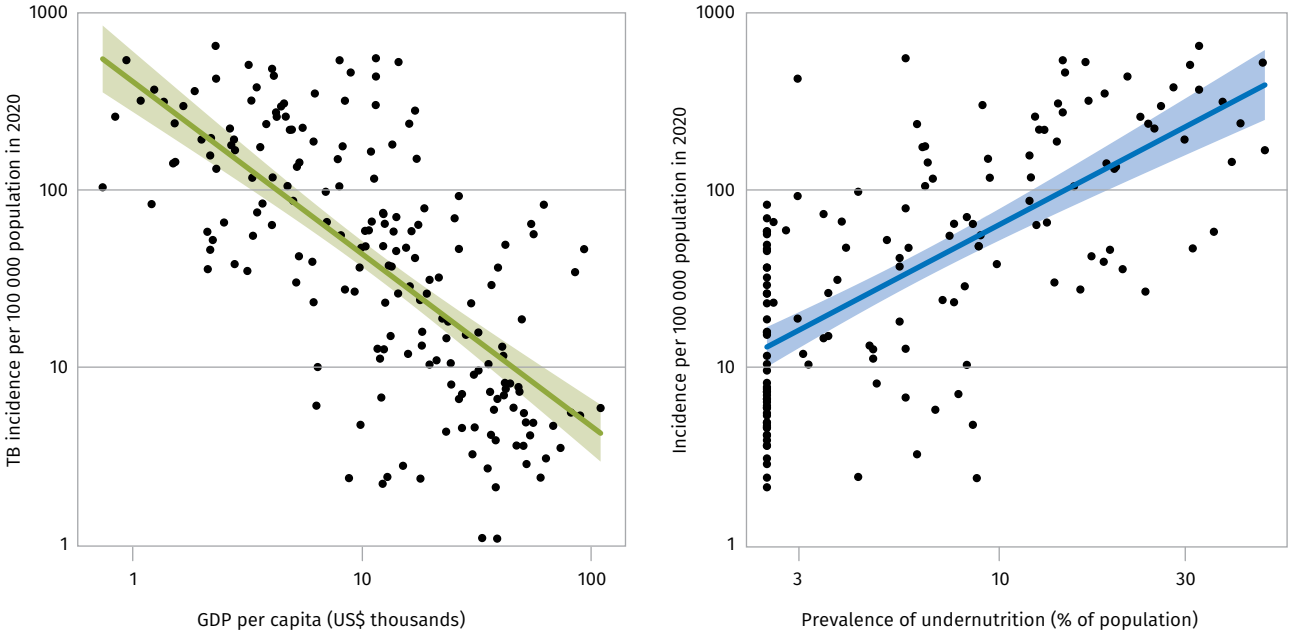


FIG. 19

Global trends in notifications of people newly diagnosed with TB (black) and the estimated number of incident TB cases (green), 2000–2020

Shaded area represents the uncertainty interval.

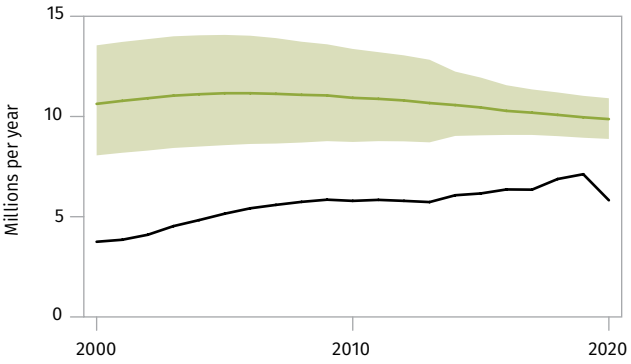
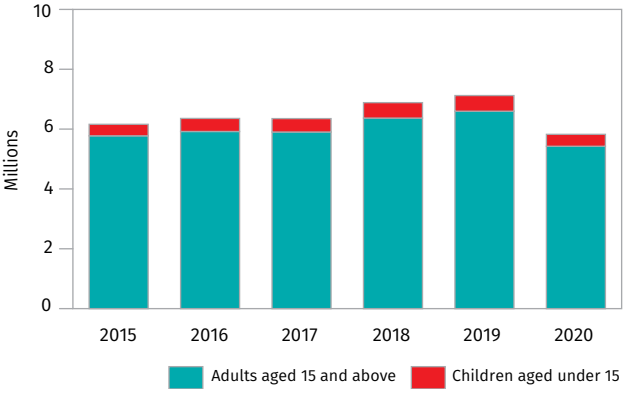


FIG. 20

The global number of people reported to have been treated for TB disease, 2015–2020



mates of below 50%: Central African Republic, Gabon, Indonesia, Lesotho, Liberia, Mongolia, Nigeria and the Philippines.

The major reversals of previous progress in increasing the number of people newly diagnosed with TB each year (**Fig. 19**, **Fig. 20**) have badly impacted progress towards the global TB treatment targets set at the UN high-level meeting (**Fig. 21**). The cumulative number of people treated between 2018 and 2020 was 19.8 million,[1] equivalent to 50% of the 5-year (2018–2022) target of 40 million. This included 1.4 million children, 41% of the 5-year target of 3.5 million.

In 2020, 10 countries collectively accounted for 74% of the global gap between estimated TB incidence and the number of people newly diagnosed with TB and reported (**Fig. 22**). The top three contributors were India, Indonesia and the Philippines (24%, 11% and 8.3%, respectively). Gaps are due to a combination of underreporting of people diagnosed with TB and underdiagnosis (owing to people with TB being unable to access health care or not being diagnosed when they do). From a global perspective, efforts to recover levels of case detection achieved before the COVID-19 pandemic are of particular importance in these countries.

In many countries, there is also a need to increase the percentage of cases confirmed bacteriologically by scaling up the use of recommended diagnostics (rapid molecular tests or culture), in line with WHO guidelines *(15)*. The microbiological detection of TB is critical because it allows people to be correctly diagnosed, is

[1] This number assumes that all those diagnosed and reported were treated.

FIG. 21

Global progress in the number of people treated for TB between 2018 and 2020, compared with cumulative targets set for 2018–2022 at the UN high-level meeting on TB

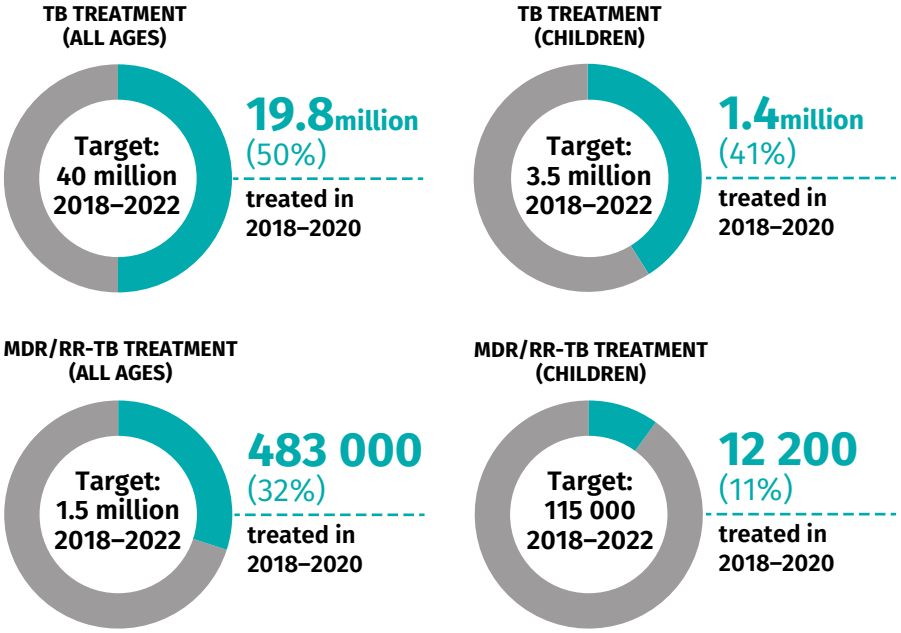
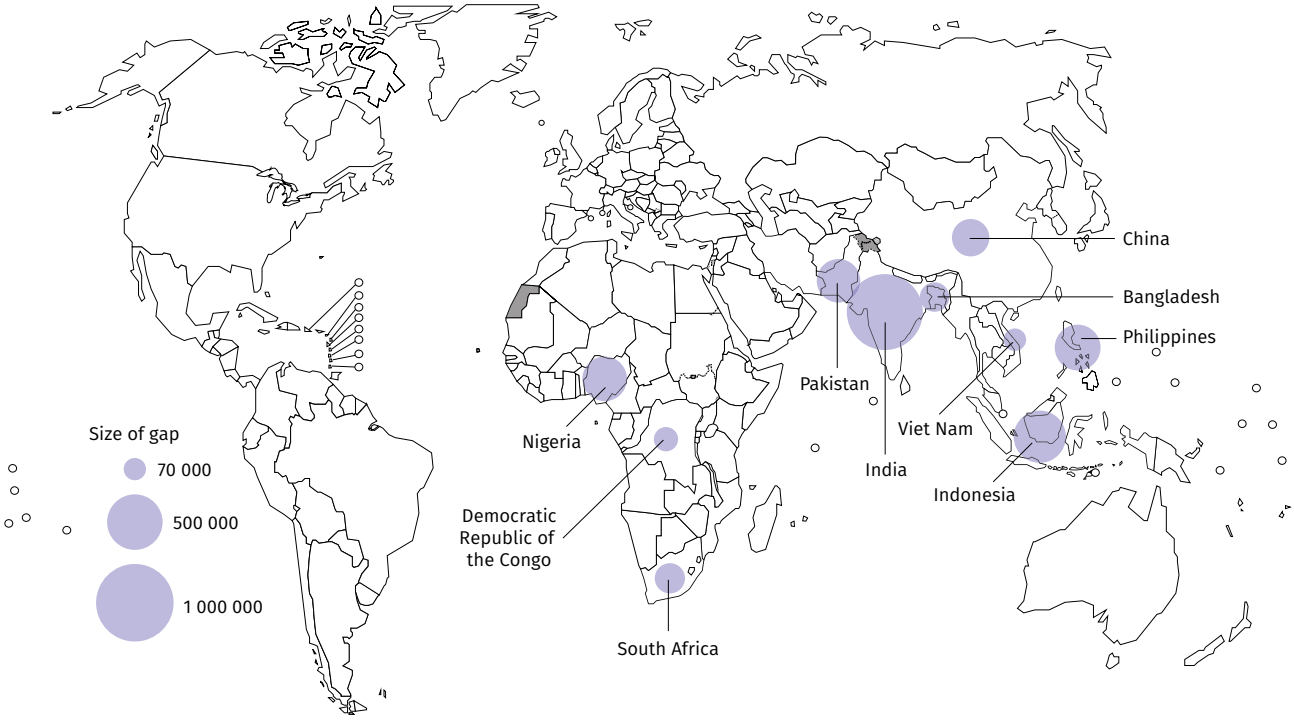


FIG. 22

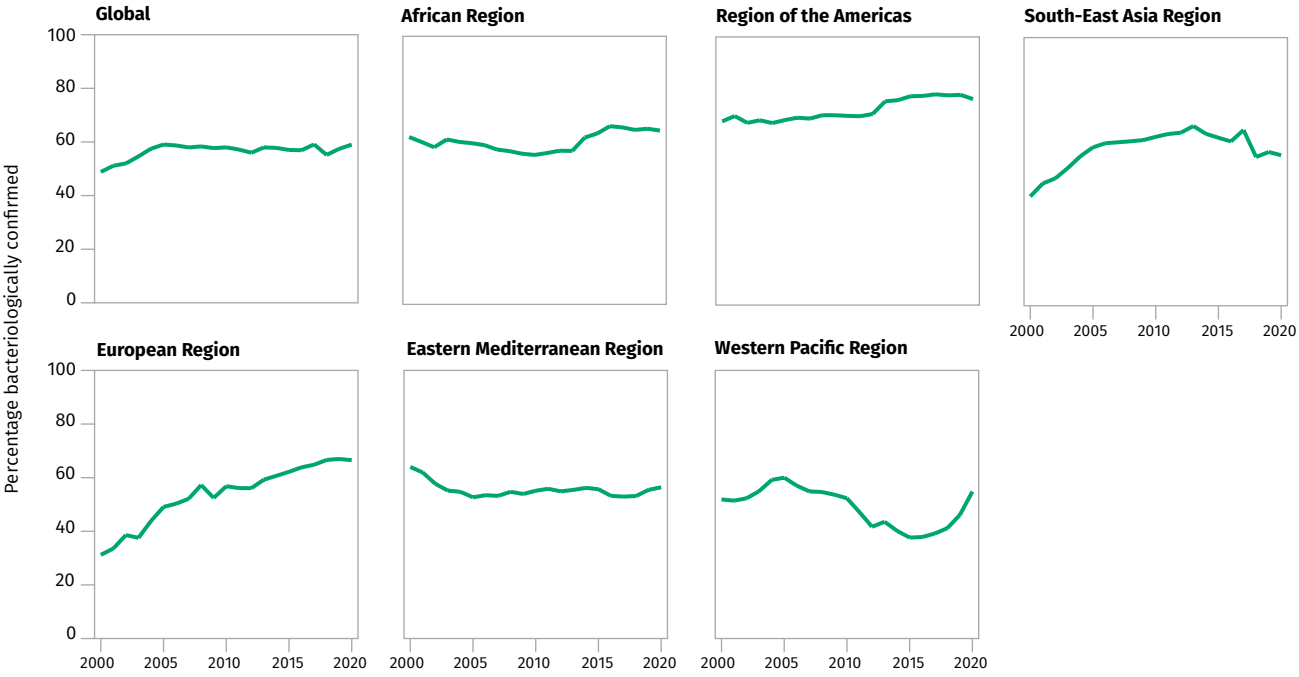
The ten countries with the largest gaps between notifications of new and relapse (incident) TB cases and the best estimates of TB incidence, 2020[a]



[a] The ten countries ranked in order of the size of the gap between notified cases and the best estimates of TB incidence in 2020 are: India, Indonesia, Philippines, Nigeria, Pakistan, China, South Africa, Bangladesh, Democratic Republic of the Congo and Viet Nam.

