GLOBAL TUBERCULOSIS REPORT

2022

World Health Organization

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Contents

Dr Tedros Adhanom Ghebreyesus
Director-General
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" *If the pandemic has taught us anything, it's that with solidarity, determination, innovation and the equitable use of tools, we can overcome severe health threats. Let's apply those lessons to tuberculosis. It is time to put a stop to this long-time killer. Working together, we can end TB.* "

Dr Tereza Kasaeva
Director
WHO Global TB Programme

“ *The report provides important new evidence and makes a strong case for the need to join forces and urgently redouble efforts to get the TB response back on track to reach TB targets and save lives. It will be an essential resource for countries, partners and civil society in the lead up to the second UN high-level meeting on TB to be held in 2023.* ”

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[1] The membership of the Task Force is described at
   https://www.who.int/groups/civil-society-task-force-on-tb.

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WHO African Region

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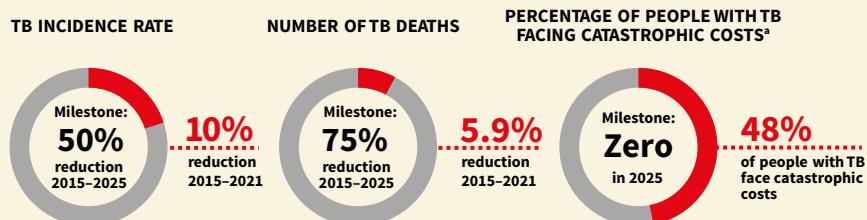
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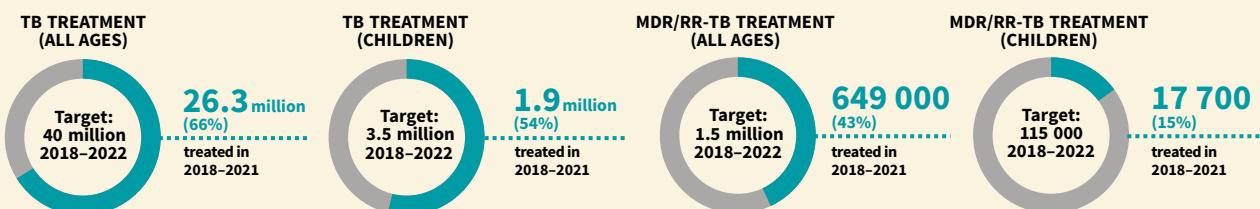
Abbreviations

AIDS	acquired immunodeficiency syndrome
ART	antiretroviral therapy
BCG	bacille Calmette-Guérin
BRICS	Brazil, Russian Federation, India, China and South Africa
CAD	computer-aided detection
CFR	case fatality ratio
CSV	comma-separated value
CI	confidence interval
COVID-19	coronavirus disease 2019
DR-TB	drug-resistant tuberculosis
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
Global Plan	*Global Plan to End TB, 2018–2022*
HBC	high burden country
HIV	human immunodeficiency virus
ICD	International classification of diseases
IGRA	interferon-gamma release assay
LMICs	low- and middle-income countries
MAF-TB	multisectoral accountability framework for tuberculosis
MDR/RR-TB	multidrug-resistant or rifampicin-resistant tuberculosis
MDR-TB	multidrug-resistant tuberculosis
NTP	national TB programme
OECD	Organisation for Economic Co-operation and Development
RR-TB	rifampicin-resistant tuberculosis
SCI	service coverage index
SDG	Sustainable Development Goal
STAG-TB	Strategic and Technical Advisory Group for TB
Task Force	WHO Global Task Force on TB Impact Measurement
TB	tuberculosis
UNAIDS	Joint United Nations Programme on HIV/AIDS
United Kingdom	United Kingdom of Great Britain and Northern Ireland
UHC	universal health coverage
UI	uncertainty interval
UN	United Nations
US	United States
USAID	United States Agency for International Development
VR	vital registration
WHO	World Health Organization
XDR	extensively drug-resistant TB
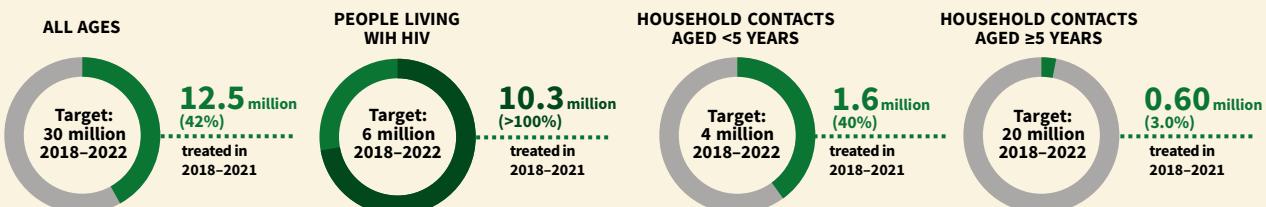
WHO End TB Strategy: 2025 milestones

TB INCIDENCE RATE

Milestone: **50%** reduction 2015–2025

10% reduction 2015–2021

NUMBER OF TB DEATHS

Milestone: **75%** reduction 2015–2025

5.9% reduction 2015–2021

PERCENTAGE OF PEOPLE WITH TB FACING CATASTROPHIC COSTS[a]

Milestone: **Zero** in 2025

48% of people with TB face catastrophic costs
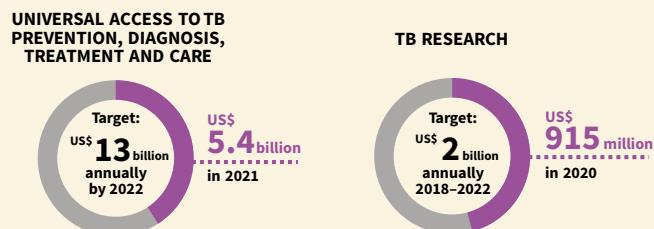
UN high-level meeting on TB: treatment targets

TB TREATMENT (ALL AGES)

Target: 40 million 2018–2022

26.3 million (66%) treated in 2018–2021

TB TREATMENT (CHILDREN)

Target: 3.5 million 2018–2022

1.9 million (54%) treated in 2018–2021

MDR/RR-TB TREATMENT (ALL AGES)

Target: 1.5 million 2018–2022

649 000 (43%) treated in 2018–2021

MDR/RR-TB TREATMENT (CHILDREN)

Target: 115 000 2018–2022

17 700 (15%) treated in 2018–2021

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

ALL AGES

Target: 30 million 2018–2022

12.5 million (42%) treated in 2018–2021

PEOPLE LIVING WIH HIV

Target: 6 million 2018–2022

10.3 million (>100%) treated in 2018–2021

HOUSEHOLD CONTACTS AGED <5 YEARS

Target: 4 million 2018–2022

1.6 million (40%) treated in 2018–2021

HOUSEHOLD CONTACTS AGED ≥5 YEARS

Target: 20 million 2018–2022

0.60 million (3.0%) treated in 2018–2021

UN high-level meeting on TB: funding targets

UNIVERSAL ACCESS TO TB PREVENTION, DIAGNOSIS, TREATMENT AND CARE

Target: US$ **13** billion annually by 2022

US$ **5.4** billion in 2021

TB RESEARCH

Target: US$ **2** billion annually 2018–2022

US$ **915** million in 2020

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 5** 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). About a quarter of the global population is estimated to have been infected with TB *(1)*, but most people will not go on to develop TB disease and some will clear the infection *(2, 3)*. Of the total number of people who develop TB each year, about 90% are adults, with more cases among men than women. The disease typically affects the lungs (pulmonary TB) but can affect other sites as well.

Without treatment, the death rate from TB disease is high (about 50%) *(4)*. With currently-recommended treatments (a 4–6 months course of anti-TB drugs), about 85% of people can be cured. Regimens of 1–6 months are available to treat TB infection. Universal health coverage (UHC) is necessary to ensure that all people with disease or infection can access these treatments. The number of people acquiring infection and developing disease (and in turn the number of deaths caused by TB) can also be reduced through multisectoral action to address TB determinants such as poverty, undernourishment, HIV infection, smoking and diabetes.

Some countries have already reduced their burden of TB disease to fewer than 10 cases and less than one 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 (i.e. TB incidence) worldwide to the levels already achieved in these low-burden countries.

Basic facts about TB and its treatment 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 2022 edition of the report is, as usual, based primarily on data gathered by WHO from national ministries of health in annual rounds of data collection.[1] In 2022, 202 countries and territories with more than 99% of the world's population and TB cases reported data (**Annex 2**).

During the COVID-19 pandemic, WHO has also collected provisional monthly or quarterly national TB case notification data on an ongoing basis from more than 100 countries with about 90% of the world's TB cases, including all high TB burden countries (**Annex 3**). The data are visualized and made publicly available as soon as they are reported *(5, 6)*. They are being used for timely monitoring of the impact of the pandemic on TB case detection, to facilitate timely action in response to observed disruptions, and as a key input to the estimates of TB disease burden (incidence and mortality) for 2020 and 2021 that are included in this report.

The 2022 edition of the report has been produced in a format that is optimized for web or app-based access and use. There is a short main report that focuses on key findings and messages (this document); webpages containing more detailed and digitized content, including a large number of interactive graphics;[2] and an app containing country, regional and global profiles as well as two slide-sets (**Annex 4**).[3] This format allows content to be made available in relatively small and "bite-sized" chunks,[4] which facilitates navigation, reading and use, especially for the vast majority of people (>90%) who access the report via a computer, tablet or mobile phone, rather than via a printed copy. All content can be accessed from the report landing page and all data can be downloaded from WHO's online global TB database *(5)*.

The top findings and messages of the 2022 report are highlighted in **Box 1**.

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[1] The data are collected from national TB programmes (NTPs) or the national entity responsible for TB surveillance.

[2] The webpages cover seven major topics: the COVID-19 pandemic and TB; TB disease burden; TB diagnosis and treatment; TB prevention; TB financing; UHC and TB determinants; and TB research and innovation. There are also webpages on "featured topics", which this year include engagement of communities, civil society and people affected by TB in the TB response; international donor funding for TB; multisectoral accountability for the TB response; and TB-related innovations during the COVID-19 pandemic.

[3] The app is free to download and enables users to have access to data for many key indicators at their fingertips.

[4] In contrast to the format of a single report document of about 200–300 pages, which was used until 2020.

Box 1. Top findings and messages in the 2022 report

The COVID-19 pandemic continues to have a damaging impact on access to TB diagnosis and treatment and the burden of TB disease. Progress made in the years up to 2019 has slowed, stalled or reversed, and global TB targets are off track.

The most obvious and immediate impact was a large global drop in the reported number of people newly diagnosed with TB. From a peak of 7.1 million in 2019, this fell to 5.8 million in 2020 (–18%), back to the level last seen in 2012. In 2021, there was a partial recovery, to 6.4 million (the level of 2016–2017). The three countries that accounted for most of the reduction in 2020 were India, Indonesia and the Philippines (67% of the global total). They made partial recoveries in 2021, but still accounted for 60% of the global reduction compared with 2019. Other high TB burden countries with large relative year-to-year reductions (>20%) included Bangladesh (2020), Lesotho (2020 and 2021), Myanmar (2020 and 2021), Mongolia (2021) and Viet Nam (2021).

Reductions in the reported number of people diagnosed with TB in 2020 and 2021 suggest that the number of people with undiagnosed and untreated TB has grown, resulting first in an increased number of TB deaths and more community transmission of infection and then, with some lag-time, increased numbers of people developing TB.

Globally, the estimated number of deaths from TB increased between 2019 and 2021, reversing years of decline between 2005 and 2019. In 2021, there were an estimated 1.4 million deaths among HIV-negative people (95% uncertainty interval [UI]: 1.3–1.5 million) and 187 000 deaths (95% UI: 158 000–218 000) among HIV-positive people,[a] for a combined total of 1.6 million. This was up from best estimates of 1.5 million in 2020 and 1.4 million in 2019, and back to the level of 2017. The net reduction from 2015 to 2021 was 5.9%, about one sixth of the way to the first milestone of the WHO End TB Strategy.

An estimated 10.6 million people (95% UI: 9.9–11 million) fell ill with TB in 2021, an increase of 4.5% from 10.1 million (95% UI: 9.5–10.7 million) in 2020. The TB incidence rate (new cases per 100 000 population per year) rose by 3.6% between 2020 and 2021, reversing declines of about 2% per year for most of the previous 2 decades. The net reduction from 2015 to 2021 was 10%, only halfway to the first milestone of the End TB Strategy.

The burden of drug-resistant TB (DR-TB) is also estimated to have increased between 2020 and 2021, with 450 000 (95% UI: 399 000–501 000) new cases of rifampicin-resistant[b] TB (RR-TB) in 2021.

Estimating TB disease burden during the COVID-19 pandemic is difficult and relies heavily on country- and region-specific dynamic models for low- and middle-income countries (LMICs). New national population-based surveys of TB disease and up-to-date cause-of-death data from national vital registration systems of high quality and coverage are needed for more accurate estimation in the wake of the pandemic.

Other negative impacts on TB during the COVID-19 pandemic include a fall between 2019 and 2020 in the number of people provided with treatment for RR-TB and multidrug-resistant TB (MDR-TB)[b] (–17%, from 181 533 to 150 469, about 1 in 3 of those in need), with a partial recovery (+7.5%) to 161 746 in 2021; and a decline in global spending on essential TB services (from US$ 6.0 billion in 2019 to US$ 5.4 billion in 2021, less than half of what is needed).

There is a strong and enduring relationship between TB incidence rates per capita and indicators of development such as average income and undernourishment. Economic and financial barriers can affect access to health care for TB diagnosis and completion of TB treatment; about half of TB patients and their households face catastrophic total costs[c] due to TB disease. Progress towards universal health coverage (UHC), better levels of social protection and multisectoral action on broader TB determinants are all essential to reduce the burden of TB disease.

There are some positive findings and success stories.

▶ Globally, the success rate for people treated for TB in 2020 was 86%, the same level as 2019, suggesting that the quality of care was maintained in the first year of the COVID-19 pandemic.

▶ In the WHO African Region, the impact of COVID-related disruptions on the reported number of people newly diagnosed with TB was limited. There was a relatively small decrease (–2.3%) from 2019–2020 and an increase in 2021.

▶ Following large falls in 2020, the reported number of people newly diagnosed with TB in 2021 recovered to 2019 levels (or beyond) in five high TB burden countries: Bangladesh, the Congo, Pakistan, Sierra Leone and Uganda.

▶ The global number of people provided with TB preventive treatment recovered in 2021, to close to 2019 levels, and the global target for provision of treatment to people living with HIV was surpassed.

▶ Three high TB burden countries have reached or passed the first milestones of the End TB Strategy for both reductions in TB incidence and TB deaths: Kenya (in 2018), the United Republic of Tanzania (in 2019) and Zambia (in 2021). Ethiopia is very close.

Intensified efforts backed by increased funding are urgently required to mitigate and reverse the negative impacts of the COVID-19 pandemic on TB. The need for action has become even more pressing in the context of war in Ukraine, ongoing conflicts in other parts of the world, a global energy crisis and associated risks to food security, which are likely to worsen some of the broader determinants of TB.

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[a] Officially classified as deaths from HIV/AIDS.
[b] Rifampicin is the most powerful first-line anti-TB drug. MDR-TB is defined as resistance to rifampicin and isoniazid.
[c] Defined as direct medical expenditures, direct nonmedical expenditures and indirect costs (e.g. income losses) that sum to >20% of household income. This indicator is not the same as the Sustainable Development Goal indicator for catastrophic health expenditures (see **Box 5** for further explanation).

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 2**) and the UN Sustainable Development Goals (SDGs) *(7, 8)*. The strategy included milestones (for 2020 and 2025) and targets (for 2030 and 2035) 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.

Reaching the milestones and targets for reductions in TB incidence required an annual decline in the TB incidence rate of 4–5% per year by 2020, accelerating to 10% per year by 2025 and then to an average of 17% per year from 2025 to 2035. Reaching the milestones

Box 2. 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[a] (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[b] (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

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

3. INTENSIFIED RESEARCH AND INNOVATION

   I. Discovery, development and rapid uptake of new tools, interventions and strategies
   J. Research to optimize implementation and impact, and promote innovations

[a] This indicator is for the combined total of TB deaths in HIV-negative and HIV-positive people. Deaths from TB among HIV-positive people are officially classified as deaths caused by HIV/AIDS, with TB as a contributory cause.
[b] This indicator is not the same as the SDG indicator for catastrophic health expenditures. See **Box 5** for further explanation.

TABLE 1

Global targets set in 2018 at the first UN high-level meeting on TB

INDICATOR	TARGET
Number of people with TB disease treated in the five years 2018–2022	40 million people, including: • 3.5 million children • 1.5 million people with drug-resistant TB, including 115 000 children
Number of people provided with TB preventive treatment in the five years 2018–2022	At least 30 million people, including: • 4 million children under 5 years of age who are household contacts of people diagnosed with TB • 20 million people in older age groups who are household contacts of people diagnosed with TB • 6 million people living with HIV
Annual funding for universal access to quality prevention, diagnosis, treatment and care of TB	At least US$ 13 billion per year by 2022
Annual funding for TB research	US$ 2 billion annually in the five years 2018–2022

and targets for reductions in TB deaths required not only these declines in TB incidence, but also reductions in the case fatality ratio (CFR; the percentage of people with TB who die from the disease). The global CFR needed to fall to 10% by 2020 and then to 6.5% (a level already achieved in high-income countries) by 2025. Key requirements to reach the milestones and targets were defined within the three pillars of the End TB Strategy (**Box 2**). They included provision of TB prevention, diagnostic and treatment services within the context of progress towards UHC and social protection; multisectoral actions to address broader social and economic determinants of TB; and technological breakthroughs, such as a new TB vaccine by 2025.

The third target of the End TB Strategy, that no TB patients and their households face catastrophic total costs[1] as a result of the disease, was set in recognition of the fact that removal of financial and economic barriers to accessing TB diagnosis and treatment is a prerequisite for achieving the milestones and targets for reductions in TB incidence and TB mortality. "Catastrophic" is defined as direct medical expenditures, direct nonmed-

ical expenditures and indirect costs (e.g. income losses) that sum to >20% of household income.

Further details about the rationale for the milestones and targets and how they were defined is available elsewhere *(9)*.

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 *(10)*.

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 *(11)*. 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**).

A high-level review of progress achieved by the end of 2022 is scheduled for 2023 (**Box 3**).

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Box 3. Review of progress towards ending TB at a UN high-level meeting in 2023

The UN General Assembly held its first-ever high-level meeting on TB in 2018. The main outcome was a political declaration *(11)*, which reaffirmed existing commitments to ending the TB epidemic and set new global TB targets for the period 2018–2022. The declaration requested a progress report in 2020, to be prepared by the UN Secretary-General with support from WHO; and ended with a commitment to a "comprehensive review by Heads of State and Government at a high-level meeting in 2023". The 2020 progress report *(12)* included 10 priority recommendations and requested WHO to work with Member States and other stakeholders on the preparations for a second high-level meeting on TB.

Preparations for a second UN high-level meeting on TB in 2023 are now underway, led by the UN secretariat with support from WHO. The meeting will be informed by national high-level reviews of progress. WHO's multisectoral and multistakeholder platform will be leveraged to support countries to undertake these reviews, in collaboration with WHO's Civil Society Taskforce on TB. The meeting is expected to result in a new political declaration.

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[1] This indicator is not the same as the SDG indicator for catastrophic health expenditures (see **Box 5** for further explanation).

3. Main findings and messages

The overarching finding of this report is that the COVID-19 pandemic continues to have a damaging impact on access to TB diagnosis and treatment and the burden of TB disease. Progress made in the years up to 2019 has slowed, stalled or reversed, and global TB targets are off track. The overarching message is that intensified efforts backed by increased funding are urgently required to mitigate and reverse the negative impacts of the pandemic on TB. The need for action has become even more pressing in the context of war in Ukraine, ongoing conflicts in other parts of the world, a global energy crisis and associated risks to food security, which are likely to further worsen some of the broader determinants of TB.

TB case notifications

Big fall in 2020, partial recovery in 2021

The most obvious and immediate impact on TB of disruptions caused by the COVID-19 pandemic was a large global fall in the number of people newly diagnosed with TB and reported (i.e. officially notified) in 2020, compared with 2019 (**Fig. 1**). Following large increases between 2017 and 2019, there was a reduction of 18% between 2019 and 2020, from 7.1 million to 5.8 million. There was a partial recovery in 2021, to 6.4 million.

A similar pattern of increases in notifications of people newly diagnosed with TB up to 2019 followed by a sharp fall in 2020 and some recovery in 2021 is evident in two of the six WHO regions: the Americas and South-East Asia (**Fig. 2**). The WHO Eastern Mediterranean Region saw a marked reduction in notifications between

2019 and 2020, followed by an almost complete recovery in 2021. In the WHO European Region, there was a clear negative impact in 2020, but the reduction from 2020–2021 was consistent with the pre-2020 trend. In the WHO Western Pacific Region, there was no recovery in 2021. The WHO African Region stood out as experiencing only a modest negative impact in 2020 (–2.3%), and notifications in 2021 were above the 2019 level. The WHO regions of South-East Asia and the Western Pacific accounted for most of the global reductions (compared with 2019): 84% of the total in 2020, and 99% in 2021.

Most (90%) of the global reduction in the reported number of people newly diagnosed with TB between 2019 and 2020 was accounted for by 10 countries (**Fig. 3a**), with the top three (India, Indonesia and the Philippines) accounting for 67%. In 2021, 90% of the reduction compared with 2019 was accounted for by only five countries (**Fig. 3b**).

Among the 30 high TB burden and three global TB watchlist countries (**Fig. 4**), the largest relative reductions in annual TB case notifications between 2019 and 2020 (ordered according to the size of the relative reduction) were in the Philippines, Lesotho, Indonesia, Zimbabwe, India, Myanmar and Bangladesh (all >20%). In 2021, there was considerable recovery in India, Indonesia and the Philippines, although not to 2019 levels. In Myanmar, the reduction in TB notifications in 2021 was even larger than in 2020. Other countries with large relative reductions between 2020 and 2021 included Mongolia and three other Asian countries that had been relatively unaffected in 2020: Cambodia, Thailand and Viet Nam. In several African countries, notifications in both 2020 and 2021 were higher than in 2019, with Nigeria being the most striking example. Countries in which 2021 notifications recovered to 2019 levels (or beyond) included Bangladesh, the Congo, Pakistan, Sierra Leone and Uganda.