FIG. 23

Percentage of new and relapse pulmonary TB cases with bacteriological confirmation, globally and for WHO regions,[a] 2000–2020



[a] The calculation for new and relapse pulmonary cases in years prior to 2013 is based on smear results, except for the European Region where data on confirmation by culture was also available for the period 2002–2012.

necessary to test for drug resistance and ensures that the most effective treatment regimen (depending on the pattern of drug resistance) can be selected as early as possible.

Of the 4.8 million people diagnosed with pulmonary TB worldwide in 2020, 59% were bacteriologically confirmed (**Fig. 23**). This was a slight increase from 57% (out of a total of 6.0 million) in 2019, but the percentage has remained virtually unchanged since 2005. There was some variation among the six WHO regions, with the highest percentage achieved in the Americas (77%) and the lowest in the Western Pacific (55%). There was also considerable variation among countries. In general, levels of confirmation were lowest in low-income countries, and highest in high-income countries (median, 81%) where there is wide access to the most sensitive diagnostic tests.

The use of rapid tests remains far too limited. A WHO-recommended rapid molecular test was used as the initial diagnostic test for only 1.9 million (33%) of the 5.8 million people newly diagnosed with TB in 2020, up slightly from 28% (out of a total of 7.1 million) in 2019. Among the 49 countries in one of WHO's three global lists of high burden countries (for TB, HIV-associated TB and MDR/RR-TB) (**Annex 3**), only 21 reported that a WHO-recommended rapid diagnostic test had been used as the initial test for more than half of their notified TB cases (a small increase from 18 in 2019).

TABLE 2

Cumulative number of deaths averted by TB and TB/HIV interventions 2000–2020 (in millions), globally and by WHO region[a]

WHO REGION	HIV-NEGATIVE PEOPLE		HIV-POSITIVE PEOPLE		TOTAL	
	BEST ESTIMATE	UNCERTAINTY INTERVAL	BEST ESTIMATE	UNCERTAINTY INTERVAL	BEST ESTIMATE	UNCERTAINTY INTERVAL
African Region	6.6	5.5–7.7	8.2	6.9–9.5	15	13–17
Region of the Americas	1.8	1.7–2.0	0.34	0.31–0.38	2.3	2.0–2.3
South-East Asia Region	23	19–28	2.8	1.9–3.8	26	22–31
European Region	2.1	1.8–2.3	0.30	0.26–0.34	2.4	2.1–2.6
Eastern Mediterranean Region	4.7	4.1–5.3	0.08	0.06–0.10	4.8	4.2–5.4
Western Pacific Region	15	14–16	0.48	0.40–0.57	16	14–17
Global	54	47–60	12	11–14	66	59–73

[a] Numbers shown to two significant figures if under 100 and to three significant figures otherwise.

The global coverage of HIV testing among people diagnosed with TB remained high in 2020, at 73% (up from 70% in 2019). However, the absolute number of people diagnosed with TB who knew their HIV status fell from 4.8 million in 2019 to 4.2 million in 2020 (a reduction of 15%). At regional level, the highest coverage in 2020 was achieved in the WHO African Region (85%) and the WHO European Region (93%). In 87 countries and territories, at least 90% of people diagnosed with TB knew their HIV status. The coverage of antiretroviral therapy (ART) among people diagnosed with TB and known to be HIV-positive was 88% in 2020, the same level as in 2019.

In 2019 (the latest annual patient cohort for which data are available), the treatment success rate for people treated for TB with first-line regimens was 86% (**Fig. 24**), ranging among WHO regions from 74% in the Americas to 91% in the Eastern Mediterranean. This high level of overall treatment success has been sustained over a period of several years. Treatment success rates remain lower among people living with HIV (77% globally in 2019), although there have been steady improvements over time. The treatment success rate for children (aged 0–14 years) was 88% in 2019. Data for people started on treatment in 2020, which will become available in 2021, will be needed to assess the impact of disruptions related to the COVID-19 pandemic.

TB treatment and provision of ART to HIV-positive people diagnosed with TB are estimated to have averted 66 million deaths between 2000 and 2020 (**Table 2**).

Drug-resistant TB: diagnosis and treatment

Recent gains reversed, targets off track

WHO uses five categories to classify cases of drug-resistant TB: isoniazid-resistant TB, RR-TB and MDR-TB (defined above), plus pre-extensively drug-resistant TB (pre-XDR-TB) and XDR-TB. Pre-XDR-TB is TB that is resistant to rifampicin and any fluoroquinolone (a class of second-line anti-TB drug). XDR-TB is TB that is resistant to rifampicin, plus any fluoroquinolone, plus at least one of the drugs bedaquiline and linezolid.

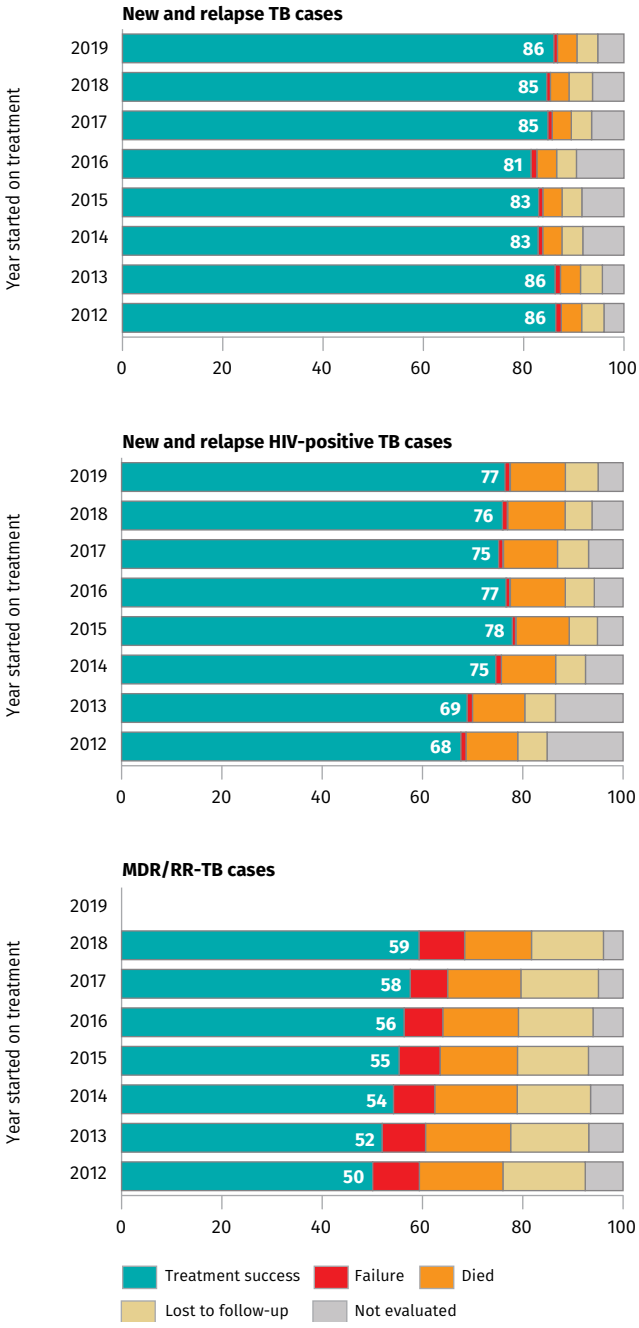
Detection of drug resistance requires bacteriological confirmation of TB and testing for drug resistance using rapid molecular tests, culture methods or sequencing technologies. Treatment requires a course of second-line drugs for at least 9 months and up to 20 months,[1] supported by counselling and monitoring for adverse events. WHO recommends expanded access to all-oral regimens *(16)*.

Globally in 2020, 71% (2.1/3.0 million) of people diagnosed with bacteriologically confirmed pulmonary TB were tested for rifampicin resistance, up from 61% (2.2/3.6 million) in 2019 and 50% (1.7/3.4 million) in 2018. Among these, 132 222 cases of MDR/RR-TB and 25 681 cases of pre-XDR-TB or XDR-TB were detected, for a

[1] There is also a 6-month regimen (bedaquiline, pretomanid and linezolid) that can be used in the context of operational research.

FIG. 24

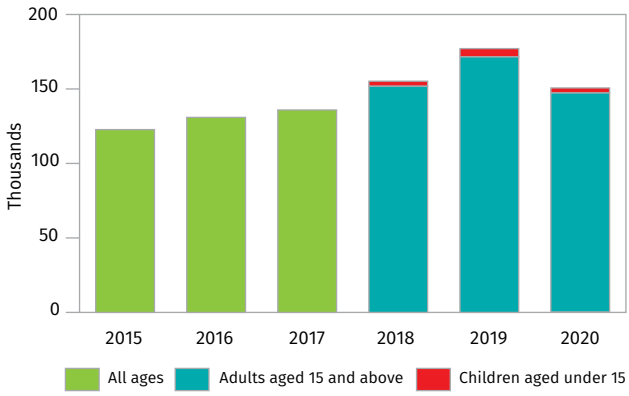
Treatment outcomes for new and relapse TB cases, new and relapse HIV-positive TB cases, and MDR/RR-TB cases, globally,[a] 2012–2019



[a] Outcomes for cohorts of people treated for MDR/RR-TB are reported one year later than other TB cohorts.

FIG. 25

The global number of people reported to have been enrolled on treatment for MDR/RR-TB, 2015–2020[a]



[a] Global data disaggregated by age are not available for the years before 2018.

combined total of 157 903. This was a large fall (of 22%) from the total of 201 997 people detected with drug-resistant TB in 2019, consistent with similarly large reductions in the total number of people newly diagnosed with TB (18%) and the total number of people diagnosed with bacteriologically confirmed pulmonary TB (17%) observed between 2019 and 2020. Worldwide, 150 359 people with MDR/RR-TB were enrolled on treatment in 2020, down 15% from the total of 177 100 in 2019 (**Fig. 25**). This level of enrolment was equivalent to about one in three of the people who develop MDR/RR-TB each year.

Reversals in progress in the number of people enrolled on treatment mean that the global targets set at the UN high-level meeting appear increasingly out of reach (**Fig. 21**). The cumulative total number of people with MDR/RR-TB who were reported as enrolled on treatment from 2018 to 2020 was 482 683, only 32% of the 5-year target (2018–2022) of 1.5 million. Considering children specifically, the cumulative number was 12 219, only 11% of the 5-year target of 115 000.

There are 10 countries that account for about 70% of the global gap between the estimated global incidence of MDR/RR-TB each year and the number of people enrolled in treatment in 2020: China, Democratic Republic of the Congo, India, Indonesia, Nigeria, Pakistan, Philippines, Russian Federation, South Africa and Viet Nam. Substantial gains in treatment coverage at the global level require particular efforts to improve testing and diagnosis of drug-resistant TB, and access to treatment, in these countries.

More positively, there have been improvements in treatment success rates (**Fig. 24**). Globally in 2018 (the latest patient cohort for which data are available), the treatment success rate for MDR/RR-TB was 59%, reflecting steady improvements in recent years from 50% in 2012. Among WHO regions, the treatment success rate in 2018 ranged from 56% in the European Region to 69% in the African Region.

By the end of 2020, 109 countries were using bedaquiline as part of treatment for drug-resistant TB (unchanged from 2019). A total of 90 countries were using all-oral longer regimens (up from 86 in 2019) and 65 were using shorter regimens[1] for the treatment of MDR/RR-TB.

There were improvements in the coverage of testing for rifampicin resistance in all six WHO regions between 2019 and 2020, with the highest level (93%) achieved in the European Region. Of the 30 high MDR/RR-TB burden countries, 18 reached coverage of testing for rifampicin resistance of more than 80% in 2020: Azerbaijan, Belarus, China, India, Kazakhstan, Kyrgyzstan, Mongolia, Myanmar, the Philippines, Republic of Moldova, the Russian Federation, South Africa, Tajikistan, Ukraine, Uzbekistan, Viet Nam, Zambia and Zimbabwe.

The global coverage of testing for resistance to fluoroquinolones remains much lower, at just over 50% worldwide in 2020. Levels were lower still (not much above 25%) in the WHO regions of the Americas, South-East Asia and the Western Pacific. The highest levels of regional and national coverage were achieved in the WHO European Region.

TB prevention

Recent gains reversed, targets mostly off track

The main health care intervention available to reduce the risk of TB infection progressing to active TB disease is TB preventive treatment.[2] Other interventions are TB infection prevention and control, and vaccination of children with the bacille Calmette-Guérin (BCG) vaccine, which can confer protection, especially from severe forms of TB in children. WHO guidance recommends TB preventive treatment for people living with HIV, household contacts of bacteriologically confirmed pulmonary TB cases and clinical risk groups (e.g. those receiving dialysis) *(17)*.[3]

The global number of people who were provided with TB preventive treatment increased from 1.0 million in 2015 to 3.6 million in 2019, but this positive trend was reversed in 2020, with a 21% reduction to 2.8 million (**Fig. 26**). This probably reflected disruptions to health services caused by the COVID-19 pandemic. The combined total of 8.7 million in 2018–2020 is only 29% of the target of 30 million for the 5-year period 2018–2022 (**Fig. 27**).

Most of those provided with TB preventive treatment to date have been people living with HIV. Globally, the annual number increased from fewer than 30 000 in 2005 to 2.3 million in 2020. This figure included 7.2 million in

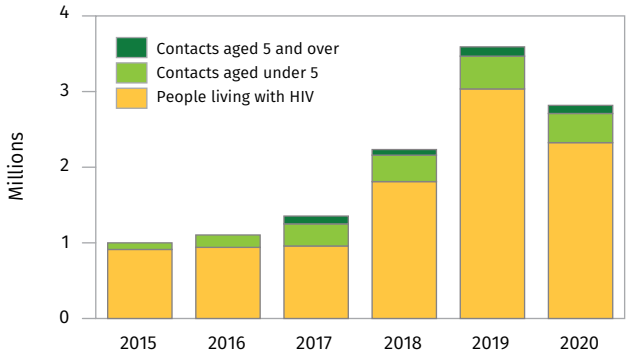
[1] This is the first year for which WHO has requested data about the use of all-oral shorter regimens, following the publication of WHO guidance about the use of these regimens in 2020.

[2] The drug regimens currently recommended by WHO are explained in **Annex 1**.

[3] Addressing broader determinants that influence TB epidemics can also help to prevent TB infection and disease. These are discussed below.

FIG. 26

The global number of people provided with TB preventive treatment, 2015–2020[a]



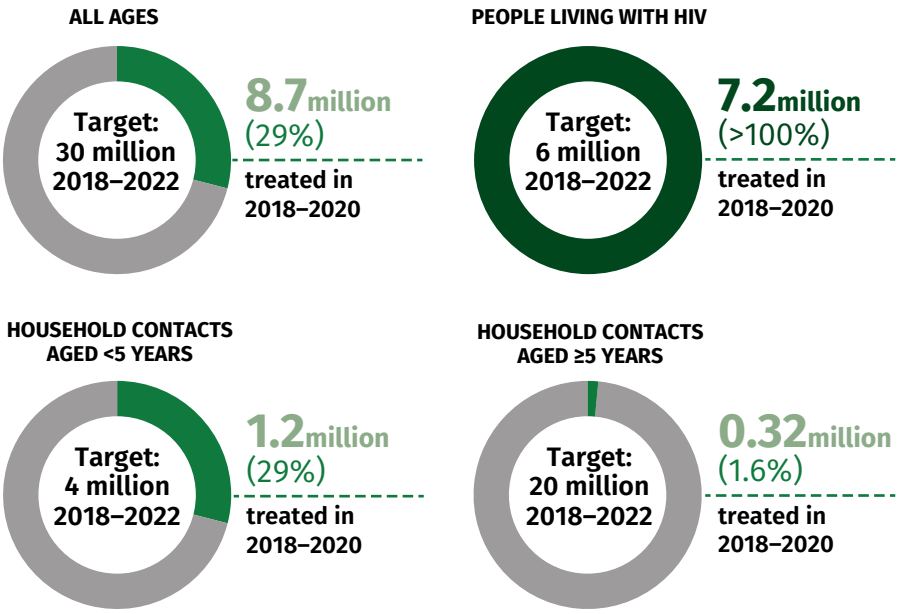
[a] The number of people living with HIV who were provided with TB preventive treatment in 2019 is lower than published in the *Global tuberculosis report 2020*. This is due to an update of the data reported by India.

cumulative number of contacts initiated on TB preventive treatment in the 3-year period 2018–2020, at 1.5 million, is only 6.2% of the 5-year target of 24 million for the period 2018–2022; this number included 1.2 million children aged under 5 years (29% of the 5-year subtarget of 4 million) and 0.32 million people in older age groups (1.6% of the 5-year subtarget of 20 million) (**Fig. 27**). In 80 countries that reported outcomes, the median completion rate for those who started treatment in 2019 was 86% (IQR: 71–96%).[1]

A substantial intensification and expansion of efforts and investment is needed to improve the provision of TB preventive treatment. This includes more TB screening at household level (especially among people aged 5 years and over), strengthening the follow-up to TB screening at both household level and among people living with HIV, and increased access to shorter (1–3 months) rifamycin-

FIG. 27

Global progress in provision of TB preventive treatment between 2018 and 2020, compared with cumulative targets set for 2018–2022 at the UN high-level meeting on TB



the years 2018–2020, meaning that the global subtarget of providing TB preventive treatment to 6 million people living with HIV between 2018 and 2022 was achieved well ahead of schedule (**Fig. 27**), despite a reduction (of 23%) from 3.0 million in 2019 to 2.3 million in 2020 (**Fig. 26**). Six countries – India, Mozambique, Nigeria, South Africa, Uganda and Zambia – collectively accounted for 74% of those started on treatment in 2020. In 20 countries that reported outcomes, the median completion rate for those who started treatment in 2019 was 84% (interquartile range [IQR]: 70–92%).

There was a similar pattern of increases up to 2019 followed by a reduction in 2020 for household contacts of people diagnosed with TB (**Fig. 26**), with an 11% reduction (from 0.56 million in 2019 to 0.50 million in 2020). The

based regimens. By June 2021, 36 countries reported using shorter rifapentine-containing regimens, up from 29 countries 1 year earlier.

The ratio of the TB notification rate among health care workers to the TB notification rate in the general adult population reflects the effectiveness of TB infection control in health facilities. The ratio should be about 1, but in 2020 it was greater than 1 in 18 countries that reported five or more TB cases among health care workers.

In 2020, 154 countries had a policy of providing BCG vaccination for the whole population, with 53 of those countries reporting coverage of at least 95%. Worryingly, 31 countries reported a reduction in coverage of 5% or

[1] This is the first year for which WHO has collected data about completion rates.

more between 2019 and 2020. This decline was greater than that seen in previous years and may reflect disruptions to health services caused by the COVID-19 pandemic.

Funding for essential TB services

Spending fell in 2020, below 50% of target

Progress in reducing the burden of TB disease requires adequate funding for TB diagnostic, treatment and prevention services, sustained over many years. However, funding in low- and middle-income countries (LMICs) that account for 98% of reported TB cases falls far short of what is needed, and there was an 8.7% decline in spending between 2019 and 2020 (from US$ 5.8 billion to US$ 5.3 billion), back to the level of 2016 (**Fig. 28**).[1] This is less than half (41%) of the global target of US$ 13 billion annually by 2022 (**Table 1**) and only 39% of the amount estimated to be required in 2020 in the Stop TB Partnership's *Global Plan to End TB, 2018–2022 (18)*.

The decline in spending between 2019 and 2020 likely reflects several factors, including the 18% reduction in the global number of people reported as diagnosed with TB between 2019 and 2020 as well as changes to models of service delivery (e.g. fewer visits to health facilities and more reliance on remote support during treatment) and reallocation of resources to the COVID-19 response *(19)*. Together, these factors mean that domestic spending on outpatient and inpatient care (excluding drugs and diagnostics) for people diagnosed with TB fell by about US$ 0.4 billion between 2019 and 2020.

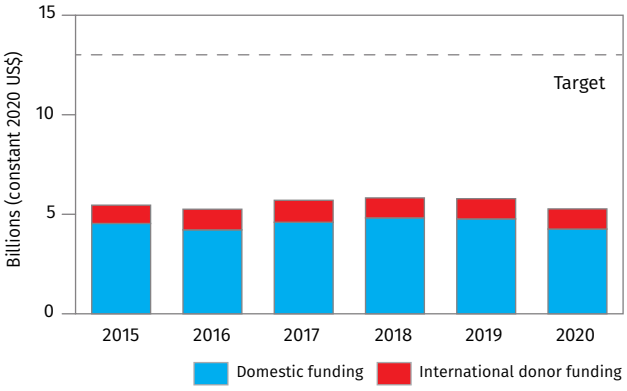
Of the total of US$ 5.3 billion available in 2020, US$ 3.2 billion was for diagnosis and treatment of drug-susceptible TB (including outpatient and inpatient care) and US$ 2.0 billion was for diagnosis and treatment of MDR/RR-TB (including outpatient and inpatient care). Both these amounts are less than half (38% and 45%, respectively) of the requirements estimated in the Global Plan (US$ 8.5 billion and US$ 4.4 billion in 2020, respectively). The remaining amount (<US$ 0.1 billion) includes funding for TB preventive treatment (covering drugs only) and interventions specifically related to HIV-associated TB.

As in the previous 10 years, most of the funding available in 2020 (US$ 4.3 billion out of a total of US$ 5.3 billion; i.e. 81%) was from domestic sources (**Fig. 29**), with the aggregate figure strongly influenced by Brazil, Russian Federation, India, China and South Africa (BRICS). Together, these five countries accounted for US$ 2.8 billion (65%) of the US$ 4.3 billion domestic funding available in 2020. Overall, 95% of the funding in BRICS and all funding in Brazil, China and the Russian Federation was from domestic sources.

In other LMICs, international donor funding remains crucial (**Fig. 29**). For example, it accounted for 53% of the funding available in the 26 high TB burden and the two global TB watchlist countries (Cambodia and Zimbabwe) outside BRICS, and 59% of the funding available in low-income countries in 2020.

FIG. 28

Funding for TB prevention, diagnostic and treatment services for 137 low- and middle-income countries[a] compared with the global target set at the UN high-level meeting on TB of at least US$ 13 billion per year, 2015–2020



[a] The 137 countries accounted for 98% of the world's officially reported TB cases in 2020.

The total amount of international donor funding per year averaged US$ 0.9 billion in the period 2010–2020, with some fluctuation (global panel of **Fig. 29**). The main source is the Global Fund to Fight AIDS, Tuberculosis and Malaria (the Global Fund), with a contribution that ranged from 69% (in 2010) to 83% (in 2017) of the total; in 2020, it was 76%. The United States Government is the largest contributor of funding to the Global Fund and also the largest bilateral donor; overall, it contributes close to 50% of international donor funding for TB.

Increases in both domestic and international funding for TB are urgently required, but provisional data suggest that allocations for 2021 will remain inadequate. For example, international donor funding reported by national TB programmes (NTPs) is expected to increase by only US$ 147 million between 2020 and 2021. Variation in the share of funding from domestic sources within a given income group suggests that there is scope to increase domestic funding in some high TB burden and global TB watchlist countries.