The 30 high TB burden and three global TB watchlist countries can be categorized into six groups, according to the timing and degree of disruptions to TB notifications during the COVID-19 pandemic (**Fig. 5**). TB detection in all countries in the first four groups was negatively impacted in one or both of 2020 and 2021. Disruptions to TB detection in 2020 and 2021 in countries in the fifth and sixth groups appear to have been nonexistent or limited; TB notifications either increased in both 2020 and 2021, or the numbers showed no or only a limited

FIG.1

Global trend in case notifications of people newly diagnosed with TB, 2015–2021
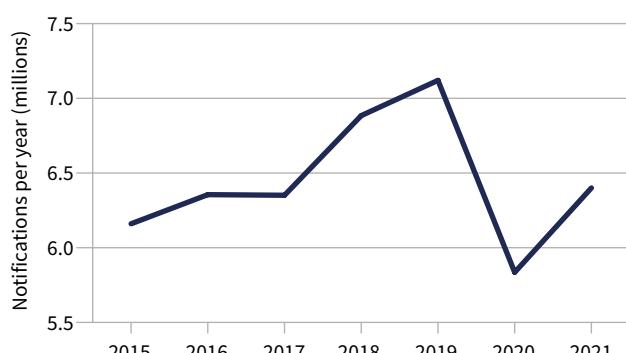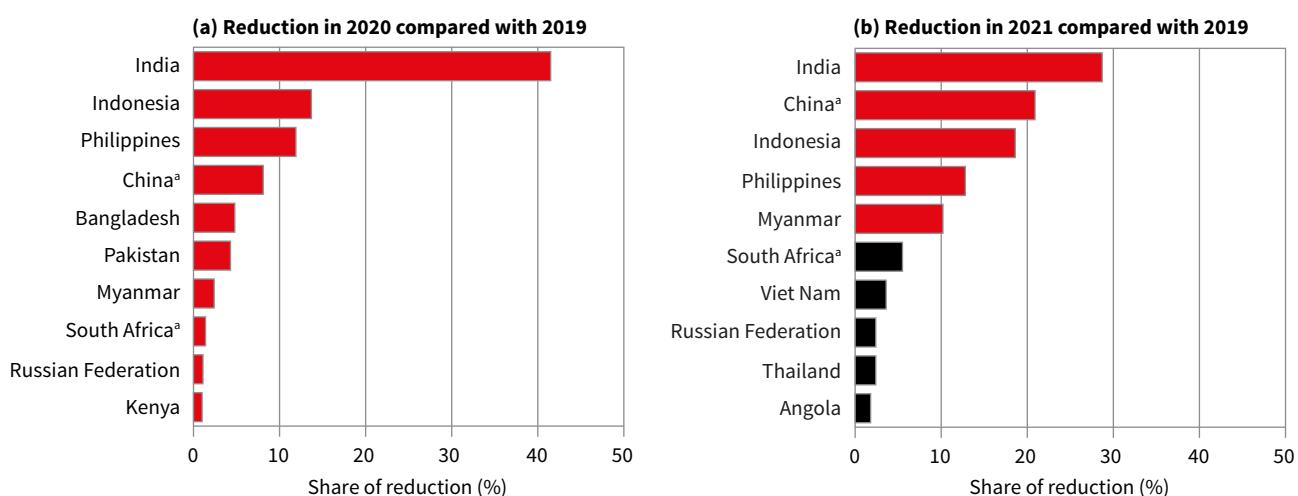
FIG. 2

Trends in case notifications of people newly diagnosed with TB by WHO region, 2015–2021

African Region

Region of the Americas

South-East Asia Region

European Region

Eastern Mediterranean Region

Western Pacific Region

FIG. 3

The top 10 countries that accounted for ≥90% of the global reduction in case notifications of people newly diagnosed with TB in 2020 and 2021, compared with 2019

Countries that accounted for 90% of the reduction are shown in **red**.

(a) Reduction in 2020 compared with 2019

India
Indonesia
Philippines
China[a]
Bangladesh
Pakistan
Myanmar
South Africa[a]
Russian Federation
Kenya

Share of reduction (%)

(b) Reduction in 2021 compared with 2019

India
China[a]
Indonesia
Philippines
Myanmar
South Africa[a]
Viet Nam
Russian Federation
Thailand
Angola

Share of reduction (%)
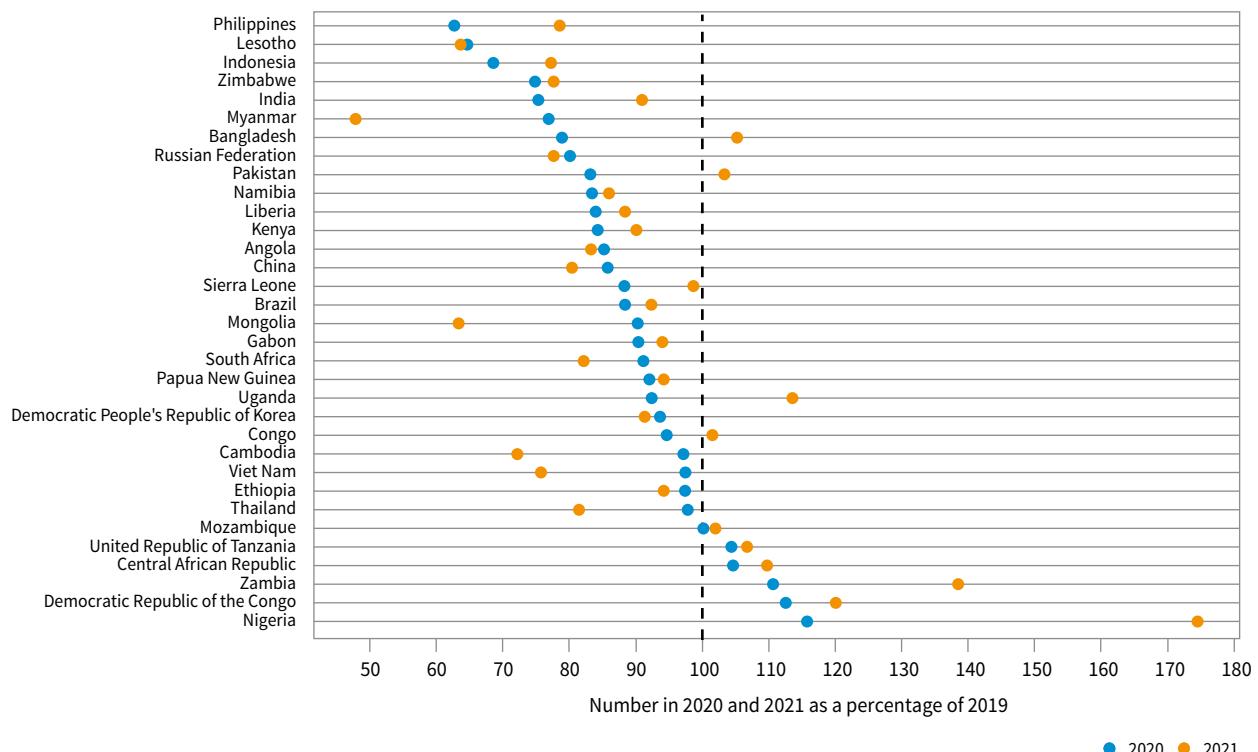
[a] Reductions in China and South Africa were consistent with, or a limited departure from, pre-2020 downward trends. See **Fig. 5F**.

FIG. 4

Case notifications of people newly diagnosed with TB in 2020 and 2021 compared with 2019, 30 high TB burden and 3 global TB watchlist countries^a

The vertical dashed line marks the level of 2019.

a   The three global TB watchlist countries are Cambodia, Russian Federation and Zimbabwe (see **Annex 3** for further explanation).

departure from a pre-2020 downward trend. The countries in these two latter groups are mostly in the WHO African Region, consistent with the regional data shown in **Fig. 2**.

The substantial disruptions to TB case detection and reporting in 2020 and 2021 probably reflect both supply-side and demand-side influences on TB diagnostic and treatment services. Examples include reduced health system capacity to continue to provide services; reduced ability to seek care in the context of lockdowns, and associated restrictions on movement; concerns
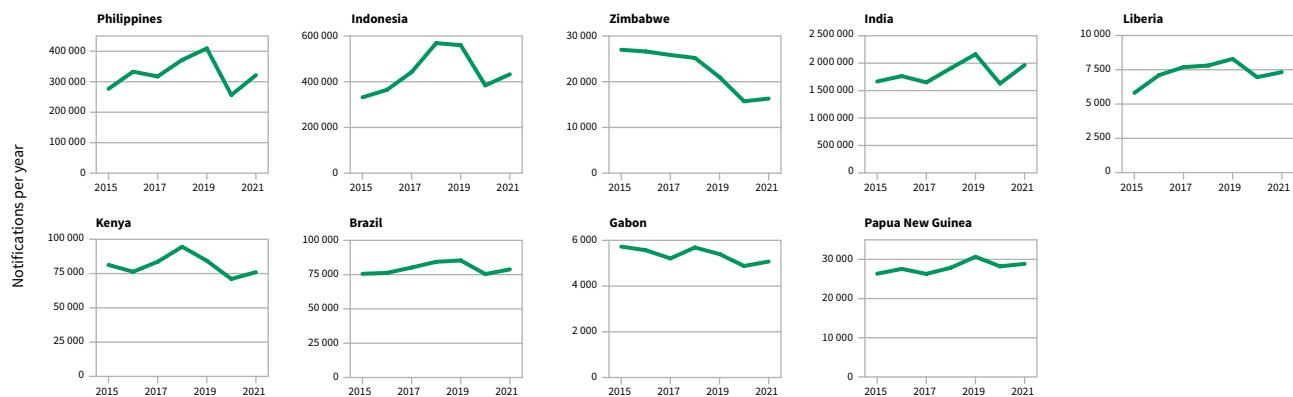
about the risks of going to health care facilities during a pandemic; and stigma associated with similarities in the symptoms related to TB and COVID-19.

Reasons for region and country variation in TB notification trends between 2019 and 2021 include differences in when they were first affected by the COVID-19 pandemic and the timing of subsequent waves of infection, the severity of the impact, the extent to which restrictions were put in place and adhered to, the capacity and resilience of health systems, and trends in the years leading up to the pandemic.

FIG. 5
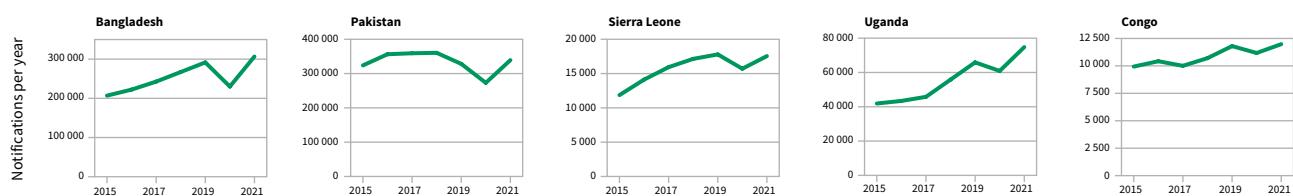
Case notifications of people newly diagnosed with TB in the 30 high TB burden and 3 global TB watchlist countries, categorized according to the timing and degree of disruptions during the COVID-19 pandemic

A. Negative impact in 2020,[a] partial recovery in 2021
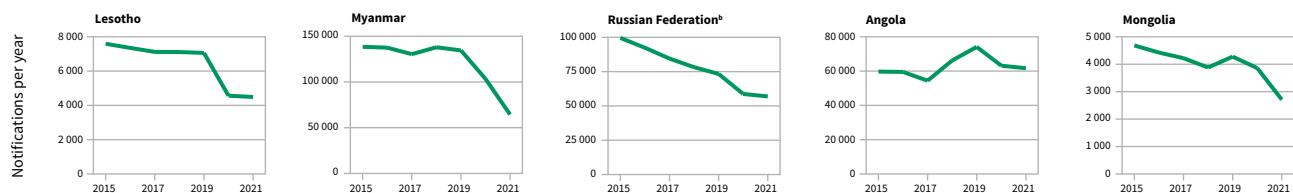
[a] Countries are shown in descending order of the relative decline (%) between 2019 and 2020, which ranged from 37% down to 8.0%.

B. Negative impact in 2020,[a] recovery to 2019 levels or beyond in 2021

[a] Countries are shown in descending order of the relative decline (%) between 2019 and 2020, which ranged from 21% down to 5.3%.
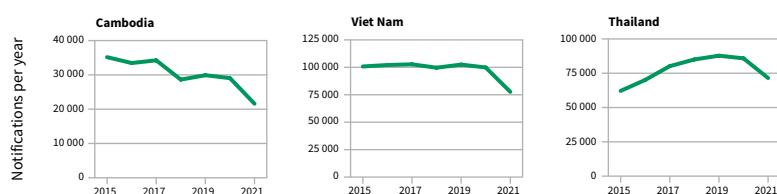
C. Negative impact in 2020,[a] further decline in 2021

[a] Countries are shown in descending order of the relative decline (%) between 2019 and 2020, which ranged from 35% down to 9.7%.
[b] The Russian Federation is included here rather than in group (f) because there was a clear discontinuity in the historic trend between 2019 and 2020: the decrease was 20%, compared with an annual decline that ranged from 6.3% to 8.6% between 2015 and 2019.
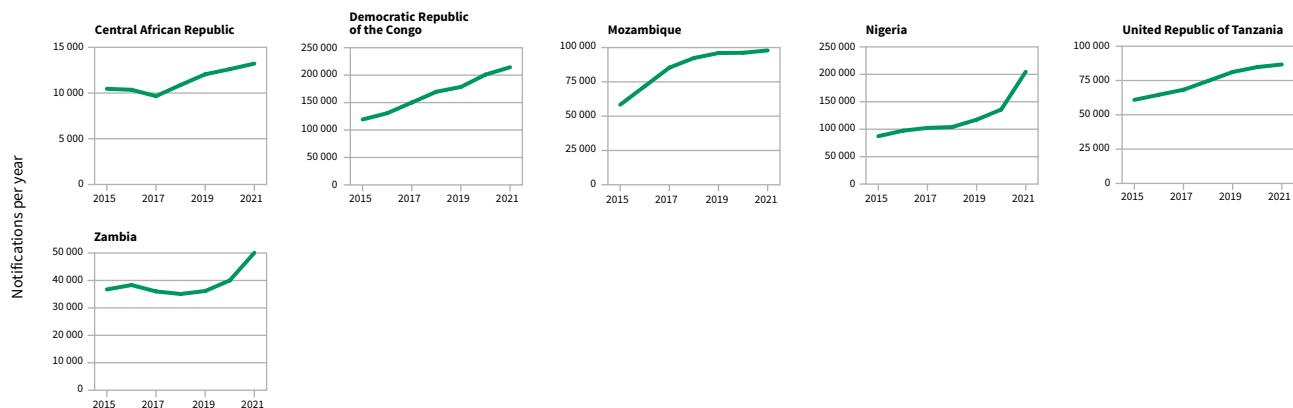
D. No or minimal negative impact in 2020,[a] negative impact in 2021[b]
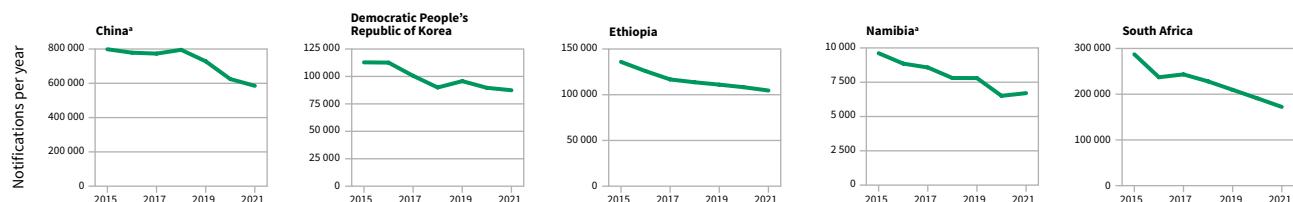
[a] <5% decline between 2019 and 2020.
[b] Countries are shown in descending order of the relative decline (%) between 2020 and 2021, which ranged from 26% down to 17%.

E. Increases in 2020 and 2021

Central African Republic; Democratic Republic of the Congo; Mozambique; Nigeria; United Republic of Tanzania; Zambia

Notifications per year

F. No or limited departure from pre-2020 downward trend

China[a]; Democratic People's Republic of Korea; Ethiopia; Namibia[a]; South Africa

Notifications per year

[a] China is included here rather than group (c), because although there was some departure from the historic trend between 2019 and 2020 (a 14% decline compared with a decline of 8.4% between 2018 and 2019), there were also efforts during this period to reduce over-diagnosis. The proportion of pulmonary cases that were bacteriologically confirmed increased from 47% in 2019 to 55% in 2020 and 58% in 2021. Year-to-year changes in Namibia also appear related to the proportion of cases that were bacteriologically confirmed.

Deaths caused by TB

Global increases in 2020 and 2021

Reductions in the reported number of people newly diagnosed with TB in 2020 and 2021 suggest that the number of people with undiagnosed and untreated TB has grown, resulting first in an increased number of TB deaths and more community transmission of infection and then, with some lag-time, increased numbers of people developing TB.[1]

However, producing estimates of TB disease burden during the COVID-19 pandemic is difficult. In the absence of reliable direct measurements of the national number of TB cases and deaths from national disease surveillance systems, vital registration (VR) systems and population-based surveys in the period 2020–2021 in most low- and middle-income countries (LMICs), it has been necessary to develop new methods for estimating TB mortality and incidence in these years. These methods rely heavily on country-specific and region-specific dynamic models and have been extensively reviewed. Key assumptions are that reductions in the reported number of people newly diagnosed with TB reflect real reductions in TB case detection[2] (rather than an increase in the underreporting of cases or a reduction in TB incidence) and a 50% reduction in TB transmission during periods of severe restrictions (lockdowns). Further details are provided in **Box 4** and **Annex 5**.

Globally, the annual estimated number of deaths from TB fell between 2005 and 2019, but the estimates for 2020 and 2021 suggest that this trend has been reversed (**Fig. 6**). There were an estimated 1.4 million deaths among HIV-negative people (95% uncertainty interval [UI]: 1.3–1.5 million) and 187 000 deaths (95% UI: 158 000–218 000) among HIV-positive people in 2021,[3] for a combined total of 1.6 million; this represents an increase from best estimates of 1.5 million in 2020

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[1] Disruptions to TB detection and treatment affect those who already have TB disease first; people who remain undiagnosed and untreated have a higher risk of death compared to those started on treatment. Most people infected through increased community transmission will not go on to develop TB disease; for those that do, the time between acquisition of infection and the development of TB disease ranges from weeks to decades. Disruptions to diagnosis and treatment therefore have a more immediate impact on TB deaths and a more delayed impact on TB incidence.

[2] This is with the exception of reductions that were consistent with a pre-2020 downward trend. Models were not used for countries that reported declines in notifications that were consistent with pre-2020 trends.

[3] Deaths from TB among HIV-positive people are officially classified as deaths caused by HIV/AIDS, with TB as a contributory cause.

Box 4. Estimation of TB incidence and mortality during the COVID-19 pandemic

During the COVID-19 pandemic, there have been reductions in the reported numbers of people newly diagnosed with TB that depart from pre-2020 trends (**Fig. 1–Fig. 5**). If these numbers reflect real reductions in diagnosis (rather than underreporting or a reduction in TB incidence), there will have been an increase in the number of people in the community with undiagnosed and untreated TB. In turn, this is likely to increase the transmission of infection. Other things being equal, the sharper, faster and more prolonged the drop in TB case detection, the bigger the size of these impacts.

Growth in the number of people with undiagnosed and untreated TB will result in an increase in the number of deaths from TB within a relatively short time frame. The impact of increased transmission on TB incidence (new cases) will be more delayed, due to the time lag (from months to many years) between acquisition of infection and progression to TB disease.

Periods of restrictions during the COVID-19 pandemic (e.g. lockdowns) as well as adjustments to behaviour (e.g. wider use of masks) could also have reduced TB transmission in 2020 and 2021. Negative impacts of the pandemic on broader TB determinants (e.g. undernourishment, poverty and income per capita) could have influenced both TB incidence and mortality.

WHO has collaborated with Imperial College, United Kingdom of Great Britain and Northern Ireland (United Kingdom) on the development and implementation of methods to estimate TB incidence and mortality during the COVID-19 pandemic *(15, 16)*. Country-specific dynamic models were developed to estimate TB incidence and mortality in 2020 and 2021 for 27 countries. These included 26 countries that reported large absolute reductions in TB notifications in 2020 or 2021 that departed from pre-2020 trends: Angola, Azerbaijan, Bangladesh, Brazil, Cambodia, China, Colombia, India, Indonesia, Kazakhstan, Kenya, Kyrgyzstan, Lesotho, Malaysia, Mexico, Mongolia, Myanmar, Nepal, Pakistan, Papua New Guinea, Peru, the Philippines, the Russian Federation, Thailand, Viet Nam and Zimbabwe;[a] plus Timor-Leste.[b] The models were fitted to monthly or quarterly TB case notification data reported to WHO for the period since January 2020 *(5)* and calibrated to pre-2020 estimates of TB incidence and mortality.[c] Region-specific models were used for 26 other LMICs with reductions in TB notifications that departed from pre-2020 trends.

Key assumptions in the models are:

▶ Reductions in TB case notifications in 2020 and 2021 reflected a negative impact on TB case detection and led to an increase in the number of people with undiagnosed and untreated TB in the community.[d]

▶ Strict lockdowns resulted in a 50% reduction in transmission (UI: 25–75%). Reductions in transmission outside periods of strict lockdown were not assumed, although measures such as mask wearing may have had an ongoing impact in some countries.

Other influential assumptions, drawing on the scientific literature, relate to the number of secondary infections per case per year (estimated by model calibration) and the rate of breakdown from TB infection to active TB disease, which was informed by a recent (2018) review of TB models *(17)*.

An important limitation is that the models do not yet account for the impact of the COVID-19 pandemic on broader TB determinants; thus, impacts on TB incidence and mortality may be understated.

The modelling methods have been extensively discussed and reviewed; for example, through:

▶ a review by WHO's Strategic and Technical Advisory Group for TB (STAG-TB) in June 2021 *(18)*;

▶ a 2-day meeting of a subgroup of the WHO Global Task Force on TB Impact Measurement (the Task Force) in May 2022 *(16)*, which brought together 32 global experts in mathematical modelling, epidemiology and statistics as well as representatives from national TB programmes (NTPs) and partner agencies, with the specific purpose of reviewing methods used by WHO to estimate TB disease burden during the COVID-19 pandemic; and

▶ in an immediate follow-up to the Task Force meeting, a further detailed review of model documentation by several global experts in TB modelling, following which comments and suggestions were addressed.

Further details about the methods used to estimate TB incidence and mortality in 2020 and 2021 (including methods used for non-modelled countries) and those used to produce estimates for 2000–2019 are provided in **Annex 5**, the report webpages and a technical appendix.

Estimates in this report are consistent with those published in 2021 *(15)*. In countries with the biggest reductions in TB notifications compared with pre-2020 trends, the estimates show a slowdown in the rate of decline in TB incidence and an increase in the number of TB deaths between 2019 and 2020. Also, as suggested by the projections included in the 2021 report, the estimates in this report show an increase in TB incidence in 2021 and a further increase in the number of TB deaths.

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[a] The models were not used to estimate TB mortality in China and the Russian Federation, because those countries reported data on the number of deaths caused by TB in the period 2020–2021 based on their national VR systems.

[b] A country-specific model was used for Timor-Leste because a regional model was not developed for the South-East Asia Region; most of the other countries in this region either met the criteria required for development of a country-specific model or notifications were consistent with pre-2020 trends.
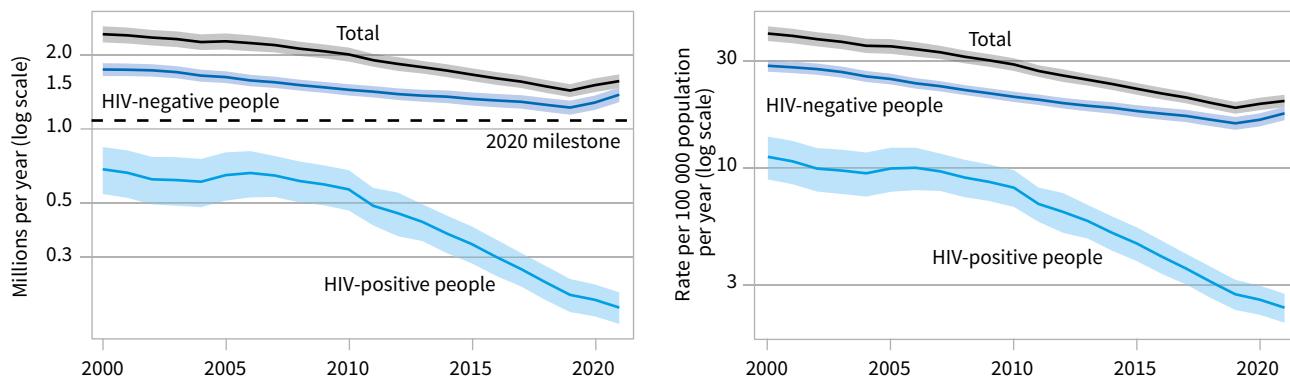
[c] Generally, these were estimates previously published by WHO, either for 2019 or for a combination of 2014 and 2019. For India, the calibration was to country-generated incidence estimates derived from a recently completed national TB prevalence survey, a previous state-level survey and programmatic data. Further details are provided in **Annex 5** and a technical appendix.