UHC and TB determinants

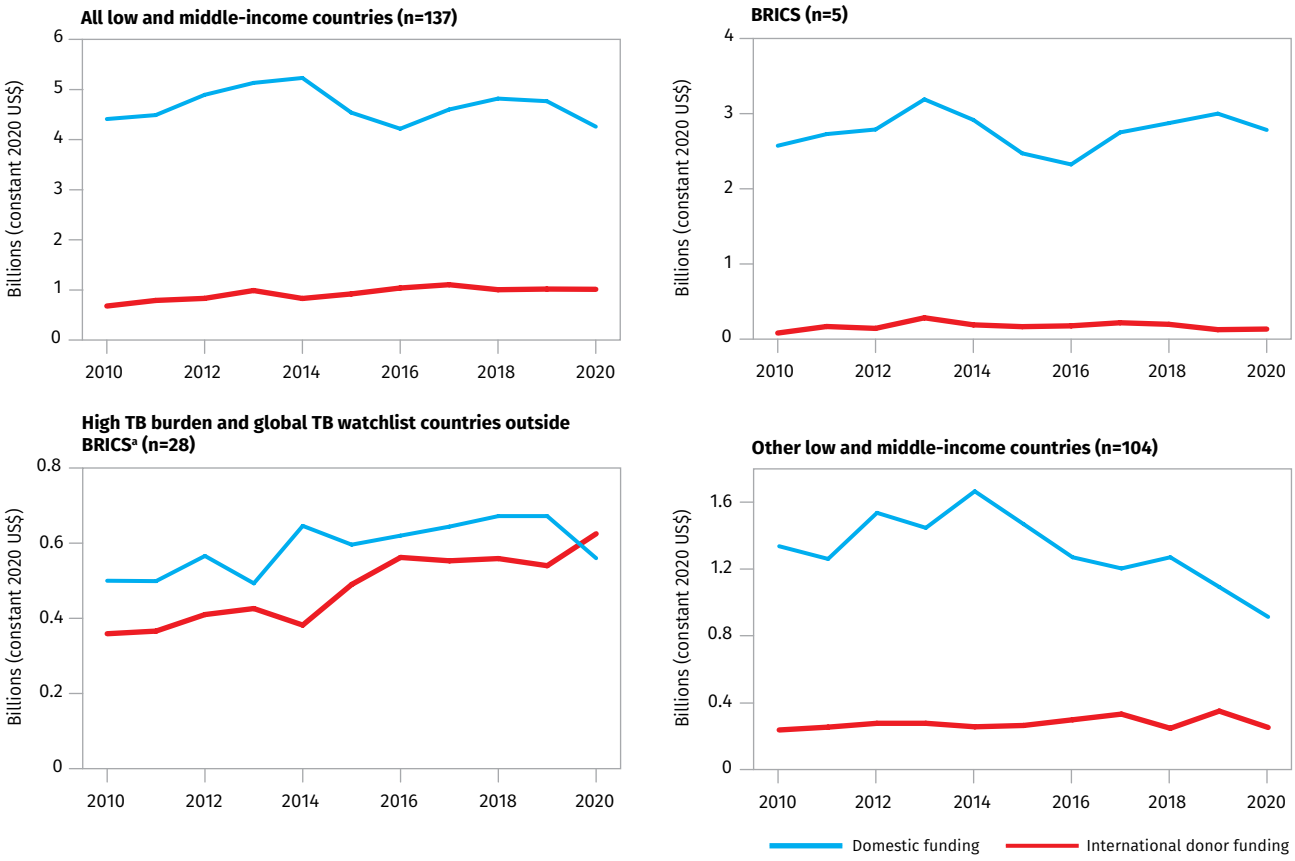
Faster progress required, TB target off track

Global TB targets for reductions in TB disease burden can only be achieved if TB diagnostic, treatment and prevention services are provided within the context of progress towards UHC, and if there is multisectoral action to address the broader determinants that influence TB epidemics and their socioeconomic impact. For example, the 2025 milestone for reducing TB deaths

[1] All amounts quoted are in constant 2020 US$.

FIG. 29

Funding for TB prevention, diagnostic and treatment services for 137 low and middle-income countries and 3 other country groups, 2010–2020



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

[a] The two global TB watchlist countries included are Cambodia and Zimbabwe.

requires that only 6.5% of those who develop TB disease die from it;[1] this is only feasible if everyone with TB can promptly access diagnostic and treatment services.

UHC means that everyone can obtain the health services they need without suffering financial hardship *(20)*. Through their adoption of the SDGs, all countries have committed to achieving UHC by 2030: Target 3.8 is "Achieve universal health coverage, including financial risk protection, access to quality essential healthcare services and access to safe, effective, quality and affordable essential medicines and vaccines for all". The two indicators to monitor progress towards this target are a UHC service coverage index (SCI), and the percentage of the population experiencing household expenditures on health care that are large in relation to household expenditures or income (indicators 3.8.1 and 3.8.2, respectively). Direct medical expenditures that account for 10% or more of household expenditure or income are classified as "catastrophic".[2]

The latest published data for the two UHC indicators are for 2017 (SCI) and 2015 (catastrophic expenditures) *(21)*.[3] Globally, the SCI was 66 (out of 100) in 2017, up from 45 in 2000. In 2015, 927 million people, or 12.7% of the world's population, faced out-of-pocket expenditures on health care that accounted for 10% or more of their household expenditure or income. These figures were both increases compared with 2000, when they were 571 million and 9.5%, respectively.

Values for both indicators in the 30 high TB burden and three global TB watchlist countries show that there is a long way to go before UHC is achieved in most of those countries (**Fig. 30**). Among high TB burden countries, Thailand stands out as having a high SCI of 80 and a low level of catastrophic health expenditures (2% of households). Although data post-2017 are not yet available, the COVID-19 pandemic is likely to have caused progress towards UHC to stall or reverse in 2020 and 2021 in many countries.

Given the importance of UHC to targets for reductions in TB incidence and mortality, the End TB Strate-

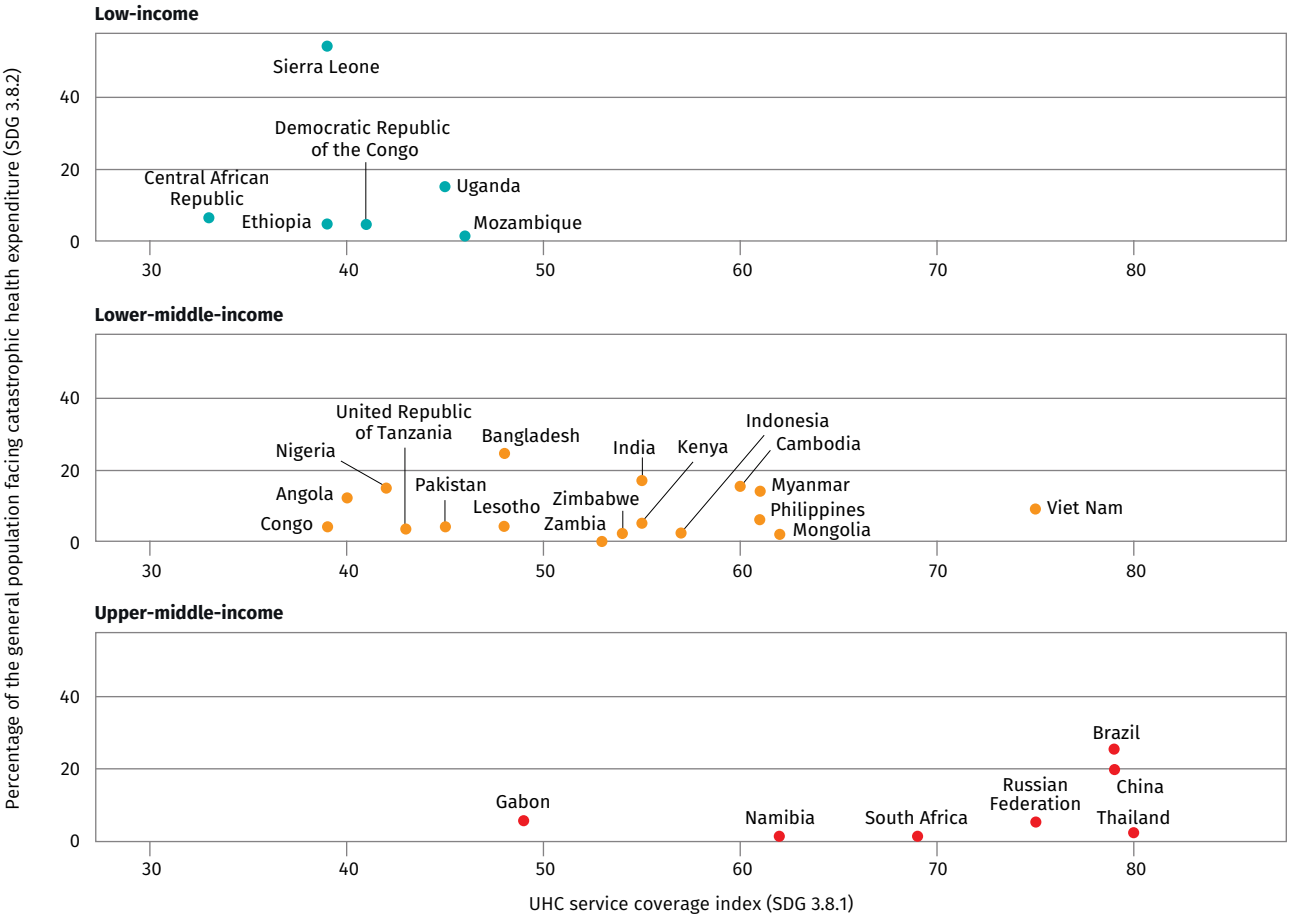
[1] The estimated percentage (also referred to as the case fatality ratio, CFR) was 15% in 2020, up from 14% in 2019.

[2] Indicator 3.8.2 is a measure of financial hardship rather than financial barriers to accessing health care. The existence of out-of-pocket payments may deter many people from seeking care.

[3] An updated WHO global report on UHC monitoring is scheduled for release in December 2021.

FIG. 30

UHC service coverage index (SDG 3.8.1)[a] and percentage of the general population facing catastrophic health expenditures (SDG 3.8.2),[b] 30 high TB burden countries and three global TB watchlist countries,[c] stratified by income group[d]



[a] Data are for 2017.

[b] Defined as ≥10% of total household consumption or income. The latest available year ranges from 2007 to 2018 for the 30 high TB burden countries.

[c] The three global TB watchlist countries are Cambodia, Russian Federation and Zimbabwe.

[d] As per the 2021 World Bank classification.

Source: WHO Universal Health Coverage data portal (http://apps.who.int/gho/portal/uhc-financial-protection-v3.jsp).

gy included a third target that no TB patients and their households face total costs that are catastrophic *(22)*. 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. The key differences between this indicator and the SDG indicator for catastrophic health expenditures (3.8.2) are explained in **Box 4**.

Since 2015, a total of 25 countries have completed a national survey of costs faced by TB patients 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%) (**Fig. 31**, **Fig. 32**). In countries that reported disaggregated data, the pooled average was considerably higher for drug-resistant TB. Survey results are being used to inform approaches to health financing, service delivery and social protection that will reduce these costs.

Many new cases of TB are attributable to five risk factors: undernutrition, HIV infection, alcohol use disorders, smoking (especially among men) and diabetes (**Table 3**). In the context of the COVID-19 pandemic, multisectoral action to address these and other determinants of TB and its consequences (**Annex 6**), including GDP per capita, poverty and social protection, is more important than ever.

Addressing broader determinants of the TB epidemic requires multisectoral accountability. The political declaration at the UN high-level meeting on TB requested the WHO Director-General to develop a multisectoral

Box 4. The difference between "catastrophic total costs" for TB patients and their households, and the SDG indicator of catastrophic expenditures on health care

It is important to distinguish between the indicator of "the proportion of the population with large household expenditures on health as a share of total household expenditure or income", which is used within the SDG monitoring framework (SDG Indicator 3.8.2), and the indicator of "the percentage of TB patients and their households facing catastrophic costs due to TB", which is part of the WHO End TB Strategy.

The SDG indicator is for the *general population*. Household expenditures on health are defined as *direct expenditures* on health by all household members who seek any type of care (preventive, curative, rehabilitative, long term care) for any type of disease, illness or health condition, in any type of setting (outpatient, inpatient, at home). They include both formal and informal expenditures. The indicator attempts to capture the impact of household expenditures on health on household ability to spend on other basic needs. The denominator of the total population includes many people who had no contact with the health system and thus had zero expenditures on health. Although these people did not experience financial hardship as a consequence of direct expenditures on health care, they may nonetheless have faced financial barriers to accessing health services that they needed.

Due to the nature of the illness, TB patients and their households can face severe direct and indirect financial and economic costs. These pose barriers that can greatly affect their ability to access diagnosis and treatment, and to complete treatment successfully. Costs included in the TB-specific indicator include not only *direct medical payments* for diagnosis and treatment, but also *direct non-medical payments* (e.g. transportation and lodging) and *indirect costs* (e.g. lost income). In contrast to SDG indicator 3.8.2, the TB-specific indicator is restricted to a particular population: *people diagnosed with TB who are users of health services that are part of NTP networks*.

Given these conceptual differences, the percentage of TB patients facing "catastrophic total costs" (defined as costs that account for >20% of their household income) is expected to be much higher than the percentage of the general population facing catastrophic expenditures on health care. Hence, the two indicators cannot and should not be compared directly.