[d] It is possible that underreporting of detected cases contributed to reductions in case notifications, but there is currently no evidence to support this.

FIG. 6

Global trends in the estimated number of TB deaths (left) and the mortality rate (right), 2000–2021

The horizontal dashed line shows the 2020 milestone of the End TB Strategy, which was a 35% reduction in the total number of TB deaths between 2015 and 2020. Shaded areas represent 95% uncertainty intervals.

and 1.4 million in 2019, and a return to the level of 2017.[1] Most of the estimated increase in TB deaths globally was accounted for by four countries: India, Indonesia, Myanmar and the Philippines.[2]

The global number of deaths officially classified as caused by TB in 2021 (1.4 million) was more than double the number caused by HIV/AIDS (0.65 million), and TB mortality has been much more severely impacted by the COVID-19 pandemic than HIV/AIDS (**Fig. 7**). In contrast to TB, deaths from HIV/AIDS continued to decline between 2019 and 2021 (13).

The latest year for which WHO has published estimates of global deaths by cause is 2019 (**Fig. 8**). In that year, TB was the 13th leading cause of death worldwide and the top cause from a single infectious agent. In 2020 and 2021, it is anticipated that TB will rank as the second leading cause of death from a single infectious agent, after COVID-19 (14).

The global pattern of a fall in the absolute number of TB deaths until 2019, followed by increases in 2020 and 2021, was evident in four of the six WHO regions (**Fig. 9**). The two exceptions were the WHO African Region, where there was a continued decline in both 2020 and 2021, and the Eastern Mediterranean Region, where an increase between 2019 and 2020 was followed by a slight decline from 2020 to 2021. The estimated number of TB deaths increased in 2020 or 2021 in most of the 30 high TB burden countries.[3]

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[1] The reduction in the total number of TB deaths between 2000 and 2019 was 41%. The net reduction between 2000 and 2021 was 36%.
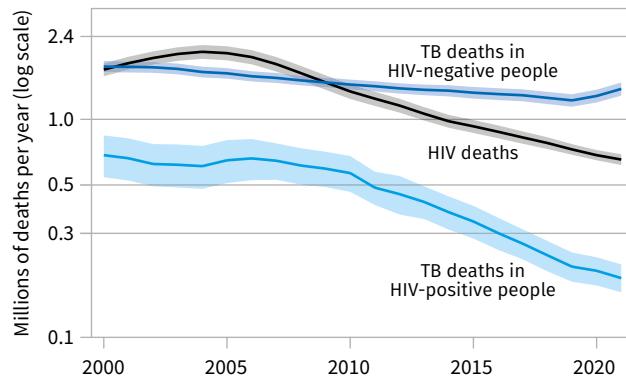
[2] This is consistent with their contributions to global reductions in the reported number of people newly diagnosed with TB in 2020 and 2021 (**Fig. 3**).

[3] In 2021, WHO updated its three lists of high burden countries for TB, MDR/RR-TB and HIV-associated TB. The lists are for 2021–2025, and they are defined and explained in **Annex 3**. Further details about trends in these and all other countries are available in the report webpages and mobile app.

FIG. 7

Global trends in the estimated number of deaths caused by TB and HIV, 2000–2021[a,b]

Shaded areas represent 95% uncertainty intervals.
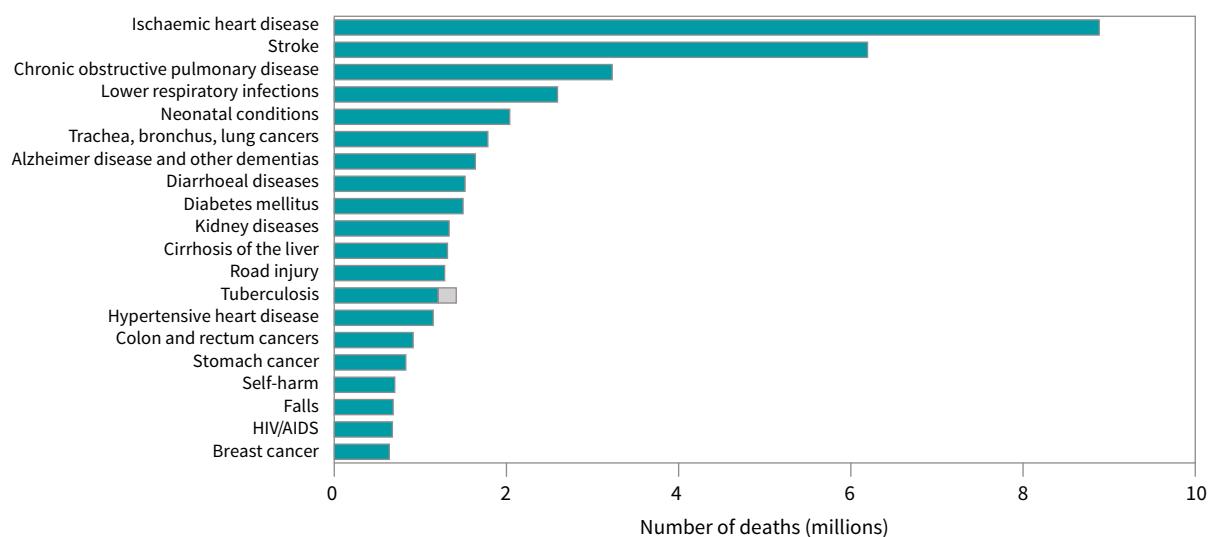
[a] For HIV/AIDS, the latest estimates of the number of deaths in 2021 that have been published by UNAIDS are available at http://www.unaids.org/en/ (accessed 15 August 2022). For TB, the estimates for 2021 are those published in this report.

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

FIG. 8

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. 9

Trends in the estimated absolute number of TB deaths (HIV-positive and HIV-negative) by WHO region, 2000–2021

The horizontal dashed line shows the first milestone of the End TB Strategy, which was a 35% reduction in the total number of TB deaths between 2015 and 2020. Shaded areas represent 95% uncertainty intervals.
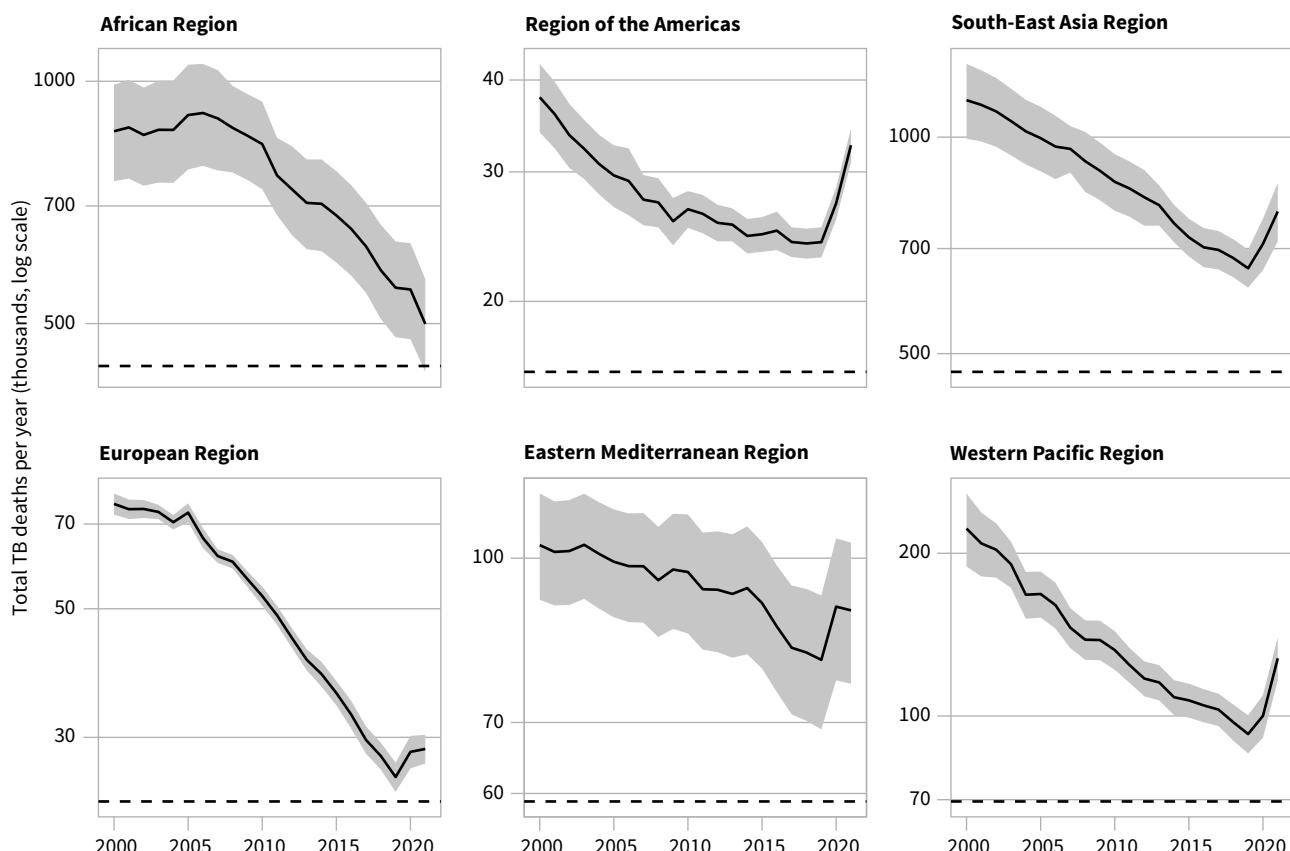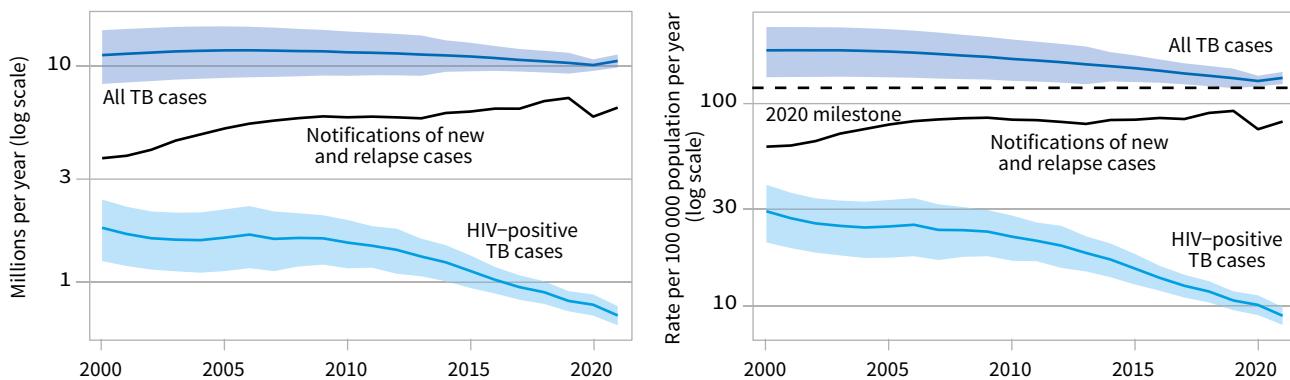
FIG. 10

Global trends in the estimated number of incident TB cases (left) and the incidence rate (right), 2000–2021

The horizontal dashed line shows the first milestone of the End TB Strategy, which was a 20% reduction in the TB incidence rate between 2015 and 2020. Shaded areas represent 95% uncertainty intervals.

In 2021, 82% of global TB deaths among HIV-negative people occurred in the WHO African and South-East Asia regions; India alone accounted for 36% of such deaths. The WHO African and South-East Asia regions accounted for 82% of the combined total of TB deaths in HIV-negative and HIV-positive people; India accounted for 32% of such deaths.

Of the global TB deaths among HIV-negative people, 54% were in men, 32% were in women and 14% were in children (aged <15 years). Of the global TB deaths among HIV-positive people, 51% were in men, 38% were in women and 11% were in children.

Number of people developing TB

Global rise in 2021, years of decline reversed

An estimated 10.6 million people (95% UI: 9.9–11 million) fell ill with TB worldwide in 2021, an increase of 4.5% from 10.1 million (95% UI: 9.5–10.7 million) in 2020,[1] reversing many years of slow decline (**Fig. 10**, left panel).[2] Similarly, the TB incidence rate (new cases per 100 000 population per year) is estimated to have increased by 3.6% between 2020 and 2021, following declines of about 2% per year for most of the past 2 decades (**Fig. 10**, right panel).[3]

These sharp reversals of progress are consistent with previous projections *(15)* and reflect the estimated impact of disruptions to essential TB services during the

COVID-19 pandemic (**Fig. 1–Fig. 5**, **Box 4**). The more pronounced impact of these disruptions on TB incidence in 2021 compared with 2020[4] can be explained by time lags between increases in TB transmission (caused by more people having undiagnosed and untreated TB) and subsequent development of disease among a proportion of those newly infected. In 2021, there was an extra year for the consequences of disruptions in 2020 to manifest, and these earlier disruptions were combined with the impact of disruptions in 2021.

At regional level, the TB incidence rate increased between 2020 and 2021 in five of the six WHO regions (**Fig. 11**). The exception was the WHO African Region, where disruptions related to COVID-19 have had little impact on the number of people diagnosed and officially notified with TB (**Fig. 2**).

Geographically, in 2021, most people who developed TB were in the WHO regions of South-East Asia (45%), Africa (23%) and the Western Pacific (18%), with smaller proportions in the Eastern Mediterranean (8.1%), the Americas (2.9%) and Europe (2.2%). The 30 high TB burden countries accounted for 87% of all estimated incident cases worldwide, and eight of these countries (**Fig. 12**) accounted for more than two thirds of the global total: India (28%), Indonesia (9.2%), China (7.4%), the Philippines (7.0%), Pakistan (5.8%), Nigeria (4.4%), Bangladesh (3.6%) and the Democratic Republic of the Congo (2.9%).

TB can affect anyone, regardless of age or sex (**Fig. 13**). The highest burden is in adult men, who accounted for 56.5% of all TB cases in 2021; by comparison, adult women accounted for 32.5% and children for 11% of cases. The higher share of TB cases among men is consistent with evidence from national TB prev-

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[1] The global estimate for 2020 is 0.2 million higher than that published in 2021 *(15)*, following an upward revision to estimates for India for the period 2000–2020. Estimates for India are currently interim. Further details are provided in **Annex 5**.
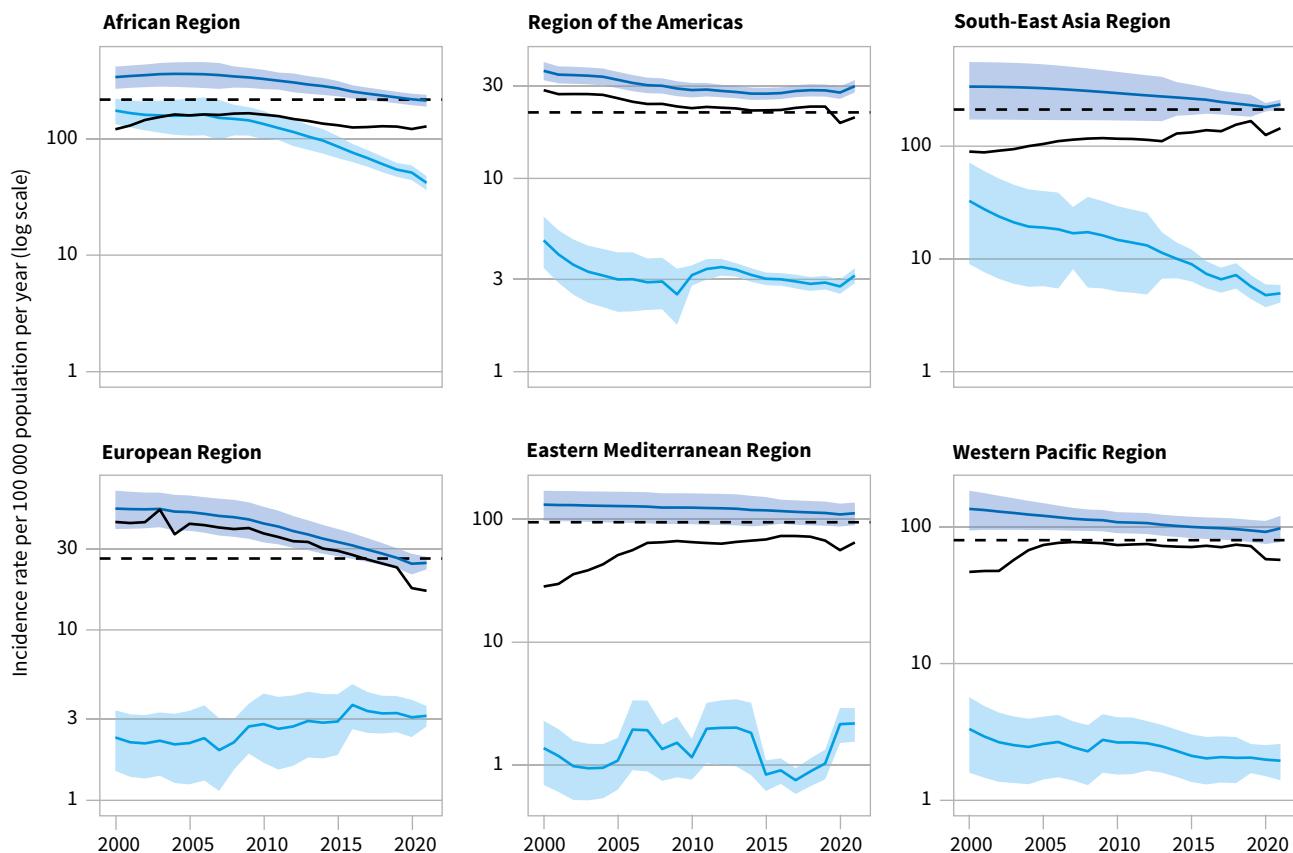
[2] The major contributors to the global increase between 2020 and 2021 were India, Indonesia and the Philippines. Collectively, TB incidence rose by about 0.4 million in these three countries. This is consistent with their contributions to global reductions in the reported number of people newly diagnosed with TB in 2020 and 2021 (**Fig. 3**).

[3] Globally, the TB incidence rate is estimated to have fallen by 30% between 2000 and 2020.
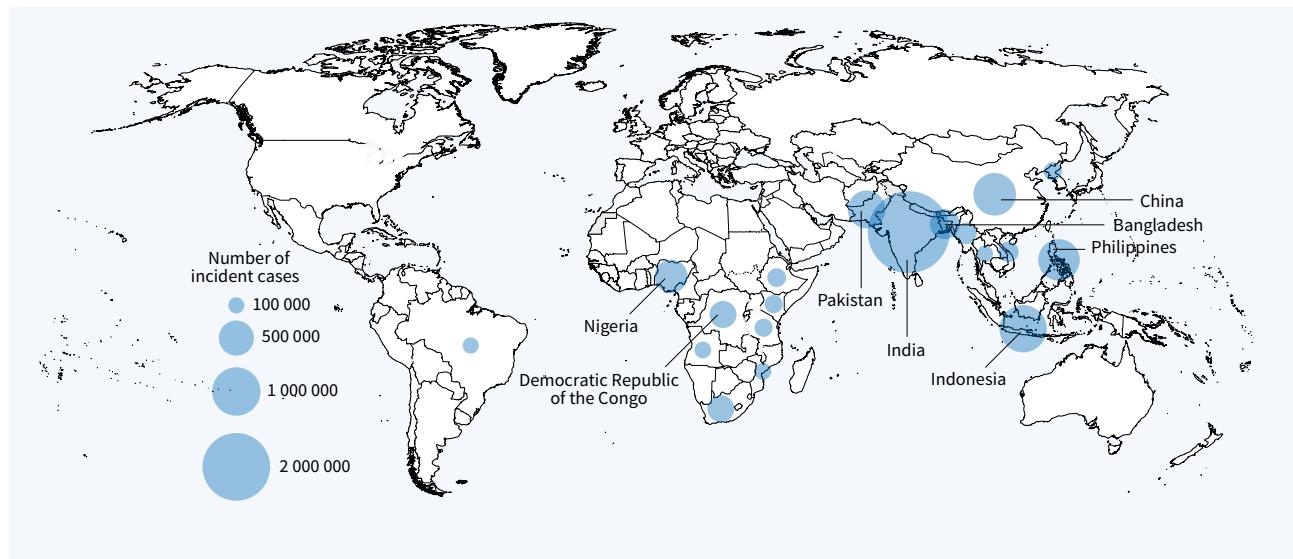
[4] TB incidence (both in terms of absolute numbers and per 100 000 population) did not increase between 2019 and 2020, but the annual rates of decline slowed slightly *(15)*.

FIG. 11

Trends in estimated TB incidence rates by WHO region, 2000–2021

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. The horizontal dashed line shows the first milestone of the End TB Strategy, which was a 20% reduction in the TB incidence rate between 2015 and 2020. Shaded areas represent 95% uncertainty intervals.

FIG. 12

Estimated TB incidence in 2021, for countries with at least 100 000 incident cases

The countries that rank first to eighth in terms of numbers of cases, and that accounted for about two thirds of global cases in 2021, are labelled.

alence surveys, which show that TB disease affects men more than women, and that gaps in case detection and reporting are higher among men.[1]

Among all incident cases of TB in 2021, 6.7% were people living with HIV; this proportion has been steadily declining for several years. The proportion of people with a new episode of TB who were coinfected with HIV was highest in countries in the WHO African Region, exceeding 50% in parts of southern Africa.
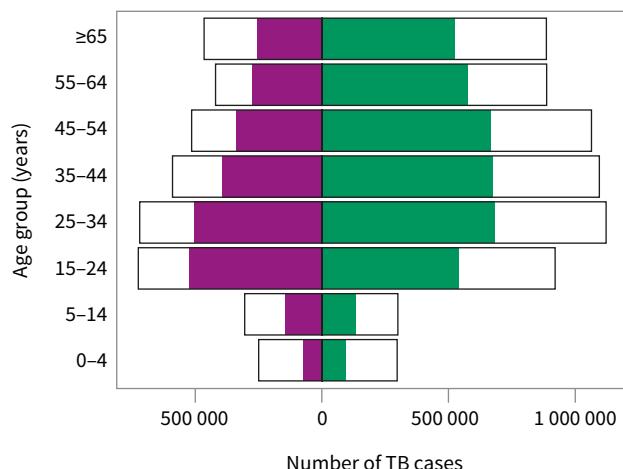
The severity of national TB epidemics, in terms of the number of incident TB cases per 100 000 population per year, varies widely among countries, from less than five to more than 500 new and relapse cases per 100 000 population per year (**Fig. 14**). In 2021, 47 countries had a low incidence of TB (<10 cases per 100 000 population per year), mostly in the WHO Region of the Americas and the European Region, plus a few countries in the 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, Gabon, Lesotho, the Philippines and South Africa.