FIG. 31

Estimates of the percentage of TB patients and their households facing catastrophic costs, national surveys implemented 2016–2020

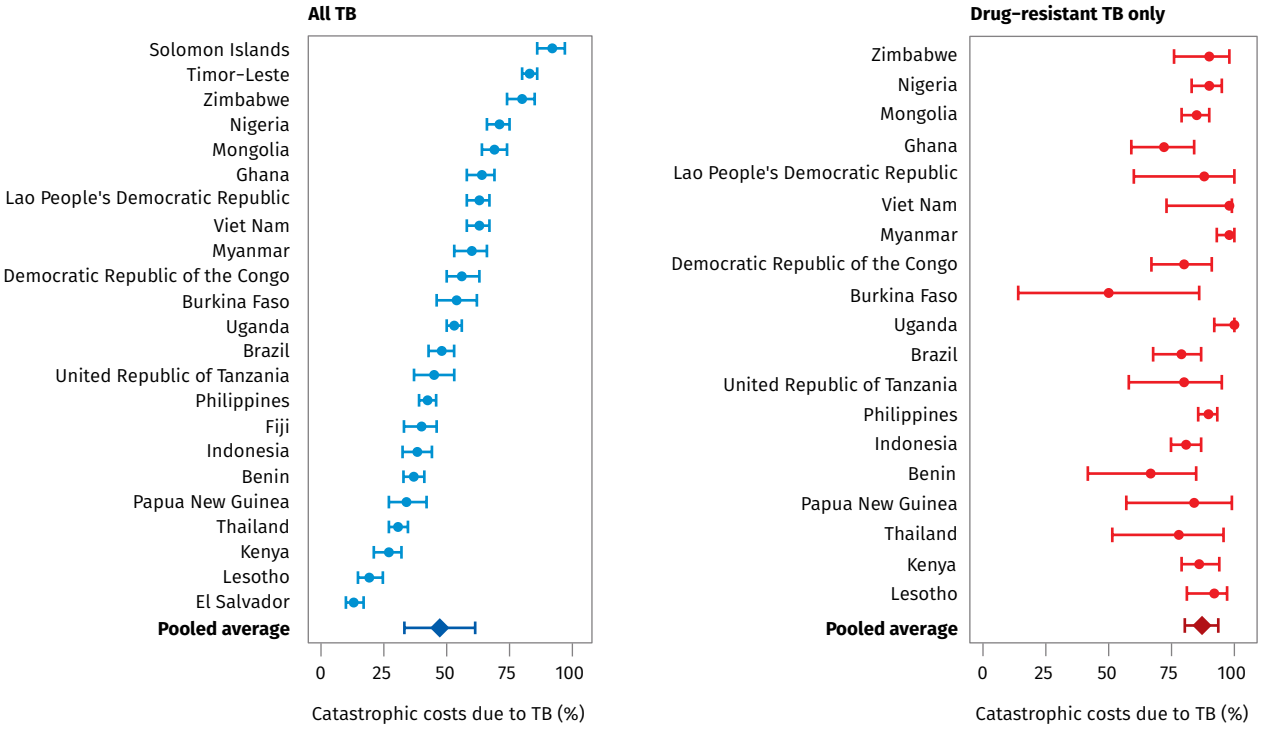


TABLE 3

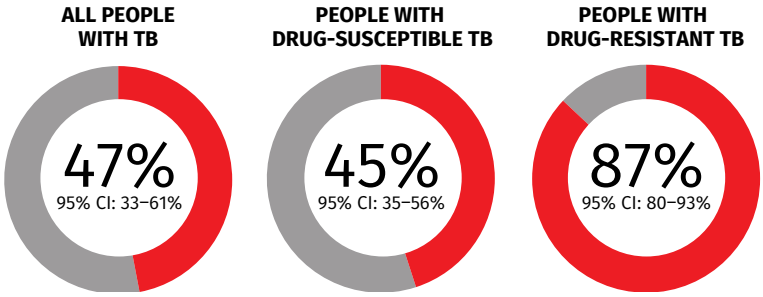
Global estimates of the number of TB cases attributable to selected risk factors, 2020

RISK FACTOR	RELATIVE RISK (UNCERTAINTY INTERVAL)		EXPOSED (MILLIONS)	POPULATION ATTRIBUTABLE FRACTION (%)	ATTRIBUTABLE TB CASES (MILLIONS, UNCERTAINTY INTERVAL)	
Alcohol use disorders	3.3	2.1–5.2	291	8.1	0.74	0.30–1.3
Diabetes	1.5	1.3–1.8	496	3.1	0.37	0.15–0.68
HIV infection	18	15–21	38	7.6	0.74	0.65–0.83
Smoking	1.6	1.2–2.1	1 050	7.1	0.73	0.25–1.5
Undernourishment	3.2	3.1–3.3	637	15	1.9	1.3–2.6

Sources: Imtiaz S et al. Eur Resp Jour (2017); Hayashi S et al. Trop Med Int Health (2018); Lönnroth K et al. Lancet (2010); World Bank Sustainable Development Goals Database (http://datatopics.worldbank.org/sdgs/); WHO Global Health Observatory (https://www.who.int/gho); and WHO Global TB Programme.

FIG. 32

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



accountability framework for TB (MAF-TB) and ensure its timely implementation. Following extensive development work, WHO finalized the framework and published it in 2019 *(23)*. To support Member States to adapt and use it, WHO has also developed a checklist that enables national assessments of the status of the main elements of the MAF-TB *(24)*.

Results from implementation of the checklist show that progress in adaptation and implementation of the MAF-TB is being made. However, engagement of all relevant sectors including civil society requires strengthening, as do mechanisms for high-level review. Given the impact of the COVID-19 pandemic, full implementation of all components of the MAF-TB could help to ensure recovery of essential TB services, enhanced social protection and faster progress towards global TB targets. In line with the global part of the MAF-TB, WHO will continue to lead the coordination of global TB monitoring, reporting and review and to provide technical support and guidance to countries and partners.

TB research and innovation

Slow progress, doubling of investment needed

The End TB Strategy targets set for 2030 and 2035 (**Box 3**) cannot be met without intensified research and innovation. When these targets were first established, it was highlighted that technological breakthroughs would be needed by 2025, so that the annual decline in the global TB incidence rate could be accelerated to an average of 17% per year between 2025 and 2035 *(22)*. Given that reductions in TB incidence achieved between 2015 and 2020 fall far short of the first 2020 milestone of the strategy (11% compared with 20%) and the projected impact of the COVID-19 pandemic on TB incidence in 2021 and 2022 (**Fig. 17**), an even faster rate of decline will now be required. Priorities include a vaccine to lower the risk of infection, a vaccine or new drug treatment to cut the risk of TB disease in the approximately 2 billion people already infected, rapid diagnostics for use at the point of care, and simpler, shorter treatments for TB disease.

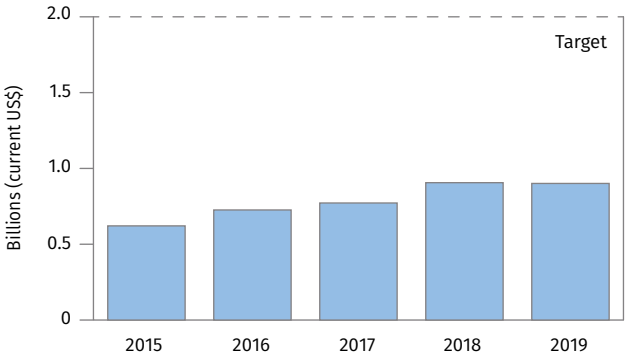
There is progress in the development of new TB diagnostics, drugs and vaccines, but this is constrained by the overall level of investment, which at US$ 0.9 billion in 2019 *(25)* falls far short of the global target of US$ 2 billion per year (**Fig. 33**).

The diagnostic pipeline remains robust in terms of the number of tests, products or methods in development. These include newer skin tests for TB infection that have better performance than tuberculin skin tests; next-generation lateral-flow lipoarabinomannan (LF-LAM) assays that perform better than currently marketed assays; amplification-based targeted next-generation sequencing assays for detecting drug-resistant TB directly from sputum specimens; and an expanding pipeline of new interferon gamma release assays to test for TB infection.

In August 2021, there were 25 drugs for the treatment of drug-susceptible TB, MDR-TB or TB infection in Phase I, Phase II or Phase III trials. These drugs comprise 16

FIG. 33

Funding for TB research, 2015–2019



Source: Treatment Action Group, Stop TB Partnership. Tuberculosis research funding trends 2005–2019. New York: Treatment Action Group; 2020 (https://www.treatmentactiongroup.org/resources/tbrd-report/tbrd-report-2020/).

new chemical entities, two drugs that have received accelerated regulatory approval, one drug that was recently approved by the US Food and Drug Administration under the limited population pathway for antibacterial and antifungal drugs, and six repurposed drugs. Various combination regimens with new or repurposed drugs, as well as host-directed therapies, are in Phase II or Phase III trials.

In August 2021, there were 14 vaccine candidates in clinical trials: two in Phase I, eight in Phase II and four in Phase III. They include candidates to prevent TB infection and TB disease, and candidates to help improve the outcomes of treatment for TB disease.

A *Global Strategy for TB Research and Innovation* was adopted by the World Health Assembly in 2020, and in 2021 WHO launched a situational assessment checklist to support country implementation *(26, 27)*. A health and economic impact assessment of the full value of new TB vaccines, which is intended to guide investments in late-stage research as well as vaccine introduction and implementation, is in preparation.

WHO has established a compendium of research studies related to TB and COVID-19 *(28)* and innovative programmatic responses to the impact of the pandemic on TB is one of the featured topics that accompanies this report (**Box 2**).

4. WHO guidance related to the COVID-19 pandemic and TB

Since the declaration of COVID-19 as a public health emergency of international concern, WHO's Global TB Programme has monitored the impact of the pandemic on TB services and provided guidance and support to NTPs and partners.

WHO information notes on TB and COVID-19 *(29, 30)* include the following advice:

- leverage the expertise and experience of NTPs, especially in rapid testing and contact tracing, for the COVID-19 response;
- maximize remote care and support for people with TB by expanding the use of digital technologies;
- minimize the number of visits to health services that are required during treatment, including through the use of WHO-recommended, all-oral TB treatment regimens and community-based care;
- limit the transmission of TB and COVID-19 in congregate settings and health care facilities by ensuring basic infection prevention and control for health staff and patients, cough etiquette and patient triage;
- support the provision of TB preventive treatment by building synergies with contact-tracing efforts related to COVID-19;
- provide simultaneous testing for TB and COVID-19 for individuals when indicated, including by leveraging TB laboratory networks and platforms; and
- ensure proactive planning and budgeting for both conditions (including for the catch-up phase), procurement of supplies and risk management.

Content related to TB has also been included in WHO guidance on maintaining essential health services and the role of community-based care during the COVID-19 pandemic *(31, 32)*.

5. Conclusions

Leaders of all UN Member States have committed to "ending the global TB epidemic" by 2030, backed up by concrete milestones and targets. Following the first UN high-level meeting on TB in 2018 and a report on TB from the UN Secretary-General in 2020 *(9)*, a review of progress achieved by the end of 2022 will take place at the UN General Assembly in 2023.

This report shows that progress towards TB milestones and targets has been hit hard by the COVID-19 pandemic. In 2020, the number of people dying from TB increased, previous declines in the annual number of people falling ill with TB slowed, far fewer people were diagnosed and treated for TB or provided with TB preventive treatment compared with 2019 and spending on essential TB services fell. TB was second only to COVID-19 as a leading cause of death from a single infectious agent. Modelling projections suggest that the impact of disruptions caused by the pandemic on the number of people developing TB and dying from the disease could be much worse in 2021 and 2022.

Global TB targets are mostly off-track, although there are some country and regional success stories.

Actions to mitigate and reverse the impact of the COVID-19 pandemic on TB are urgently needed. The immediate priority is to restore access to and provision of essential TB services such that levels of TB case detection and treatment can recover to at least 2019 levels.

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ANNEX 1

Basic facts about TB

Tuberculosis (TB) is an old disease. Studies of human skeletons show that it has affected humans for thousands of years *(1)*. Its cause remained unknown until 24 March 1882, when Dr Robert Koch announced his discovery of the bacillus responsible, subsequently named *Mycobacterium tuberculosis (2)*. The disease is spread when people who are sick with TB expel bacteria into the air (e.g. by coughing). TB typically affects the lungs (pulmonary TB) but can also affect other sites (extrapulmonary TB).

About a quarter of the world's population is infected with *M. tuberculosis*, equivalent to about 2 billion people. A relatively small proportion (5–10%) will develop TB disease during their lifetime. However, the probability of developing TB disease is much higher among people living with HIV, and among people affected by risk factors such as undernutrition, diabetes, smoking and alcohol consumption.

TB can affect anyone anywhere, but most people who develop the disease (about 90%) are adults and there are more cases among men than women.

Diagnostic tests for TB disease include sputum smear microscopy (developed >100 years ago), rapid molecular tests (first endorsed by WHO in 2010) and culture-based methods – the latter take a few weeks to provide results but remain the reference standard. TB that is resistant to first-line and second-line anti-TB drugs can be detected using rapid tests, culture methods and sequencing technologies.

Without treatment, the mortality rate from TB is high. Studies of the natural history of TB disease in the absence of treatment with anti-TB drugs (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 *(3)*.

Effective drug treatments were first developed in the 1940s. The currently recommended treatment for people with drug-susceptible TB disease is a 6-month regimen of four first-line drugs: isoniazid, rifampicin, ethambutol and pyrazinamide. The Global TB Drug Facility supplies a complete 6-month course for about US$ 40 per person. Treatment success rates for people enrolled on first-line treatment of at least 85% are regularly reported to WHO by its 194 Member States. Treatment for people diagnosed with rifampicin-resistant TB (RR-TB) and multidrug-resistant TB (MDR-TB, defined as resistance to isoniazid and rifampicin, the two most powerful anti-TB drugs) is longer, and requires drugs that are more expensive (≥US$ 1000 per person) and that cause more side-effects. Nationally, treatment success rates for rifampicin-resistant TB are typically in the range of 50–75%.

Preventive treatment is available for people with TB infection. Recommended options include: a weekly dose of rifapentine and isoniazid for 3 months (3HP), a daily dose of rifampicin plus isoniazid for 3 months (3HR), a daily dose of rifapentine plus isoniazid for 1 month (1HP), a daily dose of rifampicin for 4 months (4R), and a daily dose of isoniazid for 6 months (6H) or longer.