Drug-resistant TB (DR-TB) continues to be a public health threat. Resistance to rifampicin – the most effective first-line drug – is of greatest concern. Resistance to rifampicin and isoniazid 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 estimated number of people who developed MDR-TB or RR-TB (MDR/RR-TB) each year was

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), 2021
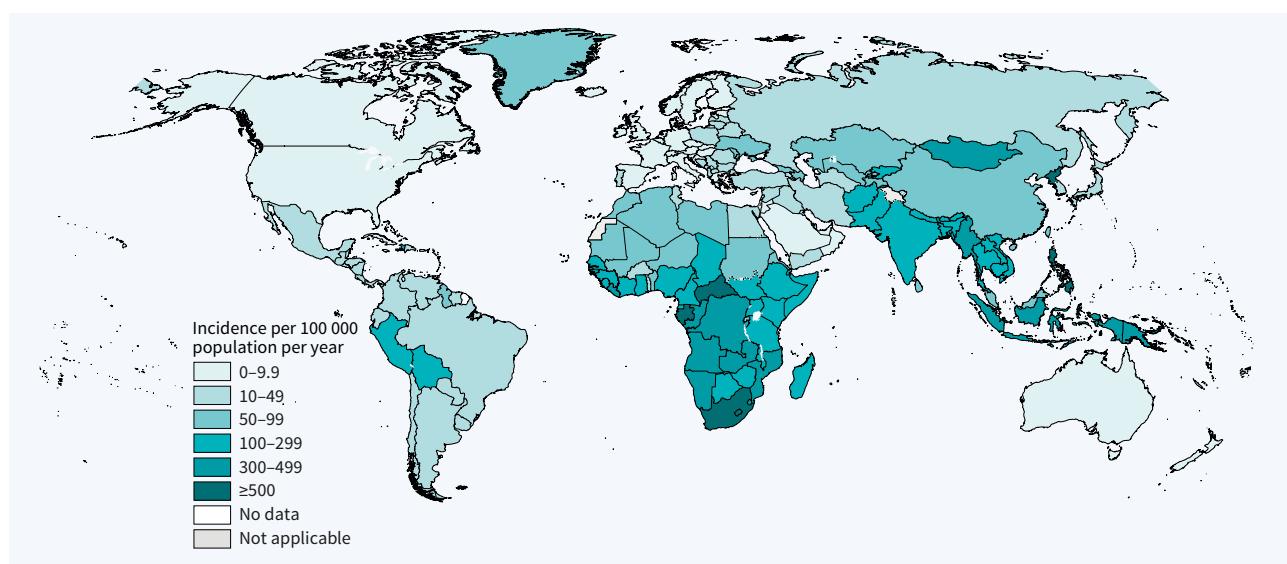
relatively stable between 2015 and 2020, but it grew in 2021 (**Fig. 15**). There were an estimated 450 000 incident cases (95% UI: 399 000–501 000) in 2021, up 3.1% from 437 000 (95% UI: 390 000–483 000) in 2020. The main explanation for the increase is the overall increase in TB incidence between 2020 and 2021 (**Fig. 10**), which is estimated to have been caused by the impact of the COVID-19 pandemic on TB detection (**Fig. 1–Fig. 5, Box 4**).

In 2021, the estimated proportion of people with

Estimated TB incidence rates, 2021

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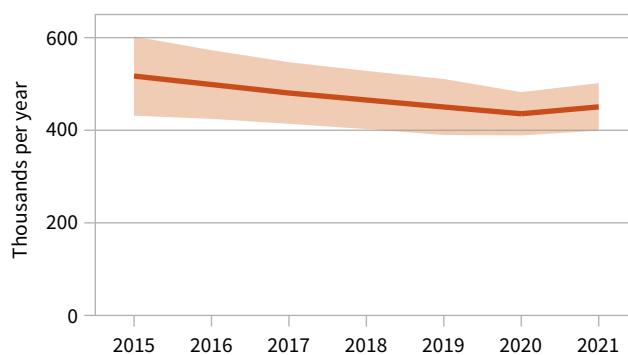
[1] For further details, see Section 2.4 of the report webpages.

FIG. 15
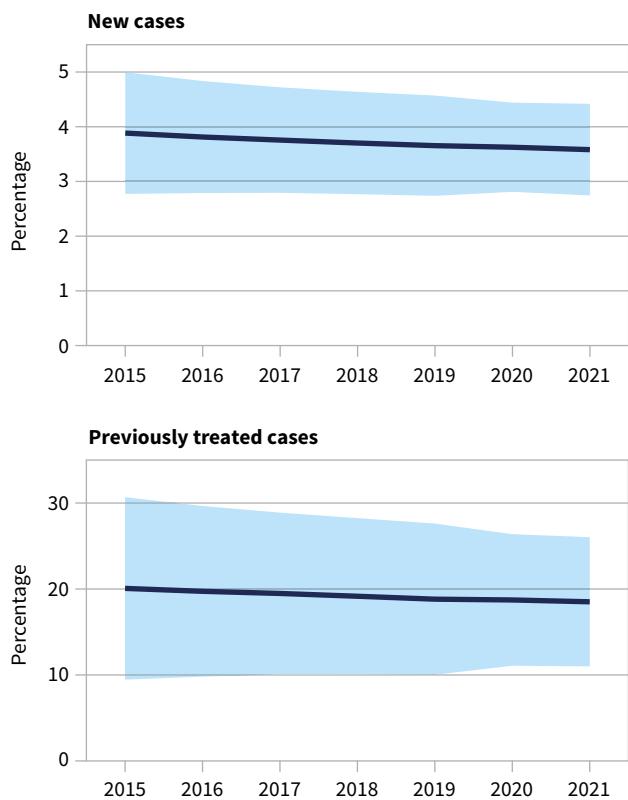
Global trend in the estimated number of incident cases of MDR/RR-TB, 2015–2021

The shaded area represents the 95% uncertainty interval.

FIG. 16

Global percentage of TB cases estimated to have MDR/RR-TB, 2015–2021

Shaded areas represent 95% uncertainty intervals.

TB who had MDR/RR-TB was 3.6% (95% UI: 2.7–4.4%) among new cases and 18% (95% UI: 11–26%) among those previously treated; the figures in 2015 were 3.9% (95% UI: 2.8–5.0%) and 20% (95% UI: 9.5–31%), respectively (**Fig. 16**).

Three countries accounted for 42% of global cases in 2021 (**Fig. 17**): India (26%), the Russian Federation (8.5%) and Pakistan (7.9%). The highest proportions (>50% of previously treated cases with MDR/RR-TB) are found in the Russian Federation and in several countries in Eastern Europe and Central Asia.

Milestones for reducing TB disease burden

Mostly not yet reached, some success stories

The first End TB Strategy milestones for reductions in TB disease burden were a 35% reduction in the total number of TB deaths (the combined total of those in HIV-negative and HIV-positive people) and a 20% reduction in the TB incidence rate, compared with levels in 2015 (**Box 2**). These milestones were set for 2020 but have not yet been reached either globally or in most WHO regions and countries. Reversals of progress during the COVID-19 pandemic mean that in 2021 they were even further away than in 2019.

Globally, the reduction in the total number of TB deaths between 2015 and 2021 was 5.9%, about one sixth of the way to the milestone of 35%. Progress achieved up to 2019 (a 14% reduction from 2015 to 2019 and a 41% reduction from 2000 to 2019) was compromised by increases in TB deaths in 2020 and 2021 (**Fig. 6**, left panel).

At regional level, the WHO African Region is now closest to reaching the first milestone, with a 26% reduction between 2015 and 2021 (**Fig. 9**). The WHO European Region had previously come close, with a reduction of 28% between 2015 and 2019,[1] but this progress was reversed in 2021; the net reduction by 2021 now stands at 21%. The decline compared with 2015 in the WHO Eastern Mediterranean Region was small, at 1.9%. The estimated number of TB deaths in 2021 was higher than in 2015 in the WHO regions of the Americas (+31%), South-East Asia (+8.6%) and the Western Pacific (+19%).

By 2021, six high TB burden countries had reached or passed the first milestone of a 35% reduction in TB deaths compared with 2015 (Bangladesh, Kenya, Mozambique, Uganda, the United Republic of Tanzania and Zambia), as had one of the one of the global TB watchlist countries (the Russian Federation)[2] (**Fig. 18**). A seventh high TB burden country, Ethiopia, was very

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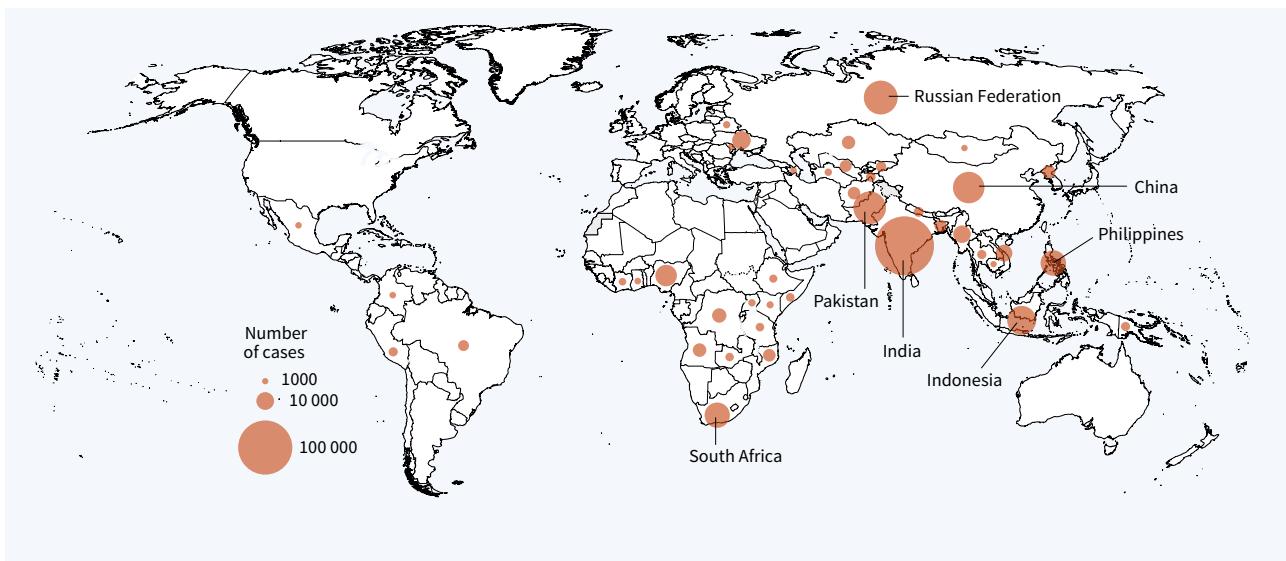
[1] Progress in this region is strongly influenced by trends in the Russian Federation.

[2] 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. 17
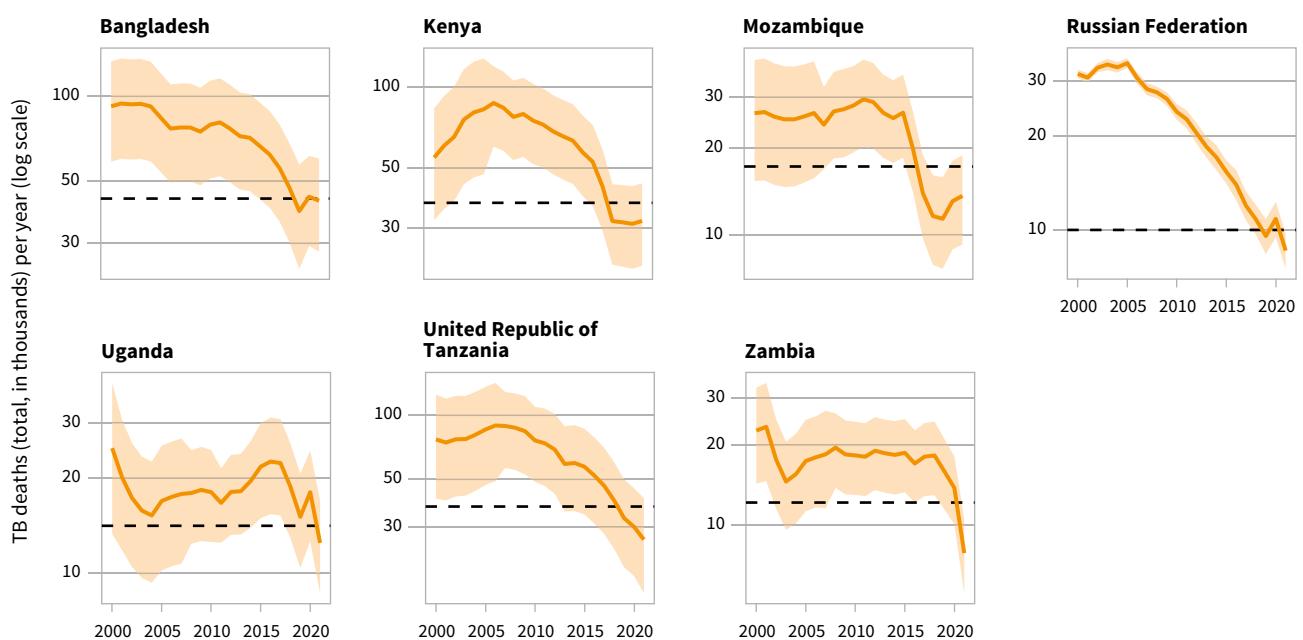
Estimated incidence of MDR/RR-TB in 2021, for countries with at least 1000 incident cases

The seven countries with the highest burden in terms of numbers of MDR/RR-TB cases, and that accounted for two thirds of global MDR/RR-TB cases in 2021, are labelled.

FIG. 18

High TB burden and global TB watchlist countries estimated to have reached, by 2021, the first milestone of the End TB Strategy

The horizontal dashed line shows the first milestone of the End TB Strategy, which was a 35% reduction in the total number of TB deaths between 2015 and 2020. Shaded areas represent 95% uncertainty intervals.

close to doing so, with a reduction of 34%. A total of 25 countries reached the milestone by or before 2021.

Globally, the cumulative reduction in the TB incidence rate from 2015 to 2021 was 10%, exactly halfway to the first (2020) milestone of 20% (**Fig. 10**, right panel).

There are two success stories at regional level (**Fig. 11**). In 2021, the WHO African Region just passed the first (2020) milestone of the End TB Strategy, with a reduction of 22% since 2015. Despite an upturn between 2020 and 2021, the TB incidence rate in the WHO European Region was still 25% lower in 2021 than in 2015. For other regions, the first milestone is still some way off, with reductions between 2015 and 2021 of 2.3% in the WHO Western Pacific Region, 5.3% in the Eastern Mediterranean Region and 11% in the South-East Asia Region. There was an increase of 9.4% in the WHO Region of the Americas.

By 2021, seven high TB burden countries had reached or passed the first milestone of a 20% reduction in the TB incidence rate compared with 2015 (Ethiopia, Kenya, Lesotho, Namibia, South Africa, the United Republic of Tanzania and Zambia), as had all three of the global TB watchlist countries (Cambodia, the Russian Federation and Zimbabwe) (**Fig. 19**). In total, 77 countries reached the milestone by or before 2021.

TB deaths and incidence beyond 2021
Further worsening possible
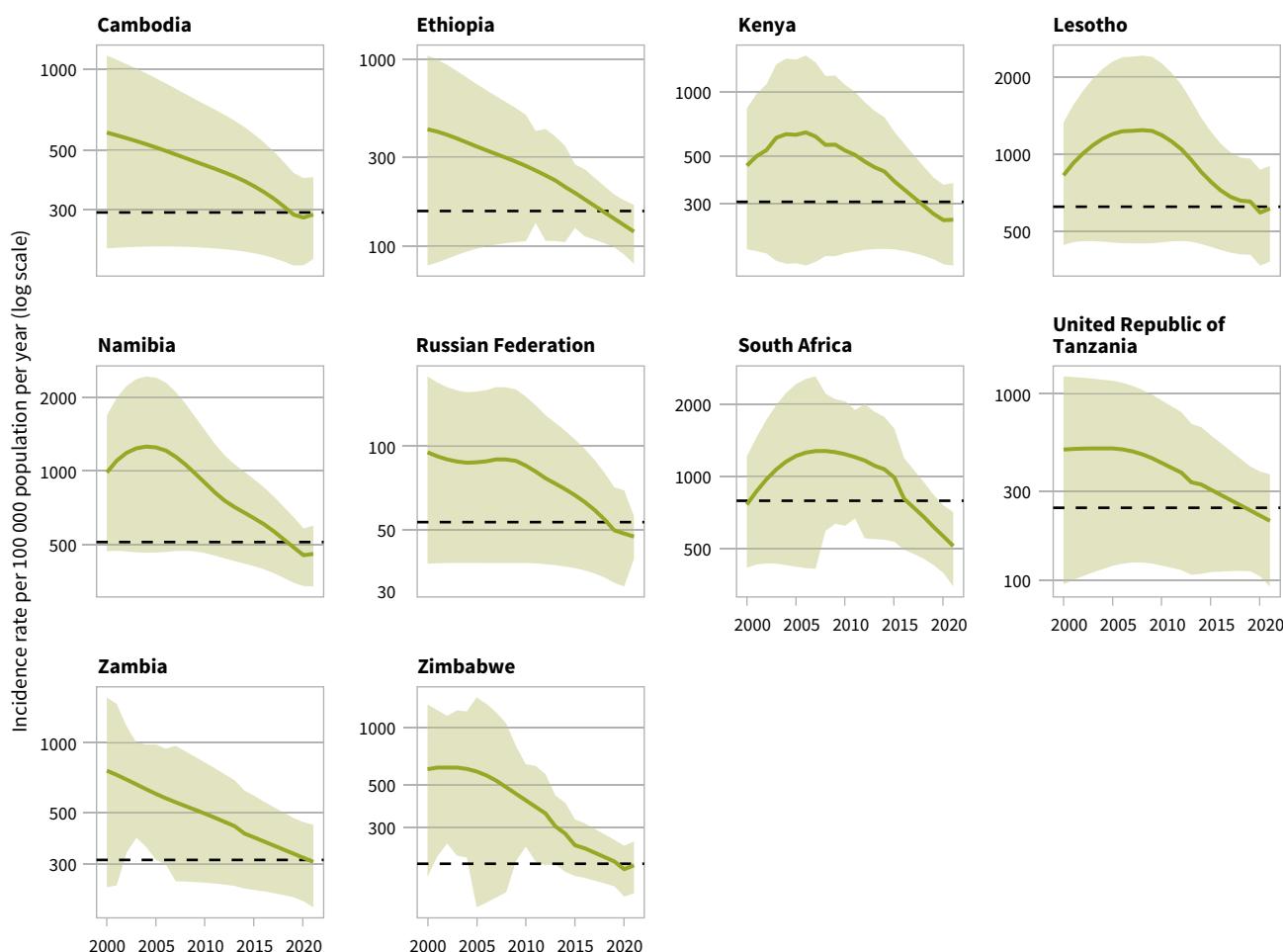
The country-specific models developed for 27 countries (**Box 4**) to estimate TB incidence and mortality in 2020 and 2021 also allow projections for subsequent years. These models suggest that there could be further increases in TB deaths and TB incidence. The faster that TB case detection can be restored (not only back to 2019 levels but also to address backlogs from 2020 and 2021), the more these potential increases can be moderated.

The current models might understate the impact of the COVID-19 pandemic on TB disease burden, because they do not yet account for negative effects on broader

FIG. 19

High TB burden and global TB watchlist countries estimated to have reached, by 2021, the first milestone of the End TB Strategy

The horizontal dashed line shows the first milestone of the End TB Strategy, which was a 20% reduction in the TB incidence rate between 2015 and 2020. Shaded areas represent 95% uncertainty intervals.

TB determinants (**Box 4**). These include average income (measured as gross domestic product [GDP] per capita) and the prevalence of undernourishment, both of which are closely associated with TB incidence (**Fig. 20**). Worsening trends in these two indicators, and others such as levels of poverty, could increase the probability of developing TB disease among people already infected with *M. tuberculosis* and their mortality rate. Declines in income may also affect health care seeking behaviour when people become unwell, making delays in TB diagnosis and treatment more likely.

Estimation of TB disease burden

New direct measurements needed

Estimating TB disease burden during the COVID-19 pandemic is difficult and currently relies on country- and region-specific dynamic models for many LMICs (**Box 4**). This is in contrast to the methods used for the period 2000–2019.[1] These included use of results from population-based surveys of the prevalence of TB disease that were implemented between 2000 and 2019 to inform estimates of TB incidence in 29 countries that accounted for about two-thirds of global TB incidence; and use of data from national VR systems or mortality surveys for the period 2000–2019 to inform estimates of the number of TB deaths in 123 countries that accounted for about 60% of the global number of TB deaths among HIV-negative people.
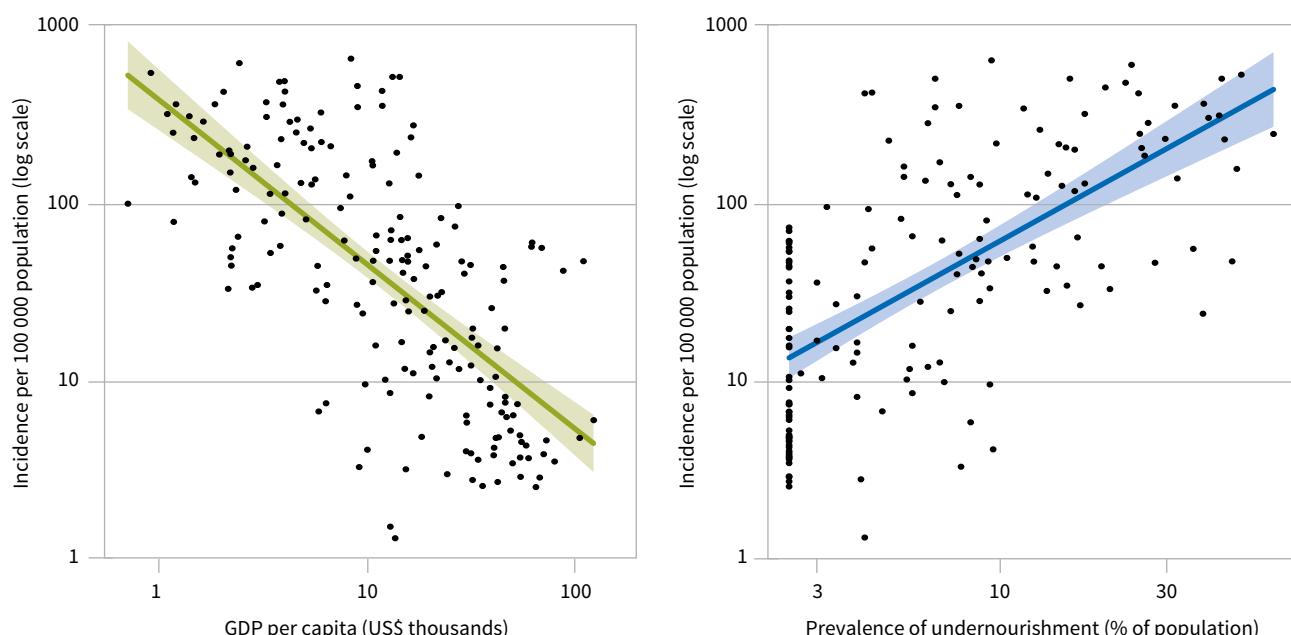
For this report, there were only two high TB burden or global TB watchlist countries for which data on the number of TB deaths in the period 2020–2021 were available from national VR systems and shared with the WHO Global TB Programme: China and the Russian Federation. The only country in which a national TB prevalence survey has been completed since 2019 is India; the survey was started in 2019 but was interrupted for several months in 2020 due to the COVID-19 pandemic and then completed in 2021. This survey has informed interim estimates of TB incidence published as part of this report.[2]

New national population-based surveys of TB disease and up-to-date cause-of-death data from national VR systems of high quality and coverage are needed for more accurate estimation in the wake of the pandemic. Inventory studies to assess the level of underreporting of people diagnosed with TB would also be helpful. Two countries are currently planning a repeat national TB prevalence survey: Cambodia and Pakistan.