The only licensed vaccine for prevention of TB disease is the bacille Calmette-Guérin (BCG) vaccine. The BCG vaccine was developed almost 100 years ago, prevents severe forms of TB in children and is widely used. There is currently no vaccine that is effective in preventing TB disease in adults, either before or after exposure to TB infection, although results from a Phase II trial of the M72/AS01E candidate are promising.

References

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2. Sakula A. Robert Koch: centenary of the discovery of the tubercle bacillus, 1882. Thorax. 1982;37(4):246–51 (https://www.ncbi.nlm.nih.gov/pubmed/6180494).
3. Tiemersma EW, van der Werf MJ, Borgdorff MW, Williams BG, Nagelkerke NJ. Natural history of tuberculosis: duration and fatality of untreated pulmonary tuberculosis in HIV negative patients: a systematic review. PLoS One. 2011;6(4):e17601 (https://www.ncbi.nlm.nih.gov/pubmed/21483732).

ANNEX 2

The WHO global TB database

A2.1 Database contents

The 2021 global tuberculosis (TB) report is based on data collected annually from 215 countries and areas, including all 194 World Health Organization (WHO) Member States. The Global TB Programme has implemented annual rounds of data collection since 1995, with an online system used since 2009. Data are stored in a global TB database that is managed by the TB monitoring, evaluation and strategic information unit of the Global TB Programme, at WHO headquarters.

The topics on which data have been collected have been consistent for many years. In 2021, as in previous years, data were collected on the following: TB case notifications and treatment outcomes, including breakdowns by TB case type, age, sex, HIV status and drug resistance; laboratory diagnostic services; monitoring and evaluation, including surveillance and surveys specifically related to drug-resistant TB; TB preventive treatment; digital systems; TB infection control; palliative care; engagement of all public and private care providers in TB prevention and care; community engagement; specific elements of the WHO multisectoral accountability framework for TB; budgets of national TB control programmes (NTPs); use of general health services (hospitalization and outpatient visits) during treatment; and NTP expenditures. A shortened version of the questionnaire was used for high-income countries (i.e. countries with a gross national income per capita of ≥US$ 12 536 in 2019, as defined by the World Bank)[1] or low-incidence countries (defined as countries with an incidence rate of <20 cases per 100 000 population or <10 cases in total in 2019).

The main round of data collection took place in April and May 2021.

High TB burden countries and selected other regional priority countries were also asked to report monthly or quarterly provisional notification data on a regular basis for 2020 and 2021 to allow assessment of trends in the context of the COVID-19 pandemic.

Countries and areas reported data via a dedicated website,[2] which was opened for reporting in April 2021. Countries in the European Union submitted data on notifications and treatment outcomes to the TESSy system managed by the European Centre for Disease Prevention and Control (ECDC). Data from TESSy were uploaded into the global TB database.

Additional data about the provision of treatment for latent TB infection to people newly or currently enrolled in HIV care, detection of TB among people newly enrolled in HIV care, and provision of antiretroviral therapy for HIV-positive TB patients were collected by the Joint United Nations Programme on HIV/AIDS (UNAIDS). These data were jointly validated by UNAIDS and the WHO's Global TB Programme and HIV department, and were uploaded into the global TB database.

Following review and follow-up with countries, the data used for the main part of this report were those that were available on **9 August 2021**. Table A2.1 shows the number of countries and territories that had reported data by **9 August 2021**.

Indicators in the Sustainable Development Goals associated with TB incidence were imported into the global TB database on **30 June 2021**. Table A2.2 shows the data sources used.

TABLE A2.1

Reporting of data in the 2021 round of global TB data collection

	COUNTRIES AND AREAS		WHO MEMBER STATES	
	NUMBER	NUMBER THAT REPORTED DATA	NUMBER	NUMBER THAT REPORTED DATA
African Region	47	46	47	46
Region of the Americas	45	37	35	32
Eastern Mediterranean Region	22	22	21	21
European Region	54	46	53	45
South-East Asia Region	11	11	11	11
Western Pacific Region	36	35	27	27
Global	215	197	194	182

A2.2 Accessing TB data using the WHO Global TB Programme website

Most of the data held in the global TB database are available online.[3] The web page provides access to comma-separated value (CSV) data files and data

[1] https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

[2] https://extranet.who.int/tme

[3] https://www.who.int/teams/global-tuberculosis-programme/data

TABLE A2.2

Data sources for indicators in the Sustainable Development Goals associated with TB incidence

SDG INDICATOR	DISPLAY NAME IN PROFILE	DATA SOURCE	NAME AT SOURCE	SOURCE URL
1.1.1	Population living below the international poverty line (% of population)	UN SDG database	Proportion of population below the international poverty line of US$1.90 per day	https://unstats.un.org/SDGAPI/v1/sdg/Series/Data?seriesCode=SI_POV_DAY1
1.3.1	Population covered by social protection floors/systems (% of population)	World Bank	Coverage of social protection and labor programs (% of population)	http://data.worldbank.org/indicator/per_allsp.cov_pop_tot
2.1.1	Prevalence of undernourishment (% of population)	World Bank	Prevalence of undernourishment (% of population)	http://data.worldbank.org/indicator/SN.ITK.DEFC.ZS
3.3.1 (*alternative*)	HIV prevalence (% of population aged 15-49 years)	WHO-GHO	Prevalence of HIV among adults aged 15 to 49 (%)	https://ghoapi.azureedge.net/api/MDG_0000000029
3.4.1 (*alternative*)	Diabetes prevalence (% of population aged ≥ 18 years)	WHO-GHO	Raised fasting blood glucose (≥7.0 mmol/L or on medication) (age-standardized estimate)	https://ghoapi.azureedge.net/api/NCD_GLUC_04
3.5.2 (*alternative*)	Alcohol use disorders, 12 month prevalence (% of population aged ≥ 15 years)	WHO-GHO	Alcohol use disorders (15+), 12 month prevalence (%) with 95%	https://ghoapi.azureedge.net/api/SA_0000001462
3.a.1 (*alternative*)	Smoking prevalence (% of population aged ≥ 15 years)	WHO-GHO	Estimate of current tobacco smoking prevalence (%) (age-standardized rate)	https://ghoapi.azureedge.net/api/M_Est_smk_curr_std
3.8.1	UHC index of essential service coverage (based on 14 tracer indicators including TB treatment)	WHO-GHO	UHC index of essential service coverage	https://ghoapi.azureedge.net/api/UHC_INDEX_REPORTED
3.8.2	Greater than 10% of total household expenditure or income on health (% of population)	WHO-GHO	Catastrophic out-of-pocket health spending (SDG indicator 3.8.2)	https://ghoapi.azureedge.net/api/FINPROTECTION_CATA_TOT_10_POP
3.8.2 (*alternative*)	Health expenditure per capita, PPP (current international $)	WHO-GHO	Current health expenditure (CHE) per capita in PPP int $	https://ghoapi.azureedge.net/api/GHED_CHE_pc_PPP_SHA2011
7.1.2	Access to clean fuels and technologies for cooking (% of population)	World Bank	Access to clean fuels and technologies for cooking (% of population)	http://data.worldbank.org/indicator/EG.CFT.ACCS.ZS
8.1.1 (*alternative*)	GDP per capita, PPP (constant 2011 international $)	World Bank	GDP per capita, PPP (constant 2011 international $)	http://data.worldbank.org/indicator/NY.GDP.PCAP.PP.KD
10.1.1 (*alternative*)	GINI index (0=perfect equality, 100=perfect inequality)	World Bank	GINI index (World Bank estimate)	http://data.worldbank.org/indicator/SI.POV.GINI
11.1.1	Population living in slums (% of urban population)	UN SDG database	Proportion of urban population living in slums (%)	https://unstats.un.org/SDGAPI/v1/sdg/Series/Data?seriesCode=EN_LND_SLUM

visualizations, as well as country, regional and global profiles (**Annex A4**).

The CSV data files are the primary resource for anyone interested in conducting their own analyses of the records in the global TB database. Data reported by countries (e.g. time series for case notifications and treatment outcomes), and WHO's estimates of TB disease burden), can be downloaded as CSV files covering all years for which data are available. These CSV files can be imported into many applications (e.g. spreadsheets, databases and statistical analysis software).

A data dictionary that defines each of the variables available in the CSV files is also available and can be downloaded.

The CSV files are generated on-demand directly from the global TB database, and may therefore include updates received after publication of the global TB report.

A2.3 Accessing TB data using the WHO Global Health Observatory

The WHO Global Health Observatory (GHO)[1] is a portal that provides access to data and analyses for monitoring the global health situation; it includes a data repository.

Data from WHO's global TB database can be viewed, filtered, aggregated and downloaded from within the GHO data repository.[2]

There is also an application programme interface (API)[3] using the open data protocol. The API allows analysts and programmers to use GHO data directly in their software applications.

[1] https://www.who.int/data/gho

[2] https://www.who.int/data/gho/data/themes/tuberculosis

[3] https://www.who.int/data/gho/info/gho-odata-api

ANNEX 3

WHO global lists of high TB burden countries

A3.1 Background

During the period 1998 to 2015, the concept of a "high burden country" (HBC) became familiar and widely used in the context of tuberculosis (TB). The first global list developed by WHO consisted of 22 HBCs with approximately 80% of the world's TB cases; this was established in 1998. Subsequently two other HBC lists, for HIV-associated TB and multidrug-resistant TB (MDR-TB), were defined.

In 2015, three WHO global lists of HBCs – for TB, TB/HIV and MDR-TB – were in use. With a new era of the United Nations (UN) Sustainable Development Goals (SDGs) and the WHO End TB Strategy starting in 2016, a thorough review of the three lists was undertaken by the WHO Global TB Programme in 2015 *(1)*. This included consideration of whether the lists should be modified (and if so how) or whether they should be discontinued. The outcome of the review was the definition of three new global HBC lists, of 30 countries each, for the period 2016–2020: one for TB, one for TB/HIV and one for MDR-TB.

WHO conducted a consultation process in 2020 and early 2021, as the basis for defining updated global HBC lists for 2021–2025.

A3.2 Global HBC lists to be used by WHO, 2021–2025

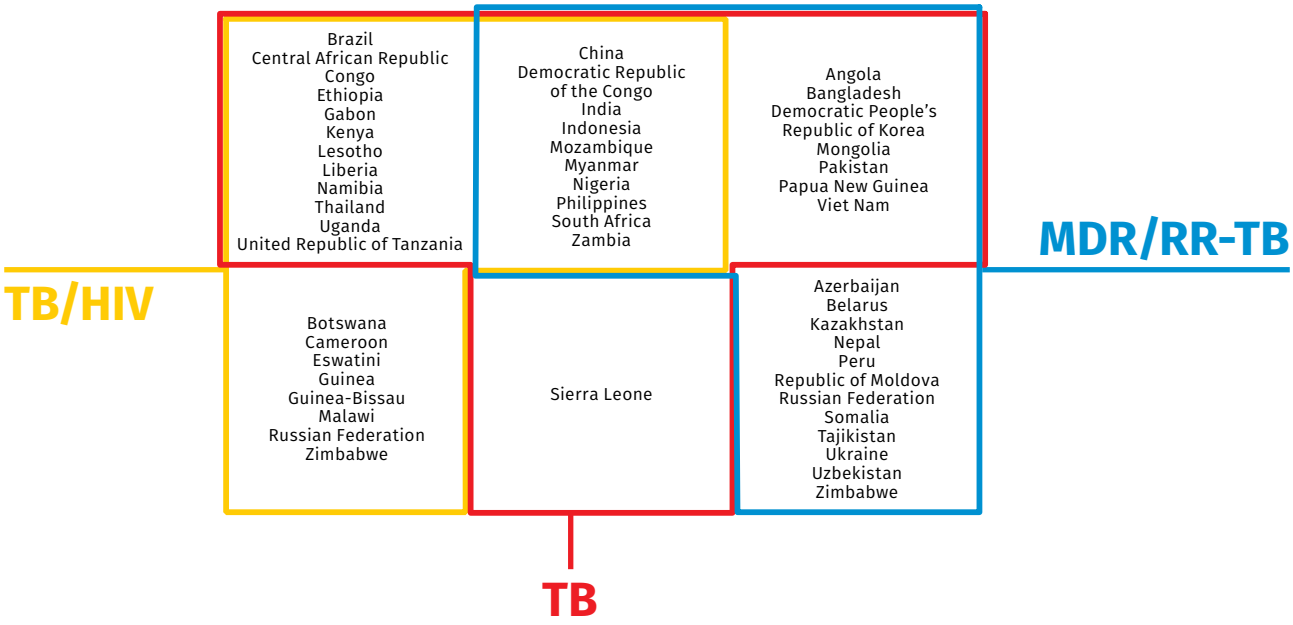
Three global HBC lists for 2021–2025 have been established: one for TB, one for HIV-associated TB and one for MDR/rifampicin-resistant TB (MDR/RR-TB). The lists have been defined using the same criteria as those agreed for the 2016–2020 lists, in combination with the WHO estimates (for 2019) of the incidence of TB, HIV-associated TB and rifampicin-resistant TB that were published in WHO's *Global Tuberculosis Report 2020*. Full details are available in a background document *(2)*.

The criteria for all three lists are the same:

- the top 20 countries in terms of their estimated absolute number of new (incident) cases in 2019; plus
- the 10 countries with the most severe burden in terms of the incidence rate (new cases per 100 000 population in 2019) that are not already in the top 20,

FIG. A3.1

The three global lists of high-burden countries for TB, HIV-associated TB and MDR/RR-TB to be used by WHO in the period 2021–2025, and their areas of overlap



and that meet a minimum threshold in terms of their absolute number of cases. The thresholds are 10 000 new cases per year for TB; and 1000 new cases per year for HIV-associated TB and rifampicin-resistant TB.

The 30 countries that are in each of the three lists are shown in **Fig. A3.1** and **Table A3.1**. There is overlap among the three lists, but 49 countries are in at least one of them. Each list accounted for 86–90% of the estimated global incidence in 2019.

The main changes compared with the previous lists for 2016–2020 are:

- **The 30 high TB burden countries.** Cambodia, the Russian Federation and Zimbabwe have transitioned out of the list; Gabon, Mongolia and Uganda have joined the list.
- **The 30 high TB/HIV burden countries.** Angola, Chad, Ghana and Papua New Guinea have transitioned out of the list; Gabon, Guinea, Philippines and the Russian Federation have joined the list.
- **The 30 high MDR/RR-TB burden countries.** Ethiopia, Kenya and Thailand have transitioned out of the list; Mongolia, Nepal and Zambia have joined the list.

The lists provide a focus for global action on TB, HIV-associated TB and drug-resistant TB in the countries where progress is most needed to achieve the targets set in WHO's End TB Strategy, the political declaration of the UN high-level meeting on TB held in 2018 and the UN SDGs (**Table 1**). They also help to build and sustain national political commitment and funding in the countries with the highest burden in terms of absolute numbers or severity and promote global monitoring of progress in a well-defined set of countries.

The 30 high TB burden countries are given particular attention in the main chapters of this report. Where estimates of disease burden and assessment of progress in the response are for HIV-associated TB or MDR/RR-TB specifically, the countries in the other two lists are given particular attention. Country profiles for all countries are available online, including in the mobile app that accompanies the report (**Annex 4**).

A3.3 Global TB watchlist

Alongside the three updated global HBC lists, WHO has established a "global TB watchlist". This consists of the three countries that have exited the global list of 30 high TB burden countries, but which nonetheless warrant continued attention and will remain a priority in terms of support from WHO. The three countries in the watchlist are Cambodia, the Russian Federation and Zimbabwe.

TABLE A3.1

Countries in the three global lists of high-burden countries for TB, HIV-associated TB and MDR/RR-TB to be used by WHO in the period 2021–2025.

The red square indicates that a country is in a list.

COUNTRY	TB	TB/HIV	MDR/ RR-TB
Angola	■		■
Azerbaijan			■
Bangladesh	■		■
Belarus			■
Botswana		■	
Brazil	■	■	
Cameroon		■	
Central African Republic	■	■	
China	■	■	■
Congo	■	■	
Democratic People's Republic of Korea	■		■
Democratic Republic of the Congo	■	■	■
Eswatini		■	
Ethiopia	■	■	
Gabon	■	■	
Guinea		■	
Guinea-Bissau		■	
India	■	■	■
Indonesia	■	■	■
Kazakhstan			■
Kenya	■	■	
Kyrgyzstan			■
Lesotho	■	■	
Liberia	■	■	
Malawi		■	
Mongolia	■		■
Mozambique	■	■	■
Myanmar	■	■	■
Namibia	■	■	
Nepal			■
Nigeria	■	■	■
Pakistan	■		■
Papua New Guinea	■		■
Peru			■
Philippines	■	■	■
Republic of Moldova			■
Russian Federation		■	■
Sierra Leone	■		
Somalia			■
South Africa	■	■	■
Tajikistan			■
Thailand	■	■	
Uganda	■	■	
Ukraine			■
United Republic of Tanzania	■	■	
Uzbekistan			■
Viet Nam	■		■
Zambia	■	■	■
Zimbabwe		■	■

In future, other countries may be considered for inclusion on this watchlist – for example, based on evidence about the impact of the COVID-19 pandemic on TB services and disease burden.

References

1. World Health Organization. Use of high burden country lists for TB by WHO in the post-2015 era (discussion paper). Geneva: World Health Organization; 2015 (https://www.who.int/tb/publications/global_report/high_tb_burdencountrylists2016-2020.pdf).
2. World Health Organization. WHO global lists of high burden countries for tuberculosis (TB), TB/HIV and multidrug/rifampicin-resistant TB (MDR/RR-TB), 2021–2025: background document. Geneva. World Health Organization; 2021 (https://apps.who.int/iris/handle/10665/341980).

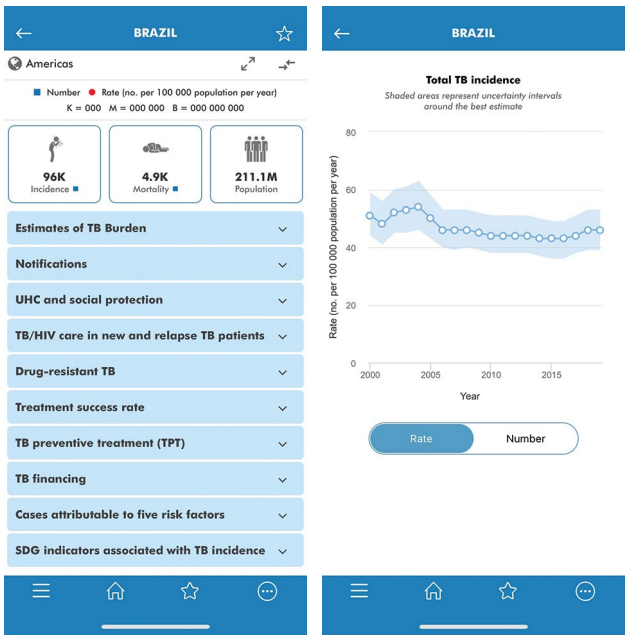
ANNEX 4

Country, regional and global profiles

Country, regional and global profiles as well as data for all key indicators for all countries and areas are available in the WHO TB Report mobile app and on the TB Data web page.[1]

A4.1 The WHO TB Report mobile app

The free WHO TB Report mobile app includes country, regional and global profiles from the global TB database, as well as a summary of the key facts and messages from the report and an overview of progress towards global TB targets. The app allows users to easily view, query and visualize data, and to define queries, including those for specific country groups. Once installed, the app works offline so that data can be accessed without an ongoing internet connection. The app is available for Android devices through Google Play and for iOS devices, such as iPhones and iPads, through the Apple Store.[2,3] It is available in English, French, Spanish and Russian.



A4.2 Online country profiles and other reports

TB data profiles are available online for all 215 countries and areas that report TB data to WHO each year, as are aggregate profiles for WHO regions and globally.[1] The profiles are available in English, French, Spanish and Russian. They are generated on-demand directly from the global TB database (**Annex 2**) and may therefore include updates received after publication of the global TB report. Estimates of TB cases attributable to five risk factors and indicators in the Sustainable Development Goals (SDGs) that are associated with TB incidence are available for all 215 countries and territories. TB financial profiles are available for more than 100 countries and territories that report detailed TB financial data to WHO.

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1 https://www.who.int/teams/global-tuberculosis-programme/data

2 https://play.google.com/store/apps/details?id=uk.co.adappt.whotbreport

3 https://apps.apple.com/us/app/tb-report/id1483112411

ANNEX 5

Updates to estimates of TB disease burden

Estimates of tuberculosis (TB) incidence and mortality in this report cover the period 2000–2020; those that are disaggregated by age and sex and those for drug-resistant TB (DR-TB) are for 2020. This annex summarizes key updates; methods are described in detail in the technical annex.

The main update in this report is the development and use of new dynamic and statistical models to produce country-specific estimates of TB incidence and mortality in 2020. These new methods were required to produce estimates that account for the major disruptions to the provision of and access to TB diagnostic and treatment services that have occurred in the context of the coronavirus (COVID-19) pandemic.

A5.1 Impact of disruptions related to the COVID-19 pandemic on TB services in 2020

Since 2006, the World Health Organization (WHO) has produced annual estimates of TB disease burden using standard methods that are clearly documented; the methods are periodically reviewed by the WHO Global Task Force on TB Impact Measurement *(1)*. However, the COVID-19 pandemic has had a major impact on access to and delivery of TB diagnostic and treatment services, evident in a sharp drop (18%) in notifications of people diagnosed with TB between 2019 and 2020. Hence, new methods were required to produce estimates of TB incidence and TB mortality in 2020 for most countries, including all high TB burden countries.

In collaboration with Imperial College (London, United Kingdom of Great Britain and Northern Ireland), WHO developed dynamic country-specific models for 16 countries. These countries – prioritized based on the size of their contribution to the global drop in TB case notifications between 2019 and 2020 – were Angola, Bangladesh, Brazil, China, India, Indonesia, Kenya, Myanmar, Pakistan, Peru, Philippines, Russian Federation, South Africa, Uganda, Ukraine and Viet Nam. Collectively, they accounted for 93% of the drop in global TB notifications between 2019 and 2020. The modelling built on collaborative work already undertaken for countries in the WHO South-East Asia Region, which has allowed managers of national TB programmes (NTPs) to explore the impact on TB disease burden of different scenarios for disruptions caused by the COVID-19 pandemic.

A key assumption in the models is that reductions in TB case notifications in 2020, relative to the expected number based on extrapolation of pre-2020 trends, were attributable to delays in diagnosis of TB and initiation of TB treatment. The other key assumption was a 50% reduction (uncertainty interval, 25–75%) in TB transmission during periods of lockdown. Country-specific data about the durations of lockdowns were compiled and reductions in transmission were assumed during these periods only.

Limitations of the models include the following:

- No age structure in the population.
- No separate classification of cases into pulmonary and extrapulmonary TB; instead, the models assume an average infectiousness for both forms of TB.
- No explicit consideration of DR-TB because, with the exception of the Russian Federation, the available notification data were for all cases, with no disaggregation. Estimates of the burden of DR-TB were estimated based on previously published methods *(1)*, described below.
- Uncertainty about key parameters. This includes the extent to which TB transmission intensity has been affected by lockdowns and other population-level restrictions and changes in behaviour during the COVID-19 pandemic. There is little directly measured evidence about the different mechanisms that have been proposed (e.g. the potential for reductions in community TB transmission to be at least partially offset by increases in household transmission).

For high-income countries or countries with no shortfall in case detection in 2020, estimates of incidence and mortality for 2020 were based on pre-2020 trends.

For all other countries, the following steps were used:

i. estimation of incidence and mortality in 2020 based on a counterfactual of pre-2020 trends (using previously published time series);

ii. prediction of the incidence and mortality rate ratio (actual incidence or mortality, accounting for the impact of disruptions, divided by the counterfactual based on pre-2020 trends), using regression models fitted to data for the 16 countries for which a dynamic model was developed, with defined pre-

dictor variables (case detection in 2019, changes in case detection in 2019–2020 and ratios of mortality to incidence); and

iii. taking the product of the estimate from step *(i)* with the predicted rate ratio from step *(ii)*.

The methods used to estimate TB incidence and mortality in 2020 were reviewed by WHO's Strategic and Technical Advisory Group for TB (STAG-TB) in June 2021 and the models were peer-reviewed by global experts who are members of the WHO Global Task Force on TB Impact Measurement and the TB modelling and analysis (TB MAC) consortium.

A5.2 Newly reported data and updated estimates from other agencies

New data on TB mortality were reported to WHO between mid-2020 and mid-2021. Several countries reported historical data that were previously missing, or made corrections to previously reported data. Updated estimates of HIV prevalence and mortality were obtained from the Joint United Nations Programme on HIV/AIDS (UNAIDS) in July 2021;[1] also, updated cause of death data reported to WHO were incorporated, with no significant increase in the number of usable country–year data points compared with the previous year.

Most estimates covering the period 2000–2019 were similar to those published in 2020.

Updates anticipated in the near future

Updates to estimates of disease burden are expected in 2021–2022 for India, following the completion of the country's first-ever national TB prevalence survey. The field operation of the survey had to be paused for several months due to the COVID-19 pandemic.

The COVID-19 pandemic will further affect estimates of incidence and mortality for 2021 in many countries and dynamic modelling will be used in more countries in preparation for the *Global tuberculosis report 2022*.

WHO also plans to assess how the burden of drug-resistant TB may be impacted by disruptions associated with the COVID-19 pandemic.

A summary of the main data sources currently available to inform estimates of TB disease burden in the 30 high TB burden countries and 3 global TB watchlist countries is shown in **Table A5.1**.

References

1. Glaziou P, Dodd PJ, Dean A, Floyd K. Methods used by WHO to estimate the global burden of TB disease. Geneva: World Health Organization; 2020 (https://www.who.int/tb/publications/global_report/TB20_Technical_Appendix_20201014.pdf).

[1] See https://www.unaids.org/en.