The relationship between GDP per capita and the prevalence of undernourishment, and TB incidence per 100 000 population, 2021[a]

a   The year of data used for GDP per capita and undernourishment is the latest year for which data are available in the World Bank (https://data.worldbank.org/) and SDG (https://unstats.un.org/sdgs/dataportal) databases, respectively.

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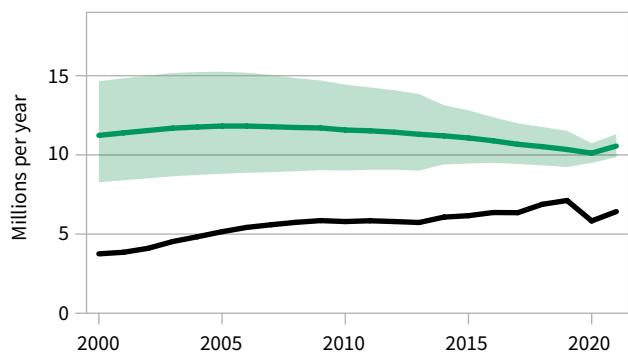
1   For further details, see Section 2.1 and Section 2.2 of the report webpages.

2   Further details are provided in **Annex 5** and the technical appendix.
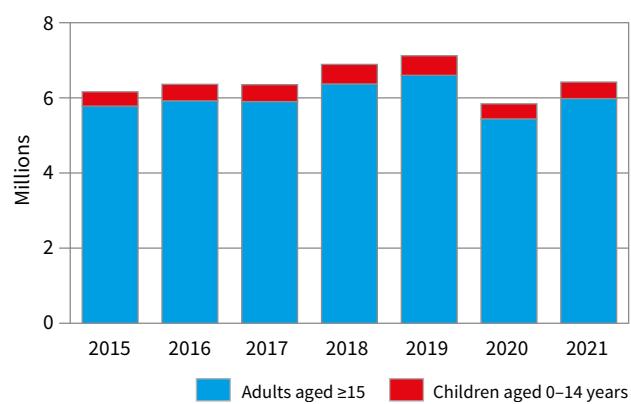
Global trends in notifications of people newly diagnosed with TB (black) and the estimated number of incident TB cases (green), 2000–2021

The shaded area represents the 95% uncertainty interval.

FIG. 22

The global number of people reported to have been treated for TB disease, 2015–2021

TB diagnosis and treatment

Partial recovery in 2021, targets off track

The gap between the estimated number of people who fell ill with TB (incident cases) and the number of people newly diagnosed and reported widened in both 2020 and 2021 compared with 2019 (**Fig. 21**), to best estimates of over 4 million in each year. This was a 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 2019, while TB incidence fell slowly. The reported number of people newly diagnosed with TB in 2020, at 5.8 million, took the world back to the level of 2012; the partial recovery to 6.4 million in 2021 is similar to the level of 2017.

Two of the countries with the largest absolute reductions in the reported number of people newly diagnosed with TB between 2019 and 2021 (**Fig. 3**), India and Indonesia, had previously been the main contributors to the large global increase that occurred between 2013 and 2019. Their combined total number of case notifications per year increased by 1.2 million in that period, but then fell by 0.7 million between 2019 and 2020, with a partial recovery (+0.4 million) in 2021.

Globally, these negative trends mean that TB treatment coverage (approximated as the reported number of people newly diagnosed with TB divided by incidence)[1] was 61% (95% UI: 57–65%) in 2021, an improvement from 58% in 2019 (95% UI, 54–61%) but down from 69% (95% UI: 62–77%) in 2019. Among the six WHO regions, treatment coverage in 2021 was highest in the Americas (with a best estimate of 69%) and lowest in the Eastern Mediterranean (with a best estimate of 58%). Of the 30 high TB burden countries, those with the highest levels of treatment coverage in 2021 included Bangladesh, Brazil, China, Uganda and Zambia. Ten high TB burden countries had worryingly low levels of treatment coverage in 2021, with best estimates of below 50%: the Central African Republic, Gabon, Indonesia, Lesotho, Liberia, Mongolia, Myanmar, Nigeria, the Philippines and Viet Nam.
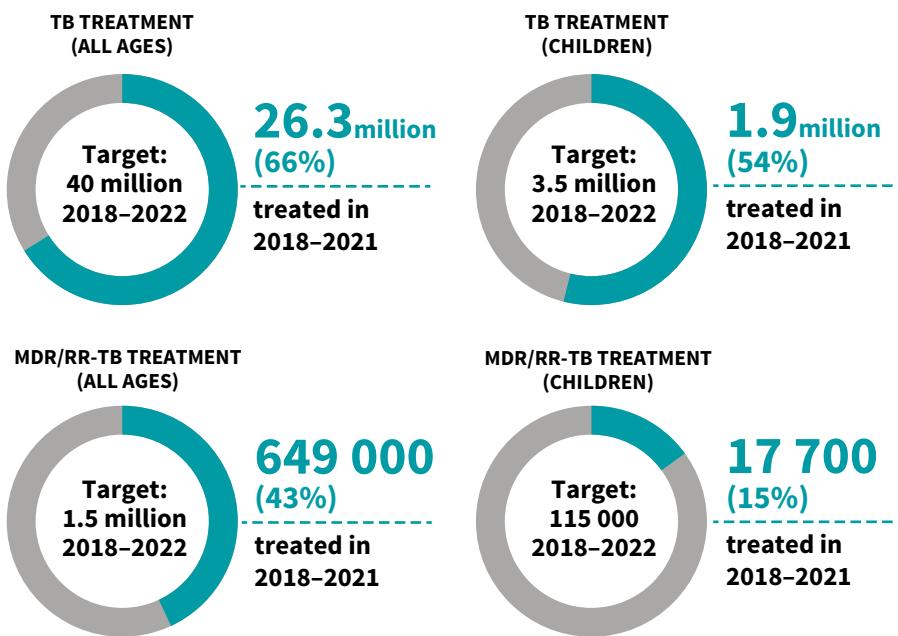
The major reversals of previous progress in increasing the number of people newly diagnosed with TB each year (**Fig. 1**) have badly impacted progress towards the global TB treatment targets set at the UN high-level meeting in 2018. The cumulative number of people treated between 2018 and 2021 was 26.3 million,[2] equivalent to 66% of the 5-year (2018–2022) target of 40 million (**Fig. 22**, **Fig. 23**). This included 1.9 million children, 54% of the 5-year target of 3.5 million.

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[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).

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

FIG. 23

Global progress in the number of people treated for TB between 2018 and 2021, compared with cumulative targets set for 2018–2022 at the UN high-level meeting on TB

TB TREATMENT
(ALL AGES)

Target:
40 million
2018–2022

26.3million
(66%)
treated in
2018–2021

TB TREATMENT
(CHILDREN)

Target:
3.5 million
2018–2022

1.9million
(54%)
treated in
2018–2021

MDR/RR-TB TREATMENT
(ALL AGES)

Target:
1.5 million
2018–2022

649 000
(43%)
treated in
2018–2021

MDR/RR-TB TREATMENT
(CHILDREN)

Target:
115 000
2018–2022

17 700
(15%)
treated in
2018–2021
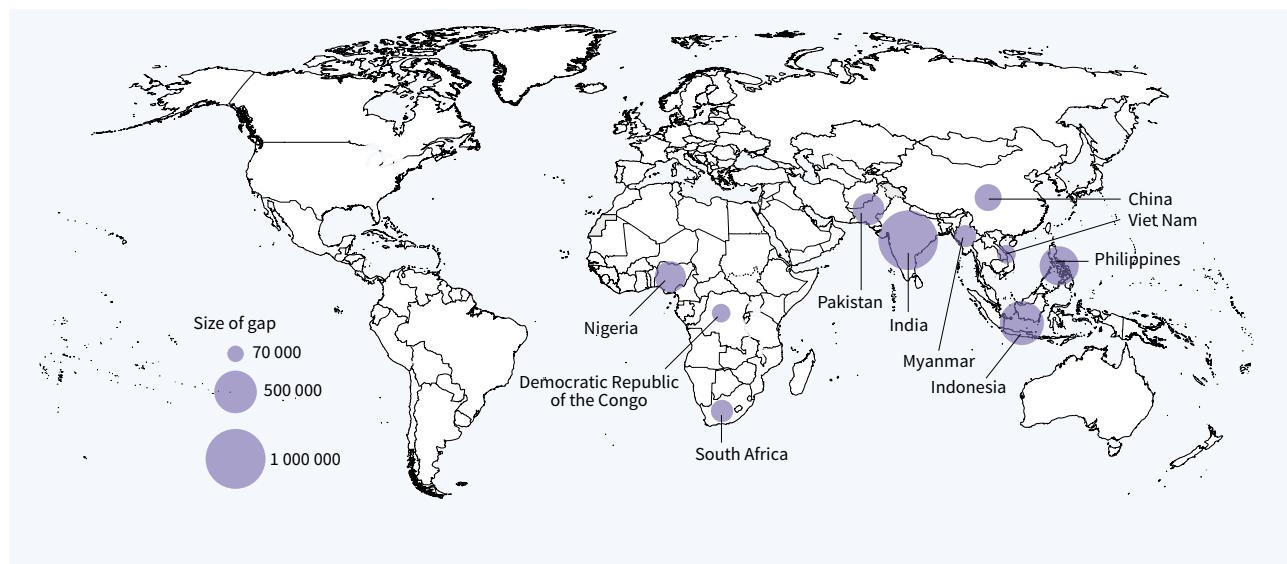
In 2021, 10 countries collectively accounted for 75% of the global gap between estimated TB incidence and the reported number of people newly diagnosed with TB (**Fig. 24**). The top five contributors were India, Indonesia, the Philippines, Pakistan and Nigeria (24%, 13%, 10%, 6.6% and 6.3%, respectively). 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 increase levels of case detection are of particular importance in these countries.

FIG. 24

The ten countries with the largest gaps between notifications of new and relapse (incident) TB cases and the best estimates of TB incidence,[a,b] 2021

China
Viet Nam
Philippines
Pakistan
India
Nigeria
Myanmar
Indonesia
Democratic Republic
of the Congo
South Africa

Size of gap
70 000
500 000
1 000 000
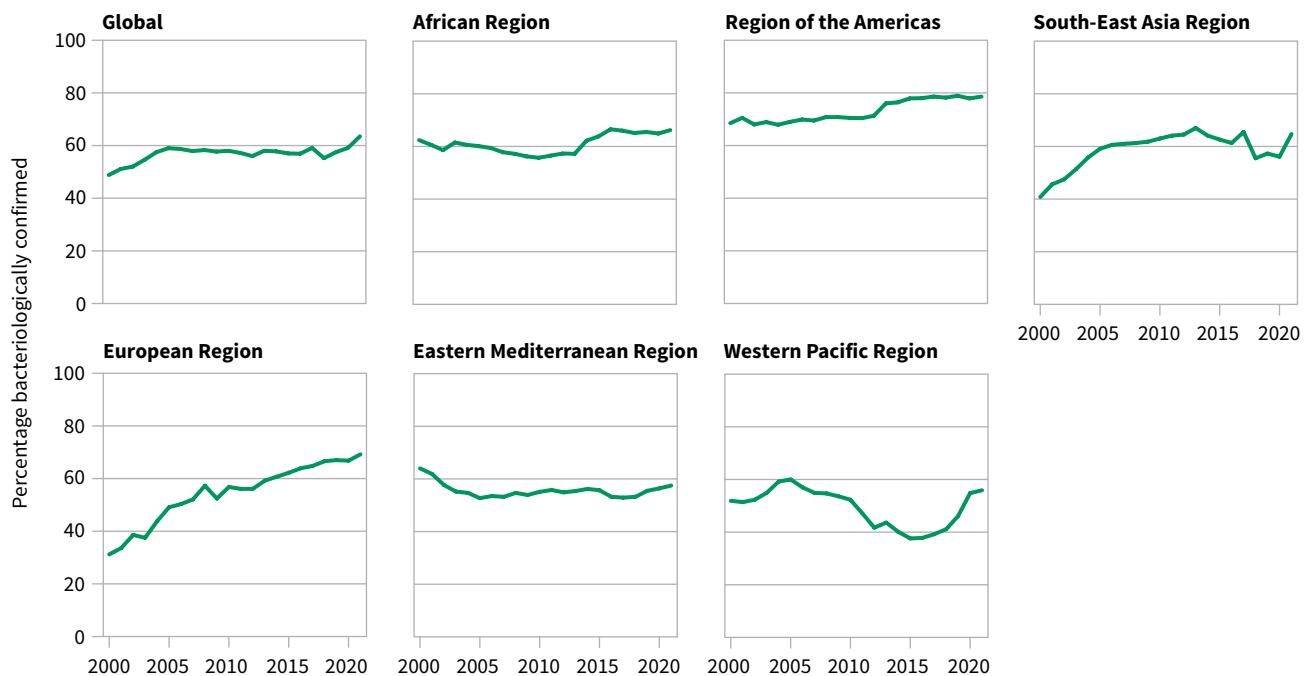
[a] The ten countries ranked in order of the size of the gap between notified cases and the best estimates of TB incidence in 2021 are: India, Indonesia, the Philippines, Pakistan, Nigeria, China, South Africa, Myanmar, Viet Nam and the Democratic Republic of the Congo.
[b] Incidence estimates for India are interim and subject to finalization, in consultation with the Ministry of Health & Family Welfare, India.

FIG. 25

Percentage of people newly diagnosed with pulmonary TB who were bacteriologically confirmed, globally and for WHO regions,[a] 2000–2021

a Data are for notified cases. The calculation for 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.

In many countries, there is also a need to increase the percentage of cases confirmed bacteriologically by scaling up the use of recommended diagnostics, in line with WHO guidelines *(19)*. The microbiological detection of TB is critical because it allows people to be correctly diagnosed, is 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 5.3 million people diagnosed with pulmonary TB worldwide in 2021, 63% were bacteriologically confirmed (**Fig. 25**). This was an increase from 59% (2.8 million out of a total of 4.8 million) in 2020. There was some variation among the six WHO regions, with the highest percentage achieved in the Americas (79%) and the lowest in the Western Pacific (56%). There was also considerable variation among countries. In general, levels of confirmation were lowest in low-income countries (median, 69%), and highest in high-income countries (median, 89%) 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 38% (2.5 million) of the 6.4 million people newly diagnosed with TB in 2021, up from 33% (1.9/5.8 million) in 2020 and 28% (2.0/7.1 million) in 2019. There was substantial variation among countries (**Fig. 26**). Among the 30 high TB burden coun-

tries, those with the highest proportions (above 90%) included Namibia, Viet Nam and Zambia. Among the 49 countries in one of the three global lists of high burden countries (for TB, HIV-associated TB and MDR/RR-TB),[1] 26 reported that a WHO-recommended rapid diagnostic test had been used as the initial test for more than half of their notified TB cases in 2021, up from 21 in 2020 and 18 in 2019.
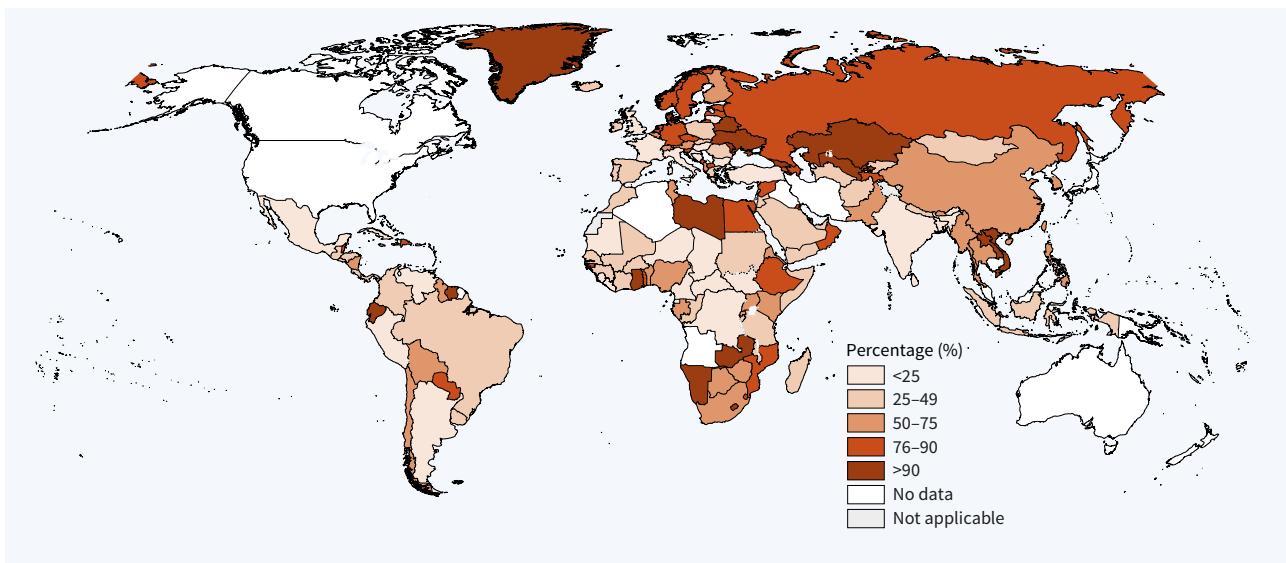
The global coverage of HIV testing among people diagnosed with TB remained high in 2021, at 76% (up from 73% in 2020). At regional level, the highest coverage in 2021 was achieved in the WHO African Region (89%) and the WHO European Region (94%). In 119 countries and territories, at least 90% of people diagnosed with TB knew their HIV status.

Among people living with HIV who develop TB, both TB treatment and antiretroviral therapy (ART) for HIV are required to prevent unnecessary deaths from TB and HIV. The global coverage of ART for people living with HIV who were newly diagnosed and reported with TB has been maintained at the high level of 89% since 2019. However, when compared with the total number of people living with HIV estimated to have developed TB in 2021, coverage was only 46% (the same level as in 2020). This was far below the overall level of coverage of ART for people living with HIV, which was 75% at the

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1 See **Annex 3**.

FIG. 26

Percentage of people newly diagnosed with TB who were initially tested with a WHO-recommended rapid test at country level,[a] 2021

a   Data are for notified cases.

end of 2021 *(20)*. The main reason for the relatively low coverage was the big gap between the estimated number of people living with HIV who developed TB in 2021 (a best estimate of 703 000) and the reported number diagnosed with TB in 2021 (368 641).

A positive finding for the first full year of the COVID-19 pandemic is that 86% of those started on first-line TB treatment in 2020 had a successful outcome; this was the same level as in 2019 and slightly better than the 85% seen in 2017 and 2018 (**Fig. 27**). This finding shows that, despite the many disruptions caused by the pandemic, the quality of treatment for those diagnosed with TB was maintained in 2020. Treatment success rates remain lower among people living with HIV (77% globally in 2020), although there have been steady improvements over time. The treatment success rate for children (aged 0–14 years) was 88% in 2020, the same level as in 2019.

Provision of TB treatment and ART to people living with HIV who were diagnosed with TB is estimated to have averted 74 million deaths between 2000 and 2021 (**Table 2**).
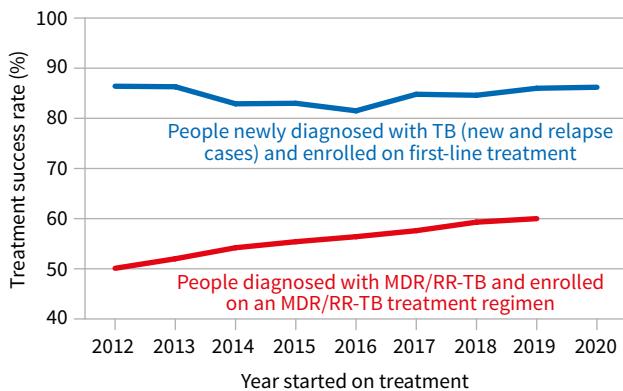
Drug-resistant TB: diagnosis and treatment

Partial recovery in 2021, targets off track

WHO uses five categories to classify cases of DR-TB: isoniazid-resistant TB, RR-TB and MDR-TB (defined above),

FIG. 27

Global success rates for people treated for TB, 2012–2020[a]

a   2012 is the first year for which WHO collected data about treatment outcomes for MDR/RR-TB.

TABLE 2

Cumulative number of deaths averted by TB and TB/HIV interventions 2000–2021 (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	7.1	6.0–8.3	8.5	7.2–9.8	16	14–17
Region of the Americas	1.9	1.8–2.1	0.36	0.33–0.39	2.3	2.1–2.4
South-East Asia Region	30	25–34	2.9	2.0–3.8	32	28–37
European Region	2.1	1.9–2.4	0.32	0.28–0.35	2.4	2.2–2.7
Eastern Mediterranean Region	5.2	4.6–5.8	0.10	0.08–0.12	5.3	4.7–5.9
Western Pacific Region	16	14–17	0.50	0.42–0.59	16	15–18
Global	62	55–69	13	11–14	74	67–81

[a] Numbers shown to two significant figures.

plus extensively drug-resistant TB (XDR-TB) and pre-XDR-TB. Pre-XDR-TB is TB that is resistant to rifampicin and any fluoroquinolone (a class of second-line anti-TB drug), whereas 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. Novel all-oral regimens for MDR/RR-TB and pre-XDR-TB can now reduce treatment duration to only 6 months, compared with older regimens lasting 20 months or more. WHO recommends expanded access to all-oral regimens, supported by counselling and monitoring for adverse events *(21)*.
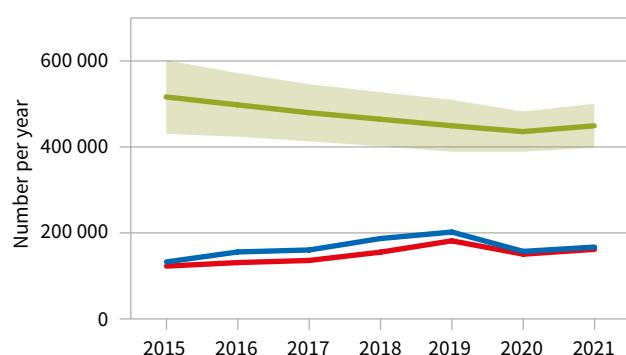
Globally in 2021, 71% of people (2.4/3.4 million) diagnosed with bacteriologically confirmed pulmonary TB were tested for rifampicin resistance, the same level of coverage as in 2020 (2.1/3.0 million) and up from 61% (2.2/3.6 million) in 2019. Among those tested, 141 953 cases of MDR/RR-TB and 25 038 cases of pre-XDR-TB or XDR-TB were detected, giving a combined total of 166 991. This was an increase (6.4%) from the combined total of 156 982 in 2020, but less than the 9.7% increase in the overall number of people diagnosed and reported with TB between 2020 and 2021. It was also still considerably lower (by 17%) than the total of 201 997 in 2019.