TABLE A5.1

Sources of data available to inform estimates of TB disease burden in the 30 high TB burden countries and the 3 global TB watchlist countries, 2000–2020. Blue indicates that a source is available, orange indicates it will be available in the near future, and red indicates that a source is not available.

COUNTRY	NOTIFICATION DATA	STANDARDS AND BENCHMARK ASSESSMENT[a]	NATIONAL INVENTORY STUDY[b]	NATIONAL TB PREVALENCE SURVEY[c]	NATIONAL DRUG RESISTANCE SURVEY OR SURVEILLANCE[d]	NATIONAL VR DATA OR MORTALITY SURVEY[e]
Angola	2000–2020	2016, 2019	–	–	–	–
Bangladesh	2000–2020	2014, 2019	–	2015	2011, 2019	–
Brazil	2000–2020	2018	–	NA	2008	2000–2019
Cambodia	2000–2020	2018	–	2002, 2011	2007, 2018	–
Central African Republic	2000–2020	2019	–	–	2009	–
China	2000–2020	–	2018	2000, 2010	2007, 2013, 2020–	2004–2018
Congo	2000–2020	2019	–	–	–	–
Democratic People's Republic of Korea	2000–2020	2017	–	2016	2014	–
Democratic Republic of the Congo	2000–2020	2017, 2019	–	–	2017	–
Ethiopia	2000–2020	2013, 2016	–	2011	2005, 2018, 2018–	–
Gabon	2000–2020	2018, 2020	–	–	–	–
India	2000–2020	2019	2016	2019–2021	2016, 2020–	2000–2014
Indonesia	2000–2020	2017, 2019	2017	2013–2014	2018	2006–2007, 2009–2015
Kenya	2000–2020	2017, 2021	2013	2015	2014, 2020–	–
Lesotho	2000–2020	2014, 2017	–	2019	2014, 2019–	–
Liberia	2000–2020	2015, 2019	–	–	–	–
Mongolia	2000–2020	2015, 2018	2022	2014–2015	2007, 2016, 2018–	2016
Mozambique	2000–2020	2013	–	2017–2019	2007, 2021	–
Myanmar	2000–2020	2014, 2017	–	2009, 2018	2013, 2018–, 2020	–
Namibia	2000–2020	2016, 2019	–	2017–2018	2008, 2015, 2018–	–
Nigeria	2000–2020	2017, 2020	–	2012	2010	–
Pakistan	2000–2020	2016, 2019	2012, 2017	2011	2013	2006, 2007, 2010
Papua New Guinea	2000–2020	2017	–	–	2014	–
Philippines	2000–2020	2016, 2019	2022	2007, 2016	2012, 2019	2000–2014
Russian Federation	2000–2020	2017	–	NA	2000–	2000–2019
Sierra Leone	2000–2020	2015, 2020	–	–	–	–
South Africa	2000–2020	2015, 2019	2019–2022	2017–2019	2002, 2014	2000–2017
Thailand	2000–2020	2013	–	2012	2012, 2018	2000–2019
Uganda	2000–2020	2013, 2019	–	2014–2015	2011, 2018–	–
United Republic of Tanzania	2000–2020	2013, 2018	2019–2022	2012	2007, 2018	–
Viet Nam	2000–2020	2013, 2019	2017	2007, 2017–2018	2006, 2012, 2018–	–
Zambia	2000–2020	2016, 2020	–	2014	2008, 2018–, 2020	–
Zimbabwe	2000–2020	2016, 2019	–	2014	2016, 2018–	–

NA, not applicable; VR, vital registration

[a] The WHO TB surveillance checklist of standards and benchmarks is designed to assess the quality and coverage of notification data (based on 9 core standards), VR data (1 standard) and data for drug-resistant TB, HIV co-infection and TB in children (3 supplementary standards). A partial assessment has been done in China. If more than two assessments have been done (Indonesia, Kenya, Nigeria, Pakistan, Philippines, Zambia and Zimbabwe), the years of the last two only are shown.

[b] Studies are currently underway in South Africa and United Republic of Tanzania. Studies are planned in Mongolia and Philippines in 2022. Prioritization of TB inventory studies is recommended in countries where a large share of TB care is provided outside the existing NTP network.

[c] The survey in India is scheduled for completion in 2021. Brazil and Russian Federation do not meet the following criteria recommended by the WHO Global Task Force on TB Impact Measurement for implementing a national prevalence survey: TB incidence ≥150 per 100 000 population per year, no vital registration system and under-5 mortality rate (probability of dying by age of 5 per 1000 live births) is >10.

[d] Data are from continuous surveillance (indicated by "–" in blue cell) based on routine diagnostic testing in China, Ethiopia, India, Kenya, Lesotho, Mongolia, Myanmar, Namibia, Uganda, Russian Federation, Viet Nam, Zambia and Zimbabwe. The surveys in Brazil, Central African Republic, Democratic People's Republic of Korea and Papua New Guinea were subnational. If more than two national surveys have been done (Cambodia, Myanmar, Thailand, Philippines, Zambia), the years of the last two only are shown. A survey is currently underway in Mozambique.

[e] Years of data availability for India, Indonesia, Pakistan and South Africa were provided to WHO by IHME.

ANNEX 6

The WHO TB-SDG monitoring framework

In 2017, the World Health Organization (WHO) developed a framework for monitoring of indicators in the United Nations (UN) Sustainable Development Goals (SDGs) that are strongly associated with tuberculosis (TB) incidence. This was done as part of the preparations for the first global ministerial conference on TB *(1)*, building on previously published work that identified clear linkages between a range of social, economic and health-related indicators and TB incidence *(2–5)*.

The TB-SDG monitoring framework comprises 14 indicators under seven SDGs (**Table A6.1**).

For SDG 3, the framework includes seven indicators:

- coverage of essential health services;
- proportion of the population with large household expenditures on health as a share of total household expenditure or income;
- current health expenditure per capita;
- HIV prevalence;
- prevalence of smoking;
- prevalence of diabetes; and
- prevalence of alcohol use disorder.

For SDGs 1, 2, 7, 8, 10 and 11, the seven indicators selected for monitoring are:

- proportion of the population living below the international poverty line;
- proportion of the population covered by social protection floors or systems;
- prevalence of undernourishment;
- proportion of the population with primary reliance on clean fuels and technology;
- gross domestic product (GDP) per capita;
- Gini index for income inequality; and
- proportion of the urban population living in slums.

Collection and reporting of data for the 14 indicators does not require any additional data collection and reporting efforts by national TB programmes (NTPs). Nor does it require data collection and reporting efforts that go beyond those to which countries have already committed in the context of the SDGs. At the global level, the UN has established a monitoring system for SDG indicators, and countries are expected to report data on an annual basis via the appropriate UN agencies (including WHO). Therefore, analysis of the status of, and trends in, the 14 indicators related to TB can be based primarily on data held in the UN's SDG database.

In some cases, the official SDG indicator was not considered the best metric, and a better (but closely related) alternative was identified and justified (five indicators under SDG 3, one under SDG 8 and one under SDG 10). In such cases, the data sources are one of the following: WHO, the Organisation for Economic Co-operation and Development (OECD), the Joint United Nations Programme on HIV/AIDS (UNAIDS) or the World Bank.

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TABLE A6.1

TB-SDG monitoring framework: indicators to monitor within SDG 3

SDG 3: Ensure healthy lives and promote well-being for all at all ages					
SDG TARGETS FOR 2030	SDG INDICATORS	ALTERNATIVE INDICATORS TO MONITOR	RATIONALE	DATA SOURCE	COLLECT DATA FOR TB PATIENTS SPECIFICALLY?
3.3 End the epidemics of AIDS, TB, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases	**3.3.1** Number of new HIV infections per 1000 uninfected population **3.3.2** TB incidence per 100 000 population	HIV prevalence	HIV is a strong risk factor for development of TB disease and is associated with poorer treatment outcomes. HIV prevalence is selected in preference to HIV incidence because it is directly measured.	UNAIDS WHO	Yes, already routinely collected. NA
3.4 Reduce premature mortality by one third from non-communicable diseases and promote mental health and well-being	**3.4.1** Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease	Prevalence of diabetes	Diabetes is a strong risk factor for development of TB disease, although a link with TB incidence at the national (as opposed to individual) level has been difficult to establish due to confounding. Diabetes prevalence is more relevant than mortality for TB since it directly influences the risk of developing TB.	WHO	Could be considered at country level, to inform planning of care for comorbidities.
3.5 Strengthen prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol	**3.5.2** Alcohol consumption per capita per year (in litres of pure alcohol) among those aged ≥15 years (harmful level defined nationally)	Prevalence of alcohol use disorder	Alcohol use is a strong risk factor for TB disease and poorer treatment outcomes at the individual level, although a link with TB incidence at the national (as opposed to individual) level has been hard to establish due to confounding. The prevalence of alcohol use disorder is the most relevant indicator in the context of TB.	WHO	Could be considered at country level, to inform planning of care for comorbidities.
3.8 Achieve UHC, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all	**3.8.1** Coverage of essential health services (defined as the average coverage of essential services based on 16 tracer interventions). **3.8.2** Proportion of population with large household expenditures on health as a share of total household expenditure or income	NA NA	Achieving UHC is required to achieve the three high-level targets of the End TB Strategy for reductions in the TB incidence rate, reductions in the number of TB deaths and elimination of catastrophic costs for TB patients and their households. TB treatment coverage has been monitored for years and is one of the 16 tracer indicators that have been selected to measure SDG indicator 3.8.1.	WHO	No
3.a Strengthen implementation of the WHO Framework Convention on Tobacco Control	**3.a.1** Age-standardized prevalence of current tobacco use among those aged ≥15 years	Prevalence of smoking among those aged ≥15 years (%)	Smoking is a strong risk factor for TB disease at the individual level, although a link with TB incidence at the national (as opposed to individual) level has been difficult to establish due to confounding.	WHO	Could be considered (e.g. to inform access to smoking cessation interventions).
3.c Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States	**3.c.1** Health worker density and distribution	Current health expenditure per capita	Health expenditure per capita is correlated with TB incidence.	WHO	No

AIDS, acquired immune deficiency syndrome; HIV, human immunodeficiency virus; NA, not applicable; SDG, Sustainable Development Goal; TB, tuberculosis; UHC, universal health coverage; UNAIDS, Joint United Nations Programme on HIV/AIDS; WHO, World Health Organization

TB-SDG monitoring framework: indicators to monitor beyond SDG 3

SDG TARGETS FOR 2030	SDG INDICATORS	ALTERNATIVE INDICATORS TO MONITOR	RATIONALE	DATA SOURCE	COLLECT DATA FOR TB PATIENTS SPECIFICALLY?
SDG 1: End poverty in all its forms everywhere					
1.1 Eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day **1.3** Implement nationally appropriate social protection systems and measures for all, including floors, and achieve substantial coverage of the poor and vulnerable	**1.1.1** Proportion of population living below the international poverty line **1.3.1** Proportion of population covered by social protection floors/systems	NA NA	Poverty is a strong risk factor for TB, operating through several pathways. Reducing poverty should also facilitate prompt health-care seeking. Countries with higher levels of social protection have lower TB burden. Progress on both indicators will help to achieve the End TB Strategy target to eliminate catastrophic costs for TB patients and their households.	UN SDG database, World Bank	No Could be considered (e.g. to facilitate access to social protection).
SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture					
2.1 End hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food year-round	**2.1.1** Prevalence of undernourishment	NA	Undernutrition weakens the body's defence against infections and is a strong risk factor for TB at the national and individual level.	UN SDG database	Could be considered (e.g. to plan food support).
SDG 7: Ensure access to affordable, reliable, sustainable, and modern energy for all					
7.1 Ensure universal access to affordable, reliable and modern energy services	**7.1.2** Proportion of population with primary reliance on clean fuels and technology	NA	Indoor air pollution is a risk factor for TB disease at the individual level. There has been limited study of ambient air pollution but it is plausible that it is linked to TB incidence.	WHO	No
SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all					
8.1 Sustain per capita growth in accordance with national circumstances and, in particular, at least 7% GDP growth per year in the least developed countries	**8.1.1** Annual growth rate of real GDP per capita	GDP per capita	Historic trends in TB incidence are closely correlated with changes in the absolute level of GDP per capita (but not with the growth rate).	World Bank	No
SDG 10: Reduce inequality within and among countries					
10.1 Achieve and sustain income growth of the bottom 40% of the population at a rate higher than the national average	**10.1.1** Growth rates of household expenditure or income per capita, overall and for the bottom 40% of the population	Gini index for income inequality	TB is a disease of poverty. Decreasing income inequalities combined with economic growth should have an effect on the TB epidemic.	World Bank OECD	No
SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable					
11.1 Ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	**11.1.1** Proportion of urban population living in slums, informal settlements or inadequate housing	NA	Living in a slum is a risk factor for TB transmission due to its link with overcrowding. It is also a risk factor for developing TB disease, due to links with air pollution and undernutrition.	UN SDG database	No

GDP, gross domestic product; NA, not applicable; OECD, Organisation for Economic Co-operation and Development; SDG, Sustainable Development Goal; TB, tuberculosis; UN, United Nations; WHO, World Health Organization.

www.who.int/tb/data

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