Worldwide, 161 746 people with MDR/RR-TB were enrolled on treatment in 2021, up 7.5% from 150 469 in 2020 but still considerably lower (by 11%) than the total of 181 533 in 2019 (**Fig. 28**, **Fig. 29**). This level of enrol-
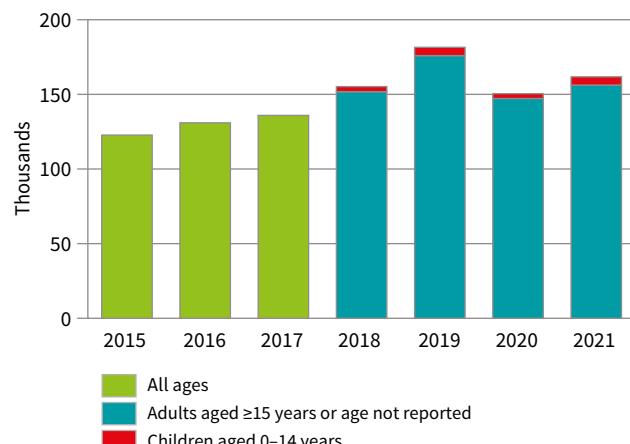
Global number of people diagnosed with MDR/RR-TB (blue) and number enrolled on an MDR/RR-TB treatment regimen (red), compared with estimates of the global number of incident cases of MDR/RR-TB (green), 2015–2021

The shaded area represents the 95% uncertainty interval.

The global number of people reported to have been enrolled on treatment for MDR/RR-TB, 2015–2021[a]

Legend:
- All ages
- Adults aged ≥15 years or age not reported
- Children aged 0–14 years

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

ment is equivalent to about one in three of the people who develop MDR/RR-TB each year (**Fig. 15**, **Fig. 28**).

Reversals in progress in the number of people enrolled on treatment mean that the global targets set at the UN high-level meeting now appear to be out of reach (**Fig. 23**). The cumulative number of people with MDR/RR-TB who were reported as being enrolled on treatment from 2018 to 2021 was 649 000, only 43% of the 5-year target (2018–2022) of 1.5 million. Considering children specifically, the cumulative number was 17 700, only 15% 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 2021: China, the Democratic Republic of the Congo, India, Indonesia, Nigeria, Pakistan, the Philippines, the Russian Federation, South Africa and Viet Nam. Substantial gains in treatment coverage at the global level requires efforts to improve testing and diagnosis of DR-TB, and access to treatment in these countries.

More positively, there have been improvements in the treatment success rate for MDR/RR-TB (**Fig. 27**). Globally in 2019 (the latest patient cohort for which data are available), the treatment success rate was 60%, reflecting steady improvements in recent years from 50% in 2012.[1] Among WHO regions, the treatment success rate in 2019 ranged from 57% in Europe to 72% in the Eastern Mediterranean.

By the end of 2021, 124 countries were using bedaquiline as part of treatment regimens for DR-TB (up from 110 in 2020). A total of 109 countries were using all-oral longer regimens (up from 92 in 2020) for the treatment of MDR/RR-TB, and 92 were using shorter regimens (up from 65 in 2020).

There was considerable variation in the coverage of testing for RR-TB among countries in 2021. Of the 30 high MDR/RR-TB burden countries,[2] 20 reached testing coverage of more than 80%: Azerbaijan, Belarus, China, Kazakhstan, Kyrgyzstan, Mongolia, Mozambique, Myanmar, Pakistan, Peru, the Philippines, the 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, being 50% in 2021. Coverage was close to 100% in the WHO European Region, and lowest in the Western Pacific Region (below 20%).

TB prevention
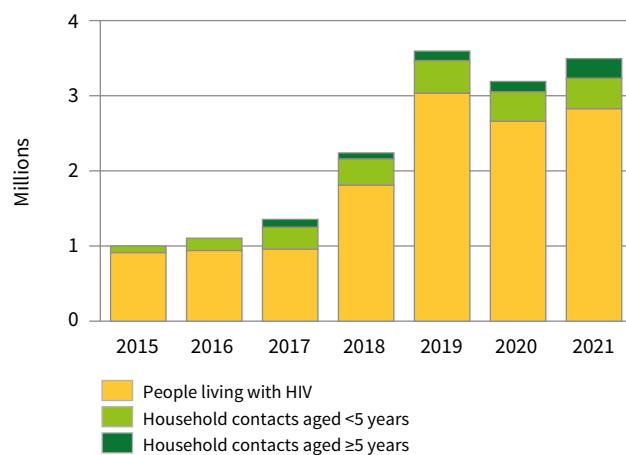
Recovery in 2021 but targets mostly off track

The main health care intervention available to reduce the risk of TB infection progressing to active TB disease is TB preventive treatment.[3] Other preventive 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) *(22)*.[4]

The global number of people provided with TB preventive treatment in 2021 was 3.5 million – still slightly below the level of 3.6 million that was reached in 2019 but a good recovery from 3.2 million in 2020 and much higher than 1.0 million in 2015 (**Fig. 30**). The combined total of 12.5 million in 2018–2021 is only 42% of the target of 30 million for the 5-year period 2018–2022 (**Fig. 31**).

FIG. 30

The global number of people provided with TB preventive treatment, 2015–2021

Y-axis: Millions (0 to 4)
X-axis: 2015, 2016, 2017, 2018, 2019, 2020, 2021

- People living with HIV
- Household contacts aged <5 years
- Household contacts aged ≥5 years

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 2.8 million in 2021. This figure included 10.3 million in the years 2018–2021, meaning that the global subtarget of providing TB preventive treatment to 6 million people living with HIV between 2018 and 2022 was not only achieved but far exceeded, well ahead

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[1] 2012 is the first year for which WHO collected data on outcomes for people enrolled on treatment for MDR/RR-TB.

[2] See **Annex 3**.

[3] The drug regimens currently recommended by WHO are explained in **Annex 1**.
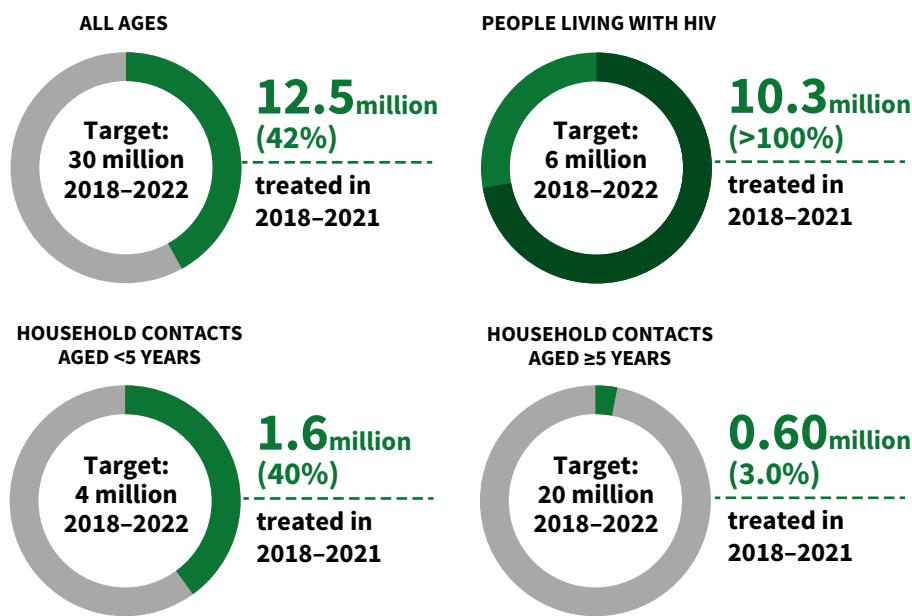
[4] Addressing broader determinants that influence TB epidemics can also help to prevent TB infection and disease. These are discussed below.

FIG. 31

Global progress in provision of TB preventive treatment between 2018 and 2021, compared with cumulative targets set for 2018–2022 at the UN high-level meeting on TB

ALL AGES

Target: 30 million 2018–2022

12.5million (42%) treated in 2018–2021

PEOPLE LIVING WITH HIV

Target: 6 million 2018–2022

10.3million (>100%) treated in 2018–2021

HOUSEHOLD CONTACTS AGED <5 YEARS

Target: 4 million 2018–2022

1.6million (40%) treated in 2018–2021

HOUSEHOLD CONTACTS AGED ≥5 YEARS

Target: 20 million 2018–2022

0.60million (3.0%) treated in 2018–2021

of schedule (**Fig. 31**). Seven countries – India, Nigeria, South Africa, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe – collectively accounted for 82% of those started on treatment in 2021. In 20 countries that reported outcomes, the median completion rate for those who started treatment in 2020 was 87%, up from 84% in 2019.

The number of household contacts of people diagnosed with TB who were provided with TB preventive treatment remained low in 2021 (**Fig. 30**), at 0.7 million. However, this was an improvement from 0.5 million in 2020 and was also above the level of 0.6 million in 2019. The cumulative number of contacts initiated on TB preventive treatment in the 4-year period 2018–2021, at 2.2 million, is only 9.2% of the 5-year target of 24 million for the period 2018–2022; this number included 1.6 million children aged under 5 years (40% of the 5-year subtarget of 4 million) and 0.6 million people in older age groups (3.0% of the 5-year subtarget of 20 million) (**Fig. 31**). In 76 countries that reported outcomes, the median completion rate for those who started treatment in 2020 was 86%, the same as in 2019.

A substantial intensification and expansion of efforts and investment is needed to improve the provision of TB preventive treatment. This includes providing more TB screening at household level (especially among people aged ≥5 years), strengthening the follow-up to TB screening at household level and among people living with HIV, and increasing access to shorter (1–3 months) rifamycin-based regimens. Treatment using these shorter regimens is expanding: in 2021, 185 350 people in 52 countries were reported to have been treated with

rifapentine-containing regimens, up from 25 657 in 37 countries in 2020.

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 2021 it was greater than 1 in 14 countries that reported five or more TB cases among health care workers.

There were concerning declines in the global coverage of BCG vaccination in 2020 and 2021. This fell from 88% in 2019 to 84% in 2021, probably due to disruptions to health services caused by the COVID-19 pandemic.

Funding for essential TB services

Spending down since 2019, far below 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 LMICs that account for 98% of reported TB cases falls far short of what is needed, and it fell between 2019 and 2021.[1]

In 2021, estimated spending on TB diagnostic, treatment and prevention services in LMICs was US$ 5.4 billion (**Fig. 32**).[2] This was slightly less than the total of US$ 5.5 billion in 2020 and down 10% from US$ 6.0 bil-

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[1]   All amounts quoted in this subsection are in constant 2021 US$.
[2]   These amounts include spending reported to WHO by national TB programmes (NTPs) and estimates (produced by the WHO Global TB Programme) of the resources used to provide inpatient and outpatient care to the reported number of people newly diagnosed with TB (**Fig. 1**).

lion in 2019. The total of US$ 5.4 billion is only 42% of the global target of US$ 13 billion annually by 2022 (**Table 1**) and only 35% of the US$ 15.6 billion estimated to be required in 2021 in the Stop TB Partnership's *Global Plan to End TB, 2018–2022 (23)*.

The decline in spending on TB services between 2019 and 2021 probably reflects several factors associated with the COVID-19 pandemic. These include reductions in the global number of people reported as diagnosed with TB between 2019 and 2021 (**Fig. 1**), 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.

Of the total of US$ 5.4 billion spent on TB services in 2021, US$ 3.2 billion was for diagnosis and first-line treatment of 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 of the requirements for 2021 that were estimated in the Global Plan *(23)*. The remaining amount (US$ 0.2 billion) includes spending on TB preventive treatment (covering drugs only), interventions specifically related to HIV-associated TB and miscellaneous items.[1]
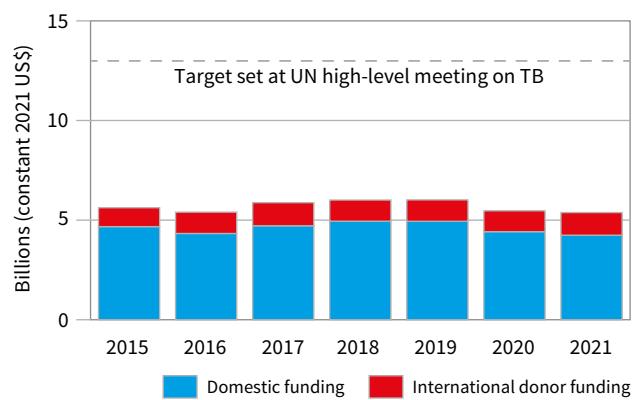
As in the previous 10 years, most of the funding used in 2021 (US$ 4.3 billion from a total of US$ 5.4 billion; i.e. 79%) was from domestic sources (**Fig. 33**), with the aggregate figure strongly influenced by Brazil, the Russian Federation, India, China and South Africa (BRICS). Together, these five countries accounted for US$ 2.7 billion (64%) of the total of US$ 4.3 billion that was provided from domestic sources in 2021. Overall, domestic sources accounted for 93% of the funding for TB diagnostic, treatment and prevention services in BRICS and all of the funding used in Brazil, China and the Russian Federation.

In other LMICs, international donor funding remains crucial (**Fig. 33**). For example, it accounted for 50% of the funding available for TB services in the 26 high TB burden and the two global TB watchlist countries (Cambodia and Zimbabwe) outside BRICS, and 42% of the funding available in low-income countries in 2021.

The total amount of international donor funding reported by national TB programmes (NTPs) in LMICs to WHO has been around US$ 1 billion per year in the period since 2010 (**Fig. 33**).[2] The main source is the Global Fund to Fight AIDS, Tuberculosis and Malaria (the Glob-

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[1] WHO uses an "other" category to capture spending on miscellaneous items.
[2] Data on TB expenditures and funding that are reported to WHO by NTPs do not include all the international donor funding that is provided to LMICs (e.g. funding channelled to entities outside the NTP). A comprehensive analysis of international donor funding for TB, based on donor reports to the Organisation for Economic Co-operation and Development (OECD), is one of the "featured topics" on the report webpages.

FIG. 32

Spending on TB prevention, diagnostic and treatment services in 136 low- and middle-income countries,[a,b,c] 2015–2021

[a] Sources: data reported by NTPs and estimates produced by the WHO Global TB Programme.
[b] The data sources, boundaries, accounting rules, and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The TB expenditure data reported here are thus not comparable with the disease expenditure data, including for TB, that are reported in WHO's Global Health Expenditure Database.
[c] The 136 countries accounted for 98% of the world's officially reported TB cases in 2021.

al Fund), with a contribution that ranged from 69% (in 2010) to 83% (in 2017) of the reported total; in 2021, it was 76%. The United States Government is the largest contributor of funding to the Global Fund and is 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. 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 second End TB Strategy milestone of a 75% reduction in TB deaths (compared with 2015) requires that only 6.5% of people who develop TB disease die from it;[3] 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

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[3] See also **Section 2** of this report. The estimated percentage in 2020 and 2021 was 15%.

FIG. 33

Spending on TB prevention, diagnostic and treatment services in 136 low and middle-income countries and 3 other country groups,[a,b] 2010–2021

All low and middle-income countries[c] (n=136)

BRICS (n=5)

High TB burden and global TB watchlist countries outside BRICS[d] (n=28)

Other low and middle-income countries (n=103)

Domestic funding   International donor funding

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

[a] Sources: data reported by NTPs and estimates produced by the WHO Global TB Programme.

[b] The data sources, boundaries, accounting rules, and estimation methods used in this report are different from those of the System of Health Accounts 2011 (SHA2011). The TB expenditure data reported here are thus not comparable with the disease expenditure data, including for TB, that are reported in WHO's Global Health Expenditure Database.

[c] The 136 countries accounted for 98% of the world's officially reported TB cases in 2021.

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

(24). 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" *(7)*. The two indicators to monitor progress towards this target are a UHC service coverage index (SCI) (Indicator 3.8.1), and the percentage of the population experiencing household expenditures on health care that are "large" in relation to household expenditures or income (Indicator 3.8.2).[1] The SCI can take values from 0 (worst) to 100 (best) and is calculated using 16 tracer indicators, one of which is the coverage of TB treatment. In

the monitoring of Indicator 3.8.2 by WHO and the World Bank, direct medical expenditures that account for 10% or more of household expenditure or income are classified as "catastrophic" *(24–26)*.
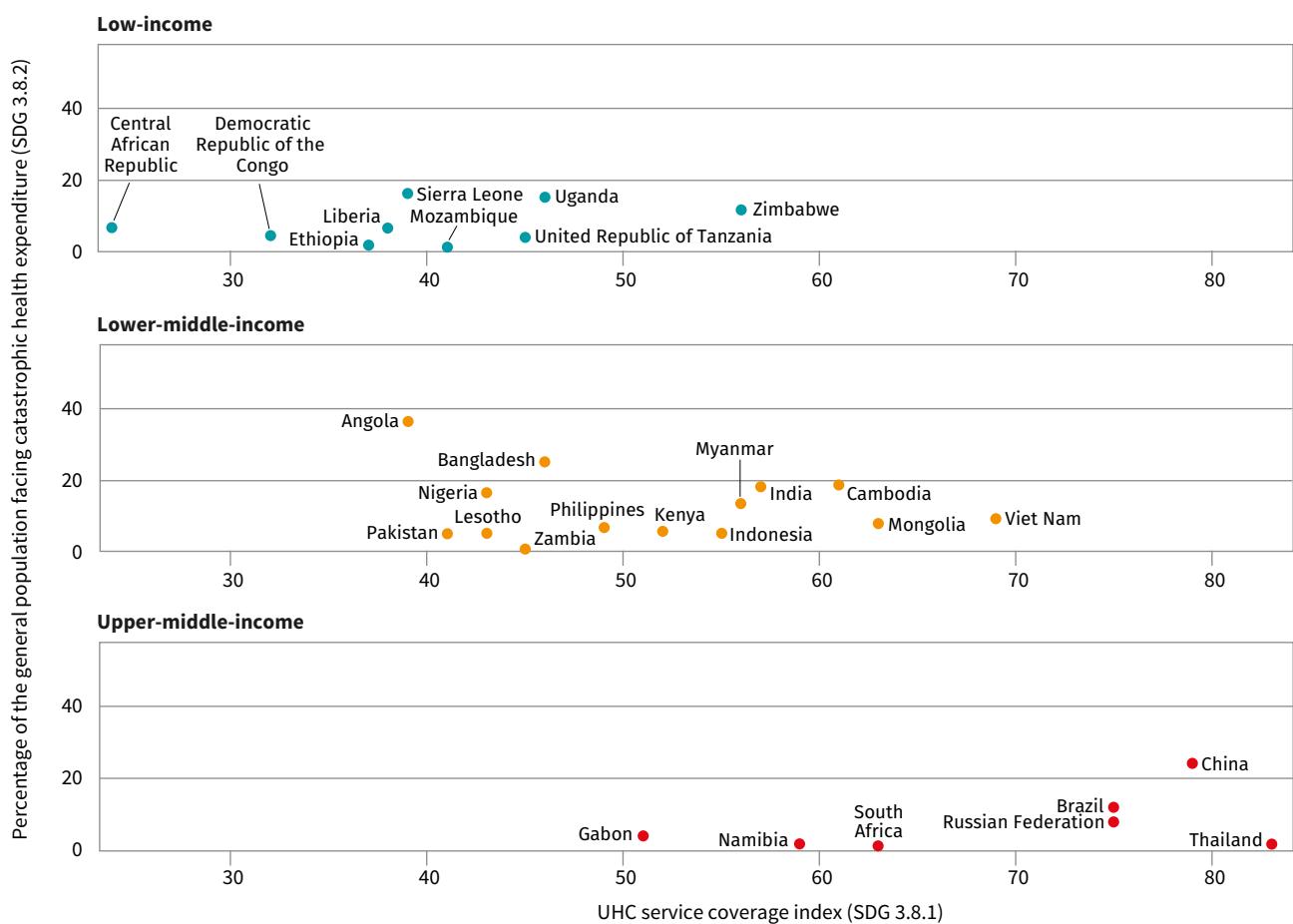
The latest published data for the two UHC indicators are for 2019 (SCI) and 2017 (catastrophic expenditures on health care) *(25, 26)*. Globally, the SCI was 67 (out of 100) in 2019, up from 45 in 2000. The proportion of the general population facing catastrophic expenditures on health care (using a threshold of >10% annual household income or expenditure) rose from 9.4% in 2000 to 13% (996 million people) in 2017.

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 the SDG targets for UHC are achieved in most of those countries (**Fig. 34**). Among high TB burden countries, Thailand stands out as hav-

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[1] 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.

FIG. 34

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] The SCI can take values from 0 (worst) to 100 (best) and is calculated using 16 tracer indicators, one of which is the coverage of TB treatment. Values shown for the SCI are estimates for the latest year for which data for SDG 3.8.2 are available.

[b] Defined as ≥10% of total household consumption or income. The latest available year ranges from 2007 to 2019 for the 30 high TB burden countries.

[c] The three global TB watchlist countries are Cambodia, Russian Federation and Zimbabwe. Data were not available for Congo, Democratic People's Republic of Korea and Papua New Guinea.

[d] The classification is for the latest year for which data for SDG 3.8.2 are available.

Source: Global Health Observatory (https://www.who.int/data/gho).

ing a high SCI (80) and a low level of catastrophic health expenditures (2% of households). A Universal Coverage Scheme (UCS) was established in 2002 to provide an explicit benefit to all citizens of Thailand not already covered by a health insurance scheme in the formal sector, supported by domestic funding and a strong primary health care system *(27)*. Although data post-2019 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 Strategy included a third target, which was that no TB patients and their households face total costs that are catastrophic *(8)*. The definition of catastrophic used for this TB-specific indicator is total costs (comprising direct medical expenditures, nonmedical expenditures and

indirect costs such as income losses) above 20% of household income. The key differences between this indicator and the SDG indicator for catastrophic health expenditures (Indicator 3.8.2) are explained in **Box 5**.

Since 2015, a total of 29 countries have completed a national survey of costs faced by TB patients and their households, of which 27 (including 16 of the 30 high TB burden countries and one of the three global TB watchlist countries)[1] 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 48% (95% CI: 36–61%) (**Fig. 35**). Among 23 countries that reported disaggregated data, the percentage facing catastrophic total costs was much high-

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[1] See **Annex 3**.

Box 5. 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) 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 because of direct expenditures on health care, they may nonetheless have faced financial barriers to accessing health services

that they needed. Hence, the SDG indicator cannot be used as a measure of financial barriers to access to health care.

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 nonmedical 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.

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er for people with DR-TB, with a pooled average of 82% (95% CI: 75–90%).

Survey results are being used to inform approaches to health financing, service delivery and social protection that will reduce these costs.[1]

Many new cases of TB are attributable to five risk factors: undernourishment, HIV infection, alcohol use disorders, smoking (especially among men) and diabetes (**Fig. 36**). In the context of the COVID-19 pandemic as well as war in Ukraine, ongoing conflicts in other parts of the world, a global energy crisis and associated risks to food security, multisectoral action to address these and other determinants of TB, such as GDP per capita (**Fig. 20**) and poverty, is more important than ever.[2]

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 accountability framework for TB (MAF-TB) and ensure its timely implementation. Following extensive development work, WHO finalized the framework and published it in 2019 *(29)*. 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 *(30)*.

Results from implementation of the checklist show that progress is being made in adaptation and implementation of the MAF-TB. 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 the recovery of essential TB services, enhanced social protection and faster progress towards global TB targets.[3] In line with the global part of the MAF-TB, WHO will continue to lead the coordination of global monitoring, reporting and review, and to provide technical support and guidance to countries and partners.

TB research and innovation
Slow progress, much more investment needed

The End TB Strategy targets set for 2030 and 2035 (**Box 2**) 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

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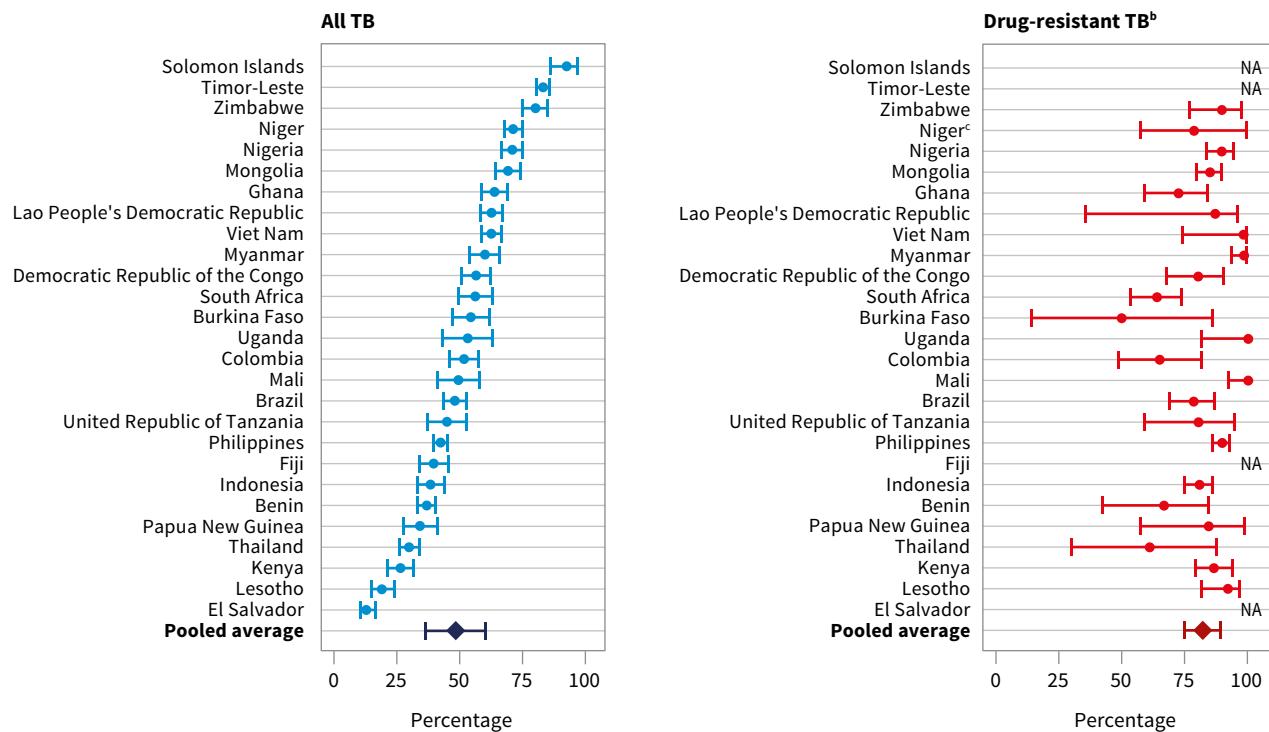
[1] Comprehensive documentation of the results and policy implications of the 21 surveys completed between 2015 and 2021 is available in a separate WHO publication *(28)*.

[2] SDG targets and indicators that are associated with TB incidence are described in **Annex 6**.

[3] For more analysis of the latest status of progress in adapting and using the MAF-TB, see one of the "featured topics" on the report webpages.

FIG. 35

Estimates of the percentage of TB patients and their households facing catastrophic costs,[a] national surveys completed 2016–2022

NA – not available.
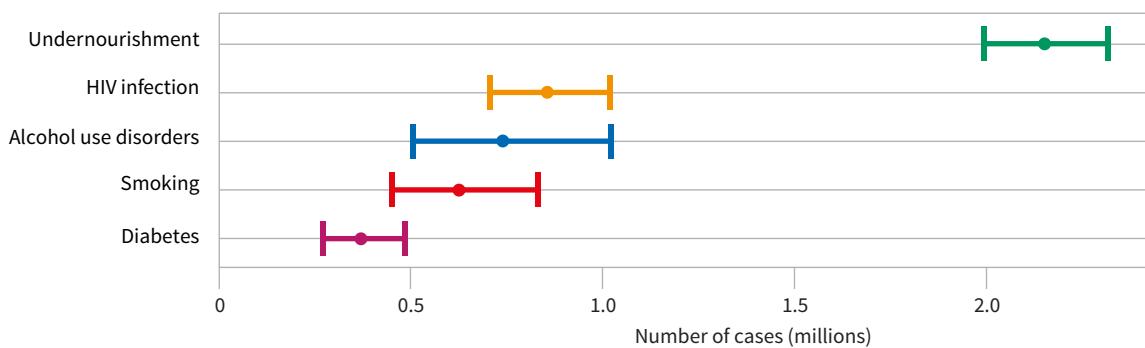
a   Defined as direct medical expenditures, direct nonmedical expenditures and indirect costs (e.g. income losses) that sum to >20% of household income. This indicator is not the same as the SDG indicator for catastrophic health expenditures; see **Box 5** for further explanation.

b   Estimates for drug-resistant TB specifically were only available for 23 countries. The calculation of confidence intervals for Mali and Uganda did not account for sampling design.
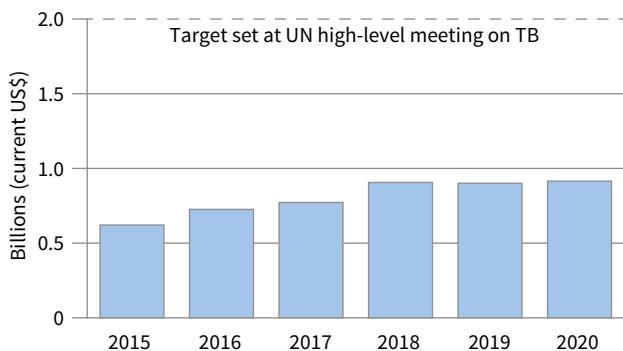
c   Since a 95% confidence interval was not included in the national survey report, a simple binomial confidence interval was calculated based on the survey sample size.

FIG. 36

Global estimates of the number of incident TB cases attributable to selected risk factors, 2021[a]

a   Sources of data used to produce estimates were: 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/data/gho); and WHO Global TB Programme.

Source: Treatment Action Group, Stop TB Partnership. Tuberculosis research funding trends 2005–2020. New York: Treatment Action Group; 2021 (https://www.treatmentactiongroup.org/resources/tbrd-report/tbrd-report-2021/)

an average of 17% per year between 2025 and 2035 *(9)*. Reductions in TB incidence achieved between 2015 and 2021 fell far short of the first 2020 milestone of the strategy (10% compared with 20%); coupled with the impact of the COVID-19 pandemic on TB incidence in 2020 and 2021 (**Fig. 10**, **Fig. 11**), this means that an even faster rate of decline will now be required to reach the targets. Priorities include a vaccine to lower the risk of infection, a vaccine or new drug treatment to cut the risk of TB disease in people already infected, rapid diagnostics for accurate detection of TB disease 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.[1] However, this is constrained by the overall level of investment. The most recently published data show a total of US$ 0.9 billion in 2020 *(31)*, less than half the global target of US$ 2 billion per year that was set for the period 2018–2022 at the first UN high-level meeting on TB (**Fig. 37**). The total falls even further short of the estimated requirement in the Stop TB Partnership's *Global Plan to End TB, 2023–2030 (32)*, which is US$ 5 billion per year.

In recent years, the diagnostic pipeline has expanded considerably in terms of the number of tests, products or methods in development. These include molecular tests for the detection of TB disease and drug resistance, interferon-gamma release assays (IGRAs) for the detection of TB infection, biomarker-based assays for detection of TB disease, computer-aided detection (CAD) for TB screening using digital chest radiography, and a new class of aerosol-capture technologies for

detection of TB disease. Three new antigen-based skin tests for TB infection that perform better than tuberculin skin tests (particularly in terms of specificity) were evaluated and recommended by WHO in 2022: the Cy-Tb skin test (Serum Institute of India, India), C-TST (Anhui Zhifei Longcom Biopharmaceutical Co. Ltd, China) and Diaskintest (JSC Generium, the Russian Federation). WHO plans to evaluate the following tests in the coming year: culture-free, targeted-sequencing solutions to test for drug resistance directly from sputum specimens; broth microdilution methods for drug susceptibility testing; and new IGRAs to test for TB infection.

In September 2022, there were 26 drugs for the treatment of TB disease in Phase I, Phase II or Phase III trials. These drugs comprise 17 new chemical entities, two drugs that have received accelerated regulatory approval, one drug that was recently approved by the United States (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 September 2022, at least 22 clinical trials to evaluate drugs and drug regimens for treatment of TB infection were being implemented. Examples included trials for the prevention of DR-TB among high-risk household contacts of TB patients with MDR-TB and trials to assess how to optimize the administration of short-course TB preventive treatment for very young children and people living with HIV.

In September 2022, there were 16 vaccine candidates in clinical trials: four in Phase I, eight in Phase II and four in Phase III. They included candidates to prevent TB infection and TB disease, and to help improve the outcomes of treatment for TB disease.

Effective vaccines are critical to achieve annual global and national reductions in TB incidence and mortality that are much faster than those achieved historically. WHO has commissioned a full-value assessment of new TB vaccines to guide investments in late-stage research as well as the subsequent introduction and implementation of any that are licensed for use. Preliminary results suggest that vaccine products which meet the preferred product characteristics of new TB vaccines would have substantive and positive health and economic impacts. This initiative as well as other recent or current efforts by WHO to support TB research and innovation are summarized in **Box 6**.

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[1] A high-level summary of the status of the pipelines for new TB diagnostics, drugs and vaccines is provided in this subsection. The report webpages (Section 7) provide more details, including graphics showing the products in each pipeline and links to websites that provide information about the clinical trials that are underway.

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Box 6. Recent or current efforts by WHO to support TB research and innovation

Recent or current efforts by WHO to support TB research and innovation include:

▶ Preparing for a high-level summit on how to accelerate progress in the development of new TB vaccines, drawing on lessons learned during the COVID-19 pandemic. It is anticipated that the summit will be held in early 2023.

▶ Preparing a report on the health and economic benefits of new TB vaccines, to guide investments in late-stage research and the introduction and implementation of new TB vaccines. The report will build on a previous publication *(33)* and associated journal articles.

▶ In March 2022, convening a multistakeholder consultation to discuss the emerging needs of Member States for policy guidance, evidence gaps for policy-making, and challenges in the translation of research evidence into policy *(34)*. The aim is to guide decision-makers who fund and implement research, to better focus their research agendas on the priorities of TB programmes and affected populations.

▶ In May 2022, submitting a progress report to the 75th World Health Assembly *(35)* on the implementation of the *Global Strategy for TB Research and Innovation (36)*.

▶ Preparing and publishing a consolidated assessment of gaps in TB research that have emerged during the process of reviewing evidence to inform WHO guideline development *(37)*.

▶ Continuing engagement in meetings of the BRICS TB Research Network *(38)*.

In the context of the COVID-19 pandemic, WHO has also established a compendium of research studies related to TB and COVID-19 *(39)*. Innovative programmatic responses to the impact of the pandemic on TB is one of the topics featured on the webpages that accompany this report.

4. Conclusions

All Member States of the UN and WHO have committed to "ending the global TB epidemic" by 2030, with concrete milestones and targets included in the WHO End TB Strategy (adopted in 2014) and the political declaration that was the key outcome of the first-ever UN high-level meeting on TB in 2018.

This report shows that the COVID-19 pandemic has had a damaging impact on access to TB diagnosis and treatment and the burden of TB disease. Progress made in the years up to 2019 has slowed, stalled or reversed, and global TB targets are off track.

The most obvious impact has been a substantial reduction (compared with 2019) in the reported number of people newly diagnosed with TB in both 2020 and 2021, suggesting an increase in the number of people with undiagnosed and untreated TB. The most severe consequence has been an estimated increase in the number of people dying from TB. In 2021, the estimated number of deaths caused by TB was more than double the number caused by HIV/AIDS. In the near future, it is possible that TB will once again be the leading cause of death worldwide from a single infectious agent, replacing COVID-19.

Intensified efforts backed by increased funding for essential TB services as well as research are urgently required to mitigate and reverse the negative impacts of the COVID-19 pandemic on TB. The top priority is to restore access to and provision of essential TB services, so that levels of TB case detection and treatment can recover to at least 2019 levels.

The need for action has become even more pressing in the context of war in Ukraine, ongoing conflicts in other parts of the world, a global energy crisis and associated risks to food security. These are likely to further worsen some of the broader determinants of TB, such as levels of income and undernourishment.

The comprehensive review by heads of state and government of the status of the TB epidemic and progress in response efforts at a UN high-level meeting in 2023 provides an opportunity for renewed global commitments and actions towards the goal of ending TB.

References

1.   Houben RM, Dodd PJ. The global burden of latent tuberculosis infection: a re-estimation using mathematical modelling. PLoS Med. 2016;13(10):e1002152. doi: 10.1371/journal.pmed.1002152.

2.   Emery JC, Richards AS, Dale KD, McQuaid CF, White RG, Denholm JT et al. Self-clearance of Mycobacterium tuberculosis infection: implications for lifetime risk and population at-risk of tuberculosis disease. Proceedings of the Royal Society B. 2021;288(1943):20201635. doi: https://doi.org/10.1098/rspb.2020.1635.

3.   Behr MA, Edelstein PH, Ramakrishnan L. Is Mycobacterium tuberculosis infection life long? BMJ. 2019;367:l5770. doi: https://doi.org/10.1136/bmj.l5770.

4.   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. doi: 10.1371/journal.pone.0017601.

5.   Provisional tuberculosis (TB) notifications [website]. Geneva: World Health Organization; 2022 (https://worldhealthorg.shinyapps.io/tb_pronto/).

6.   Tuberculosis data [website]. Geneva: World Health Organization; 2022 (https://www.who.int/tb/data/en/).

7.   Sustainable Development Goals [website]. New York: United Nations; 2022 (https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals).

8.   Global strategy and targets for tuberculosis prevention, care and control after 2015 (Resoultion WHA67.1, Agenda item 12.1). Geneva: World Health Assembly; 2014 (http://apps.who.int/gb/ebwha/pdf_files/WHA67/A67_R1-en.pdf).

9.   Floyd K, Glaziou P, Houben R, Sumner T, White RG, Raviglione M. Global tuberculosis targets and milestones set for 2016–2035: definition and rationale. Int J Tuberc Lung Dis. 2018;22(7):723–30. doi: 10.5588/ijtld.17.0835.

10. Moscow Declaration to End TB; First WHO global ministerial conference on ending TB in the sustainable development era: a multisectoral response. Geneva: World Health Organization and the Ministry of Health of the Russian Federation; 2017 (https://www.who.int/publications/i/item/WHO-HTM-TB-2017.11).

11. Resolution 73/3: Political declaration of the high-level meeting of the General Assembly on the fight against tuberculosis. New York: United Nations General Assembly; 2018 (https://www.who.int/publications/m/item/political-declaration-of-the-un-general-assembly-high-level-meeting-on-the-fight-against-tuberculosis).

12. Report of the Secretary-General. Progress towards the achievement of global tuberculosis targets and implementation of the political declaration of the high-level meeting of the General Assembly on the fight against tuberculosis. 75th session. Item 132 of the provisional agenda. New York: United Nations General Assembly; 2020 (https://undocs.org/en/A/75/236).

13. AIDS info [website]. Geneva: UNAIDS; 2022 (https://aidsinfo.unaids.org/).

14. Coronavirus (COVID-19) dashboard [website]. Geneva: World Health Organization; 2022 (https://covid19.who.int/).

15. Global tuberculosis report 2021. Geneva: World Health Organization; 2021 (https://www.who.int/publications/i/item/9789240037021).

16. Report of a subgroup meeting of the WHO Task Force on TB Impact Measurement: methods used by WHO to estimate TB disease burden. Geneva: World Health Organization; 2022 (https://apps.who.int/iris/handle/10665/363428).

17. Menzies NA, Wolf E, Connors D, Bellerose M, Sbarra AN, Cohen T et al. Progression from latent infection to active disease in dynamic tuberculosis transmission models: a systematic review of the validity of modelling assumptions. Lancet Infect Dis. 2018;18(8):e228–e38. doi: https://doi.org/10.1016/S1473-3099(18)30134-8.

18. Strategic and Technical Advisory Group for Tuberculosis (?STAG-TB)?: report of the 21st meeting, 21–23 June 2021. Geneva: World Health Organization; 2021 (https://apps.who.int/iris/handle/10665/351132).

19. WHO consolidated guidelines on tuberculosis. Module 3: Diagnosis – rapid diagnostics for tuberculosis detection 2021 update. Geneva: World Health Organization; 2021 (https://www.who.int/publications/i/item/9789240029415).

20. Global HIV & AIDS statistics – fact sheet [website]. Geneva: Joint United Nations Programme on HIV/AIDS (UNAIDS); 2021 (https://www.unaids.org/en/resources/fact-sheet).

21. WHO consolidated guidelines on tuberculosis. Module 4: Treatment – drug-resistant tuberculosis treatment. Geneva: World Health Organization; 2020 (https://www.who.int/publications/i/item/9789240007048).

22. WHO consolidated guidelines on tuberculosis. Module 1: Prevention – tuberculosis preventive treatment. Geneva: World Health Organization; 2020 (https://www.who.int/publications/i/item/who-consolidated-guidelines-on-tuberculosis-module-1-prevention-tuberculosis-preventive-treatment).

23. The Global Plan to End TB, 2018–2022. Geneva: Stop TB Partnership; 2019 (https://www.stoptb.org/advocate-to-endtb/global-plan-to-end-tb).

24. World Health Organization/World Bank. Tracking universal health coverage: 2017 global monitoring report. Geneva: World Health Organization; 2017 (https://apps.who.int/iris/bitstream/handle/10665/259817/9789241513555-eng.pdf).

25. World Health Organization/World Bank. Tracking universal health coverage: 2021 global monitoring report. Geneva: World Health Organization; 2021 (https://www.who.int/publications/i/item/9789240040618).

26. World Health Organization/World Bank. Global monitoring report on financial protection in health 2019. Geneva: World Health Organization; 2020 (https://apps.who.int/iris/bitstream/handle/10665/331748/9789240003958-eng.pdf).

27. Tangcharoensathien V, Witthayapipopsakul W, Panichkriangkrai W, Patcharanarumol W, Mills A. Health systems development in Thailand: a solid platform for successful implementation of universal health coverage. Lancet. 2018;391(10126):1205–23. doi: 10.1016/S0140-6736(18)30198-3.

28. National surveys of costs faced by TB patients and their households, 2015–2021. Geneva: World Health Organization; In press.

29. Multisectoral accountability framework to accelerate progress to end tuberculosis by 2030. Geneva: World Health Organization; 2019 (https://apps.who.int/iris/handle/10665/331934).

30. WHO Multisectoral accountability framework for TB (MAF-TB): baseline assessment checklist for country use in pursuing a national MAF-TB. Geneva: World Health Organization; 2020 (https://www.who.int/publications/m/item/who-multisectoral-accountability-framework-for-tb-(maf-tb)-baseline-assessment-checklist-for-country-use-in-pursuing-a-national-maf-tb).

31. Treatment Action Group, Stop TB Partnership. Tuberculosis research funding trends 2005–2020. New York: Treatment Action Group; 2021 (https://www.treatmentactiongroup.org/wp-content/uploads/2021/12/tb_funding_2021.pdf).

32. The Global Plan to End TB, 2023–2030. Geneva: Stop TB Partnership; 2022. https://omnibook.com/embedview/dc664b3a-14b4-4cc0-8042-ea8f27e902a6/en

33. Gebreselassie N, Hutubessy R, Vekemans J, den Boon S, Kasaeva T, Zignol M. The case for assessing the full value of new tuberculosis vaccines. Eur Respir J. 2020;55(3):1902414. doi: https://doi.org/10.1183/13993003.02414-2019.

34. Second WHO consultation on the translation of tuberculosis research into global policy guidelines. Geneva: World Health Organization; 2022 (https://www.who.int/publications/i/item/9789240050907).

35. Global Strategy for Tuberculosis Research and Innovation (A75/10). Consolidated report by the Director-General. Seventy-fifth World Health Assembly. Geneva: World Health Organization; 2022 (https://apps.who.int/gb/ebwha/pdf_files/WHA75/A75_10Rev1-en.pdf).

36. Global Strategy for Tuberculosis Research and Innovation (WHA73.3). Seventy-third World Health Assembly. Geneva: World Health Organization; 2020 (https://apps.who.int/gb/ebwha/pdf_files/WHA73/A73_R3-en.pdf).

37. Evidence and research gaps identified during development of policy guidelines for tuberculosis [website]. Geneva: World Health Organization; 2021 (https://www.who.int/publications/i/item/9789240040472).

38. BRICS TB Research Network [website]. Cape Town: BRICS TB Research Network Secretariat; 2022 (https://bricstb.samrc.ac.za/).

39. Compendium of TB/COVID-19 studies. Geneva: World Health Organization; 2022 (https://www.who.int/teams/global-tuberculosis-programme/covid-19/compendium).

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). Most people who develop the disease (about 90%) are adults and there are more cases among men than women.

Diagnostic tests for TB disease have improved substantially in recent years. There are now several rapid molecular tests that are recommended by WHO as the initial diagnostic test for TB, some of which can detect drug resistance simultaneously *(3)*. These tests can be used at the lower levels of the health system. There are also rapid molecular tests specifically for the detection of resistance to several first- and second-line anti-TB drugs, and sequencing technologies that can provide a comprehensive individual profile of drug resistance. The older method of sputum smear microscopy (developed >100 years ago) is still widely used for TB diagnosis in low and middle-income countries but is increasingly being replaced with rapid tests. Culture testing remains the reference standard for TB diagnosis. Following diagnosis, smear or culture (as opposed to rapid molecular tests) are necessary to monitor an individual's response to treatment. In addition, culture is required for the detection of resistance to newer anti-TB drugs and may also be used as a confirmatory test in settings and situations in which people have a low pre-test probability of having TB disease.

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 *(4)*.

Effective drug treatments were first developed in the 1940s. The latest WHO guidelines published in 2022 *(5)* include a strong recommendation for a 6-month regimen of isoniazid (H), rifampicin (R), ethambutol (E) and pyrazinamide (Z) for people with drug-suscepti-

ble TB (both pulmonary and extrapulmonary): all four drugs for the first two months, followed by H and R for the remaining 4 months. They also include new recommendations that people aged 12 years and older with drug-susceptible pulmonary TB may be treated with a 4-month regimen of rifapentine (P), H, Z and moxifloxacin (M), and that children and adolescents between 3 months and 16 years of age with non-severe TB (and without suspicion or evidence of resistance to R and H) may be treated with a 4-month regimen (2 months of H, R, Z and sometimes also E, followed by 2 months of H and R). Treatment success rates of at least 85% for people enrolled on the 6-month regimen are regularly reported to WHO by its 194 Member States.

Treatment for people diagnosed with R-resistant TB (RR-TB) and multidrug-resistant TB (MDR-TB, defined as resistance to H and R) is more difficult and requires drugs that cause more side-effects *(6)*. Nationally, treatment success rates for RR-TB are typically in the range of 50–75%; the global average has been improving in recent years, reaching 60% in the most recent patient cohort for which data are available. Treatment for pre-extensively drug-resistant TB (pre-XDR-TB, defined as TB that is resistant to R and any fluoroquinolone) and XDR-TB (resistance to R, any fluoroquinolone and at least one of bedaquiline or linezolid) is even more difficult and treatment success rates are typically low.

A global modelling study published in 2016 estimated that about a quarter of the world's population had been infected with *M. tuberculosis (7)*. Recent analyses and commentary suggest that the number of those currently infected is lower, given that some people will clear the infection *(8, 9)*. An older modelling study published in 2000 estimated that about 5–10% of people infected with TB will go on to develop TB disease at some point during their lifetime *(10)*. 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.

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

The only licensed vaccine for prevention of TB dis-

ease 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 licenced vaccine that is effective in preventing TB disease in adults, either before or after exposure to TB infection; however, results from a Phase II trial of the M72/AS01E candidate are promising *(11)*.

References

1. Hershkovitz I, Donoghue HD, Minnikin DE, May H, Lee OY, Feldman M, et al. Tuberculosis origin: the Neolithic scenario. Tuberculosis. 2015;95 Suppl 1:S122–6 (https://www.ncbi.nlm.nih.gov/pubmed/25726364, accessed 15 August 2022).

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, accessed 15 August 2022).

3. WHO consolidated guidelines on tuberculosis. Module 3: Diagnosis – rapid diagnostics for tuberculosis detection 2021 update. Geneva: World Health Organization; 2021 (https://www.who.int/publications/i/item/9789240029415).

4. 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, accessed 15 August 2022).

5. WHO consolidated guidelines on tuberculosis, Module 4. Treatment – drug-susceptible tuberculosis treatment. Geneva: World Health Organization; 2022 (https://www.who.int/publications/i/item/9789240048126)

6. WHO consolidated guidelines on tuberculosis, Module 4: Treatment – drug-resistant tuberculosis treatment. Geneva: World Health Organization; 2020 (https://www.who.int/publications/i/item/9789240007048).

7. Houben RMGJ, Dodd PJ. The Global Burden of Latent Tuberculosis Infection: A Re-estimation Using Mathematical Modelling. PloS Medicine 2016 (https://doi.org/10.1371/journal.pmed.1002152, accessed 15 August 2022).

8. Emery JC, Richards AS, Dale KD, McQuaid FC, White RG, Denholm JT and Houben RMGJ. Self-clearance of Mycobacterium tuberculosis infection: implications for lifetime risk and population at-risk of tuberculosis disease. Proceedings of the Royal Society B 2021 (https://royalsocietypublishing.org/doi/full/10.1098/rspb.2020.1635, accessed 15 August 2022).

9. Behr MA, Edelstein PH, Ramakrishnan L. Is Mycobacterium tuberculosis infection life long? BMJ 2019;367:l5770 (https://www.bmj.com/content/367/bmj.l5770, accessed 15 August 2022).

10. Vynnycky E, Fine PE. Lifetime risks, incubation period, and serial interval of tuberculosis. American journal of epidemiology. 2000;152(3):247–63.

11. Tait DR, Hatherill M, Van Der Meeren O, Ginsberg AM, Van Brakel E, Salaun B et al. Final analysis of a trial of M72/AS01E vaccine to prevent tuberculosis. N Eng J Med. 2019;381(25):2429–39 (https://pubmed.ncbi.nlm.nih.gov/31661198/, accessed 15 August 2022).

The WHO global TB database

A2.1 Database contents

The 2022 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 2022, 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; contact screening and TB preventive treatment; digital systems; TB infection control; 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$ 12 696 in 2020, 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 2020).

The main round of data collection took place in April and May 2022.

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 2021 and 2022 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 2022. Countries in the European Union submitted data on notifications and treatment outcomes to the TESSy system managed by the European Centre for Disease

Reporting of data in the 2022 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	47	47	47
Region of the Americas	45	40	35	34
South-East Asia Region	11	11	11	11
European Region	54	48	53	47
Eastern Mediterranean Region	22	22	21	21
Western Pacific Region	36	34	27	27
Global	215	202	194	187

Prevention and Control (ECDC). Data from TESSy were uploaded into the global TB database.

Additional data about the provision and completion of TB preventive treatment 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 **29 August 2022**. **Table A2.1** shows the number of countries and territories that had reported data by **29 August 2022**.

Indicators in the Sustainable Development Goals associated with TB incidence were imported into the global TB database on **30 June 2022**. **Table A2.2** shows the data sources used.

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

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

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.

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[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

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
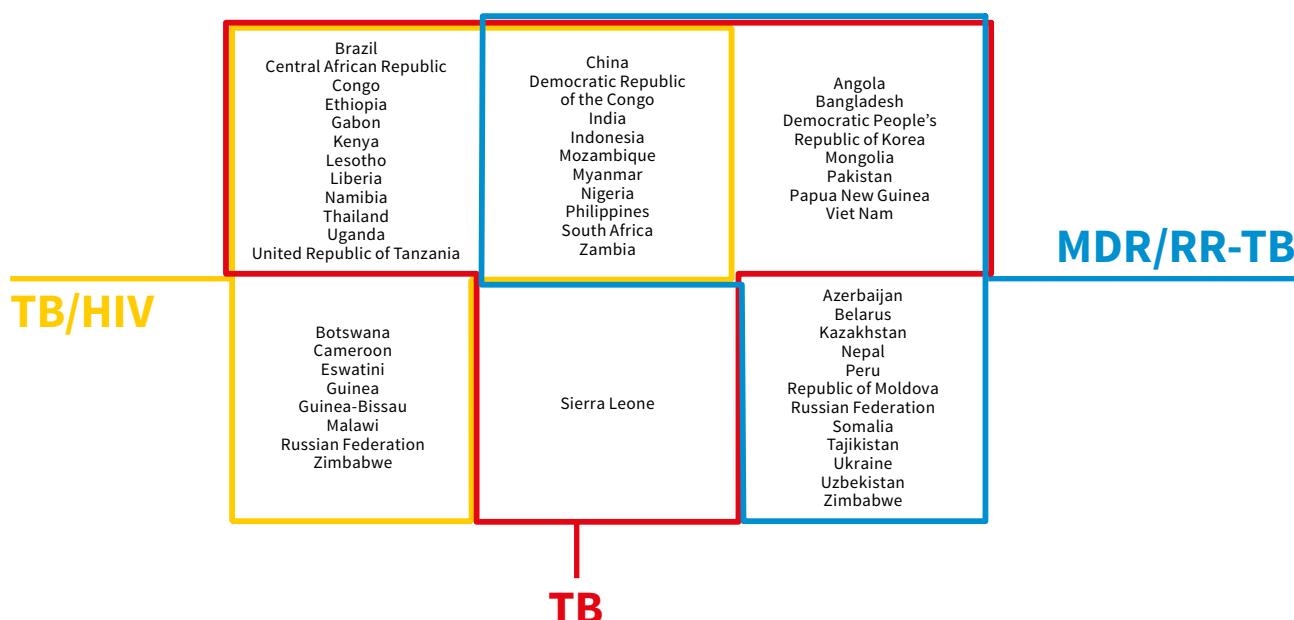
Three global HBC lists for 2021–2025 have been established: one for TB, one for HIV-associated TB and one for MDR/rifampicin-resistant TB (MDR/RR-TB). The lists were defined using the same criteria as those agreed for the 2016–2020 lists, in combination with the WHO estimates (for 2019) of the incidence 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 popula-

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

tion in 2019) that are not already in the top 20, 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 transitioned out of the list; Gabon, Mongolia and Uganda joined the list.

- **The 30 high TB/HIV burden countries.** Angola, Chad, Ghana and Papua New Guinea transitioned out of the list; Gabon, Guinea, Philippines and the Russian Federation joined the list.

- **The 30 high MDR/RR-TB burden countries.** Ethiopia, Kenya and Thailand transitioned out of the list; Mongolia, Nepal and Zambia 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 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 exited the global list of 30 high TB burden countries in 2021, 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).
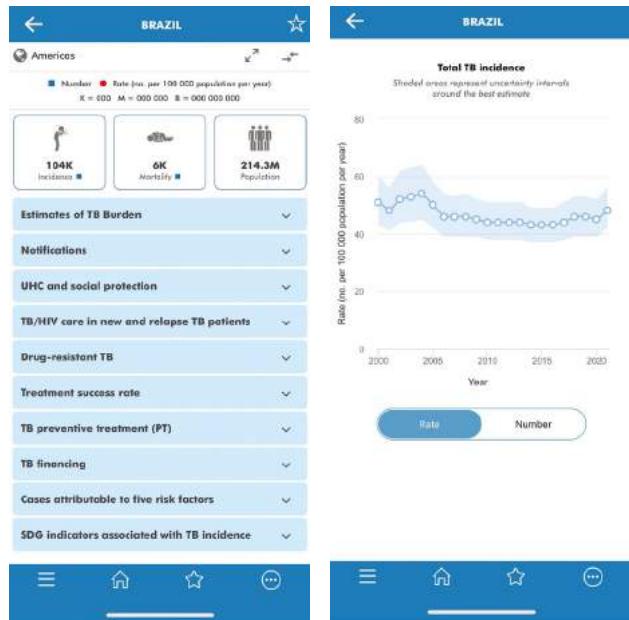
Country, regional and global profiles

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

Updates to estimates of TB disease burden

The report includes estimates of tuberculosis (TB) incidence and mortality for the period 2000–2021; estimates of TB incidence and mortality disaggregated by age and sex for 2021; and estimates of the incidence of rifampicin-resistant TB (RR-TB) for the period 2015–2021. This annex summarizes the main updates to the methods used to produce these estimates, compared with those used for the *Global tuberculosis report 2021 (1, 2)*. Details are provided in a technical appendix.

There were four major updates for this report:

1. **Expanded use of country-specific dynamic models to estimate TB incidence and mortality in 2020 and 2021.** Models were used for 27 countries, up from 16 the previous year. Countries for which models were used were those with large absolute reductions in the reported number of people newly diagnosed with TB in 2020 or 2021 (case notifications) relative to pre-2020 trends; these reductions were interpreted as being due to reduced detection of people with TB, in turn resulting in an increase in the number of people with undiagnosed and untreated TB in the community. Models were needed to produce estimates of TB incidence and mortality that accounted for these disruptions to TB diagnosis and treatment, in the absence of any direct measurements of TB disease burden in these years.[1]

2. **Use of region-specific dynamic models to estimate TB incidence and mortality in 2020 and 2021.** Although individual countries may have reported large relative reductions in case notifications, in absolute terms these reductions may not have been sufficient to warrant their inclusion in the country-specific modelling described above. Instead, region-specific models were used for any such countries that reported a cumulative reduction in TB case notifications of 10% or more in 2020 to 2021 inclusive, relative to pre-2020 trends. A total of 26 countries met this criterion. This method was used in place of the statistical model used in 2021 *(2)*.

3. **Updated estimates of TB incidence in India for the period 2000–2019.** This update was based on the availability of new survey and programmatic data but remains interim in nature.

4. **Production of time series of estimates of the incidence of RR-TB.** Previous global TB reports from the World Health Organization (WHO) included estimates for the latest calendar year only. New methods were developed in 2022 to allow the production of time series of estimates for the period 2015–2021. The time series are for the absolute number of incident RR-TB cases and the proportions of TB cases (new and previously treated) that have RR-TB.

Estimates of TB incidence and mortality in all high-income countries in 2020 and 2021 were produced using the same methods as those used pre-2020; that is, notification data with a standard adjustment for incidence, and vital registration (VR) data for mortality.[2] For low- and middle-income countries (LMIC) that were not modelled (i.e. those for which case notifications in 2020 and 2021 did not show a substantial reduction relative to pre-2020 trends), the methods used to estimate TB incidence and mortality before 2020 were retained for use in 2020 and 2021, with the assumption that pre-2020 trends continued in 2020 and 2021.

Country-specific and region-specific dynamic models

The models were developed through a collaboration between WHO and Imperial College, London (United Kingdom of Great Britain and Northern Ireland) *(1–3)*.

Key assumptions used in the models are:

- Reductions in TB case notifications reflect reduced case detection. It is possible that underreporting of detected cases may contribute to reductions in case notifications, but there is currently no evidence to support this.

- Strict lockdowns resulted in a 50% reduction in transmission (with an uncertainty interval of 25–75%). Reductions in transmission outside periods of strict lockdown were not assumed, although measures such as mask wearing may have had an ongoing effect on transmission in some countries.

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[1] For two of the modelled countries, China and the Russian Federation, national vital registration (VR) data on the number of deaths caused by TB were reported to the World Health Organization (WHO) in the period 2020–2021. These data were used in preference to modelled estimates.

[2] If VR data for 2020 and 2021 were not available, it was assumed that pre-2020 trends were sustained.

The time periods for which reductions in transmission were modelled were based on compilation of country-specific data about the durations of lockdowns.

Other influential assumptions, drawing on the scientific literature, relate to the number of secondary infections per case per year (estimated by model calibration); and the rate of breakdown from TB infection to active TB disease, which was informed by a recent (2018) review of TB models *(4)*.

An important limitation is that the models do not yet account for the impact of the coronavirus (COVID-19) pandemic on broader TB determinants, such as undernourishment, poverty and other factors known to be associated with TB. Impacts on TB incidence and mortality may thus be understated.

For countries for which region-specific models were used, it was assumed that they experienced the same changes to annual incidence and mortality, relative to 2019 levels, as those modelled at the regional level.

The modelling methods were extensively discussed and reviewed in 2021 and 2022. These activities included:

- a review by WHO's Strategic and Technical Advisory Group for TB (STAG-TB) in June 2021 *(5)*;

- a 2-day meeting of a subgroup of the WHO Global Task Force on TB Impact Measurement (the Task Force) in May 2022 *(3)*, which brought together 32 global experts in mathematical modelling, epidemiology and statistics as well as representatives from national TB programmes (NTPs) and partner agencies, with the specific purpose of reviewing methods used by WHO to estimate TB disease burden during the COVID-19 pandemic and new methods for producing time series of estimates for the incidence of RR-TB (see below); and

- in an immediate follow-up to the Task Force meeting, a further detailed review of model documentation by several global experts in TB modelling, after which comments and suggestions were addressed.

Estimates of TB incidence in India, 2000–2019

A national TB prevalence survey was implemented in 2019–2021. The results were released in March 2022. Subsequently, the Indian Council of Medical Research (ICMR), which led implementation of the survey and analysis of results, worked with India's national TB elimination programme (NTEP) in the Ministry of Health & Family Welfare and with the WHO Country Office to produce provisional estimates of TB incidence for the period 2015–2021. These estimates used the national survey results in combination with a previous state-level survey (in Gujarat in 2011) and programmatic data for 2015–2021. They suggest estimates of TB incidence that are higher in each year (by about 0.2 million) than

those published in the *Global tuberculosis report 2021 (1)*.

Following discussions and consultations among the NTEP, ICMR and WHO during August and September 2022, the provisional incidence estimates for 2015–2019 were combined with the use of the WHO country-specific model for India that was developed to estimate TB incidence and mortality in 2020 and 2021 (as described above).[1] Estimates for the period 2000–2014 were then adjusted upwards compared with those published in previous WHO reports, for consistency with updated estimates for the period 2015–2019.

The methods used to estimate TB mortality in India remain unchanged from those used in 2021.

Estimates of TB incidence and mortality in India for 2000–2021 are interim and subject to finalization, in consultation with India's Ministry of Health & Family Welfare.

Estimates of the incidence of multidrug-resistant TB or RR-TB, 2015–2021

Until this report, estimates of the number of incident cases of multidrug-resistant TB (MDR-TB) or RR-TB (MDR/RR-TB) were produced for the latest complete calendar year only, using the most recent data point from each country. In 2022, new methods were developed to produce a time series of estimates for the period 2015–2021. These methods have been extensively discussed and reviewed *(3, 6)*.

For the first time, the proportions of new and previously treated TB cases that had MDR/RR-TB at global, regional and country levels were estimated for the period 2015–2021. The general approach for estimation of these proportions was to use hierarchical regression models fitted within a Bayesian paradigm to all national-level surveillance and survey data since 2000 that met pre-defined quality criteria (described in the technical appendix).

The estimates of the proportions of new and previously treated TB cases with RR-TB for each year over the period 2015–2021 were then used in combination with the formula that has been previously used by WHO to produce estimates of RR-TB incidence for a single year. The formula includes parameters related to TB incidence overall, the proportion of TB cases that are diagnosed with a relapse episode of TB, the risk that an incident case of TB will fail treatment or be lost to follow-up, and the relative risk of RR-TB in relapse cases compared with new cases *(6)*.

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[1] This was done because the ICMR-led analysis does not currently incorporate the impact of disruptions related to the COVID-19 pandemic to TB case detection in 2020 and 2021. In 2021, TB case notifications in India fell by 25% compared with 2019; there was a partial recovery in 2021 (see **Fig. 3** and **Fig. 4** of this report).

Other updates

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 2022.

Overview of data sources available to inform estimates of TB disease burden in high TB burden and global TB watchlist countries

A summary of the main data sources currently available to inform estimates of TB disease burden in the 30 high TB burden countries and three global TB watchlist countries is shown in **Table A5.1**. Maps that illustrate the main methods used to estimate TB incidence and mortality for the periods 2000–2019 and 2020–2021 are provided on the report web pages (**Section 2.1** and **Section 2.2**).

References

1. Global tuberculosis report 2021. Geneva: World Health Organization; 2021 (https://www.who.int/publications/i/item/9789240037021).

2. Methods used by WHO to estimate the global burden of TB disease. Geneva: World Health Organization; 2021 (https://www.who.int/publications/m/item/methods-used-by-who-to-estimate-the-global-burden-of-tb-disease).

3. Report of a subgroup meeting of the WHO Task Force on TB Impact Measurement: methods used by WHO to estimate TB disease burden. Geneva: World Health Organization; 2022 (https://apps.who.int/iris/handle/10665/363428).

4. Menzies NA, Wolf E, Connors D, Bellerose M, Sbarra AN, Cohen T et al. Progression from latent infection to active disease in dynamic tuberculosis transmission models: a systematic review of the validity of modelling assumptions. Lancet Infect Dis. 2018;18(8):e228–e38. doi: https://doi.org/10.1016/S1473-3099(18)30134-8.

5. Strategic and Technical Advisory Group for Tuberculosis (STAG-TB): report of the 21st meeting, 21–23 June 2021. Geneva: World Health Organization; 2021 (https://apps.who.int/iris/handle/10665/351132).

6. Methods for estimating the incidence of drug-resistant TB (background document 2). Subgroup meeting of the WHO Task Force on TB Impact Measurement: methods used by WHO to estimate TB disease burden. Geneva: World Health Organization; 2022 (https://cdn.who.int/media/docs/default-source/hq-tuberculosis/global-task-force-on-tb-impact-measurement/meetings/2022-05/tf-2022-05-2-background--document-2--dr-tb.pdf?sfvrsn=a8757cfa_3).

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, 2000–2021. 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	2000–2021	2016, 2019	–	–	–	–
Bangladesh	2000–2021	2014, 2019	–	2015	2011, 2019	–
Brazil	2000–2021	2018	–	NA	2008	2000–2019
Cambodia	2000–2021	2018	–	2002, 2011	2007, 2018	–
Central African Republic	2000–2021	2019	–	–	2009	–
China	2000–2021	–	2018	2000, 2010	2007, 2013, 2020–	2004–2020
Congo	2000–2021	2019	–	–	–	–
Democratic People's Republic of Korea	2000–2021	2017	–	2016	2014	–
Democratic Republic of the Congo	2000–2021	2017, 2019	–	–	2017	–
Ethiopia	2000–2021	2013, 2016	–	2011	2005, 2018, 2018–	–
Gabon	2000–2021	2018, 2020	–	–	–	–
India	2000–2021	2019	2016	2019–2021	2016, 2020–	2000–2014
Indonesia	2000–2021	2017, 2019	2017	2013–2014	2018	2006–2007, 2009–2015
Kenya	2000–2021	2017, 2021	2013	2015	2014, 2020–	–
Lesotho	2000–2021	2014, 2017	–	2019	2014, 2019–	–
Liberia	2000–2021	2015, 2019	–	–	–	–
Mongolia	2000–2021	2015, 2018	2023	2014–2015	2007, 2016, 2018–	2016
Mozambique	2000–2021	2013	–	2017–2019	2007, 2021, 2021–	–
Myanmar	2000–2021	2014, 2017	–	2009, 2018	2013, 2018–, 2020	–
Namibia	2000–2021	2016, 2019	–	2017–2018	2008, 2015, 2018–	–
Nigeria	2000–2021	2017, 2020	–	2012	2010	–
Pakistan	2000–2021	2016, 2019	2012, 2017	2011	2013	2006, 2007, 2010
Papua New Guinea	2000–2021	2017	–	–	2014	–
Philippines	2000–2021	2016, 2019	2023	2007, 2016	2012, 2019, 2021–	2000–2014
Russian Federation	2000–2021	2017	–	NA	2000–	2000–2021
Sierra Leone	2000–2021	2015, 2020	–	–	–	–
South Africa	2000–2021	2015, 2019	2019–2022	2017–2019	2002, 2014, 2021–	2000–2017
Thailand	2000–2021	2013	–	2012	2012, 2018	2000–2019
Uganda	2000–2021	2013, 2019	–	2014–2015	2011, 2018–	–
United Republic of Tanzania	2000–2021	2013, 2018	–	2012	2007, 2018, 2021–	–
Viet Nam	2000–2021	2013, 2019	2017	2007, 2017–2018	2006, 2012, 2018–	–
Zambia	2000–2021	2016, 2020	–	2014	2008, 2018–, 2020	–
Zimbabwe	2000–2021	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] A study is currently underway in South Africa. Studies are planned in Mongolia and the Philippines in 2023. Prioritization of TB inventory studies is recommended in countries where a large share of TB care is provided outside the existing NTP network.

[c] 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 available from continuous surveillance (indicated by "-" in blue cell) based on routine diagnostic testing in China, Ethiopia, India, Kenya, Lesotho, Mongolia, Mozambique, Myanmar, Namibia, Philippines, South Africa, Uganda, United Republic of Tanzania, 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 (Myanmar, Thailand, Philippines, Zambia), the years of the last two only are shown.

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

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.

References

1. Monitoring and evaluation of TB in the context of the Sustainable Development Goals in Policy Briefs: WHO Global Ministerial Conference Ending TB in the Sustainable Development Era: Multisectoral Response. Geneva: World Health Organization; 2017. (https://www.who.int/conferences/tb-global-ministerial-conference/Ministerial_Conference_policy_briefs.pdf)

2. Lienhardt C, Glaziou P, Uplekar M, Lönnroth K, Getahun H, Raviglione M. Global tuberculosis control: lessons learnt and future prospects. Nat Rev Microbiol. 2012;10(6):407 (https://www.ncbi.nlm.nih.gov/pubmed/22580364,).

3. Lönnroth K, Castro KG, Chakaya JM, Chauhan LS, Floyd K, Glaziou P et al. Tuberculosis control and elimination 2010–50: cure, care, and social development. Lancet. 2010;375(9728):1814–29 (https://www.ncbi.nlm.nih.gov/pubmed/20488524).

4. Lönnroth K, Jaramillo E, Williams B, Dye C, Raviglione M. Tuberculosis: the role of risk factors and social determinants. In: Blas E & Kurup A (eds.), Equity, social determinants and public health programmes. 2010 (https://apps.who.int/iris/bitstream/handle/10665/44289/9789241563970_eng.pdf;jsessionid=067BC8BA3F7A5366C05BE34404F9D8F6?sequence=1).

5. Lönnroth K, Jaramillo E, Williams BG, Dye C, Raviglione M. Drivers of tuberculosis epidemics: the role of risk factors and social determinants. Soc Sci Med. 2009;68(12):2240–6 (https://www.ncbi.nlm.nih.gov/pubmed/19394122).

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 negatively 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 1: End poverty in all its forms everywhere

SDG TARGETS FOR 2030	SDG INDICATORS	ALTERNATIVE INDICATORS TO MONITOR	RATIONALE	DATA SOURCE	COLLECT DATA FOR TB PATIENTS SPECIFICALLY?
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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